Continuing Authorities Program (CAP) 1135

Clarence Cannon Dam at Mark Twain Lake

Draft Integrated Feasibility Report and Environmental Assessment
NEPA ID: EAXX-202-00-B3P-1770292779

US Army Corps of Engineers - St. Louis District
Project Sponsor: Missouri Department of Conservation
DRAFT March 2026

Table of Contents

Executive Summary 8

1 Introduction 12
- 1.1 Study Authority and Project Selection 12
- 1.2 Study Area 14
  - 1.2.1 Site Features 18
- 1.1 Purpose and Need 20
- 1.2 Study Scope 20
- 1.3 Agency Participants and Coordination 20
- 1.4 Prior Reports and Existing Projects in Vicinity 21

2 Need for and Objectives of Action 22
- 2.1 Problems 22
- 2.2 Opportunities 22
- 2.3 Resource Significance 22
  - 2.3.1 Institutional Significance 22
  - 2.3.2 Public Significance 23
  - 2.3.3 Technical Significance 24
- 2.4 Goals 24
  - 2.4.1 NFS Management Goals 24
- 2.5 Planning Objective 25
- 2.6 Planning Constraints and Considerations 25
  - 2.6.1 Constraints 25
  - 2.6.2 Considerations 25

3 Existing Conditions/Future Without Project Conditions 27
- 3.1 Resources Not Evaluated in Detail 27
- 3.2 Hydraulics, Hydrology, and Water Control 27
  - 3.2.1 Resiliency 28
  - 3.2.2 Hydropower 28
  - 3.2.3 Navigation 29
  - 3.2.4 Operations 29
- 3.3 Environmental 30
  - 3.3.1 Aquatic Organism and Wildlife 30
  - 3.3.2 Terrestrial Habitat 34
  - 3.3.3 Wetlands and Water Quality 35
  - 3.3.4 Hazardous, Toxic and Radioactive Waste (HTRW) 37
  - 3.3.5 Protected Species 38
- 3.4 Invasive Species 42
- 3.5 Recreation and Aesthetics 42
- 3.6 Traffic and Roadways 45
- 3.7 Air Quality and Noise Levels 47
- 3.8 Socioeconomics and Demographics 48
- 3.9 Cultural and Historic Resources 49
  - 3.9.1 National Historic Preservation Act 52
  - 3.9.2 Archaeological and Historic Preservation Act 52
  - 3.9.3 Tribal Resources 52
- 3.10 Real Estate 53

4 Plan Formulation 54

4.1 Overview 54
4.2 Management Measures 54
4.2.1 Measures 54
4.2.2 Evaluation and Initial Screening of Measures 57
4.3 Formulation of Alternatives 58
4.3.1 Initial Array of Alternatives 58
4.3.2 Screening of the Initial Array 63
4.3.3 Focused Array of Alternatives 69
4.3.4 Screening of the Focused Array 69
4.3.5 Final Array of Alternatives 69

5 Environmental Consequences 76
5.1 Hydraulics, Hydrology, and Water Control 76
5.2 Environmental 77
5.2.1 Aquatic Organisms and Wildlife 77
5.2.2 Terrestrial Habitat 77
5.2.3 Wetlands and Water Quality 78
5.2.4 Hazardous, Toxic and Radioactive Waste (HTRW) 78
5.2.5 Protected Species 79
5.3 Invasive Species 80
5.4 Recreation and Aesthetics 80
5.5 Traffic and Roadways 81
5.6 Air Quality and Noise Levels 81
5.7 Socioeconomics and Demographics 82
5.2 Cultural and Historic Resources 82
5.2.1 Archaeological and Historic Preservation Act 82
5.2.2 Tribal Resources 82

6 Evaluation and Comparison of Final Array of Alternatives 85
6.1 Habitat Modeling 85
6.2 Hydraulic and Hydrological Modeling 86
6.3 Costs Development 86
6.4 Cost Effective and Incremental Cost Analysis 87
6.4.1 Principles and Guidelines 90
6.4.2 Four Accounts 91
6.5 Comprehensive Benefits 93
6.6 Selection of the Tentatively Selected Plan 93

7 Tentatively Selected Plan 96
7.1 Plan Features 96
7.2 Cost Estimates 98
7.3 Design Consideration 99
7.3.1 Surveys 99
7.3.2 Geotechnical Explorations 99
7.3.3 HTRW and Clean Water Act 100
7.3.4 Hydraulics & Hydrology 100
7.3.5 Civil 100
7.4 Construction Considerations 100
7.4.1 Environmental Commitments 101
7.4.2 Air Quality 101
7.4.3 Permits 101
7.4.4 Schedule Constraints 101

7.4.5 Access & Staging 102
7.5 Real Estate Considerations 102
7.6 O&M Consideration 102
7.7 Post-Construction Evaluation 103
7.8 Environmental Operating Principles (EOPs) 103
7.9 Risks and Uncertainties 104
8 PUBLIC INVOLVEMENT, COORDINATION, AND CONSULTATION 105
8.1 Coordination Meetings 105
8.2 Coordination by Correspondence 105
8.2.1 Public Review 105
8.3 Implementation Responsibilities 105
8.3.1 US Army Corps of Engineers 106
8.3.2 Missouri Department of Conservation 106
9 Recommendation 107
10 Literature Cited 108
11 List of Report Preparers 109

List of Figures

Figure 1 Photo of Clarence Cannon Dam and TCW, ca. early 1980s (Source: Mark Twain Lake Project Office) 14
Figure 2 Study Area Location 16
Figure 3 Clarence Cannon Dam Features 17
Figure 4 Cross Section of Existing Site Features 19
Figure 5 Example Lake Temperature Dynamics 30
Figure 6 Clarence Cannon and Mark Twain Lake recreation features. 44
Figure 7 Clarence Cannon and Mark Twain Lake access roads 46
Figure 8. Examples of the sound level and decibel (dB) level of various of sources. 48
Figure 9 Surface-Positioned Axial Flow Pump Destratifier 60
Figure 10 Oxygen Injection System for the Savannah Harbor Expansion Project 61
Figure 11 Flaming Gorge Dam System 62
Figure 12 Location of Backwater Slough 63
Figure 13 Potential Location of On-Bank Plant 64
Figure 14 Temperature Curtain Conceptual Cross Section 70
Figure 15 TCW Elevations: Existing, 585 Feet, 588 Feet 72
Figure 16 Location of Water Quality Gage 86
Figure 17 Best Buy Action Alternative 89
Figure 18 Array of Alternatives Differentiated by Cost Effectiveness 89
Figure 19 TSP: Raise TCW to 585 97

List of Tables

Table 1. Prior Reports, Projects, and Programs 21
Table 2 Technical Resource Significance of Study Area 24
Table 3. Fish Mortality numbers (Source: MDC) and Lake Elevation and dissolved oxygen data (Source: USACE) 33
Table 4 List of Federally Listed Threatened and Endangered Species Potentially Occurring within the Study Area. 38
Table 5. Invasive and Noxious Species at Mark Twain Lake Study area. 42
Table 6. Six pollutants and their standard criteria designated by the USEPA. 47

Table 7. Socioeconomic information for Monroe and Ralls Counties, Missouri. Data as of American Community Survey (ACS) 5-Year Estimate from the U.S. Census. 48
Table 8. Demographic information for Monroe and Ralls Counties, Missouri. Data as of American Community Survey (ACS) 5-Year Estimate from the U.S. Census 49
Table 9 Archaeological Sites Along Re-Regulation Pool 51
Table 10 Measures Considered for Initial Evaluation 55
Table 11 Screening of Initial Array of Alternatives 67
Table 12 Summary Table of Screened & Retained Alternatives 74
Table 13 Status of Environmental Compliance 83
Table 14 Environmental Outputs 86
Table 15 Cost Estimates for Action Alternatives 87
Table 16 Array of Alternatives Differentiated by Cost Effectiveness 88
Table 17 Incremental Cost Analysis of Cost Effective and Best Buy Alternatives 90
Table 18 RECONS Summary 92
Table 19 Total and Net AAHUs of Final Array 92
Table 20 Summary of Comprehensive Benefits across P&G accounts 93
Table 21 Table of Effects of Final Array 95
Table 22 Project Implementation Schedule 98
Table 23 Summary of the Quantities for the TSP Measures 98
Table 24 Project Design and Construction Cost Estimates (FY26 Price Level) 98
Table 25 Cost Sharing 98
Table 26 Total Annual Cost per Average Annual Habitat Unit 99
Table 27 Major O&M Components, Associated Frequencies, & Costs 103
Table 28. Post-Construction Evaluation Description. 103

List of Appendices

Appendix A Environmental Compliance & Coordination
Appendix B Habitat Evaluation & Quantification
Appendix C Clean Water Act
Appendix D Monitoring and Adaptive Management
Appendix E FONSI
Appendix F Civil Engineering
Appendix G Structural Engineering
Appendix H HTRW
Appendix I Cost Engineering
Appendix J Economics
Appendix K Resiliency Analysis
Appendix L Real Estate Plan
Appendix M Hydraulics and Hydrology

List of Acronyms

Acronym	Meaning	Acronym	Meaning
CAP	Continuing Authorities Program	USACE	United States Army Corps of Engineers
CFS	Cubic feet per second	DOI	U.S. Department of Interior
NGVD 29	National Geodetic Vertical Datum of 1929	OAP	Operational Action Plan
USGS	United States Geological Survey	ESA	Endangered Species Act; Environmental Site Assessment
FWP	Future With Project	ER	Engineer Regulation
FWOP	Future Without Project	T&E	Threatened and Endangered
NGOs	Non-Governmental organizations	FID	Federal Interest Determination
SHPO	State Historic Preservation Office	EPA	Environmental Protection Agency
RM	River Miles	MDC	Missouri Department of Conservation
CE/ICA	Cost Effectiveness/Incremental Cost Analysis	LEDPA	Least Environmentally Damaging Plan Available
TSP	Tentatively Selected Plan	FWCA	Fish and Wildlife Coordination Act
PL	Public Law	WRDA	Water Resources Development Act
PDT	Project Delivery Team	ATR	Agency Technical Reviews
IFR/EA	Integrated Feasibility Report and Environmental Assessment	OMRR&R	Operation, Maintenance, Repair, Replacement and Rehabilitation
CWA	Clean Water Act	DQC	District Quality Control
FONSI	Finding of No Significant Impact	USFWS	United States Fish and Wildlife Service
SWPA	Southwestern Power Administration	EA	Environmental Assessment
MoDNR	Missouri Department of Natural Resources	NEPA	National Environmental Protection Act
TCW	Temperature Control Weir	NFS	Non-Federal Sponsor
P&G	Principle and Guideline	NER	National Ecosystem Restoration
EQ	Environmental Quality	OSE	Other Social Effects
NED	National Economic Development	RED	Regional Economic Development
mg/L	Milligrams per Liter	kW	Kilowatt
HEP	Habitat Evaluation Procedure	AAHU	Average Annual Habitat Unit
HUs	Habitat Units	FY	Fiscal Year
FTE	Full-Time Equivalent	EC	Engineer Circular
HTRW	Hazardous, Toxic and Radioactive Waste	ECO-PCX	Ecosystem Restoration Planning Center of Expertise
IDC	Interest During Construction	IWR	Institute for Water Resources
ASA(CW)	Assistant Secretary of the Army for Civil Works	ERDC	Engineering Research and Development Center
EO	Executive Order	PMP	Project Management Plan
FCSA	Feasibility Cost Share Agreement	MVD	Mississippi Valley Division
RECONS	Regional ECONomic System	ORD	OpenRoads Designer
MAM	Monitoring and Adaptive Management	PED	Preconstruction Engineering and Design
CAD-BIM	Computer-Aided Design - Building Information Modeling	MBTA	Migratory Bird Treaty Act
MOA	Memorandum of Agreement	CY	Cubic Yard
EOPs	Environmental Operating Principles	USBR	U.S. Bureau of Reclamation

Acronym	Meaning	Acronym	Meaning
BLM	Bureau of Land Management	PPA	
NAVD	North American Vertical Datum	DO	Dissolved Oxygen
SOCC	Species of Conservation Concern	NRCS	Natural Resources Conservation Service
WQS	Water Quality Standards	USGS	US Geological Survey
WQMP	Water Quality Management Plan	ASTM	American Society for Testing and Materials
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act	REC	Recognized Environmental Conditions
NAAQS	National Ambient Air Quality Standards	IPaC	Information for Planning and Consultation
$\mu g/m^3$	Micrograms per Cubic Meter	ppb	Parts per Billion
PM_2	Particulate Matter	ppm	Parts per Million
AHPA	Archaeological and Historic Preservation Act	NRHP	National Register of Historic Places
NHPA	National Historic Preservation Act	ARA	Abbreviated Risk Analysis
dB	Decibels	APE	Area of Potential Effects
WCM	Water Control Manual	H&H	Hydrology & Hydraulics
NNBF	Natural and Nature-Based Features	HSI	Habitat Suitability Index
NWP	Nationwide Permit	BMPs	Best Management Practices
WNS	White-Nose Syndrome	NLAA	Not Likely to Adversely Affect
CEQ	Council on Environmental Quality		

EXECUTIVE SUMMARY

Introduction

This Clarence Cannon Dam Feasibility Report with Integrated Environmental Assessment is conducted under the Continuing Authorities Program, Section 1135 Authority. Section 1135 of the Water Resources Development Act of 1986, as amended, provides the United States Army Corps of Engineers (USACE) authority to modify existing USACE projects to restore the environment and construct new projects to restore areas degraded by USACE projects. This study evaluated the feasibility and environmental effects of implementing measures at Clarence Cannon Dam to address low dissolved oxygen coming into the reregulation pool.

The study was conducted on the Clarence Cannon Dam at Mark Twain Lake, located in Ralls County, Missouri, in partnership with the Missouri Department of Conservation (MDC) as the non-Federal sponsor (NFS). If constructed, total project costs would be shared 75% federal and 25% non-federal. MDC, as the NFS, provided a letter confirming its support of the project.

Project Background Information

The Flood Control Act of 28 June 1938 authorized a dam and reservoir on the Salt River as part of a general comprehensive plan for flood control in the Upper Mississippi River Basin. A restudy of the project indicated the feasibility of a multi-purpose development that included hydroelectric power. The construction of Mark Twain Lake and Clarence Cannon Dam began in 1970 and was completed in 1983. Clarence Cannon Dam contains a hydroelectric power plant with two hydropower units capable of producing up to 58,000 kW of power. Located upstream of the dam is a temperature control weir (TCW) with a crest elevation of 580 feet NGVD 29. The re-regulation dam, which impounds water for storage and allows for control of the volume and intensity of downstream releases, is located 9.5 miles downstream of the Clarence Cannon Dam.

Purpose and Need

Regular occurrences of low dissolved oxygen (DO) measuring below 5 mg/L cause stress on fish species leading to reoccurring fish mortality events and ecosystem disruption (i.e., mussels, invertebrates, food web disruption, slow growth, behavior change, habitat loss, and more) within the study area. Without federal action, poorly oxygenated water will continue to move through the hydropower turbines into the re-regulation pool, leading to low DO levels, fish mortality events, and ecosystem disruption downstream of the dam.

Low DO at the study site is partially driven by three-layered temperature stratification from late spring and early fall that occurs behind the TCW located upstream of the main Clarence Cannon Dam. The upper layer is highly biologically productive with DO levels sufficient to sustain aquatic life. The middle layer contains a horizontal plane with the greatest water temperature change. The lowest layer consists of cold, dense water with DO levels as low as 0 mg/L. DO levels steadily drop over the course of the summer as stratification becomes stronger. When power generation is initiated, low DO water travels through the turbines and enters the re-regulation pool.

This study evaluated the need for and means to address improvement of DO levels for the benefit of aquatic species and a sustainable and productive ecosystem. An ancillary benefit of improving DO conditions may be more water availability during periods of peaking hydropower because dam operators would no longer need to spill water as often to mitigate low DO.

Plan Formulation
During this feasibility study, 19 structural, nonstructural, natural and nature based measures were considered to address the problems resulting from low DO. After an initial evaluation, 17 measures were screened and the remaining two measures were then used to create logical combinations of alternatives for evaluation.

The project team developed an initial array of 15 alternatives, including the No Action Alternative. After evaluating the initial array using habitat modeling and the Principle and Guideline (P&G) Criteria (completeness, effectiveness, efficiency, and acceptability), 11 alternatives were screened. The final array of alternatives for evaluation included:

- No Action Alternative
- Alternative 1: Temperature Control Curtain
- Alternative 8a: Raise Temperature Control Weir (TWC) (585 Elevation)
- Alternative 8b: Raise Temperature Control Weir (588 Elevation)

These alternatives were compared and evaluated using a variety of methods including: costs and benefits using Cost-Effectiveness and Incremental Cost Analysis (CE/ICA), risk analysis, and the P&G accounts based on National Economic Development (NED), Regional Economic Development (RED), Environmental Quality (EQ), and Other Social Effects (OSE) factors. Habitat modeling was also utilized, the results of which are provided in Table ES - 1, as Habitat Units (HU). The Average Annual Habitat Units (AAHUs) in Table ES – 1 are representative of HU gains or losses, annualized by summing the cumulative HUs using a formula the incorporates all target years in the period of analysis. This analysis was used to compare and evaluate the alternatives, ultimately leading to the identification of the Tentatively Selected Plan (TSP).

Table ES - 1 Outputs for the Final Array of Alternatives

Alternative	Cumulative HU	Gross AAHU	Net AAHU
No Action	2590	52	0
Alternative 1	4052	81	29
Alternative 8a	3941	79	27
Alternative 8b	4052	81	29

Tentatively Selected Plan
After the aforementioned evaluation, Alternative 8a: Raise TCW to 585, was identified as the TSP (Tentatively Selected Plan) (Figure ES - 1). This plan consists of raising the existing Temperature Control Weir to 585 elevation. The TSP was identified as the Total Net Benefits Plan, National Ecosystem Restoration (NER) Plan, and Least Environmentally Damaging Plan Available (LEDPA). Alternative 8a: Raise TCW to 585 yields 27 net AAHUs for an average annual cost over the 50-year period of analysis, starting at year 2030, of $775,000. This equates to an average annual cost per AAHU of $10,000 using the FY26 federal discount rate of 3.25%. Implementation of this alternative would restore and improve the aquatic ecosystem function of approximately 370 acres of riverine habitat. The TSP is supported by the NFS (MDC).

The Total Project Cost of the TSP is $17,431,000 with the federal and non-federal shares estimated at $13,073,000 and $4,358,000, respectively. The annual operation, maintenance, repair, replacement and rehabilitation (OMRR&R) costs are $46,000. MDC is responsible for OMRR&R of the constructed project.

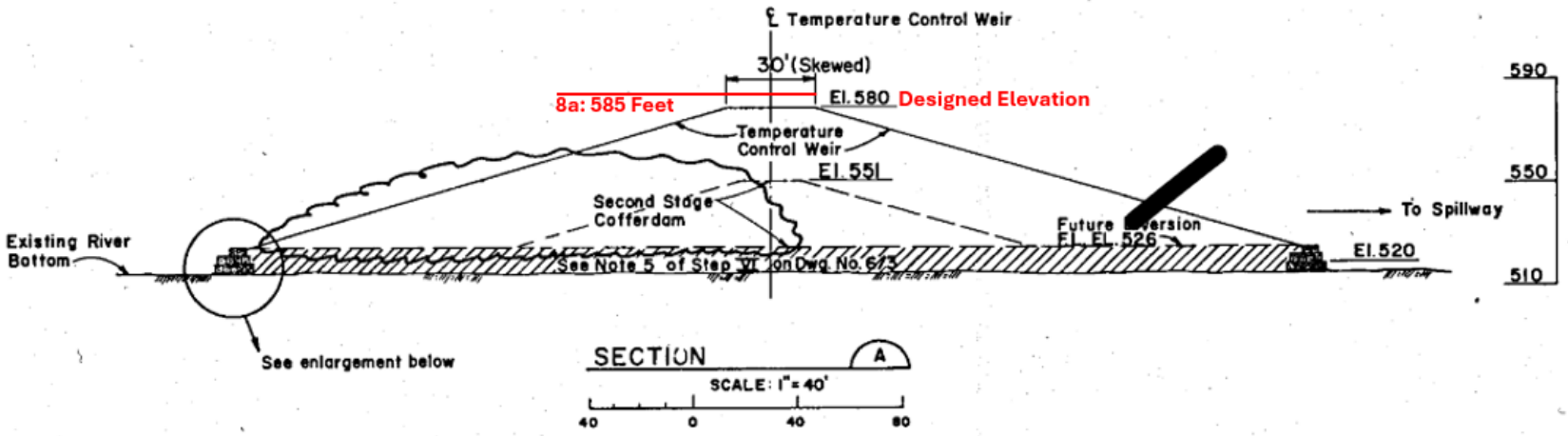


Figure ES - 1 Tentatively Selected Plan: Alternative 8a Raise Temperature Control Weir (TWC) (585 Elevation)

Plan Implementation
The Feasibility Report is scheduled to conclude in the fall of 2026. Pending funding availability, construction is proposed to begin in 2028 and conclude in 2030. The TSP is supported by the NFS (MDC).

Environmental Resources
Through the preparation of an integrated Environmental Assessment (EA), all significant resources in the study area were evaluated, and it was determined there would be no effect or less than significant effects on all resources, leading to the preparation of a Finding of No Significant Impact (FONSI). The United States Fish and Wildlife Service (USFWS) has been involved with the project from the initial planning and scoping stages. Fish and Wildlife Coordination Act (FWCA) was initiated with the USFWS to provide recommendations to minimize impacts on fish and wildlife resources.

Views of the Public, NFS, Stakeholders, and Tribes
In accordance with NEPA, the Draft IFR/EA and unsigned FONSI will be available to interested members of the public during a 30-day public review period, yet to be scheduled. MDC has been actively engaged throughout the feasibility study. They are in support of the TSP and continue to work with the project team. Tribal consultation is ongoing. National Historic Preservation Act Section 106 compliance is being completed.

Reviews
The following USACE reviews will be conducted prior to final report approval: District Quality Control (DQC) Reviews, Agency Technical Reviews (ATR), Legal Reviews, Policy Reviews, and a Public Review.

1 INTRODUCTION

This Integrated Feasibility Report and Environmental Assessment (IFR/EA) documents the planning process for evaluating potential alternatives to address the issue of water releases from the main lake into the re-regulation pool containing low levels of dissolved oxygen (DO), putting stress on aquatic organisms within the pool and causing fish mortality events.

The U.S. Army Corps of Engineers (USACE), St. Louis District (District), has prepared this draft report to present a detailed account of the planning, engineering, construction, and environmental considerations that resulted in the Tentatively Selected Plan (TSP) for the Continuing Authorities Program (CAP) 1135 Clarence Cannon Dam at Mark Twain Lake Project. The report meets USACE planning guidance (ER1105-2-103) and National Environmental Protection Act (NEPA) requirements.

USACE follows a six-step planning process that is documented in this Feasibility Report. The report is organized by the six steps, beginning with identifying the problems and opportunities in the study area (Section 2). The second step, and Section 3 of this report, focuses on inventorying and forecasting conditions. In this chapter, the relevant Existing Conditions in the study area are catalogued, and the Future Without Project Conditions are extrapolated from what is currently known about the area and what is expected to change over the next 50 years, from 2030 to 2080, if the proposed project is not implemented. The next steps are to formulate, evaluate, and compare alternatives (Section 4 through Section 6). Selection of a Tentatively Selected Plan (TSP) (Section 7) is the final step of the planning process.

Under the NEPA, an environmental assessment (EA) is required for this project, which is integrated into this report. The EA requires an assessment of the affected environment (also referred to as Existing Conditions, included in Section 3), a description of reasonable alternatives (Section 4), and an analysis of the environmental consequences of implementing each of the proposed alternatives (Section 5).

Evidence gathering, risk management, and non-Federal Sponsor (NFS) and stakeholder involvement occurred throughout the planning process. This report summarizes the multidisciplinary efforts of the Project Delivery Team (PDT), which includes the District, NFS, and other partners.

The first $100,000 of the feasibility phase was provided by the federal government. The remaining costs are cost-shared, 50% by the federal government and 50% by the NFS, the Missouri Department of Conservation (MDC). Design and construction of the project would be cost-shared between USACE (75%) and MDC (25%). After project completion, the operation, maintenance, rehabilitation, restoration, and replacement (OMRR&R) cost would be 100% NFS responsibility.

1.1 Study Authority and Project Selection

Authority is provided by Section 1135 of the Water Resources Development Act of 1986, as amended, also referred to as Section 1135 of the Continuing Authorities Program. CAP Section 1135 (33 U.S.C. 2309a) authority, as amended:

> SEC. 1135 (33 USC 2309a) - Project modifications for improvement of environment
>
> a) Determination of need
> The Secretary is authorized to review water resources projects constructed by the Secretary to determine the need for modifications in the structures and operations of

such projects for the purpose of improving the quality of the environment in the public interest and to determine if the operation of such projects has contributed to the degradation of the quality of the environment.

(b) Authority to make modifications
The Secretary is authorized to carry out a program for the purpose of making such modifications in the structures and operations of water resources projects constructed by the Secretary which the Secretary determines (1) are feasible and consistent with the authorized project purposes, and (2) will improve the quality of the environment in the public interest.

(c) Restoration of environmental quality
(1) In general, If the Secretary determines that construction of a water resources project by the Secretary or operation of a water resources project constructed by the Secretary has contributed to the degradation of the quality of the environment, the Secretary may undertake measures for restoration of environmental quality and measures for enhancement of environmental quality that are associated with the restoration, through modifications either at the project site or at other locations that have been affected by the construction or operation of the project, if such measures do not conflict with the authorized project purposes.

This project is being conducted under the Section 1135 authority given the ecosystem impacts associated with the creation and operation of Clarence Cannon Dam.

The Flood Control Act of 28 June 1938 authorized a dam and reservoir on the Salt River as part of a general comprehensive plan for flood control in the Upper Mississippi River Basin. A restudy of the project indicated the feasibility of a multi-purpose development that included hydroelectric power. The project was authorized by Section 203 of the Flood Control Act of 23 October 1962 (PL 87-874). The construction of Mark Twain Lake and Clarence Cannon Dam began in 1970 and was completed in 1983. Construction was completed in three phases. Phase 1, from 1970 to 1973, consisted of preparation of the foundation. Phase II, from 1973 to 1978, consisted of the construction of the concrete section, earthen embankment, spillway, power plant substructure, and downstream works. Phase III, from 1978 to 1983, consisted of the construction of the power plant superstructure and installation of turbines, generators, and related equipment. Figure 1 below shows the area immediately upstream of Clarence Cannon Dam before construction completed, circa early 1980s.

Figure 1 Photo of Clarence Cannon Dam and TCW, ca. early 1980s (Source: Mark Twain Lake Project Office)

The reservoir, originally named the Joanna Reservoir, was officially renamed Clarence Cannon Dam and Reservoir on 27 October 1965. Clarence Cannon Dam and Reservoir was officially renamed Clarence Cannon Dam and Mark Twain Lake on 29 December 1981. The authorized purposes of Mark Twain Lake are flood risk management in the Salt River Basin, hydroelectric power generation, water supply, fish and wildlife conservation, recreation, and incidental navigation.

Sponsor. MDC is the NFS. Operation, maintenance, rehabilitation, restoration, and replacement (OMRR&R) is the responsibility of the Sponsor in accordance with Water Resources Development Act (WRDA) 1992, Public Law 102-580, 33 U.S.C. § 652(e)(7)(A). The O&M responsibilities of the Sponsor will be addressed in the proposed Memorandum of Agreement for the Project. OMRR&R costs and actions will be further refined/documented during the Design and Implementation Phase.

1.2 Study Area

Mark Twain Lake is located in northeastern Missouri on the Salt River in the Salt River Basin. Mark Twain Lake spans both Ralls and Monroe Counties, is located approximately 20 miles southwest of Hannibal, MO, and 140 miles north of St. Louis, MO. Clarence Cannon Dam and its associated re-regulation dam are located in Ralls County, MO, upstream from the confluence with the Mississippi River at river miles (RM) 63 and 53.5, respectively. Figure 2 shows the site in relation to St. Louis and Figure 3 identifies the features of Clarence Cannon

Dam.

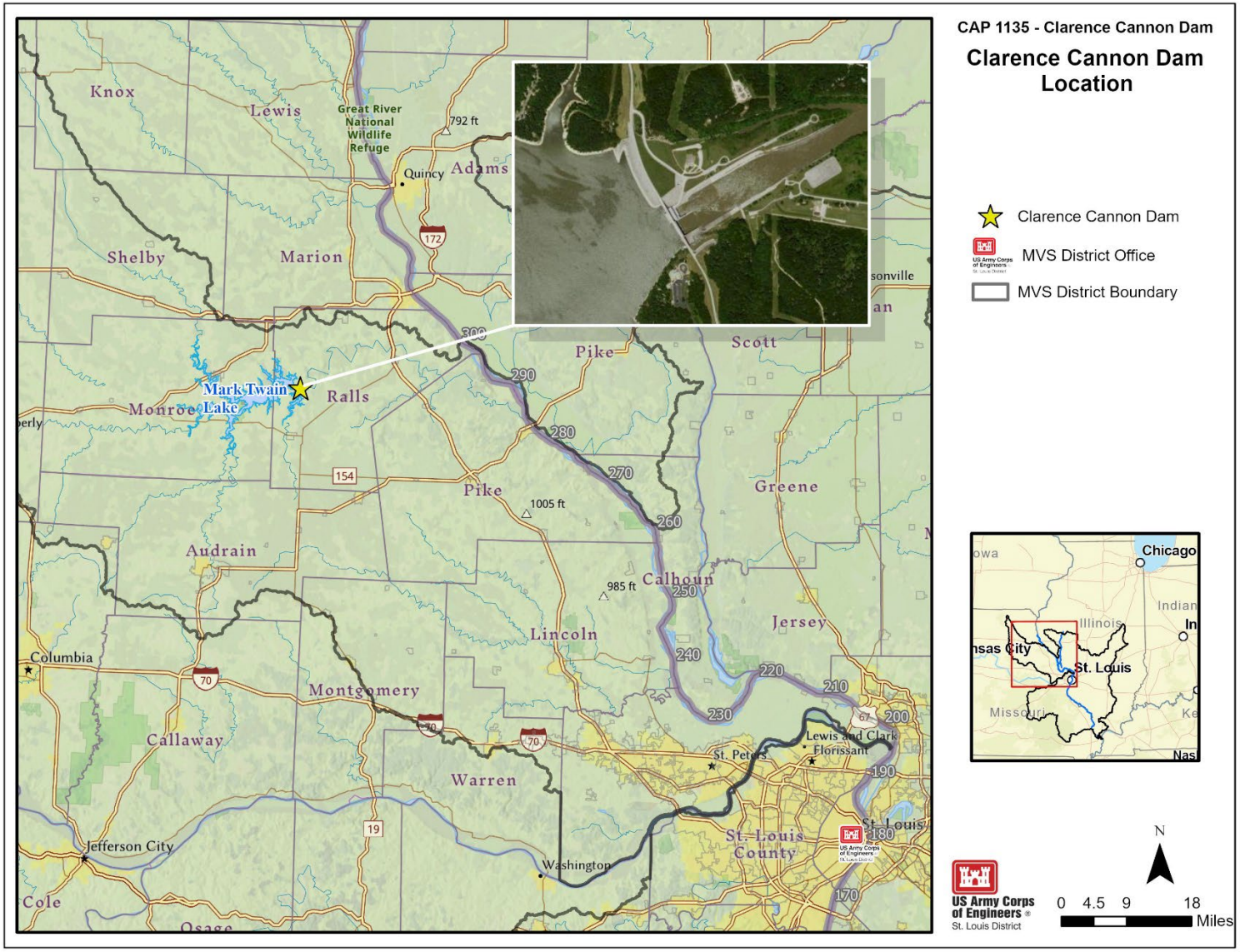


Figure 2 Study Area Location

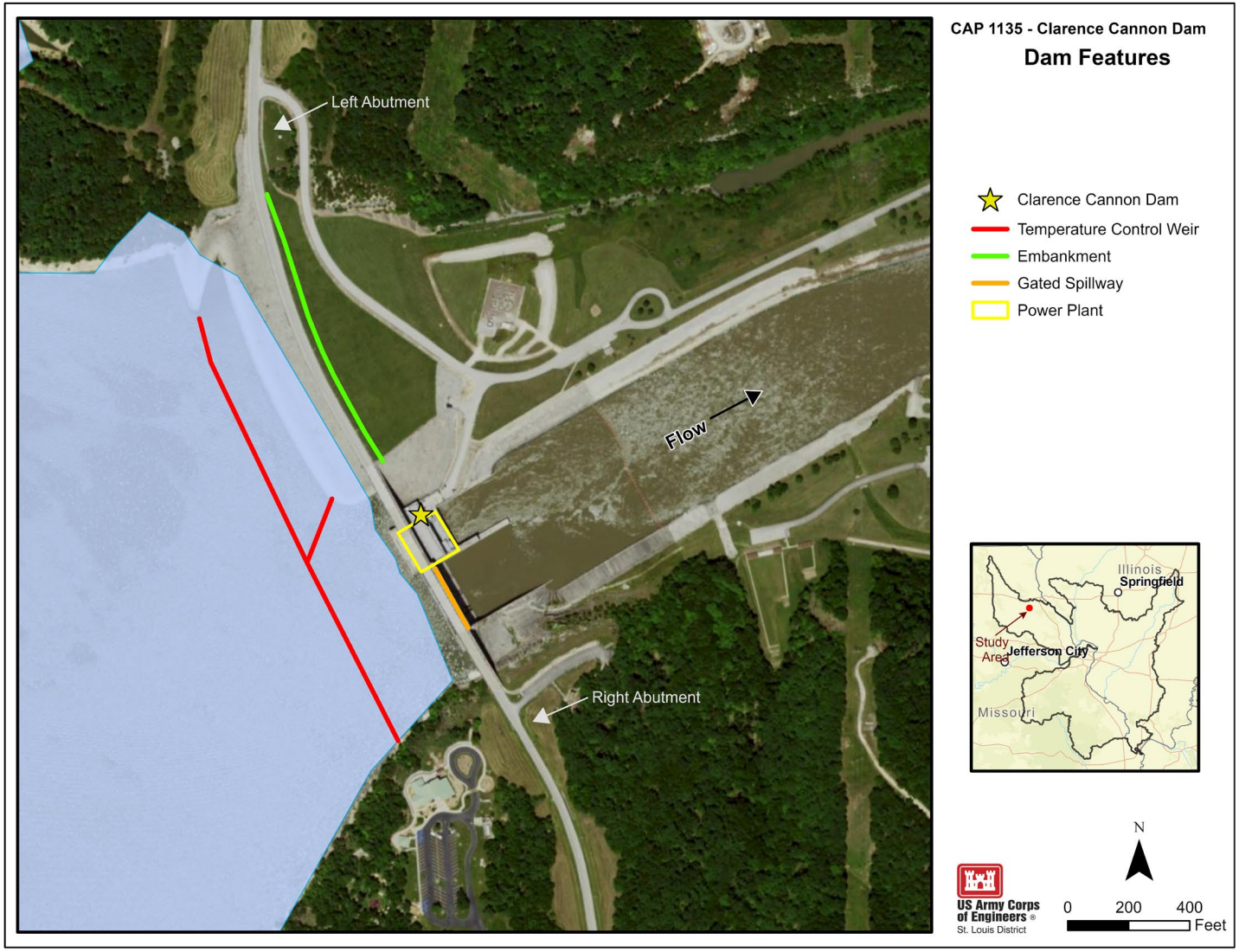


Figure 3 Clarence Cannon Dam Features

1.2.1 Site Features

The physical components of the study area include Clarence Cannon Dam and its associated features: the hydroelectric power plant, water temperature control weir (TCW), and re-regulation dam. State Highway J crosses over the top of the dam. The dam is 1,940 feet long with its centerline running in a near north-south direction. The concrete portion of the dam is 846 feet long and borders the valley's southern rim. The earthen portion is 1,094 feet long and borders the northern side of the basin. The dam has two hydropower units capable of producing 58,000 kilowatts of electricity collectively. A second dam, the re-regulation dam, is located about 9.5 miles downstream of the main dam and impounds water for storage and to control downstream release volumes and intensities.

A TCW, approximately 780 feet long and consisting of rolled earth embankment, gabion baskets, and concrete capstones, is located approximately 400 feet upstream of the main dam with a crest elevation of 580 feet NGVD 29. The TCW acts as a skimming weir, which allows warmer oxygenated water to be released through the turbines during periods of lake stratification; however, when the lake's water level is high, cooler, poorly oxygenated water passes through the turbines and into the re-regulation pool during power generation. During periods of non-generation at this elevation, low oxygenated water fills the forebay between the TCW and main dam. This water leaks through the wicket gates into the re-regulation pool. Upon initiation of hydropower generation, this poor-quality water is flushed downstream below the dam and into the regulation pool. Figure 4 shows the existing site features at Clarence Cannon Dam.

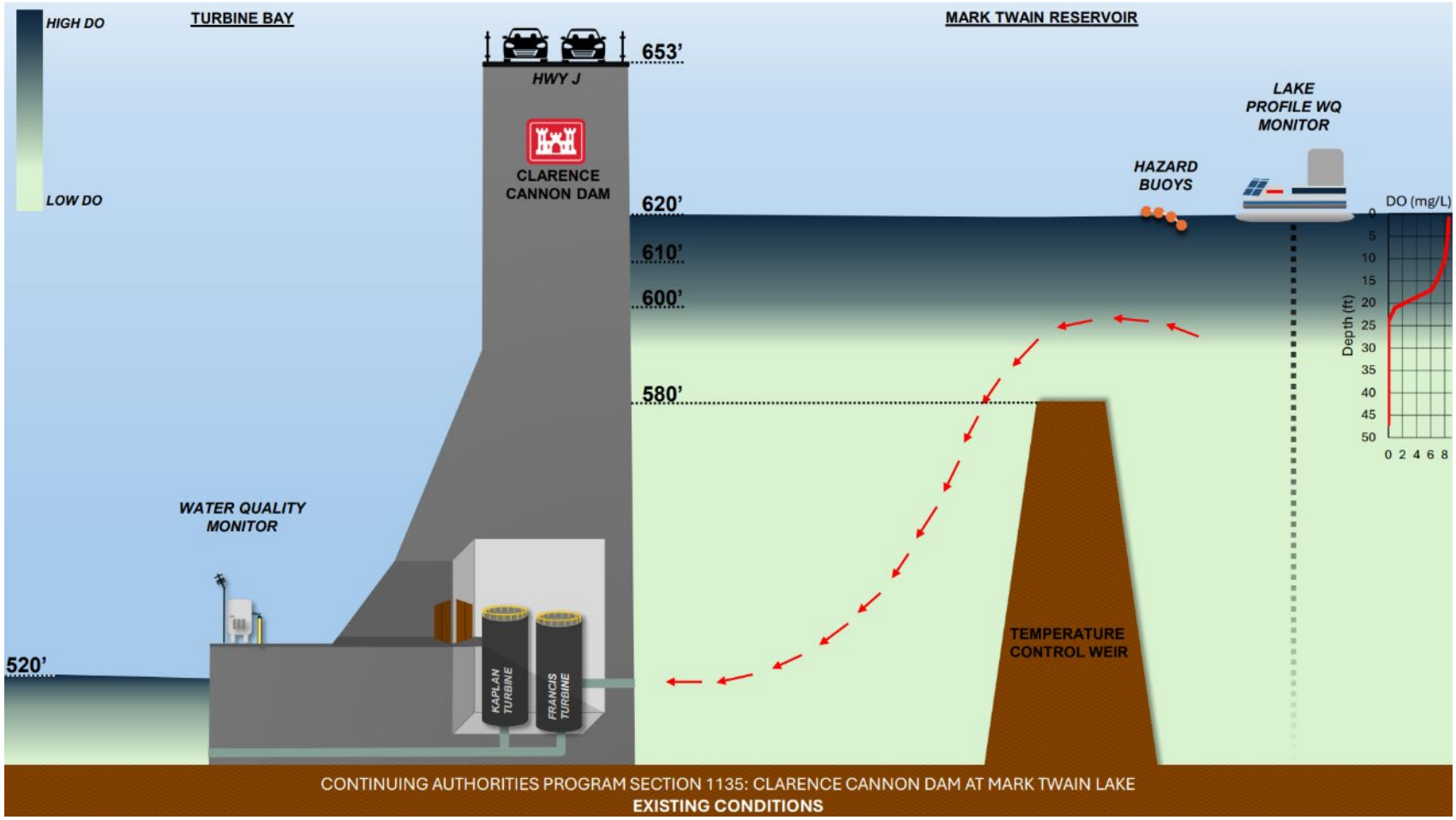


Figure 4 Cross Section of Existing Site Features

1.1 Purpose and Need

The purpose of the proposed federal action is to improve dissolved oxygen (DO) levels in the water released from the Clarence Cannon Dam, ultimately increasing habitat quality in order to support and sustain a healthy aquatic ecosystem in the re-regulation pool and downstream reaches of the Salt River.

The action is needed to address recurring fish mortality events and ecosystem disruption caused by low DO levels in the study area. Water quality monitoring has shown regular occurrences of DO measuring below the critical threshold of 5 mg/L, which causes significant stress on aquatic species.

These low DO conditions are driven by natural seasonal thermal stratification from late spring to early fall in the water upstream of the Temperature Control Weir (TCW). This process creates a bottom layer of cold, dense water with DO levels as low as 0 mg/L. During hydropower operations, this poorly oxygenated water is drawn through the turbines and discharged into the re-regulation pool.

Without federal action, this cycle will continue, leading to persistent low DO levels, ongoing fish mortality, and the disruption of the downstream aquatic ecosystem. An ancillary benefit of improving DO conditions may be increased water availability for peaking hydropower generation, as the need to spill water to mitigate low DO would be reduced. Detailed discussion of the problems and opportunities within the study area are outlined in Sections 2.1 and 2.2.

1.2 Study Scope

This feasibility study focuses on investigating engineering measures to improve aquatic habitat quality by improving dissolved oxygen concentrations in the discharges from Clarence Cannon Dam. Larger system changes, including recommendations to change hydropower operations, or other habitat improvement in the re-regulation pool or Mark Twain Lake are outside of the scope of this CAP study.

1.3 Agency Participants and Coordination

Scoping is an early and open process for determining the range of issues to be addressed and for identifying the significant concerns related to a proposed Federal action. During the planning process, a variety of communication methods with the affected public, agencies, and organization occurred. USACE conducted scoping and coordination with the following State and Federal agencies, as well as other interested parties:

- Missouri Department of Conservation (MDC)
- U.S. Fish and Wildlife Service (USFWS)
- U.S. Environmental Protection Agency (USEPA)
- State Historic Preservation Office (SHPO)
- Tribal Nations

Study collaborators discussed problems, opportunities, and potential management measures through numerous coordination meetings. While not comprehensive, the following meetings are examples of coordination:

- Pre-Charette Site Visit (21 November 2024)
- Scoping Charette Meeting (04 December 2024)
- Habitat Model Evaluation Workshop (14 August 2025)
- Interagency Team Meetings (reoccurring)

1.4 Prior Reports and Existing Projects in Vicinity

USACE and MDC have conducted a number of studies relevant to this planning report. Table 1 is a brief list of studies relevant to this study. Additional literature cited can be found in Section 10 and at the end of each appendix.

Table 1. Prior Reports, Projects, and Programs

Year	Study/Report/Environmental Document Title	Relevance
1981	Mark Twain Lake Hydraulics Water Quality Study Temperature Control Weir Memo	Summarizes a USACE internal study which found that raising the weir would improve temperature/DO problems
1993	Water Quality Studies at Clarence Cannon Dam, Missouri	Provides historical data on water quality
2010	Clarence Cannon Powerhouse Inspection Report for Capability of Increasing Dissolved Oxygen in Water Passing Through the Turbines	Review of turbine designs and operating characteristics to determine ways to quickly provide for air injection via the turbine
Multiple	Missouri Pollution and Fish Kill Investigations	Provide historical data on fish mortality events
2023	Continuing Authorities Program (CAP) Federal Interest Determination (FID) Fact Sheet	Established federal interest for the project and acted as a starting point for the feasibility phase of the project

This feasibility report references these reports and studies but also utilizes knowledge gained from the on-site experiences and observations of MDC employees and USACE dam operators.

2 NEED FOR AND OBJECTIVES OF ACTION

2.1 Problems

Problems in the study area were identified through analysis of existing reports, analysis of existing data, and consultation with state agencies, federal agencies, and other non-Governmental organizations (NGOs) familiar within the study area. The identified problems and opportunities guided the study's inventory of existing conditions, forecast of future conditions and the development of the study objectives. As a result, the following problems were identified by the PDT:

1. Temperature stratification (see Section 3.3 for more detail) occurs in the lake upstream of the Clarence Cannon Dam TCW during warm months, leading to poorly oxygenated water collecting near the bottom of the lake.
2. Poorly oxygenated water enters the re-regulation pool through the turbines when power generation occurs, putting stress on aquatic organisms within the pool and causing fish mortality events.

2.2 Opportunities

Within the study area there are opportunities for additional beneficial outcomes beyond addressing the stated problems. The following opportunities were identified by the PDT:

- Strengthen relationships between NFS, stakeholders, and the public
- Provide incidental benefits to enhance recreation (e.g., more live fish for anglers) and reduce public safety risk in association with aquatic habitat improvements
- Improve habitat for threatened and endangered (T&E) mussel, fish, and aquatic plant species that may be present in the re-regulation pool
- Drive funding to local economy through construction workforce
- Improving conditions up and downstream could make more water available for peaking hydropower because dam operators would no longer need to spill water to mitigate low DO conditions

2.3 Resource Significance

The criteria for determining the significance of resources are provided in the Federal Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (Water Resources Council 1983) (P&G) and USACE planning guidance ER 1105-2-103. Protecting and restoring significant resources is in the national interest. The significance and the relative scarcity of the resources helps determine the federal interest in the project. Significant resources in the study area include natural and cultural resources that are recognized as significant by institutions and the public.

Ecosystem restoration projects generate nonmonetized benefits that can be challenging to quantify. Along with other methods of evaluation, including cost-effectiveness and incremental cost analyses (CE/ICA), information about acceptability, completeness, efficiency and effectiveness, and the evaluation of comprehensive benefits, information on the significance of ecosystem outputs will help determine whether the proposed environmental investment is worth its cost and whether a particular alternative should be recommended. Statements of significance provide qualitative information to help decisionmakers evaluate whether the value of the resources of any given restoration alternative is worth the costs incurred to produce them. ER-1105-2-103 states that the significance of restoration outputs should be recognized in terms of institutional, public, and/or technical importance.

2.3.1 Institutional Significance

Institutional significance is based on institutional recognition, or the importance of an environmental resource is acknowledged in the laws, adopted plans, and other policy statements of public agencies, tribes, or private groups.

The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. In Missouri state water quality standards generally require that DO levels in warm water fisheries not drop below 5 mg/L to protect aquatic life, with levels below this considered impaired if they occur for more than 10% of measurements during critical periods.

The following laws and policies also demonstrate institutional significance:

- Fish and Wildlife Coordination Act, as amended (16 U.S.C.§ 661) & Endangered Species Act (ESA) of 1973, as amended – The institutional importance of threatened and endangered species is addressed by multiple federal statutes. For instance, the Endangered Species Act (ESA) of 1973 and the Fish and Wildlife Coordination Act both necessitate consultation with the USFWS for the conservation of these species. For this study, it is relevant to the improvement of aquatic habitat and protection of bat species around Clarence Cannon Dam at Mark Twain Lake.
- Archeological and Historic Preservation Act (AHPA) – It addresses the preservation of historical and archeological data that might otherwise be lost or destroyed. Mark Twain Lake is considered culturally rich place, AHPA ensures that archeological sites threatened by the creation, operation, or maintenance of Mark Twain Lake are salvaged or documented before destruction.

2.3.2 Public Significance

Public recognition means that some segment of the general public recognizes the importance of an environmental resource as evidenced by people engaged in activities that reflect an interest or concern for that particular resource. Such activities may involve membership in an organization, financial contributions to resource-related efforts, providing volunteer labor, and correspondence regarding the importance of the resource.

Since 2010, an interagency team consisting of staff from MDC, USACE, Missouri Department of Natural Resources (MoDNR), and SWPA, have worked together to develop and implement an Operational Action Plan (OAP) to address low DO concentration problems that often occur during the summer months below Clarence Cannon Dam tailwater and downstream for 9.5 miles at the re-regulation pool water quality gages. The DO levels are monitored routinely between the dam tailwater and the re-regulation dam. The purpose of the OAP is to keep agency stakeholders informed of water quality conditions and power generation needs and provide technical input to attempt to minimize stress and mortality to aquatic life, while still fulfilling the dam's hydropower mission.

Clarence Cannon Dam and Mark Twain Lake are owned by the federal government and regulated by the District's Water Control Section within the Hydrology and Hydraulics Branch. It is one of Missouri's largest lakes, consisting of 18,600 surface acres of water at normal pool and over 36,000 acres of land, totaling approximately 54,700 acres. There are 500 campsites, 17 boat ramps, two marinas, over 40 miles of trails, the M.W. Boudreaux Memorial Visitor Center, and Mark Twain State Park. Mark Twain Lake is known for its fishing resources and is frequented by sport fisherman and tourists who visit the area for fishing tournaments, camping, festivals, etc.

2.3.3 Technical Significance

Technical significance is based on technical recognition, or the importance of an environmental resource based on scientific or technical knowledge or judgment of critical resource characteristics. Scarcity, representativeness, status and trends, connectivity, limiting or critical habitat, and biodiversity describe technical significance. Differences across geographical areas and spatial scales may determine whether a resource is significant.

- Scarcity is a measure of a resource's relative abundance within a specified geographic range.
- Representativeness is a measure of a resource's ability to depict the natural habitat or ecosystems within a specified range.
- Status and Trend are measures of the relationship between previous, current, and future conditions.
- Connectivity is the measure of the potential for movement and dispersal of species throughout a given area or ecosystem.
- Limiting or Critical Habitat is the measure of resources present supporting significant species.
- Biodiversity is a measure of the variety of distinct species and the genetic variability within them.

Table 2 identifies the technical significance of these five resources within the study area.

Table 2 Technical Resource Significance of Study Area

Resource	Aquatic Habitat	Biotic Community
Scarcity	High quality aquatic habitat is scarce in the region due to low DO.	The biotic community is scarce in the area due to low DO.
Representativeness	Representative of the Mark Twain Lake and Salt River in the region	Representative of Biotic community in the region.
Status and Trend	Several reports show the effects of low DO water in quantity of aquatic organisms in the re-regulation pool, particularly fish and freshwater mussels. USACE continues monitoring water quality, MDC and USFWS continue monitoring aquatic species.	Ecosystem affected in the re-regulation pool due to low DO water. USFWS and MDC continue the monitoring of the bats and biotic community.
Connectivity	Reports show due to low DO during summer months high degree of disconnection in aquatic habitats throughout the Clarence Cannon Dam and re-regulation pool. Aquatic habitat disruption	Due to low DO during summer months, there is disconnection throughout biotic communities.
Biodiversity	High level of aquatic biodiversity in Mark Twain Lake and re-regulation pool. Most recent surveys: 19 mussel species, 22 fish species, 8 game species, 14 non-game species	There has been a loss of biodiversity in the project areas of biotic community. MDC stocking efforts have improved the condition but still having aquatic habitat disruption due to low DO.

2.4 Goals

The overarching goal of the study is to identify a long-term solution to decrease stress on aquatic species and communities in the re-regulation pool caused by low DO releases from the dam and to be compliant with water quality standards under the Clean Water Act.

2.4.1 NFS Management Goals

According to the Mark Twain Lake 2025 Master Plan, the Mark Twain Lake Project Office coordinates with MDC on management of a "viable and productive fishery population

described in the MDC Mark Twain Lake Fishery Management Plan." Management goals of MDC for the re-regulation pool include:

- Maintain a viable, multi-species sport fishery in the re-regulation pool downstream of Clarence Cannon Dam.
- Advance knowledge of mollusk biology, ecology, status, and threats to guide effective conservation and habitat restoration
- Implement and evaluate conservation and management actions that protect mollusks and restore resilient aquatic habitats
- Work with USACE, when re-regulation pool drawdowns occur below 522.5 feet to carry out drawdown mussel sampling recommendations as written in the 2010 Mussel Survey

2.5 Planning Objective

This study was conducted to examine the feasibility of an ecosystem restoration project in the area. Specific study objectives are created to determine whether individual management measures can solve the problems while taking advantage of the opportunities identified and avoiding the constraints. The following objective was developed based on study area problems, opportunities, and goals, as well as federal regulations:

- Reduce regular occurrences of DO measuring below 5 mg/L to reduce stress on aquatic species and decrease the frequency and size of fish mortality events within the study area over the period of analysis.

2.6 Planning Constraints and Considerations

2.6.1 Constraints

A constraint limits the extent of the planning process.

Universal Constraints:

- The recommended plan cannot violate applicable federal and Tribal laws, regulations, and policies.
- Restoration measures should not increase flood heights or adversely affect private property or infrastructure.

Study Specific Planning Constraints:

- The geometry of the dam does not allow for major infrastructure changes
- Avoid/minimize alteration of turbines
- Avoid/minimize adverse impacts to the operations of Mark Twain Lake and/or SWPA hydropower production
- Avoid prescribing changes to Mark Twain Lake operations
- Avoid/minimize reduction of the head differential across the dam
- Avoid/minimize adverse impacts to cultural resources in Mark Twain Lake

2.6.2 Considerations

Considerations are impacts or outcomes from which alternative plans should avoid or minimize impacts.

Environmental Laws and Regulations. Construct measures consistent with federal, state, and local laws. Therefore, the following are considered when analyzing alternatives:

- Avoid or minimize negative impacts to threatened and endangered species
- Avoid or minimize negative impacts to cultural resources

- Follow applicable water quality codes and existing statutes
- Avoid adverse social impacts

Project-Specific. The following are considered when analyzing alternatives:

- Avoid/minimize adverse impacts to incidental navigation for recreation on Salt River
- Follow applicable water quality codes and existing statutes
- Changing operations at the dam would potentially present legal issues and take years to approve
- Avoid/minimize increasing bank erosion in the re-regulation pool that may negatively impact cultural resources or exacerbate reverse encroachment on left bank
- Heavy flows downstream limit the type and location of measures within the re-regulation pool
- Avoid/minimize adverse impacts to environment, including to federal or state T&E species potentially present

Sponsor. The following was considered when analyzing alternatives:

- Sponsor O&M budgets and capability.

3 EXISTING CONDITIONS/FUTURE WITHOUT PROJECT CONDITIONS

The Existing and Future Without Project (FWOP) condition is developed to describe the current and most likely future conditions in the study area if no federal action is taken to address the identified problems. The FWOP is the basis from which alternative plans are formulated and impacts are assessed and can be defined as “conditions that are reasonably foreseeable as existing in the absence of a federal action are the baseline for the assessment of meaningful effects of a potential project. ” (ER 1105-2-103). This section is not a comprehensive discussion of every resource within the study area but instead focuses on those aspects of the environment that were identified as relevant issues during scoping, had the potential to affect, or may be affected by the considered alternatives. The environmental effects on these resources are described in Section 5.

A 50-year period of analysis was used to forecast the FWOP and FWP conditions. The period of analysis was limited to 50 years in accordance with USACE regulations (ER 1105-2-103), even though project measures are anticipated to continue having beneficial effects beyond 50 years. The base year (the year when a proposed project is expected to be operational or, in this case, when construction is complete and benefits begin accruing) considered for this study is 2030, assuming funding is available, and period of analysis continues until 2080.

Assumptions are one of the most common ways to address uncertainty in a planning study. Several assumptions have been made in forecasting the FWOP scenario:

1. Water management for Mark Twain Lake and the re-regulation pool would continue as they do now.
2. No substantial change to current operation and maintenance budgets for the NFS or the Mark Twain Lake Project Office.
3. Water quality conditions in the re-regulation pool will continue to be below the DO standard of 5 mg/L and cause fish mortality events.
4. Within 50 years, it is assumed water temperatures will increase up to 1.8 degrees Celsius, based on USFWS, United States Geological Survey (USGS) model and academic paper (See Appendix B – Habitat Evaluation and Quantification). Assuming a low-emissions pathway, annual-mean temperatures could increase in the range of 2°F to 8°F (NOAA, 2022). See Appendix K for more in-depth analysis on future changes in temperature.

3.1 Resources Not Evaluated in Detail

The PDT eliminated resources that were not in the area of potential effect or would not be impacted by the alternatives from further evaluation. These resources include, but are not limited to:

- Wild and Scenic Rivers (there are no designated wild and scenic rivers in or near the study area)
- Mineral Resources
- Prime Farmland & Soils
- Topography & Geology

The PDT focused on information gathered from the study area and the area of potential effect.

3.2 Hydraulics, Hydrology, and Water Control

Clarence Cannon Dam consists of a compacted earth embankment (crest elevation of 653

feet NGVD29), grated concrete spillway, concrete hydroelectric power plant, and a temperature control weir. The spillway is topped by four Tainter gates separated by a stilling basin. The 780-foot-long TCW is constructed of rolled earth and has a crest elevation of 580 feet NGVD29. It is located 400 feet upstream of the dam. The power plant north of the spillway and contains two turbine generators. The invert elevation of the intake structure is 520 feet NGVD29 and the outlet elevation is 483 feet NGVD29. The re-regulation dam consists of compacted earth embankment, gated concrete spillway, sluice gate, and an operating house. Mark Twain Lake is regulated by the Water Control Section within the Hydrologic and Hydraulics Branch of the St. Louis District.

3.2.1 Resiliency

Long-term weather variability is expected to result in adverse impact to habitats and organisms within the study area, but these impacts would not be the result of the No Action. The resiliency assessment is contained in Appendix K – Resiliency Analysis. There is moderate risk for changes in hydrometeorological factors to threaten the efficacy of the project. The primary risk is to the environmental concern of low-DO levels in the re-regulation pool downstream of the dam. Temperatures are likely to increase in the future in this region, resulting in higher energy demands for cooling buildings. Hydropeaking would increase at the dam to meet increased demand, which would result in more low-DO water being released downstream. Additionally, the duration, magnitude, and frequency of flood events are likely to increase. Water withheld in the reservoir for longer periods of time along with additional high-oxygen-demand contaminants from increased runoff could result in further eutrophication of the reservoir. For more detailed information on the evidence gathered to support these conclusions, consult Appendix K.

3.2.2 Hydropower

Hydropower is an authorized purpose of Mark Twain Lake and Clarence Cannon Dam, and provides peaking power to the Southwestern Power Administration (SWPA), which delivers power to cooperatives and municipalities in Missouri, Arkansas, Kansas, Oklahoma, Louisiana, and Texas (MTL Master Plan, 2025). Clarence Cannon Dam's hydroelectric power plant can produce up to 58,000 kilowatts of power. The power plant includes one 27,000 kW Kaplan conventional generator and one 31,000 kW Francis reversible motor/generator that has the capability to pump water from the re-regulation pool back into Mark Twain Lake. When both units are operating at capacity, up to 5,400,000 gallons of water pass through the turbines per minute. The re-regulation dam creates a storage pool that impounds water for storage and controlled releases, mitigating downstream fluctuations.

When the lake level is between 590 and 606 feet, hydroelectric power generation occurs to meet the needs of SWPA in conjunction with other project purposes. The frequency of hydropower generation decreases as the lake drops below 606 feet to conserve water in the hydropower pool. When the lake level is between 590 feet and 606 feet, hydroelectric power generation is scheduled to meet the needs of SWPA in conjunction with other project purposes. The frequency of hydropower generation decreases as the lake drops below 606 feet to conserve water in the hydropower pool.

Hydroelectric power generation is scheduled to meet the needs of SWPA in conjunction with other project purposes. Normal lake drawdown as the result of hydroelectric power generation is limited to two feet per calendar week (i.e., Sunday through Saturday) or four feet per month (i.e., any consecutive four calendar week period) during May through October. During the remainder of the year, normal lake drawdown is limited to two feet per week with no monthly maximum. At times, the Water Control Office has given SWPA the

option to generate limited power to maintain the required minimum water level in the re-regulation pool. If SWPA does not generate, water is spilled. This water is not attributed to hydroelectric power generation as it pertains to lake drawdown limits. The total release is limited as necessary to prevent adverse impacts downstream of the project.

3.2.3 Navigation

The Clarence Cannon Dam and Mark Twain Lake navigation project purpose is achieved incidentally on the Mississippi River during low-flow periods by the release of water for non-consumptive water supply, water quality enhancement, improvement of downstream fisheries, and hydroelectric power generation.

3.2.4 Operations

Clarence Cannon Dam is the impoundment for Mark Twain Lake and has an average daily flowrate of 1,570 cfs, maximum of 104,500 cfs, and minimum of 50 cfs. Flow and discharge regulations can be found in the Water Control Manual for Mark Twain Lake (2011). Releases from the dam are dependent on a variety of factors, including lake level and hydropower demands. There are two functions to release water downstream: through the spillway structure Tainter gates or through the intake gates by means of the hydropower units. During releases, the re-regulation pool fills and the two re-regulation dam Tainter gates operate to release flows. The re-regulation dam releases a minimum of 50 cfs at all times.

Mark Twain Lake utilizes a release schedule developed to provide flood control benefits and achieve other project objectives. The preferred method of release is through the turbines first and Tainter gates second. Releases from Mark Twain Lake may be required to improve downstream water quality conditions in the re-regulation pool and lower Salt River. Release decisions are based on DO data collected in real-time within the re-regulation pool. If DO concentrations drop below the 5 mg/l criteria based on 10 CSR 20-7.031, subsection (4) part (J) Dissolved Oxygen, the preferred method of release is discharging water through the Tainter gates solely or in combination with hydroelectric power generation units.

An interagency effort established procedures to improve communication and coordination when DO drops to 5mg/L or below, providing a framework and guide for action as conditions require by establishing procedures for improved communications and coordination between agencies. The long-term operational objective is to maintain DO concentrations in the re-regulation pool at 5 mg/L or greater as much as possible. DO levels are optimized through the use of operational actions. To accomplish this, an enhanced DO monitoring program was developed and operational response actions are scaled to the severity of DO depletions and current hydropower requirements. Tainter gate releases and/or hydropower generation may be utilized to optimize DO concentration at the downstream monitoring station. Implementation of the plan is the responsibility of USACE, MDC, MoDNR, and SWPA. These agencies comprise the Mark Twain DO Working Group who meet to discuss flow conditions, water management constraints, power needs, water quality, and operational constraints.

Clarence Cannon Dam and the re-regulation dam are operated as one project. Releases depend on the lake pool elevation, inflow rate, downstream runoff, and river stages on the Lower Salt River, Salt River tributaries, and the Mississippi River. During the growing season (April 1st to October 31st), daily releases average 10,000 csf or less from Clarence Cannon Dam until an elevation of 615 feet is exceeded. Releases may be restricted due to flooding.

The release rate from Clarence Cannon Dam will vary between 0 to 12,000 cfs. These fluctuations can be dampened by operation of the re-regulation dam. Hydroelectric power

generation releases are passed through the re-regulation dam in to minimize the potential for downstream bank caving. The re-regulation pool attenuates the rate of release from Clarence Cannon Dam so hydroelectric power is generated at a more efficient rate without exceeding the downstream channel capacity, and flow fluctuations can be reduced. The re-regulation dam gates control the rate at which water is released.

3.3 Environmental

Between late spring and early fall, Mark Twain Lake experiences temperature stratification, similar to what is depicted in Figure 5. This is driven by warming of the upper layer of the lake. In the summer months, as temperatures continue to increase, the top layer of the lake warms, leading to a temperature difference that eventually creates a physical force strong enough to resist mixing between the layers. This results in a three-layered temperature stratification. The upper layer (epilimnion) is a lighter, well-mixed, highly biologically productive layer with DO levels sufficient to sustain aquatic life. The middle transitional zone (metalimnion) contains a horizontal plane (thermocline) where the greatest water temperature change is found. The metalimnion layer prevents wind mixing. The lowest layer (hypolimnion) consists of cold, dense water with DO levels reaching as low as 0 mg/L. DO levels in the hypolimnion at Mark Twain Lake steadily drop over the course of the summer as stratification becomes stronger, leaving a limited amount of DO by late summer. DO levels are depleted in the hypolimnion largely due to decomposition of biological material that falls from the highly productive epilimnion.

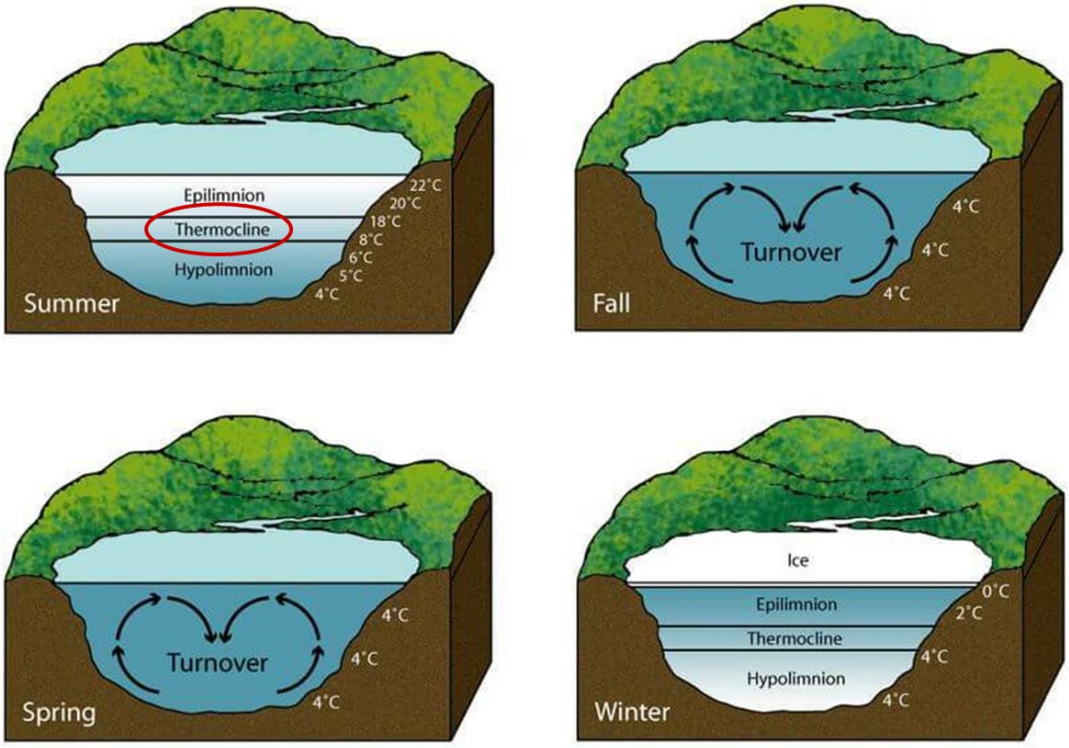


Figure 5 Example Lake Temperature Dynamics

3.3.1 Aquatic Organism and Wildlife

The waters of the lake and tailwater also have diverse forms of phytoplankton, zooplankton, aquatic insects, crustaceans, amphibians and reptiles. The area also provides resources for a variety of mammals and birds, and the area surrounding Mark Twain Lake serves as a

home for white tailed deer, wild turkey, foxes, racoons, black bear, and more.

It is anticipated that the aquatic habitat will continue to degrade as a result of expected increased temperatures and decreased DO. Decreased DO levels would exclude aquatic organisms that cannot live in poorly oxygenated water. The diversity of aquatic organisms would decrease as water temperatures increase and oxygen levels decrease. Furthermore, some aquatic organisms are generalized in their habitat needs, while others are specialized, so a drop in habitat diversity can cause an adverse impact over time as specialist organisms are excluded from the study area. Drops in habitat diversity can cause drops in species diversity and composition within the remaining habitats.

3.3.1.1 Freshwater mussels

Mussels are an important food source for many animals, including fish, small mammals, and some birds. They filter algae, bacteria, and other particles from the water, improving water quality and cycling nutrients and energy in streams and lakes. Because mussels are sensitive to habitat disturbance and pollution, they are good indicators of the overall health of aquatic ecosystems and water quality.

Within the re-regulation pool downstream of Clarence Cannon Dam, there were important mussel resources documented by MDC in 2016. During a drawdown of the re-regulation pool that year, MDC conducted mussel surveys on two sites. Between the survey sites, two species of special interest were found: wartyback and deertoe. The species collected included during the 2016 survey included Pink Heelsplitter (*Pyganodon grandis*), Fragile Papershell (*Leptodea fragilis*), Giant Floater (*Pyganodon grandis*), Pondmussel (*Sagittunio nasutus*), Pistolgrip (*Tritogonia verrucosa*), Pocketbook (*Lampsilis cardium*), Threeridge (*Amblema plicata*), Deertoe (*Truncilla truncata*), Mapleleaf (*Quadrula quadrula*), Fatmucket (*Lampsilis siliquoidea*), Paper Pondshell (*Utterbackia imbecillis*), Plain Pocketbook (*Lampsilis cardium*), Threehorn Wartyback (*Obliquaria reflexa*), Lilliput (*Toxolasma parvum*), White Heelsplitter (*Lasmigona complanata complanata*), Pimpleback (*Cyclonaias pustulosa*), Fawnsfoot (*Truncilla donaciformis*), Wartyback (*Quadrula nodulata*), and Pink Papershell (*Potamilum ohiensis*).

Under the FWOP condition, degradation of aquatic habitat for mussel species is expected to continue. As habitat quality within the study area decreases (e.g., increases in temperature, reductions in DO), recruitment of mussel species is expected to continue to decline, and more sensitive species may be lost. Habitat degradation is the leading factor in the decline of mussel species. Changes in water quality and quantity from a variety of human activities have degraded mussel habitats. Dams can create silt-laden impoundments that are unsuitable for most mussels and obstruct the movements of host fish that are essential to mussel reproduction.

3.3.1.2 Fish & Fish Mortality

In May 2025, MDC sampled fish and conducted electrofishing surveys in the study area, as well as other targeted locations to assess the fish community. The species collected included Smallmouth Buffalo (Ictiobus bubalus), Largemouth Bass (Micropterus dolomieu), White Bass (Morone chrysops), Green Sunfish (Lepomis cyanellus), Black Crappie (Pomoxis nigromaculatus), Flathead Catfish (Pylodictis olivaris), Slender Madtom (Noturus exilis), Common Carp (Cyprinus carpio), Quillback (Carpiodes cyprinus), River Redhorse (Moxostoma carinatum), Freshwater Drum (Aplodinotus grunniens), Orangespotted Sunfish (Lepomis humilis), White Crappie (Pomoxis annularis), Bluegill (Lepomis macrochirus), Bigmouth Buffalo (Ictiobus cyprinellus), River Carpsucker (Carpiodes carpio), Channel

Catfish (Ictalurus punctatus), Gizzard Shad (Dorosoma cepedianum), Brook Silverside (Labidesthes sicculus), Walleye (Sander vitreus), and Blue Catfish (Ictalurus furcatus).

Although not found in the basin recently, lake sturgeon, which are state endangered, are likely to occur periodically in the lower Salt River due to past stockings in Mark Twain Lake and restoration efforts in the Mississippi River. They are attracted to the flows created in coordination between MDC, USACE, and SWPA within the rocky habitat that was created when the infrastructure around the re-regulation dam was redone after 2008.

As stated, fish mortality below Clarence Cannon Dam as a direct result of low DO levels is a recurring issue. Summary reports from MDC, with data going back to 1994, show that approximately 28,000 fish have been killed as a direct result of low DO water being discharged through the Clarence Cannon Dam turbines. The data completeness and accuracy are influenced by a number of factors, including but not limited to: whether a fish mortality event was noticed, the observer reported the incident to MDC, MDC was able to travel to the re-regulation pool, and how much time passed between the initial report and the count taken by MDC. Fish species identified in the kill reports include crappie, walleye, largemouth bass, bluegill, catfish, carp, buffalo, gizzard shad, and freshwater drum (Table 3).

Table 3. Fish Mortality numbers (Source: MDC) and Lake Elevation and dissolved oxygen data (Source: USACE)

Date	Crappie	Gizzard Shad	Freshwater Drum	Bluegill	Largemouth Bass	Walleye	Combined Spps. (Shad, Carp, Catfish, Buffalo)	Total	Lake Elevation	% of DO Observations <5 mg/L in Turbine Bay*
8/8/1994			Small # / No Data					No Data	604	No Data
8/6/1995		No Data	75					75	607	No Data
8/10/1995			200				2	202	607	No Data
7/12/2010							200	200	623	24
7/23/2010								No Data	628	23
8/9/2010	375						125	500	626	20
8/16/2010	150	550						700	620	30
7/8/2013								No Data	620	33
7/12/2013	1000		4		2		13	1019	618	100
7/21/2014								No Data	610	3
6/22/2015							100	100	620	17
8/3/2015	1000		24					1024	622	100
8/8/2015	21947			1	1	1		21950	619	100
9/8/2015	200							200	605	93
6/14/2017	1895						11	1906	611	99
7/21/2021	10							10	627	100
							Total Documented Fish Killed	**27886**		

**Note: The percentage of DO observations less than 5 mg/L in the turbine bay just downstream of the main dam was calculated by dividing the number of daily measurements reported as less than 5 mg/L by the total number of daily measurements, then multiplying by 100.*

A backwater slough exists on the left bank of the re-regulation pool, downstream of the turbine bay. High numbers of deceased fish have been observed in this area during fish mortality events. It is assumed that the fish were using the slough as a refuge from the high flows in the main channel that were largely cold and anoxic and die-offs started to occur when available oxygen was fully consumed. This phenomenon is not uncommon at other USACE projects downstream of the dam, such as Carlyle Lake located in Carlyle, IL. Alternatively, the fish may have died in the main channel and were pushed into the backwater slough by the hydrologic flows.

Under the FWOP conditions, MDC will continue monitoring lake sturgeon in the area and will recommend water management practices at the Clarence Cannon Dam during fish spawning seasons. Additionally, low DO concentrations in the re-regulation pool during summer months are expected to persist, increasing the risk of potential fish kills.

3.3.2 Terrestrial Habitat

Prior to construction of the lake, about half of the present fee-owned project land was forested. The majority of this land was located above the lake pool elevation. The white oak-black oak-northern red oak (Forest Cover Type No. 52) is the most common association on upland sites. The white oak association (Forest Cover Type No. 53) also occurs frequently. Shagbark hickory comprises a substantial stocking on most upland sites. Dominant trees include white oak, northern red oak, and black oak. Hickory (*Carya* spp.), and ash (*Fraxinus* spp.) usually occupy the co-dominant or intermediate class. Sugar maple, elm, black cherry, red bud, flowering dogwood, and serviceberry are the predominant understory species. Understory shrub species include fragrant sumac, corralberry, greenbriar, and various forms of shade tolerant grasses.

The Mark Twain Lake property supports numerous species of wildlife including white-tailed deer, turkey, rabbits, squirrels, opossums, raccoons, beavers, foxes, coyotes, bobcats, various amphibians, reptiles, nesting and migratory birds, and small rodents. Although the project is located in the Mississippi Flyway, the major flights of waterfowl normally pass down the Mississippi to the east and the Grand River to the west. However, the lake does support a viable population of waterfowl. Many migratory songbirds, owls, and hawks are known to use the Mark Twain Lake area. Nest boxes provide nesting spaces for wood ducks, purple martins, house wrens, tree swallows, bluebirds, bats, and squirrels. The wildlife management and environmental stewardship activities conducted on the Mark Twain Lake Project lands in general have created an exceptional, well diversified ecological setting that has benefitted and attracted a wide variety of wildlife species.

Executive Order (EO) 11988 Floodplain Management directs federal agencies to avoid, to the extent possible, the long and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative. Engineering Regulation (ER) 1165-2-26 Implementation of EO 11988 on Floodplain Management outlines the USACE policy for compliance with EO 11988. ER 1165-2-26 states it is the policy of USACE to formulate projects which, to the extent possible, avoid or minimize adverse impacts associated with use of the base floodplain and avoid inducing development in the base floodplain unless there is no applicable alternative. The base floodplain is defined as the area subject to a one percent chance of flooding in any given year.

The study area encompasses the Make Twain Lake, re-regulation and its associated riparian area, all of which are within the base floodplain as defined by ER 1165-2-26. There is

currently the Clarence Cannon Dam, a recreation and boat ramp within the 100-year floodplain of the study area. However, the staging area is located outside of the floodplain zone (Appendix A – Environmental Compliance and Coordination).

Under the FWOP, no change on vegetation and wildlife resources are anticipated. The study area would not see any changes that would redefine the 100-year, or base, floodplain. No development is expected to occur within the base floodplain under FWOP.

3.3.3 Wetlands and Water Quality

Wetlands are areas where frequent and prolonged presence of water at or near the ground surface dictates the kinds of soils that form, the plants that grow, and fish and/or wildlife that use the habitat. Wetland habitats are important ecosystems because they provide flood control and storm barriers. Wetlands filter out harmful chemicals and pollutants from aquatic systems.

According to the USFWS National Wetland Inventory Map (USFWS, 2025), there are two types of wetlands in the Proposed Action Area, lacustrine (Mark Twain Lake) and riverine (Salt River) (Appendix A – Environmental Compliance and Coordination). Mark Twain Lake is considered a jurisdictional Waters of the U.S.

Mark Twain Lake's watershed covers 1,472,000 acres, with just over half covered by row crop agriculture. Grassland and prairie cover a quarter of the land in the watershed. These land uses are typical of northern Missouri, where the soils are deep and fertile. Agricultural runoff and municipal wastewater treatment facilities are the primary potential source of pollution into the Mark Twain Lake watershed. Additional sources are marinas, recreational watercraft discharges and wildlife fecal material runoff. The MoDNR currently lists Mark Twain Lake as impaired for mercury (fish consumption) and the re-regulation pool of the Salt River impaired for mercury and dissolved oxygen (MoDNR, 2024).

Water quality sampling is conducted by USACE with a watershed approach to establish trend analysis and maintain water quality at or above state and federal regulations. Water quality monitoring is conducted to assure safe conditions for human recreation, wildlife, and aquatic life as maintained and managed within the lake system. As funding allows, the water quality management program for the lake includes monitoring of baseline chemical, biological, and physical parameters, ecological trends, swimming beach E. coli, and investigation of problem areas to maintain compliance with state and federal standards. The sampling and analysis conducted at the Mark Twain Lake sites reflect the minimal set of parameters needed to analyze the current status of water quality for the Mark Twain Lake system. Real-time monitors are deployed during March through November annually. These include, at a minimum, temperature and DO in 15-minute intervals and are deployed at the following fixed locations: downstream wing wall of the turbine bay of Clarence Cannon Dam (surface water) and upstream wing wall of the re-regulation dam (one at surface and one 3 meters deep). Additionally, a profiling water quality monitoring station is deployed in the lake just upstream of Clarence Cannon Dam. This real-time monitor measures temperature and DO at every meter down to 14 meters (roughly 46 feet), four times a day.

Consideration of water quality encompasses a wide range of watershed influences, including tributary streams, point and non-point pollution sources, flow alteration due to navigation structures, and drought and flood events. Variations in land use practices and cover types determine the level and type of sediment, nutrient, and contaminant inputs into the Salt River

and its tributaries. Water Quality Standards (WQS) are foundational to the Clean Water Act (CWA). An objective of the CWA is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The National Water Quality Inventory Report to Congress (305(b) report) is the primary vehicle for informing law makers and the public about surface water quality conditions. This document integrates all state 305(b) and 303(d) data, characterizes water quality, identifies widespread water quality problems of national significance, and describes various programs implemented to restore and protect our waters. Each state, under the 303(d) section of the CWA, is required to identify waters which fail to meet WQS and the designated beneficial use. The MoDNR compiles surface water quality data from various sources, combines the data with MoDNR collected data, and determines if those waters meet the state WQS. The objectives of WQS are to protect uses by applying criteria, expressed as concentrations, loads, or narrative statements.

The level of protection given to a stream, river, or lake depends on the expected, or "designated use(s)," of that water resource. Once a designated use is assigned to a water body, it is considered "classified" and listed in the MDNR WQS as such. Missouri waters are designated for various uses including aquatic life, wildlife, agricultural use, primary contact (e.g., swimming, water skiing), secondary contact (e.g., boating, fishing), industrial use, public and food-processing water supply, and aesthetic quality. Antidegradation policy requires actions to maintain and protect high quality waters and existing water quality. MoDNR has listed the following impairments on the most recently approved 303(d) 2022 list: mercury in fish tissue (atmospheric deposition) and dissolved oxygen (MDNR, 2022). The MoDNR 2024/2026 proposed section 303(d) listed waters report has not been approved as of time of writing.

USACE has implemented a Water Quality Management Plan (WQMP) as part of the O&M activities associated with managing USACE's civil works projects throughout the District. The WQMP addresses surface water quality management issues and adheres to the guidance and requirements specified by the CWA, as well as the self-imposed Engineering Regulation (ER) 1110-2-8154, "Water Quality and Environmental Management for USACE Civil Works Projects" (USACE, 2018). Water quality monitoring is implemented to fulfill five primary objectives that drive the WQMP:

- Establish baseline conditions, identify significant water quality trends, and document problems and accomplishments.
- Ensure that surface water quality, as affected by District projects, is suitable for project purposes, existing water uses, public health and safety, and in compliance with applicable state and federal water quality standards.
- Provide support to water control, project operations, and navigation for regulations and modifications.
- Investigate special problems, design and implement modifications, and improve water management procedures.
- Establish and maintain strong working partnerships and collaborations with appropriate entities within and outside USACE regarding water quality.

Historic USACE water quality monitoring at Mark Twain Lake includes physical, chemical, and biological data. As funding and staff availability allows, seasonal sampling is conducted in major tributaries, the lake, and immediately downstream of Mark Twain Lake. Sampling

includes in-situ and laboratory analysis. Additionally, real-time data monitors are installed and maintained just above the main dam in the lake, in the main dam turbine bay, and on the upstream wing wall of the re-regulation dam. Water quality concerns identified by the WQMP include dissolved oxygen, Atrazine, chlorophyll-a, iron, manganese, bacteria, and total phosphorus (USACE, 2025).

A long-term water quality analysis of data from the Clarence Cannon turbine bay monitor revealed that between June and September, DO measured less than 5 mg/L 35% of the time on average.

The Mark Twain Lake Water Control Manual and the annual Mark Twain Lake Water Quality Report both document USACE's water quality activities, including sampling and analysis, in greater detail. Continued coordination and cooperation exist between USACE, the Missouri Department of Conservation (MDC), Missouri Department of Natural Resources (MoDNR), and the Southwestern Power Administration (SWPA) concerning lake levels and water quality affecting aquatic life and fish spawning. This coordination combined with USACE's comprehensive monitoring program enables USACE to be proactive in managing water quality at the project area.

Under the FWOP scenario, water quality conditions at Clarence Cannon Dam are expected to remain consistent with current conditions in the short term; however, as water quality continues to decline over time, portions of the study area may become unsuitable for fish and mussel species during certain times of the year, resulting in the loss of more sensitive fish species. Changes in water quality and habitat quality could also increase abundances of species that are more tolerant of the temperature and low DO levels, including non-native species. Water released during power generation during the summer months is expected to continue to be low in oxygen. In shallow areas or the re-regulation pool, temperatures would be expected to increase over the existing conditions and stay elevated for longer periods of time. DO concentrations would be expected to drop during those same time periods, leading to more intense adverse impacts on aquatic life.

3.3.4 Hazardous, Toxic and Radioactive Waste (HTRW)

USACE regulations (ER-1165-2-132, ER 200-2-3) and Division policy require procedures be established to facilitate early identification and appropriate consideration of potential Hazardous, Toxic, and Radioactive Waste (HTRW) in reconnaissance, feasibility, preconstruction engineering and design, land acquisition, construction, operations and maintenance, repairs, replacement, and rehabilitation phases of water resources studies or projects by conducting a Phase I Environmental Site Assessment (ESA). USACE specifies that these assessments follow the process/standard practices for conducting a Phase I ESA published by the American Society for Testing and Materials (ASTM).

The purpose of a Phase I ESA is to identify, to the extent feasible in the absence of sampling and analysis, the range of contaminants (i.e. Recognized Environmental Conditions, RECs) within the scope of the U.S. Environmental Protection Agency's (EPA) Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and petroleum products. Current policy is to avoid known HTRW to the extent practicable or until hazard risks and potential liability are mitigated.

A Phase I ESA has been conducted for the Clarence Cannon Dam CAP 1135 project using methods outlined by ASTM E1527-21. This included a records review, physical site visit, and communications with persons knowledgeable of the project footprint and adjoining

properties. This assessment has revealed no RECs in connection with the subject property. The subject property contains no major sites of interest that would impact the project's design, cost, or schedule. The environmental impact for the migration of off-site contaminants onto the study area is negligible. Thus, a Phase II ESA is currently not recommended. It is however recommended that a Site Health and Safety Plan, and a Quality Control Plan are submitted by the awarded contractor, discussed internally by USACE personnel, and implemented to prevent environmental hazards from being developed during construction. The USACE, Environmental Quality and HTRW Section, Environmental and Munitions Branch (CEMVS EC-EQ) should be contacted immediately if future development of the property discovers hazardous or toxic materials.

3.3.5 Protected Species

3.3.5.1 Bald and Golden Eagle

Bald eagles (*Haliaeetus leucocephalus*) winter along the major rivers of Illinois and Missouri, and at scattered locations some remain throughout the year to breed. Perching and feeding occurs along the edge of open water, from which eagles obtain fish. The bald eagle is protected under the Bald and Golden Eagle Protection Act and by the Migratory Bird Treaty Act. Recommendations to minimize potential project impacts to eagles and nests are provided by the USFWS in the agency's National Bald Eagle Management Guidelines publication (USFWS, 2007). The guidelines recommend: 1) maintaining a specified distance between the activity and the nest (660-foot buffer area); 2) maintaining natural areas (preferably forested) between the activity and nest trees (landscape buffers); and 3) avoiding certain activities during the breeding season. Specifically, construction activity is prohibited within 660 feet of an active nest during the nesting season, which in the midwest is generally from late January through late July.

There are three documented bald eagle nests in the project vicinity, one near Clarence Cannon Dam and the other two in the re-regulation pool. These nests are not visible from the study area and are outside the recommended 660-foot buffer area.

Under FWOP, bald eagles or their nests at Clarence Cannon Dam are expected to remain consistent with current conditions.

3.3.5.2 Federal Threatened and Endangered Species

In accordance with Section 7(a)(2) of the Endangered Species Act (ESA) of 1973 (as amended), federally funded, constructed, permitted, or licensed project must take into consideration impacts to federally listed and proposed threatened or endangered species.

The U.S. Fish and Wildlife Service (USFWS) was contacted via USFWS Information for Planning and Consultation (IPaC) website on 26 January, 2026, for list of federally-listed threatened, endangered and candidate species that could potentially be located on the study area (Project Code: 2025-0025099; Appendix A - Environmental Compliance and Coordination). Six species were listed as potentially occurring in the action area (Table 4). No critical habitats have been identified within the study area.

Table 4 List of Federally Listed Threatened and Endangered Species Potentially

Occurring within the Study Area.

Common Name (*Scientific Name*)	Listing Status	Habitat
Gray Bat (*Myotis grisescens*)	Endangered	Caves and mines; rivers and reservoirs adjacent to forests.
Indiana Bat (*Myotis sodalis*)	Endangered	Hibernacula in caves and mines; maternity and foraging habitat in small stream corridors with well-developed riparian woods; upland forests.
Northern Long-eared Bat (*Myotis septentrionalis*)	Endangered	Hibernacula in caves and mines; roots under loose tree bark on dead or dying trees; forages near sources of water.
Tricolored Bat (*Perimyotis subflavus*)	Proposed Endangered	Hibernates in caves and mines – swarming in surrounding wooded areas in autumn. Roosts and forages in upland forests during late spring and summer.
Monarch Butterfly (*Danaus plexippus*)	Proposed Threatened	During the breeding season, monarchs lay their eggs on their obligate milkweed host plant.
Western Regal Fritillary (*Argynnis idalia occidentalis*)	Proposed Threatened	A migratory insect that uses violet plants as a reproductive host. Found in tall grass prairie habitat.

Gray Bat (*Myotis grisescens*) The gray bat is a federally listed, endangered mammal species (USFWS 2025a). The gray bat occupies a limited geographic range in limestone karst areas of southeastern United States, including Missouri. With rare exception, the gray bat roosts in caves year-round. In winter, most gray bats hibernate in vertical (pit) caves with cool, stable temperatures below 10 degrees Celsius. Summer caves, especially those used by maternity colonies, are nearly always located within a kilometer (0.6 miles) of rivers or reservoirs over which the bats feed. The summer caves are warm with dome ceilings that trap body heat. Most gray bats migrate seasonally between hibernating and 15 maternity caves, and both types of caves are located in Missouri. Gray bats are active at night, foraging for insects over water or along shorelines, and they need a corridor of forest riparian cover between roosting caves and foraging areas. They can travel as much as 20 kilometers (12 miles) from their roost caves to forage.

Gray bats are endangered largely because of their habit of living in large numbers in only a few caves, thus making the species vulnerable to human disturbance and habitat loss or modification. Disturbance of gray bats in their caves during their hibernation can cause them to use their energy reserves and could lead to starvation. Disturbances to their caves during their nursing season (June and July) can frighten females causing them to drop non-volant pups to their death in panic to flee from the intruder. Additionally, many important caves that have been historically used by gray bats have been inundated by reservoirs. The commercialization of caves, and alterations of the air flow, temperature, humidity, and amount of light can make the cave unsuitable habitat for gray bats and drive bats away. The fatal bat disease, white-nose syndrome (WNS) has not yet been documented to adversely affect the gray bat. However, because gray bats are cave obligates, and considering how WNS has decimated other cave-dwelling bat species, WNS could be another significant threat to the gray bat.

Indiana bat (*Myotis sodalist*) The Indiana bat is typical of the Myotis species in its appearance. Flying insects are the typical prey and its diet reflects the species present in its available foraging habitat. It typically forages along the shorelines of rivers and lakes, in the canopy of trees in floodplains and in upland forests. In summer, habitat consists of wooded or semi-wooded areas, mainly along streams. Females, solitary or in small maternity colonies, bear their offspring in hollow trees or under loose bark of living or dead trees. Trees standing in sunny openings are attractive because of warmer air spaces and crevices under the bark. Maternity sites have been reported as occurring in riparian areas, floodplain forests, and upland habitats. Habitat for the Indiana bat extends from eastern Oklahoma, north to Iowa, Wisconsin, and Michigan (USFWS, 2025b), east to New England and south to western North Carolina, Virginia, and northern Alabama. Northern populations migrate south to Alabama, Tennessee, Kentucky, Indiana, Missouri, and West Virginia for winter. Limestone caves with pools are preferred for hibernacula. Hall (1962) noted that preferred caves are of medium size with large, shallow passageways.

Northern Long-Eared Bat (*Myotis septentrionalis*) The northern long-eared bat is a federally listed, threatened mammal species (Federal Register 4 May 2015). The northern long-eared bat is sparsely found across much of the eastern and north central United States and spends winter hibernating in caves and mines. They typically use large caves or mines with large passages and entrances; constant temperatures; and high humidity with no air currents. Within hibernacula, they are found in small crevices or cracks (USFWS, 2025c). During summer, northern long-eared bats roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. Males and non-reproductive females may also roost in cooler places like caves and mines. This bat seems opportunistic in selecting roosts, using tree species based on suitability to retain bark or provide cavities or crevices. They have also been found, rarely, roosting in structures like barns and sheds (USFWS, 2025c). Foraging occurs in floodplain and upland forests. Forest fragmentation, logging and forest conversion are major threats to the species. One of the primary threats to the northern long-eared bat is the fungal disease white-nose syndrome which has killed an estimated 5.5 million cave-hibernating bats in the northeast, southeast, midwest, and Canada.

Tricolored bat (*Perimyotis subflavus*) On September 13, 2022, the USFWS announced a proposal to list the tricolored bat as endangered since it is in danger of extinction throughout all or a significant portion of its range. The tricolored bat is a small insectivorous bat that is distinguished by its unique tricolored fur and often appears yellowish to nearly orange. The once common species is wide ranging across the eastern and central United States and portions of southern Canada, Mexico, and Central America. During the winter, tricolored bats are often found in caves and abandoned mines, although in the southern United States, where caves are sparse, tricolored bats are often found roosting in road associated culverts. During the spring, summer, and fall, tricolored bats are found in forested habitats where they roost in trees, primarily among leaves of live or recently dead deciduous hardwood trees, but may also be found in Spanish moss, pine trees, and occasionally human structures (USFWS, 2025d). Tricolored bats face extinction due primarily to the range-wide impacts of WNS, which has caused estimated declines of more than 90% in affected tricolored bat colonies across the majority of the species range. Suitable summer roost and foraging habitat may be located in the forested areas in vicinity of the study area.

Monarch Butterfly (*Danaus plexippus*) has been a candidate species since December 2020. Much of the monarch butterfly's life is spent migrating between Canada, Mexico, and the United States. Grasslands of central North America, particularly the area known as the Corn Belt and areas vegetated by milkweed (*Asclepias syriaca L.*), comprise the majority of

its summer breeding areas. During the breeding season, monarchs lay eggs on their obligate milkweed host plant and larvae emerge after two to five days (USFWS, 2025e). Nectar sources are also required by the butterflies to fuel fall migration and spring flights northward. Monarch populations of eastern North America have declined 90%, primarily due to deforestation, illegal logging, increased development, agricultural expansion, livestock raising, forest fires, and other threats to their migratory paths and summer and overwintering habitats. Chemical-intensive agriculture, increasing acreage converted to row crops, and mowing/herbicide treatment of roadsides have contributed to a decline of milkweed, the only plant eaten by monarch caterpillars.

Western Regal Fritillary (*Argynnis idalia occidentalis*) is listed as a Proposed Threatened species by the USFWS (USFWS, 2025f). This particular butterfly has a large rusty orange color with distinctive rows of white spots that's curve across the wings. The western regal fritillary is now almost completely confined to high-quality native tallgrass prairie habitats. Much of the western regal fritillary's life is spent migrating across Arkansas, Colorado, Connecticut, Delaware, Illinois, Indiana, Iowa, Kansas, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, South Dakota, Vermont, Virginia, West Virginia, Wisconsin, and parts of Canada in search of its host plant, prairie violets. Populations are declining because their prairie habitat is disappearing.

Under FWOP conditions, there are no anticipated adverse effects on the listed bat and butterfly species, and conditions are likely to remains similar to existing conditions.

3.3.5.3 State-Listed Species

In addition to federally-listed species, state-listed threatened and endangered species also have the potential to occur in or near the study area. MDC was contacted via the Missouri Natural Heritage Database website on 23 October 2025, for a list of state-listed species that could potentially be located in the study area (MDC project ID: 18457).

On 11 November 2025, the MDC Natural Heritage Report resulted in a Level Two Report. The following species listed as threatened or endangered by the state of Missouri as potentially occurring in the vicinity of the Proposed Action Area: Little Brown Myotis Bat (*Myotis lucifugus*), and Bald Eagle (*Haliaeetus leucocephalus*, see Section 7.7.1-Bald and Golden Eagle) (Appendix A - Environmental Compliance and Coordination).

Little Brown Myotis Bat (*Myotis lucifugus*) has a widespread range in North America from Alaska-Canada boreal forest south through most contiguous United States including Missouri and into central Mexico. This species was once very abundant but has experienced severe declines in eastern North America due to WNS (USFWS, 2025g). They use a wide range of habitats and often use human-made structures for resting and maternity sites. They typically roost in caves and mines in the winter, and they can be found in trees, artificial structures, bat houses, under rocks and in piles of wood in the summer. Foraging habitat requirements are generalized, occurring primarily over streams and other bodies of water, along the margins of lakes and streams or in woodlands near water. The state ranks this species as S2: imperiled. Given the variety of habitat conditions, this species is found with an occurrence proximity to the study area of less than three miles.

Under FWOP scenario, is anticipated no adverse effect on the little brown myotis bat and likely remains similar to existing conditions.

3.4 Invasive Species

Invasive species continue to pose significant threats to project resources. Infestations of invasive plants, diseases (e.g., zoonotic or epizootic), animals, and insects are fast becoming one of the greatest threats to the earth's biological diversity, as well as human health. Feral hogs, spongy moths, and Asian long-horned beetles are not yet found within the study area but are expected to be in the future and will have tremendous consequences both in actual cost to manage and overall dynamic change to the ecosystem they invade. The Operational Management Plan contains additional information on the invasive species. Invasive species control, education, and management programs will be closely coordinated with lake stakeholders and partners, and MDC and other appropriate agencies to identify and address emerging issues. Several invasive and noxious species are found at Mark Twain Lake study area (Table 5).

Table 5. Invasive and Noxious Species at Mark Twain Lake Study area.

Invasive Species	Category	Distribution
Reed Canary Grass (***Phalaris arundinacea***)	Nonnative	Isolated Patches
Eastern Red Cedar (***Juniperus virginiana***)	Native	Isolated Patches
Multiflora Rose (*Rosa multiflora***)**	Nonnative	Isolated Patches
Crown Vetch (***Securigera varia***)	Nonnative	Isolated Patches
Autumn Olive (*Elaeagnus umbellata*)	Nonnative	Widely Distributed
Sericea Lespedeza (***Lespedeza cuneata***)	Nonnative	Widely Distributed
Purple Loosestrife (***Lythrum salicaria***)	Nonnative	Isolated Patches
Japanese Honeysuckle (***Lonicera japonica***)	Nonnative	Isolated Patches
Amur Honeysuckle (***Lonicera maackii***)	Nonnative	Isolated Patches
Honey Locust (*Gleditsia triacanthos*)	Native	Isolated Patches
Black Locust (***Robinia pseudoacacia***)	Native	Isolated Patches
Tree of Heaven (***Ailanthus altissima***)	Nonnative	Isolated Patches
Invasive Carp (***Cyprinus carpio***)	Nonnative	Isolated Patches
Brome Grass (***Bromus***)	Nonnative	Isolated Patches
Fescue Grass (***Festuca arundinacea***)	Nonnative	Widely Distributed
Poison Ivy (***Toxicodendron radicans***)	Native	Isolated Patches
Sudden Oak Death (***Phytophthora ramorum***)	Native	Isolated Patches
Zebra Mussel (***Dreissena polymorpha***)	Nonnative	Isolated Patches
Emerald Ash Borer (***Agrilus planipennis***)	Nonnative	Widely Distributed
Callery Pear (***Pyrus calleryana***)	Nonnative	Isolated Patches
Japanese Beetle (***Popillia japonica***)	Nonnative	Widely Distributed

Under the FWOP, it is anticipated that the invasive species previously identify would have opportunity to establish and proliferate in the study area. Frequent habitat disruption caused by low DO would be detriment to the native species within the area.

3.5 Recreation and Aesthetics

Approximately 55,000 acres of land and water are available for public use. Mark Twain Lake is the most popular water-based recreation location in northeast Missouri and receives approximately 1.1 million visits per year (USACE, 2025). There are a variety of outdoor recreation activities areas and facilities managed by USACE located at Mark Twain Lake, including a visitor center, three campgrounds, two group camping areas, nine picnic facilities, six major and 19 secondary boat launching areas, six nature trails, two marinas, an archery

range, a shooting range, disc golf, and two beaches. Hunting and fishing opportunities are available on all USACE lands and waters except where restricted and posted due to recreational development or safety (Figure 6). The sparkling waters and scenic lands of Clarence Cannon Dam and Mark Twain Lake provide countless opportunities for outdoor recreation and an outstanding aesthetic quality on the lake and surrounding area. The most common activities engaged in are fishing, boating, water-skiing, sailing, camping, picnicking, swimming, and hunting. Additional activities include bike riding, kayaking, hiking, sight-seeing, and wildlife viewing/nature photography.

The Proposed Action Area is at the Clarence Cannon Dam located within the Warren G. See North and South Spillway and encompasses multiple recreational resources. Facilities located here include a boat ramp, picnic facility, campground, toilets, playgrounds, shooting range, and disc golf course.

Under FWOP conditions, low DO would be expected to continue, potentially damaging aesthetically pleasing recreational and natural areas. Recreational and natural areas would potentially become covered with dead fishes, which is generally considered unpleasant.

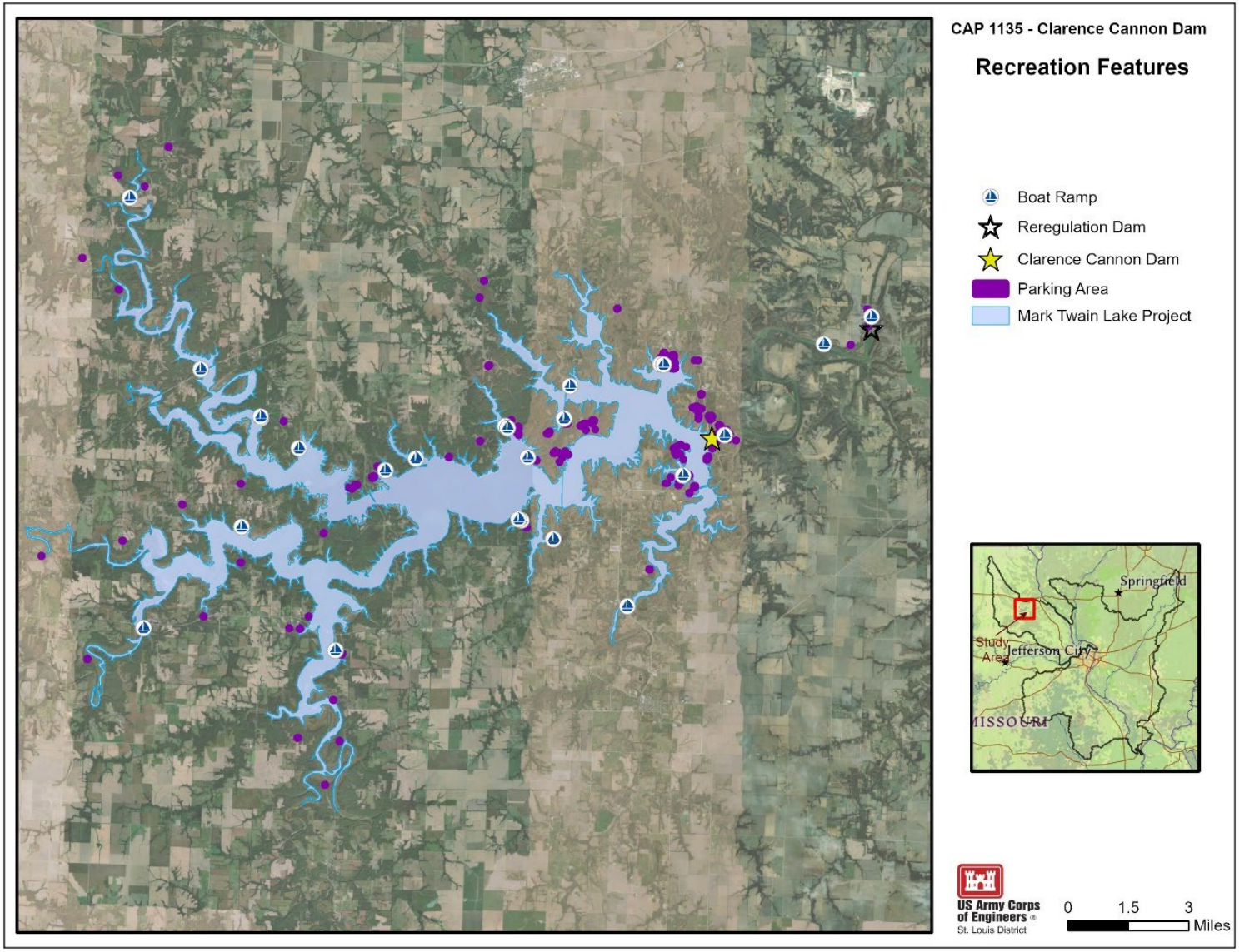


Figure 6 Clarence Cannon and Mark Twain Lake recreation features.

3.6 Traffic and Roadways

Access to Mark Twain Lake is facilitated by network of U.S. Highways, State Highways and county roads located primarily in Monroe and Ralls counties, Missouri.

Mark Twain Lake is served on the north by U.S. Highway 24 and on the south by State Highway 154. State Highway J crosses Clarence Cannon Dam and is the primary north-south transportation corridor on the eastern side of the lake (Figure 7). These highways provide the public with safe and adequate access to all areas of Mark Twain Lake.

FWOP conditions are not expected to have adverse effects on traffic and roadways.

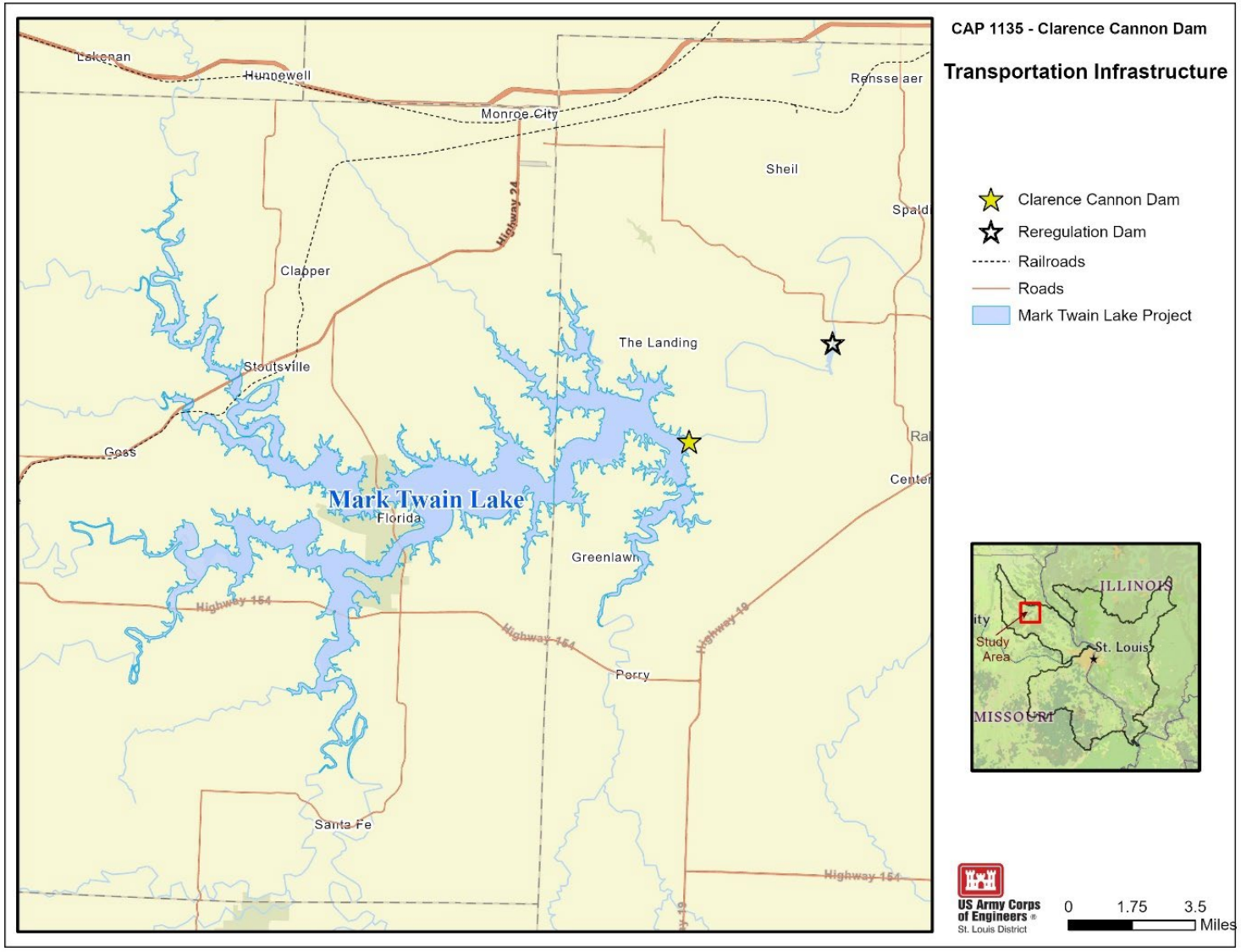


Figure 7 Clarence Cannon and Mark Twain Lake access roads.

3.7 Air Quality and Noise Levels

The Clean Air Act of 1963 requires the USEPA to designate National Ambient Air Quality Standards (NAAQS). The USEPA has identified standards for six pollutants: lead, sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, particulate matter (less than 10 microns and less than 2.5 microns in diameter), along with some heavy metals, nitrates, sulfates, volatile organic and toxic compounds (Table 6). The study area is in Ralls County, which are in attainment for all six EPA air quality standards (USEPA, 2025).

Table 6. Six pollutants and their standard criteria designated by the USEPA.

Pollutant	Averaging time	Criteria	Form
Carbon monoxide	8 hours	9 ppm	Not to be exceeded more than once per year
	1 hour	35 ppm	
Lead	Rolling 3 month	0.15 µg/m^3	Not to be exceeded
Nitrogen dioxide	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	1 year	53 ppb	Annual Mean
Ozone	8 hours	0.070 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution ($PM_{2.5}$)	1 year	12.0 µg/m^3	Annual mean, averaged over 3 years
	24 hours	35 µg/m^3	98th percentile, averaged over 3 years
Sulfur dioxide	1 hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years

The land use surrounding the study area includes Clarence Cannon Dam operations, recreational areas, open space, transportation, and agricultural zones. There are no major population centers near the study area. Agricultural and open space areas typically have noise levels in the range of 30-70 decibels (dB) depending on their proximity to major transportation facilities. Noise associated with major transportation such as highways, railroads, airports and others, would be greater than those in rural areas. In addition to dam operations at the study area, recreation-related noise, and traffic, such as by vehicles, boat and outdoor gun range, are the main source of noise within the study area. Figure 8 illustrates common sounds and their associated noise levels.

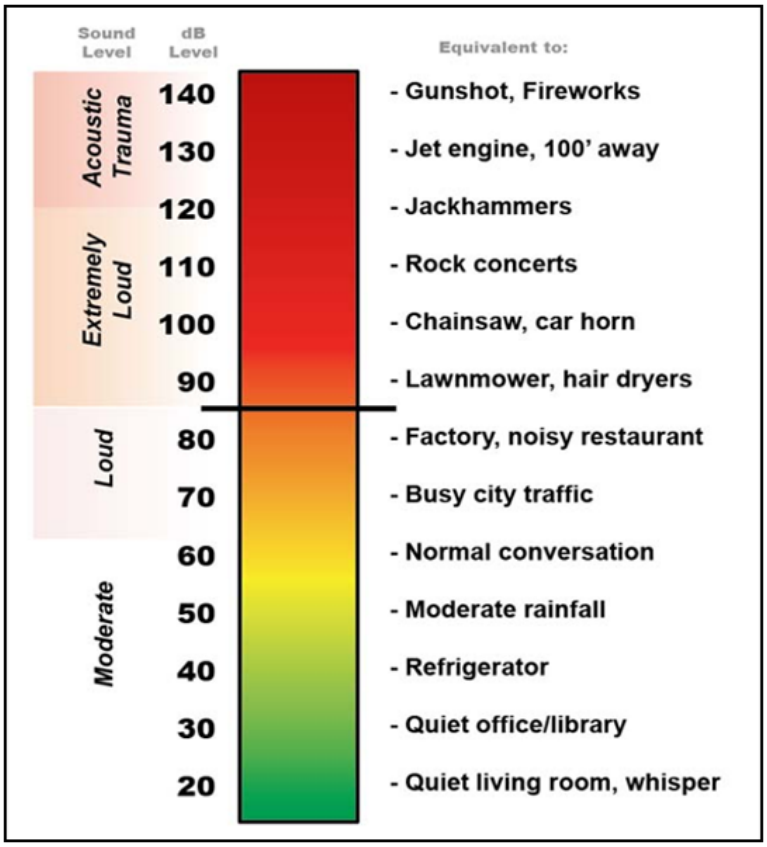


Figure 8. Examples of the sound level and decibel (dB) level of various of sources.

Under FWOP, the air quality and noise levels would remain similar to existing conditions.

3.8 Socioeconomics and Demographics

Natural and recreational resources at Mark Twain Lake provide ample social, economic and environmental benefits for both visitors and local economy. Having local recreation options close to the reservoir promotes economic investment, environmental awareness, and social well-being to local residents and visitors by providing jobs, education, solitude, and exercise opportunities. Recreation at Mark Twain Lake is also an economic engine for local business, communities and the region. The lake area has many businesses including a water park, winery, campgrounds, restaurants, hotels, resorts, antique shops, specialty shops, hardware stores, realtors, grocery stores and more. Mark Twain Lake is bordered by three towns, Monroe City, Paris, and Perry. These communities have adapted to the lake and offer many services and specialty shops (Explore Mark Twain Lake, 2025). Clarence Cannon Dam is located in Ralls county in northeast Missouri. Demographic and economic information for Ralls and Monroe County was obtained from the United Stated Census (Table 7 and Table 8).

Table 7. Socioeconomic information for Monroe and Ralls Counties, Missouri. Data as of American Community Survey (ACS) 5-Year Estimate from the U.S. Census.

Socioeconomics	Monroe County	Ralls County
Population (as of ACS 2023)	8,672	10,394
Median Age of Population (years)	46.0	46.0
Number of Households	3,467	3,959

Socioeconomics	Monroe County	Ralls County
Median Household Income (2023 dollars)	$48,299	$62,054
Residents with Bachelor's Degree or Higher	17.4%	17.5%
Employment Rate	50.4%	54.4%
Poverty Level	16%	12.6%

Table 8. Demographic information for Monroe and Ralls Counties, Missouri. Data as of American Community Survey (ACS) 5-Year Estimate from the U.S. Census

Racial Demographics (%)	Monroe County	Ralls County
White	92.9%	93.4%
Black or African American	4.0%	1.9%
American Indian and Alaska Native	0.5%	0.1%
Asian	0.1%	0.3%
Native Hawaiian & other Pacific Islander	0.0%	0.0%
Two or More Races	2.1%	3.5%
Hispanic	1.7%	1.2%

Under FWOP, socioeconomics and demographic conditions in the study area are likely to remain similar to existing conditions.

3.9 Cultural and Historic Resources

The District performed a records review of the study area to determine if archaeological sites have been previously recorded in the study area and to determine if any archeological studies have been conducted in the study area. There are over 1500 known archaeological sites located within and around Mark Twain Lake. During the 1970s, archaeological surveys and mitigation of archaeological sites took place for the construction of the Clarence Cannon Dam and subsequent inundation of the area that created Mark Twain Lake. These surveys were not officially recorded with Missouri SHPO but are referenced in various documents as the Cannon Reservoir Archaeological Project. Immediately adjacent to the dam are five archaeological sites, RA303, RA304, RA282, RA317, and RA79. None of the sites were evaluated for eligibility to the National Register of Historic Places (NRHP).

Site RA303 was located northwest of the dam underwater within Mark Twain Lake near the current location of the TCW. It was originally identified in 1959 as a precontact village occupied during the Archaic and Woodland periods. During a 1974 archaeological salvage excavation, site RA303 was supposed to be excavated, but it was discovered that it had already been destroyed by dam construction.

Site RA304, located in Mark Twain Lake, west of Clarence Cannon Dam, was originally identified in 1955 as a precontact village occupied during the Woodland period. It also was selected to be excavated during the 1974 archaeological salvage operation but was found to have been buried under 20-30 feet of spoil dirt from the dam construction and was therefore left undisturbed.

Site RA282, a moderate lithic scatter identified in 1975, is located southwest of the current visitor's center. At the time this site was identified, it was also determined it had been severely impacted by the construction of buildings on the ridgetop.

Sites RA317 and RA79 were both located east of Clarence Cannon Dam along the southern bank of the Salt River and are thought to actually be two parts of the same

Late Woodland village site. While RA317 was identified in 1959, Site RA79 did not have a date of identification recorded. These sites also were slated to be excavated during the 1974 archaeological salvage operation but were determined to have been destroyed by the dam construction.

Along the nine-mile expanse of the Salt River between Clarence Cannon Dam and the re-regulation dam are 30 sites located within 100 meters (328 feet/0.06 miles) of the banks of the river below the bluff. These are summarized in Table 9. Most of these sites have already been impacted by normal inundation, erosion, or past excavations. The current status of eight sites (RA10, RA101, RA140, RA222, RA504, RA505, RA510, and RA511) are unknown

FWOP conditions are not expected to have adverse effect on historic properties.

Table 9 Archaeological Sites Along Re-Regulation Pool

Site #	Reported	Cultural Affiliation	Site Type	Status
RA10	Unknown	Unknown	Rock Shelter	Unknown
RA101	Unknown	Unknown Precontact	Rock Art	Unknown
RA136	1974	Early through Late Woodland	Habitation	Erosion and Excavation
RA140	1975	Woodland or Protohistoric	Rock Art	Unknown
RA141	1975	Unknown Precontact	Rock Shelter	Inundation at normal pool
RA154	1975	Unknown Precontact	Lithic Scatter	Inundation at normal pool
RA160	1975	Late Archaic; Woodland	Habitation	Inundation at normal pool
RA161	1975	Woodland	Habitation	Inundation at normal pool
RA164	1975	Middle Woodland	Lithic Scatter	Inundation at normal pool
RA165	1975	Late Woodland	Habitation	Inundation at normal pool
RA167	1975	Archaic	Habitation	Inundation at normal pool
RA168	1975	Unknown Precontact	Lithic Scatter	Inundation at normal pool
RA196	1975	Woodland	Habitation	Inundation at normal pool
RA198	1975	Unknown Precontact	Lithic Scatter	Inundation at normal pool
RA199	1975	Unknown Precontact	Lithic Scatter	Inundation at normal pool
RA222	1975	Woodland	Habitation	Unknown
RA223	1975	Woodland	Habitation	Inundation at normal pool
RA224	1976	Late Archaic; Middle Woodland; Late Woodland; Mississippian	Habitation	Excavation & Inundation at normal pool
RA235	1975	Woodland	Habitation	Inundation at normal pool
RA239	1975	Late Archaic; Middle Woodland; Late Woodland	Habitation	Inundation at normal pool
RA258	1975	Unknown Precontact	Lithic Scatter	Inundation at normal pool
RA259	1975	Unknown Precontact	Lithic Scatter	Inundation at normal pool
RA261	1975	Unknown Precontact	Lithic Scatter	Inundation at normal pool
RA264	1975	Woodland	Lithic Scatter	Inundation at normal pool
RA265	1975	Woodland	Habitation	Inundation at normal pool
RA502	1975	Unknown Precontact	Lithic Scatter	Inundation at normal pool
RA504	Unknown	Unknown	Unknown	Unknown
RA505	Unknown	Unknown	Unknown	Unknown
RA510	Unknown	Unknown	Unknown	Unknown
RA511	Unknown	Unknown	Unknown	Unknown

3.9.1 National Historic Preservation Act

The National Historic Preservation Act (NHPA) of 1966, as amended by Public Law 96-515 (94 Stat. 2987), established national policy for historic preservation, authorized the Secretary of the Interior to expand and maintain a NRHP, and created the Advisory Council on Historic Preservation. Section 106 specifies that federal agencies, before approval of any expenditure or before issuance of any license, must consider the effect of the action on any property included in or eligible for the NRHP.

TSP project features include the placing stone on top of the TCW, an access road, a staging area, and tree clearing around portions of the access road and staging area. The access road is an already constructed dirt and gravel road that has been utilized since the late 1970s based upon a 1979 aerial photograph. This same photograph shows a building where the staging area will be placed. Tree clearing will include the cutting of trees and grinding down the stumps to avoid ground disturbance. Based on evidence of previous disturbance within the access road and staging area, and lack of ground disturbance for the tree removal and raising of the TCW, the District has determined that no historic properties will be affected by the TSP. Consultation with SHPO took place via a letter on 25 February 2026, informing them of the District's decision. This consultation is ongoing and will be satisfied prior to approval of the final decision document.

3.9.2 Archaeological and Historic Preservation Act

The Archaeological and Historic Preservation Act (AHPA) of 1974 amended and expanded the Reservoir Salvage Act of 1960, requiring federal agencies to provide for the preservation of historical and archaeological data, including material evidence, that might otherwise be destroyed or lost as a result of an undertaking. Subsequent legislation in 2014 requires federal agencies to invest in historic preservation programs overseen by a historic preservation specialist to protect historic properties and objects belonging to the agency. Compliance with the AHPA will be met through the Section 106 of NHPA process.

3.9.3 Tribal Resources

All federal agencies are required to consult with Indian tribes under NHPA to determine if properties of traditional religious and cultural importance are within the area of potential effects (APE). Additionally, federal agencies are required under EO 13175 to consult to strengthen the United States government-to-government relationships with Indian tribes.

Under the federal trust responsibility - also referred to as the trust doctrine - USACE recognizes the relationship between sovereign Indian tribes and the federal government and is obligated to uphold rights reserved by or granted to Indian tribes by treaties, federal statues, and executive orders. Sovereignty is the foundation of tribal governments, and their sovereign status affords them special recognition and treatment under federal law. All federally recognized tribes are responsible for their own governance and management.

Lakes and streams, as well as the plants and animals associated with them, can hold spiritual, economic, and subsistence value for tribes. Natural resources are fundamentally significant to Native American cultural identity. Under the trust doctrine, USACE owes a fiduciary duty to tribes. The nature of that duty depends on the underlying substantive laws (e.g., treaties, statutes, agreements) upholding the duty. Where USACE actions may affect tribal lands or off- reservation treaty rights, the trust duty includes a substantive obligation to protect these lands and treaty rights "to the fullest extent possible".

The majority of the 35 archaeological sites that have been previously identified in the study

area are prehistoric and would be of interest to Tribal Nations. The District initiated consultation with 18 Tribal Nations that have an interest in this area on 21 January 2026, to discuss the alternatives, chosen TSP and to request that Tribal Nations provide the District with any known traditional cultural places, sacred sites, or other areas of concern (Appendix A - Environmental Compliance and Coordination). No Tribes responded to the initial request to consult. On 25 February 2026, the District consulted with the same 18 Tribal Nations via a letter pertaining to the District's determination of No Historic Properties Affected. This consultation is ongoing and will be satisfied prior to approval of the final decision document.

Under the FWOP scenario, the status of Tribal Resources is expected to remain similar to existing conditions.

3.10 Real Estate

The Clarence Cannon Dam at Mark Twain Lake CAP 1135 project is located entirely on federally owned land managed by the USACE. The study area consists of three crucial tracts acquired in fee simple in 1966: Tract 100 (239 acres), Tract 106 (267.3 acres), and Tract 111 (277.7 acres). The dam structure itself is situated on Tracts 106 and 100. For complete details and exhibits, see Appendix L – Real Estate Plan.

4 PLAN FORMULATION

4.1 Overview

The USACE planning process, as well as NEPA, requires USACE to evaluate a range of reasonable alternatives. The PDT incorporated national planning goals and procedures which are defined in the “Planning Guidance Notebook” (ER 1105-2-103). Local standards and criteria were used by the PDT and integrated into the project design. The study team tried to take advantage of any secondary opportunities that the ecosystem restoration project might offer (for example, water quality and associated incidental benefits). For planning purposes, the period of analysis was established as 50 years starting in 2030. The period of analysis is the period of time an alternative would have significant beneficial effects.

A management measure is a feature (such as a structural element that requires construction or assembly on-site) or an activity (a non-structural action) that can be combined with other management measures to form alternative plans. Management measures were developed to address project problems, meet study goals and objectives, and to capitalize on study area opportunities outlined in this section. Management measures were derived from a variety of sources including prior studies, existing projects, academic research papers, and the interdisciplinary team.

4.2 Management Measures

A management measure is a feature or activity that can be implemented at a specific geographic site to address one or more planning objectives. Measures are used to formulate alternatives and can be combined in a number of ways. USACE, MDC, SWPA, and MoDNR participated in several brainstorming sessions early in the planning phase to identify potential management measures. Additionally, management measures were derived from measures identified in the FID document, as well as from measures identified in academic research and previous reports from USACE and other government agencies (e.g., the Bureau of Land Management). Structural measures are physically constructed features that can meet the planning objective(s). Nonstructural measures alter behavior, policies, or procedures to meet planning objective(s). Natural and nature-based features (NNBF) are landscape features that provide functions relevant to flood risk management or ecosystem restoration. Management measures were developed for this project to address problems, meet objectives, and to capitalize upon study area opportunities.

4.2.1 Measures

Table 10 describes the measures initially proposed to address the identified problems.

Table 10 Measures Considered for Initial Evaluation

Measure	Short Description
Temperature Control Curtain	Impermeable curtain mounted on TCW and attached to booms with floatation capacity, Flexible or fixed configuration, Flexible configuration allows operators to lower/raise curtain regardless of water level, PDT evaluated the fixed configuration that rises and falls with the water level in the lake
Upstream Aeration	Bubbler lines located upstream of the TCW. Air is pulled from the atmosphere and released into the lake
Destratification Device	Mechanical mixing or circulation to reduce vertical temperature stratification within a reservoir, Effectiveness decreases as reservoir size increases (i.e., Bubble plumes, buoyant jets, air-lift systems, fan systems)
Liquid Oxygen Injection	Bubbler lines located upstream of the TCW, similar to the Section 212 Program Wolf Creek oxygen diffuser project. Pure oxygen in liquid form would be brought in by trucks, pumped into the bubbler lines, and released into the lake
Downstream Onbank Oxygen Injection Plant	A facility downstream of the Clarence Cannon Dam removes water from the pool, mixes it in tanks with pure oxygen, and places the water back in the pool
Retrofit Turbines with Air Admission System	Air is pumped through the turbines, so oxygenated water is released during power generation
Raise TCW	Addition of stone to raise elevation of TCW and improve functionality
Gated Selective Withdrawal Systems	Allows operators to select elevation to pull water from before it passes through Tainter gates and/or turbines, allows mixing of different temperatures and DO levels to achieve desired conditions
Block Off Backwater Slough	A slough area downstream and slightly north of the dam filled in to prevent fish from entering and being exposed to potentially stressful conditions
Deepen Backwater Slough	Slough is dredged to increase water depth to help reduce water temperatures and improve refuge areas to mitigate stressful conditions for fish entering the slough
Submerged Aquatic Vegetation in Backwater Slough	Rooted aquatic plants placed in the slough to produce oxygen and decrease the low DO stressor on fish entering the slough
Nutrient Fixing Vegetation	Aquatic vegetation effective at fixing nitrogen placed in the slough
Riparian Vegetation	Vegetation suited for riparian areas planted to enhance plant communities along the river and potentially contribute to increases in oxygen in the re-regulation pool
Aeration “W” Weir	Placement of a weir immediately downstream of the Clarence Cannon Dam to encourage mixing and oxygen entrainment in order to increase oxygen levels in the pool
Riffles	Placement of stone immediately downstream of the Clarence Cannon Dam to encourage mixing and oxygen entrainment in order to increase oxygen levels in the pool
Paddlewheel	A waterwheel or impeller that agitates the water and introduces oxygen into the pool
Utilize Spillway Water	Releasing water through the Tainter gates to mitigate low DO levels when water quality monitors indicate levels are dropping
Cryogenic Distillation	Creation of pure liquid oxygen using specific temperatures to remove different gases from atmospheric air. The oxygen is then pumped into the system upstream of the TCW in bubbler lines
Oxygen Adsorption	Creation of liquid oxygen using pressure swing adsorption and adsorbent material that pulls oxygen from

Measure	Short Description
	atmospheric air. The oxygen is then pumped into the system upstream of the TCW in bubbler lines

4.2.2 Evaluation and Initial Screening of Measures

Measures were screened and eliminated throughout the plan formulation process based on the Principles and Guidelines criteria:

Completeness: Extent to which the measure provides and accounts for all necessary investments or actions to ensure realization of the planning objectives. Must consider the sustainability and long-term aspects of plans and whether all resource requirements are included.

Effectiveness: Extent to which the measure contributes to achieving the planning objectives to which an alternative alleviates specified problems and achieves specified opportunities. Does not mean all planning objectives need to be addressed or fully realized.

Efficiency: Extent to which the measure or alternative is the most cost-effective means of addressing the specified problems and realizing the specified opportunities, consistent with protecting the nation's environment. Determined through a comparison of the costs and benefits of each alternative.

Acceptability: Workability and viability of the measure or alternative with respect to acceptance by federal and non-federal entities and the public, and compatibility with existing laws, regulations and public policies.

Implementability: Extent to which the alternative is feasible from technical, environmental, economic, financial, political, legal, institutional, and social perspectives.

Satisfaction: Extent to which the plan is welcome from a political or preferential perspective. This is qualitative, but consideration of the degree of support of a plan is important.

The following measures were screened for effectiveness before the formulation of alternatives based on previous studies and existing knowledge:

1. Retrofit Turbines with Air Admission System – Previous studies have shown that this measure does not effectively increase DO levels. This measure would also create cavitation on the turbines, thus increasing the costs and maintenance required to continue operations.
2. Aeration "W" Weir – There is a potential loss of turbine head if the tailwater pool is increased, potential increased risk as a navigation safety hazard due to channel obstruction, and routine inspection and maintenance would be required.
3. Riffles – There is a potential increased risk as a navigation safety hazard due to channel obstruction, and the degree of DO improvement is highly dependent on flow and water elevation.
4. Paddlewheel - Research indicated paddlewheels are effective in smaller systems, and there is a potential increased risk as a navigation safety hazard due to channel obstruction.

Management measures that contributed to the study objective and met the P&G criteria were carried forward and used to formulate alternatives. Not all measures initially retained for further evaluation ended up in the final array of alternatives, but they were considered in the

formulation of alternatives, often as standalone measures. Throughout the planning process, measures were screened following further research, planning iterations, preliminary cost estimation, discussions with subject matter experts, and/or discussions where measures identified carried unacceptable risks were screened.

4.3 Formulation of Alternatives

Measures initially deemed feasible were carried forward for consideration in the development of alternatives. Alternatives are combinations of one or more measures that contribute to attaining the planning objectives. This section describes considerations that led to the development of an initial array of alternatives for this project and the evaluation of alternative plans' ability to meet project objectives. Many of the measures identified are capable of acting as standalone alternatives.

Formulation strategies, defined by Planning Manual Part II: Risk-Informed Planning 2017, are a set of conditional decisions that shape and guide the development of alternatives. The formulation strategies combine measure(s) together into alternatives based on the study goal, objectives, planning criteria, and opportunities, while avoiding constraints. To narrow the focus of possible combinations of the retained measures, formulation strategies were developed to guide the creation of alternatives. Formulation strategies combine the measure(s) into alternatives based on study goals, objectives, planning criteria, and opportunities while avoiding constraints. Ultimately, USACE engineers used professional judgment to combine the potential management measures into alternatives. Measures were combined based on appropriate dependencies and exclusivities.

4.3.1 Initial Array of Alternatives

The following subsections describe the initial array of alternatives developed from the list of measures described in Section 4.7.

Alternative 0: No Action

USACE is required to consider a "No Action" option as an alternative to comply with requirements of the NEPA. The No Action alternative is synonymous with the FWOP condition. The No Action alternative would not include any further action by the federal government under the CAP Section 1135, and no additional costs to USACE would be generated. The No Action alternative would consist of the Mark Twain Lake managers and/or Clarence Cannon Dam operators continuing with operations as laid out in the Water Control Manual (WCM), Section 7-07:

> "a. Objective. The objective is to ensure that the quality of water released from Cannon Dam and the Reregulation Dam meets the State of Missouri standards under 10 CSR 20-7.031 (4)(J)Dissolved Oxygen. This regulation states that waters of the state of Missouri must maintain a level of 5 mg/L dissolved oxygen.
>
> b. Regulation Procedure. In coordination between the Environmental Engineering office and the Water Control office, releases from Mark Twain Lake may be required, in order to improve downstream water quality conditions in the Reregulation Pool and lower Salt River. These decisions will be based upon dissolved oxygen data collected in real-time within the re-regulation pool, located at the re-regulation pool stream gage. If the dissolved oxygen concentrations drop below the 5 mg/L criteria based on 10 CSR 20-7.031, subsection (4) part (J) Dissolved Oxygen, the preferred method of releases to increase dissolved oxygen concentrations into the re-regulation pool would be discharging water through the Tainter gates solely or in combination with

hydroelectric power generation units."

The USACE Water Control office is tasked with the management of releases from Clarence Cannon Dam within established guidelines as laid out in the WCM and balanced against hydropower demand, fisheries management, cultural protection, flood risk, downstream landowner impacts, recreation, and water quality. During summer months, hydropower demand is consistently high. Monitoring of conditions occurs daily and coordination between the stakeholders of the Mark Twain DO Working Group (see Section 3.2.2) is conducted at least weekly. The objective is to maintain DO concentrations in the re-regulation pool at 5 mg/L or greater; however, there are periods when low DO water passes through the turbines, resulting in concentrations below 5 mg/L in a portion of the re-regulation pool. The volume of low DO water passing through the turbines during periods of lake temperature stratification largely depends on the thermocline elevation in Mark Twain Lake, number and sequence of hydropower unit startup, and duration of hydropower generation. Despite efforts to maintain water quality through daily monitoring and active coordination, DO has been recorded below 5 mg/L for approximately 35% of the time at the Clarence Cannon Dam turbine bay gage from June to September for the years 2006 to 2023. Within that timeframe, July saw the highest percentage on average of low DO at 47%. Under a No Action alternative and/or no project scenario, USACE would fail to meet requirements as laid out in ER 1110-2-8154 during conditions similar to those observed from June to September for the years 2006 to 2023, as described in Section 1.2 of this report.

Alternative 1: Temperature Control Curtain
Alternative 1 consists of a temperature control curtain as a standalone measure. Temperature control curtains can be designed as fixed or flexible configurations. A flexible or adjustable curtain can be lowered or raised to allow water at different elevations to pass over the curtain without solely depending on pool elevation. Added benefits include the ability to let colder water pass over the curtain to combat projected increased water temperatures as well as optimizing the size of the opening for different conditions. A fixed curtain raises or lowers in response to the water surface elevation and would require no active operation.

The PDT researched fixed and flexible curtain configurations by looking into sites similar to Clarence Cannon Dam, but no flexible temperature curtains or existing fixed configurations were found that functioned by allowing water to pass over the top of the curtain as would be needed at Clarence Cannon. Projects researched included the Whiskeytown Reservoir and the Lewiston Reservoir. Both sites have fixed temperature control curtains installed to ensure cold water passes downstream. As part of the PDT research, numerous manufacturers were contacted; however, they did not offer flexible curtains as options. Thus, the PDT did not have a frame of reference to develop quantities or costs for the flexible configuration and moved forward with the fixed configuration.

The main design elements of a fixed curtain are the bottom and shore anchors, floating stability tanks, top floating boom and curtain. Its position would be directly controlled by the pool elevation. A flexible design would require the same elements as a fixed curtain but also mechanical/electrical operating mechanisms, multiple controlling points for raising and lowering the curtain due to its size, an electrical hookup or source and may require manual labor as well. These additional design elements for a flexible configuration would increase costs and O&M requirements, which is unfeasible for the NFS. Using professional judgment, the PDT concluded that the ability for the curtain to have an adjustable intake did not justify the increase in O&M. Therefore, the team moved forward with the fixed configuration for evaluation.

Alternative 2: Upstream Aeration
Alternative 2 consists of upstream aeration bubbler lines as a standalone measure. This system would pull air from the local atmosphere and inject the gas into the lake.

Alternative 3: Destratification Device
Alternative 3 consists of a destratification device, such as a surface-positioned axial flow pump (Figure 9), buoyant jets, and air-lift systems, located upstream of Clarence Cannon Dam. Local destratification techniques target stratification immediately upstream of intakes and can be effective in larger reservoirs.

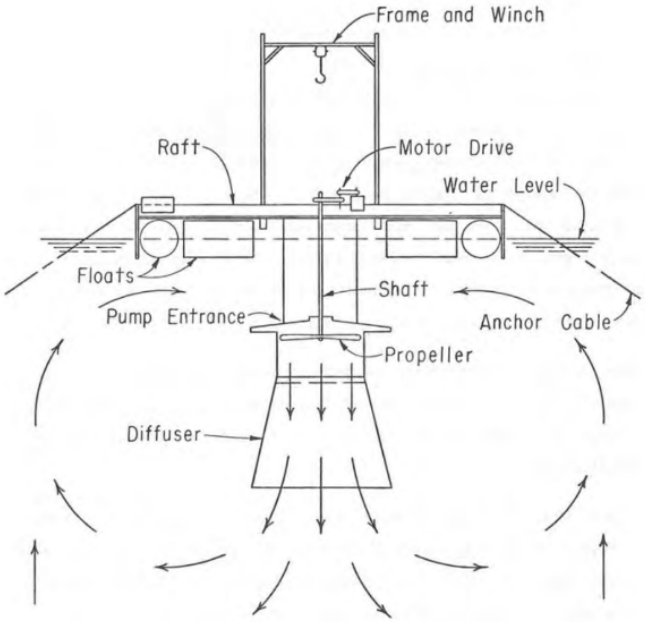


Figure 9 Surface-Positioned Axial Flow Pump Destratifier

Alternative 4: Liquid Oxygen Injection
Alternative 4 consists of liquid oxygen bubbler lines as a standalone measure. Based on discussions with the Section 212 Program Wolf Creek oxygen diffuser project team members, this measure would require multiple daily deliveries of pure liquid oxygen, a paved area large enough for delivery trucks to offload and turn around, and a metal plate to catch any spilled liquid oxygen. The liquid oxygen would cool water temperatures and potentially mitigate expected increases in temperature over the next 50 years.

Alternative 5: Downstream On-bank Oxygen Injection Plant
Alternative 5 consists of a downstream on-bank oxygen injection plant based on the Oxygen Injection System for the Savannah Harbor Expansion Project (Figure 10). This measure would require multiple daily deliveries of pure liquid oxygen, a paved area large enough for delivery trucks to offload and turn around, a metal plate to catch any spilled liquid oxygen, and sufficiently large enough space for the facility. The liquid oxygen would cool water temperatures and potentially mitigate expected increases in temperature over the next 50 years.

Figure 10 Oxygen Injection System for the Savannah Harbor Expansion Project

Alternative 6: Temperature Control Curtain + Upstream Aeration
Alternative 6 would combine the temperature curtain and upstream aeration system to block poorly oxygenated water while also increasing the level of oxygen available in the lake.

Alternative 7: Temperature Control Curtain + Liquid Oxygen Injection
Alternative 7 would combine the temperature curtain and liquid oxygen system to block poorly oxygenated water while also increasing the level of oxygen available in the lake. Additionally, the liquid oxygen would cool water temperatures.

Alternative 8: Raise TCW
Alternative 8 consists of raising the existing TCW to block poorly oxygenated water from reaching the turbine intake. Two sub-alternatives were developed based on potential elevations increases:

8a: 585 Elevation
An increase in elevation from 580 to 585 would block low DO water from passing over the TCW under more conditions than the designed elevation, based on existing water quality data.

8b: 588 Elevation
An increase in elevation from 580 to 588 is expected to block low DO from passing over the TCW under most conditions, based on existing water quality data.

Alternative 9: Gated Selective Withdrawal System
Alternative 9 consists of a gated selective withdrawal system as a standalone measure (Figure 11). This is a complex system consisting of massive steel framing and shutter gates at different elevations allowing operators to select which elevations to pull water from before passing downstream through the penstocks and turbines. The PDT researched projects with similar systems, particularly the Flaming Gorge Dam system as there was more information and recent data available. Bureau of Reclamation and Dam personnel provided documentation that the PDT used to begin developing a feasibility level design of a similar system at Clarence Cannon Dam.

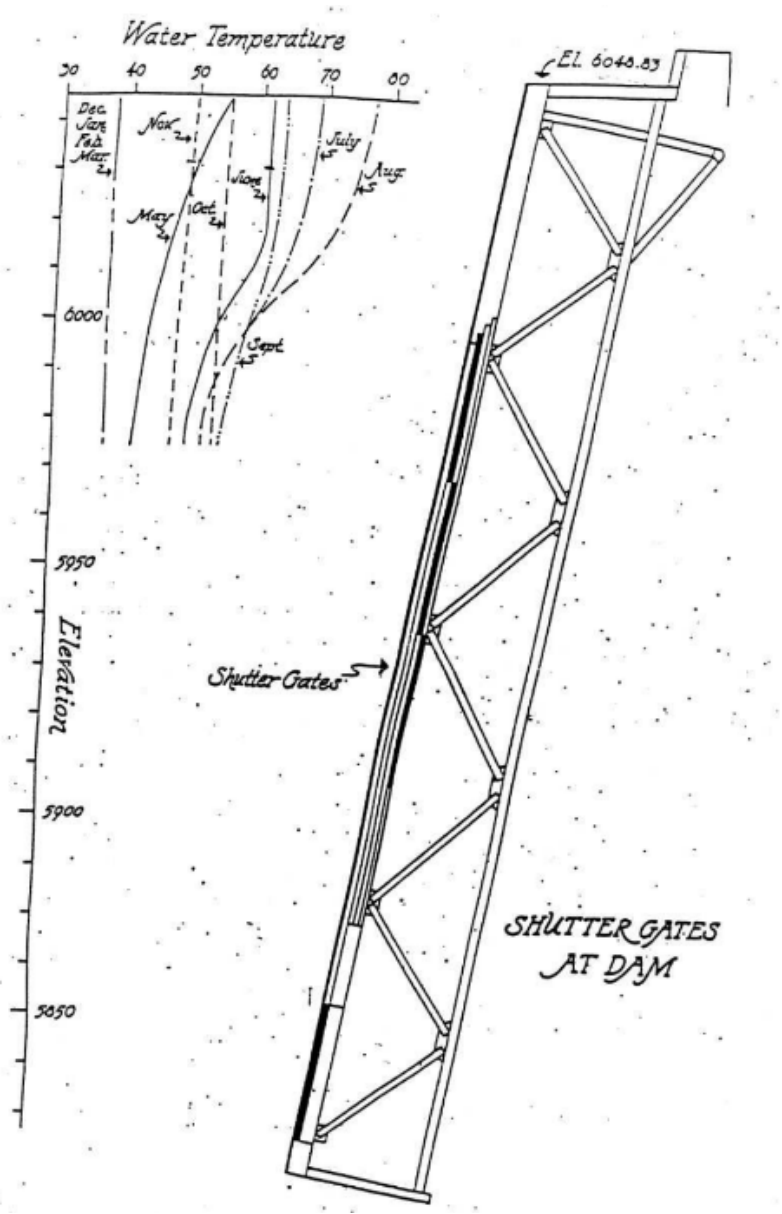


Figure 11 Flaming Gorge Dam System

Alternative 10: Cryogenic Distillation
Alternative 10 consists of cryogenic distillation as a standalone measure. This measure allows pure oxygen to be created on-site using an on-bank cooling system, which is then injected into the lake.

Alternative 11: Oxygen Adsorption
Alternative 11 consists of oxygen adsorption as a standalone measure. This measure creates liquid oxygen from atmospheric air using pressure swing adsorption and adsorbent material (i.e., zeolite). The liquid oxygen would contain trace amounts of other gases. The liquid is then injected into the lake.

Alternative 12: Raise Temperature Control Weir + Liquid Oxygen Injection
Alternative 12 would combine raising the TCW with the liquid oxygen system to block poorly

oxygenated water while also increasing the level of oxygen available in the lake. Additionally, the liquid oxygen would cool water temperatures.

Alternative 13: Backwater Slough
Alternative 13 consists of blocking off or deepening the backwater slough (Figure 12) and adding submerged aquatic vegetation, nutrient fixing vegetation, and/or riparian vegetation to achieve desirable conditions in the backwater slough area where a large number of deceased fish were surveyed after the August 8th 2015 fish mortality event.

Figure 12 Location of Backwater Slough

Alternative 14: Utilize Spillway Water
Alternative 14 consists of the utilization of spilling water to mitigate for low DO levels as indicated by water quality monitoring data.

4.3.2 Screening of the Initial Array

As the PDT moved through the planning process, a number of alternatives were screened after it was determined that they did not meet the P&G criteria (see Section 4.2.2 for a description of the four criteria). Since many of the alternatives were composed of standalone measures, or two measures, alternatives were also screened by default when the associated measures were screened (Table 11).

Alternative 2: Upstream Aeration
This alternative was screened for Effectiveness. After internal discussion and discussions with MDC and MoDNR, the PDT determined this measure would increase the temperature of the water due to pulling warm atmospheric air during the summer months when the oxygenation would be needed. Thus, the PDT expected this alternative to have a negative impact on the study area by 2080.

Alternative 3: Destratification Device
This alternative was screened for Effectiveness. Modeling produced by the Section 212 Program Wolf Creek oxygen diffuser project indicated temperature increases of 5 degrees Celsius. The PDT relied on this modeling because full H&H modeling with a CE-QUAL-W2 model was outside the scope of this project. Using the Wolf Creek Project's data, the PDT determined that similar warming would occur in the study area and would have a negative impact on the study area by 2080.

Alternative 4: Liquid Oxygen Injection
This alternative was screened for Acceptability. After internal discussion, the NFS determined that continual liquid oxygen deliveries and staffing of a facility would be cost prohibitive for the agency. There is also a risk of liquid oxygen spills, which could cause environmental damage and would require mitigation by the NFS.

Alternative 5: Downstream On-bank Oxygen Injection Plant
This alternative was screened for Acceptability & Effectiveness. After internal discussion, the NFS determined that continual liquid oxygen deliveries and staffing of a facility is cost prohibitive for the agency. There is also a risk of liquid oxygen spills, which could cause environmental damage and would require mitigation (removal of ignition sources and fuel, and potentially evacuation) by the NFS.

Additionally, the plant would need to be placed a distance downstream of the dam due to the limited availability of suitable locations along the banks of the re-regulation pool with adequate space for the facility (Figure 13). As a result, the portion of the pool immediately downstream of the dam, where the majority of deceased fish have been found, would not be oxygenated

Figure 13 Potential Location of On-Bank Plant

Alternative 6: Temperature Control Curtain + Upstream Aeration

This alternative was screened when upstream aeration was screened for anticipated negative impacts, since the temperature control curtain was retained as a standalone measure.

Alternative 7: Temperature Control Curtain + Liquid Oxygen Injection
This alternative was screened when liquid oxygen injection was screened since temperature curtains were already evaluated as a standalone measure.

Alternative 10: Cryogenic Distillation
This alternative was screened for Efficiency. The distillation process produces contaminated water as a byproduct, which would need to be removed from the site and disposed of properly by the NFS, which is anticipated to be cost prohibitive based on professional judgement.

Alternative 11: Oxygen Adsorption
This alternative was screened for Acceptability. After internal discussion, the NFS determined that staffing of a facility is cost prohibitive for the agency. Additionally, if a spill occurs after adsorption is complete but before it is injected into the water column, environmental damage may occur and would require mitigation by the NFS.

Alternative 12: Raise Temperature Control Weir + Liquid Oxygen Injection
This alternative was screened when liquid oxygen injection was screened since raising the TCW was already evaluated as a standalone measure.

Alternative 13: Backwater Slough
This alternative was initially formulated under the assumption that the major fish mortality event on 8 August 2015 was caused by high temperatures and/or low DO within the backwater slough area. During the analysis of potential measures for inclusion, it was determined that the deceased fish likely died in the main channel of the re-regulation pool and were pushed back into the slough or died as a result of rapid water lowering rather than as a result of conditions within the slough itself. Also, both MDC and the Clarence Cannon Dam staff had concerns about alterations to the area, given the presence of mussels and the quality aquatic habitat the backwater area provides during non-flood conditions. Prior to screening, the following measures were considered for inclusion under this alternative:

- Block Off Backwater Slough
- Deepen Backwater Slough
- Submerged Aquatic Vegetation in the Backwater Slough
- Nutrient Fixing Vegetation
- Riparian Vegetation

When this alternative was screened, all associated measures were also screened as they would be ineffective in other areas of the re-regulation pool due to the range of flow conditions and pool elevations.

Alternative 14: Utilize Spillway Water
This alternative was initially formulated under the assumption that the Clarence Cannon Dam Water Control Manual did not explicitly allow for the operations described in the No Action alternative. After further research, it was determined that releases from Mark Twain Lake are allowed in order to improve downstream water quality conditions in the re-regulation pool and

Salt River.

Note on Hydraulics & Hydrology Modeling
After extensive research and coordination with the Engineering Research and Development Center (ERDC), a number of applicable models were identified, including but not limited to the CE-QUAL-W2 model and Discrete Bubble Model. ERDC provided a rough estimate of the price ranges associated with the development and calibration of the baseline CE-QUAL-W2 model ($150,000 to $250,000, dependent on data availability and project complexity), as well as the additional costs associated with the evaluation of structural or operational alternatives ($75,000 to $150,000 per alternative). Both the costs and timeline to run the model are outside the scope, schedule, and budget of the project at this stage. However, all measures that would have required the use of this modeling were screened for other reasons.

Table 11 Screening of Initial Array of Alternatives

Measure	Associated Alternative	P&G Criteria Not Met	Notes
Upstream Aeration	Alternative 2 & 6	Effectiveness	PDT determined the measure would have a negative impact in the study area.
Destratification Device	Alternative 3	Effectiveness	Modeling produced by the Section 212 Program Wolf Creek oxygen diffuser project indicated temperature increases of five degrees Celsius, and PDT determined a similar negative impact would occur in the study area.
Liquid Oxygen Injection	Alternative 4, 7, & 12	Acceptability	Continual liquid oxygen deliveries and staffing of a facility is cost prohibitive. There is also a risk of liquid oxygen spills.
Downstream On-bank O2 Injection Plant	Alternative 5	Acceptability Effectiveness	Continual liquid oxygen deliveries and staffing of a facility is cost prohibitive. There is also a risk of liquid oxygen spills. Additionally, the plant would need to be placed a distance downstream of the dam due to the availability of locations with adequate space for the facility. Thus, the portion of the pool downstream of the dam where the majority of deceased fish have been found would not be oxygenated
Oxygen Adsorption	Alternative 10	Acceptability	Staffing of a facility is cost prohibitive. There is also a risk of liquid oxygen spills.
Cryogenic Distillation	Alternative 11	Acceptability	Process produces contaminated water as byproduct, which would need to be removed from the site and disposed of properly by the NFS, which is cost prohibitive when combined with staffing of a facility
Block Off Backwater Slough	Alternative 13	Acceptability Effectiveness	Screened with Backwater Slough alternative
Deepen Backwater Slough	Alternative 13	Acceptability Effectiveness	Screened with Backwater Slough alternative
Submerged Aquatic Vegetation in Backwater Slough	Alternative 13	Effectiveness	Screened with Backwater Slough alternative
Nutrient Fixing Vegetation	Alternative 13	Effectiveness	Screened with Backwater Slough alternative

Measure	Associated Alternative	P&G Criteria Not Met	Notes
Riparian Vegetation	Alternative 13	Effectiveness	Screened with Backwater Slough alternative
Utilize Spillway Water	Alternative 14	Completeness	This is part of the No Action alternative, which includes the actions the dam operators take to mitigate low DO when conditions allow that are permitted by the Water Control Manual

4.3.3 Focused Array of Alternatives

The focused array included the following alternatives:

- Alternative 0: No Action
- Alternative 1: Temperature Control Curtain
- Alternative 8a: Raise TCW to 585
- Alternative 8b: Raise TCW to 588
- Alternative 9: Gated Selective Withdrawal System

4.3.4 Screening of the Focused Array

Alternative 9: Gated Selective Withdrawal System

This alternative was screened for Efficiency. The PDT contacted a number of manufacturers who provided cost estimates that were incorporated into the quantity and cost development of the focused array of alternatives. Furnishing and installation of gates was estimated to be between $26 million to $35 million. These quantities were developed using the existing structure at Flaming Gorge Dam as a basis of design. The selective withdrawal system at Flaming Gorge consists of an upper and lower shutter gate system that allows water at different elevations to pass into the penstocks. Each system of gates is raised by hoist machinery consisting of wire ropes, hoist drums, gear reducers, and an electric motor. The hoist machinery was estimated at over one million dollars. Quantities and costs were not developed for the structural frame before the PDT screened the measure and alternative.

Using professional judgment, the PDT determined that the significant project costs relative to the estimated AAHUs (81) would not be cost efficient compared to the other alternatives in the final array, which are expected to produce 81 and 79 AAHUs (See Section 6.1), respectively, at substantially lower costs. Additionally, due to its complex design, construction would likely last longer than SWPA's non-generation period.

4.3.5 Final Array of Alternatives

The following alternatives were retained and carried through to the final array:

4.3.5.1 Alternative 0: No Action Alternative

4.3.5.2 Alternative 1: Temperature Control Curtain

A fixed temperature control curtain system consists of an impermeable curtain attached to a surface floating boom with heavy duty chains anchored to the banks and stabilized at the bottom, in this case the top of the TCW, with weighted tanks and ballast weighted chains. Additional floating tanks are used to help with horizontal stability. The top of the curtain is set at a lower elevation than the top boom, shallow enough to prevent low DO water from passing into the penstocks but deep enough to allow necessary flow to pass and not disrupt power generation. Its vertical floating position would be directly controlled by the pool elevation. Information for staging and access can be found in the Appendix F - Civil Engineering.

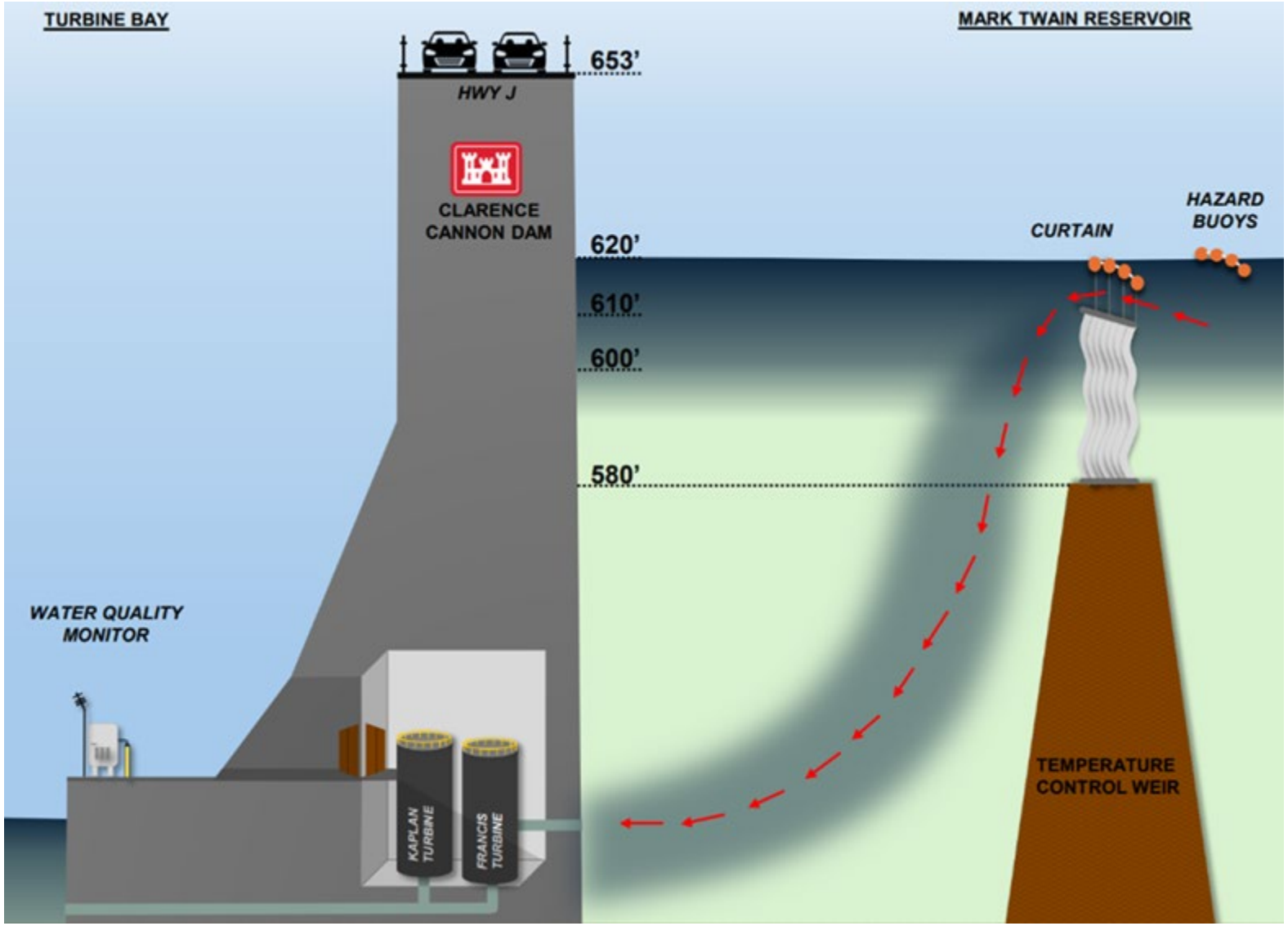


Figure 14 Temperature Curtain Conceptual Cross Section

(a) Risks

With this measure, there is the possibility of damage to the curtain from floating or submerged debris. This risk increases during high pool or flood conditions. The size of the curtain needed may also be prohibitive. Fluctuation of the reservoir's water surface can have a negative impact on the curtain and its anchorage system, also leading to damage. Due to the projected rise of water temperatures, fish downstream could be negatively affected by the warmer water allowed over the fixed curtain.

Based on existing temperature curtain projects, it is anticipated that replacement and regular repair would be needed to keep the curtain functional. A protective barrier installed in front of the curtain could mitigate the risk of damage due to floating debris, but this measure was not included in the costs of the curtain and therefore excluded from analysis. After discussion with the NFS, they determined that this risk is acceptable to the agency. SWPA was also consulted and did not express concerns regarding the curtain impacting hydropower generation. Furthermore, modeling will be completed in PED to confirm flood heights are not increased as well as confirming that no private property or infrastructure would be adversely affected due to the installation of the temperature control curtain.

4.3.5.3 Alternative 8: Raise TCW

The TCW was constructed as a skimming weir to prevent cold, poorly oxygenated water from passing through Clarence Cannon Dam and was designed to an elevation of 580ft. During the summer months, however, the lake is stratified and often rises to the point at which the thermocline – the depth at which temperature and oxygen content decline drastically - is above the TCW. Raising the TCW includes building the weir up higher with additional rock to decrease the frequency and duration of low DO releases through Clarence Cannon Dam's turbines and/or Tainter gates. The higher the weir is raised corresponds to higher protection from low DO water passing over the weir. The current alignment for increasing the TCW height is at the structure's current centerline, therefore, for every vertical foot of increase, the weir's footprint will increase by three feet horizontally on each side of the weir. This can be optimized during PED by shifting the alignment for raising the weir to the upstream side of the TCW if any encroachment on Clarence Cannon Dam is observed. The PDT coordinated with the Portland District to determine at what elevation the TCW, if raised to that height, will begin to adversely impact power generation. Based on this analysis, raising the weir to 585 is not anticipated to impact power generation when the lake is at or above the power pool elevation of 590.

For comparative purposes, two elevations (585 feet and 588 feet) were selected for evaluation with the understanding that more benefit is anticipated as weir height increases. Information for staging and access can be found in the Appendix L - Civil Engineering. Figure 15 shows the designed elevation, as well as the elevations of 585 feet and 588 feet. The final elevation will be determined during PED to optimize costs and benefits.

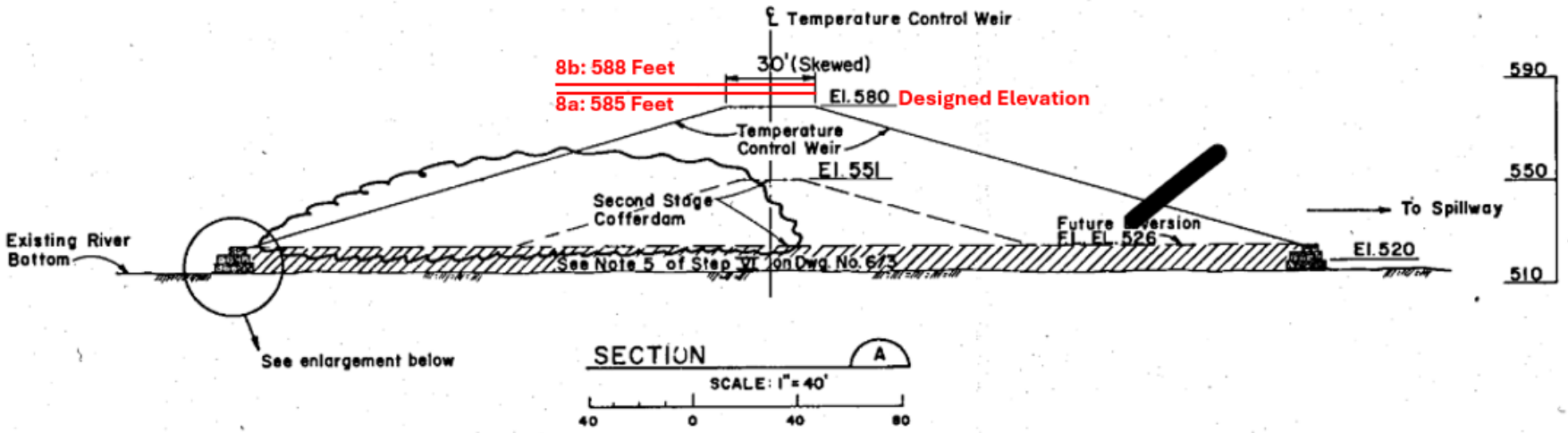


Figure 15 TCW Elevations: Existing, 585 Feet, 588 Feet

(a) Alternative 8a: Raise TCW (585)

This alternative consists of adding stone to the existing TCW to raise the elevation by five feet. Based on historical data from the lake profiler and turbine bay water quality monitors, the PDT anticipated the weir would improve DO levels.

(b) Alternative 8b: Raise TCW (588)

This alternative consists of adding stone to the existing TCW to raise the elevation by eight feet. Based on historical data from the lake profiler and turbine bay water quality monitors, the PDT anticipated the weir would improve DO levels.

Per the WCM, the hydroelectric power pool is between 590 and 606 feet in elevation. While the power pool allows SWPA to generate at an elevation as low as 590 feet, that is unlikely to occur based on past generation activity. Management of the Mark Twain Lake pool elevation aims to keep the lake from dropping below 600 feet because many cultural sites become exposed. The PDT selected 588 feet as the maximum elevation to allow for approximately 12 feet of water to pass over the TCW for potential generation at a pool elevation of 600 feet.

(c) Risks

Placing additional stone on top of the existing weir will increase the weight on the underlying geology. There is a potential risk of voids in the bedrock collapsing under the extra weight. In the future, fish downstream could be negatively affected by the warmer water allowed over the TCW due to the projected rise of water temperatures. Further modeling will be completed in PED to confirm flood heights are not increased, as well as confirming that no private property or infrastructure would be adversely affected due to raising the TCW.

Raising the TCW also has the potential to negatively impact power generation above a certain elevation. During discussions with SWPA, the agency did not express immediate concerns about raising the elevation to 585 feet and the PDT coordinated with the Portland District to perform an initial hydraulic analysis regarding potential impacts to power generation. Based on this analysis, raising the weir to 585 is not anticipated to impact power generation when the lake is at or above the power pool elevation of 590. USACE will revisit hydrological and hydraulic modeling to support regulatory compliance, demonstrate due diligence, and verify results from the Portland District’s initial hydraulic analysis.

Table 12 shows the initial array of alternatives the PDT formulated. Screened measures and alternatives are identified by gray cells.

Table 12 Summary Table of Screened & Retained Alternatives

Measure	0 (No Action)	1	8a	8b	2	3	4	5	6	7	9	10	11	12	13	14
Temperature Control Curtain		X							X	X						
Raise TCW			X	X										X		
Gated Selective Withdrawal Systems											X					
Upstream Aeration					X				X							
Destratification Device						X										
Liquid Oxygen Injection							X			X				X		
Downstream On-bank Oxygen Injection Plant								X								
Cryogenic Distillation												X				
Oxygen Adsorption													X			
Block Off Backwater Slough															X	
Deepen Backwater Slough															X	
Submerged Aquatic Vegetation in Backwater Slough															X	
Nutrient Fixing Vegetation															X	
Riparian Vegetation															X	
Utilize Spillway Water																X

4.3.5.4 Staging & Access

For all action alternatives, the staging area for material and equipment and access road would be located in a previously disturbed area, by a former building. Staging location was selected based on distance and accessibility. No permanent staging area is anticipated.

5 ENVIRONMENTAL CONSEQUENCES

This section describes the potential environmental consequences in the potential project area associated with the Final Array of Alternative. The No Action Alternative serves as the baseline for comparison to FWP actions. The Final Array of Alternatives include the No Action Alternative, Alternative 1, and Alternatives 8a and 8b.

Potential impacts are described using the following terms:

- Intensity
  - Negligible – No noticeable effects to the resource in the project area.
  - Minor – Noticeable impacts to the resource in the project area, but the resource is still mostly functional.
  - Moderate – The resource is impaired, so that it cannot function normally.
  - Major – The resource is severely impaired so that it is no longer functional in the project area.
- Effects
  - Beneficial – A positive change in the condition or appearance of the resource or a change that moves the resources toward a desired condition.
  - Adverse – A changes that moves the resource away from a desired condition or detracts from its appearance or conditions.
  - Direct – An effect on a resource by an action at the same place and time.
  - Indirect – An effect from an action that occurs later or possibly at a different place and often to a different resource but is still reasonably foreseeable.
- Duration
  - Short term – Temporary effects caused by the construction and/or implementation of a selected alternative.
  - Long term – Lasting effects caused by an alternative after the action has been completed and/or after the action is in full and complete operation.

5.1 Hydraulics, Hydrology, and Water Control

No Action Alternative:

Under No Action Alternative, no federal action would be taken to address the low DO affecting the study area. The water quality during summer months expected to be cold, poorly oxygenated water would continue to move through turbines and reregulation pool, leading to low DO levels, fish mortality events, and ecosystem disruption. For protecting the aquatic habitat from low DO, interagency cooperation and actions would continue from Clarence Cannon Dam. The current interagency cooperation results in spilling water through the Tainter gates to improve downstream low DO conditions. This has an adverse impact on hydropower activities because any spilled water through the Tainter gates is water that cannot be utilized to generate power. Under the No Action Alternative, this is expected to continue.

Alternatives 1, 8a, & 8b:

Under Alternative 1, 8a, and 8b no anticipated impacts to hydropower production are anticipated at this time. The PDT coordinated with the USACE Portland District to determine at what elevation the TCW, if raised to that height, would begin to adversely impact power generation. Based on this analysis, raising the weir to 585 is not anticipated to impact power generation when the lake is at or above the power pool elevation of 590.

5.2 Environmental

All Alternatives:
During summer months, Mark Twain Lake develops a three-layered temperature stratification due to a lack of turnover in the lake. The stratification is a driver of conditions in the downstream ecosystem. This temperature stratification during summer months would still occur, regardless of implementation of a project. The thermocline zone is not expected to change under Alternative 1, 8a, and 8b.

5.2.1 Aquatic Organisms and Wildlife

No Action Alternative:
Under the No Action Alternative, the water quality during summer months expected to be cold, poorly oxygenated water would continue to move through turbines and reregulation pool. As water quality declines, the study area becomes unsuitable for aquatic organisms specially fish and mussel species. This could result in ecosystem disruption, a loss of sensitive species and potential increase in species more tolerant of the temperature DO levels.

Alternative 1:
Under Alternative 1, low DO levels and water quality conditions would improve during the warmer months at the study area. In addition, because of improving the DO levels the proposed action alternative would enhance aquatic habitat and would make this area more suitable for fish, mussels and macroinvertebrates. Best management practices (BMPs) are anticipated to prevent contamination of aquatic resources due to construction-related activities and staging area. However, the proposed structure could cause disruption to fish species during construction.

Alternatives 8a & 8b:
Under Alternatives 8a and 8b, low DO levels and water quality conditions would improve during the warmer months at the study area. Additionally, because of improving the DO levels the proposed action alternative would enhance aquatic habitat and would make this area more suitable for fish, mussels and macroinvertebrates. Furthermore, the placement of rock would provide more spawning area for some fish species. BMPs are anticipated to prevent contamination of aquatic resources due to construction-related activities and staging area.

5.2.2 Terrestrial Habitat

No Action Alternative:
Under No Action Alternative, no construction would be made. No effects or change in terrestrial habitat would be expected.

Alternative 1, 8a & 8b:
Under Alternative 1, 8a, and 8b, around 3.25 acres of terrestrial habitat located within the proposed construction area for the access roads and staging area is on USACE property that has been previously disturbed. Tree and vegetation removal would be required in order to create the access and staging area. Terrestrial species would experience a terrestrial decline in habitat availability from the tree clearing. After construction, areas would be allowed to revegetate naturally. Adverse impacts to forest bat species would be minimized by adhering to the winter tree clearing restriction. Tree clearing would only be allowed between 1 November to 31 March to avoid the time of year when bats are roosting in trees. Impacts on terrestrial resources are anticipated to be minor, and short term. No changes on floodplain

would be expected.

5.2.3 Wetlands and Water Quality

No Action Alternative:
Under No Action Alternative, no federal action would be taken to address the low DO affecting the study area. Wetlands and vegetated areas such as forested riparian areas, may be negatively impacted by low DO in adjacent waters, primarily due to factors like high water temperatures or excessive organic matter decomposition The water quality during summer months is expected to be cold, poorly oxygenated water would continue to move through turbines and reregulation pool, leading to low DO levels, fish mortality events, and ecosystem disruption. No changes to existing water quality in the area are expected to occur.
Also, continue with no compliance with the jurisdictional Waters of the U.S.

Alternative 1:
Under Alternative 1, low DO levels and water quality conditions would improve in the warmer months at the study area. In addition, because of improving the DO levels the proposed action alternative would enhance aquatic habitat. The contractor would be required to follow BMPs to minimize the effects of runoff from the construction on top of the TCW and staging area. No impacts to wetlands by the Proposed Actions are anticipated.

Impacts to water quality due to construction would be minor and short term. Overall, DO levels would improve and water quality would be in compliance with the CWA (5 mg/L). Additionally, there would be no permanent loss of aquatic resources due to the project impacts and no compensatory mitigation would be required.

Alternatives 8a & 8b:
Under Alternatives 8a and 8b, low DO levels and water quality conditions would improve in the warmer months at the study area. In addition, because of improving the DO levels the proposed action alternatives would enhance aquatic habitat. Between alternative 8a and 8b, raise of the TCW and the better DO levels are anticipated as weir height increases. The contractor would be required to follow BMPs to minimize the effects of runoff/sedimentation, any suspension of solids from the agitation of placing rock on the TCW and staging area. No impacts to wetlands by the Proposed Actions are anticipated. The impacts to water quality due to construction would be minor and short term. Overall, DO levels would improve and water quality would be in compliance with the CWA (5 mg/L).

USACE has verified that the project complies with the Nationwide Permit (NWP) 27 for Aquatic Ecosystem Restoration, Enhancement, and Establishment Activities (Appendix C – Clean Water Act). NWP 27 is applicable because the work involves rehabilitation of an existing TCW for the improvement of the aquatic habitat. This NWP is valid until March 14, 2026, unless the District Engineer modifies, suspends, or revokes the nationwide permit authorizations in accordance with 33 CFR 330.5(d), prior construction NWP 27 will be reevaluated. Additionally, there would be no permanent loss of aquatic resources due to the project impacts, and no compensatory mitigation would be required.

5.2.4 Hazardous, Toxic and Radioactive Waste (HTRW)

No Action Alternative:
Under No Action Alternative, the water quality during summer months expected to be cold, poorly oxygenated water would continue to move through turbines and reregulation pool, leading to low DO levels, fish mortality events, and ecosystem disruption. No changes to the HTRW status in the area would occur.

Alternative 1:
Under Alternative 1, low DO levels and water quality conditions would improve in the warmer months at the study area. The contractor would be required to follow BMPs as well as adhere to all applicable environmental regulations. No HTRW impacts due to construction are anticipated.

Alternatives 8a & 8b:
Under Alternatives 8a and 8b, low DO levels and water quality conditions would improve in the warmer months at the study area. The contractor would be required to follow BMPs as well as adhere to all applicable environmental regulations. No HTRW impacts due to construction are anticipated.

5.2.5 Protected Species

5.2.5.1 Bald and Golden Eagle

All Alternatives:
No impacts to bald eagles, golden eagles, or their nests, are anticipated under No Action and Alternatives 1, 8a, and 8b. If a bald eagle or golden eagle nest is observed during construction activities, then the USFWS would be contacted, and the guidelines would be implemented.

5.2.5.2 Federal Threatened and Endangered Species

No Action Alternative:
The No Action Alternative would likely remain similar to existing conditions on the listed bat and butterfly species.

Alternatives 1, 8a & 8b:
Gray Bat, Indiana Bat, Northern Long-eared Bat, and Tricolored Bat **-** No caves would be impacted by the project. There is the possibility that construction activities could disturb bats foraging in the lake corridor, but this impact would be minor and would not significantly disturb normal behavior patterns due to individuals being able to relocate to other nearby foraging areas. Staging area is located in an area that has been previously disturbed by a former building. Trees around the access road and staging area will be cut and their stumps ground down to avoid ground disturbing activities. As a BMP, in order to minimize impacts to tree roosting bat species, tree clearing for access and staging area would be restricted to the bat non-active period between 1 November through 31 March. Due to the site-specific information, the St. Louis District determined the proposed project *may affect but is not likely to adversely affect* the Gray Bat, Indiana Bat, Northern Long-eared Bat, and Tricolored Bat.

Monarch Butterfly and Western Regal Fritillary Butterfly - Project activities associated with construction equipment may temporarily interfere with monarch and western regal fritillary butterflies or their habitat. Staging area is located in an area that has been previously disturbed by a former building. Trees around the access road and staging area will be cut and their stumps ground down to avoid ground disturbing activities. Due to the site-specific information, the St. Louis District has made a *no effect* determination for the Monarch Butterfly and Western Regal Fritillary Butterfly.

In compliance with the Fish and Wildlife Coordination Act, a letter dated 29 January 2026, the U.S. Fish and Wildlife Service supports the TSP and express their recommendations to help minimize impacts to species and habitats (found Appendix A – Environmental Compliance and Coordination).

5.2.5.3 State-Listed Species

No Action Alternative:
Under No Action Alternative, would likely remain similar to existing conditions to state-listed species.

Alternatives 1, 8a & 8b:
Under Alternative 1, 8a, and 8b, no bald eagle nests are located within 660 feet of the Proposed Action area and staging area. Noise due to construction activities in the vicinity of the Proposed Action Area would be temporary but could affect the resting and maternity site for little brown myotis bat. Staging area is located in an area that has been previously disturbed by a former building. Trees around the access road will be cut and their stumps ground down to avoid ground disturbing activities. All tree clearing associated with the project would occur during the inactive season from tree clearing would be restricted to the bat non-active period between 1 November through 31 March. Overall, no adverse impacts to state-listed species are anticipated.

5.3 Invasive Species

No Action Alternative:
Under the No Action Alternative, the spread of invasive species with low DO waters is expected to continue and is not anticipated to alter the overall issue with these species. However, frequent habitat disruption caused by low DO presents opportunities for colonization at the Proposed Action Area.

Alternatives 1, 8a & 8b:
Under Alternatives 1, 8a and 8b, the spread of invasive species is expected to continue as well. Additionally, BMPs shall be required to avoid the spread of invasives species by construction equipment. The proposed action would have a minor temporary effect on invasive species due to construction.

5.4 Recreation and Aesthetics

No Action Alternative:
Under No Action Alternative, periods of Low DO concentrations would persist during the summer months. Additionally, stress to aquatic life and fish mortality will continue to occur during the warm months. Recreational and natural areas would potentially become covered with dead fish or another dead aquatic organism, which is generally considered aesthetically unpleasant. No impacts to recreational activities and aesthetics would result from No Action Alternative.

Alternatives 1, 8a, & 8b:
All action alternatives would be expected to improve DO conditions and lead to fewer fish mortality events, thus improved fish habitat could draw more recreational users.

The Proposed Action Area is located upstream Clarence Cannon Dam, with the Ray Behrens Boat Ramp being the closest existing access point. The contractor would be permitted to utilize that ramp for launching and removal of the equipment and materials needed for construction. Ray Behrens Boat Ramp would be closed to the public during construction. The construction staging area site would be off-limits to all recreationists. The direct work zone area would be off-limits to boating traffic in order to ensure boater safety. Under Alternative 1, 8a and 8b, recreation and aesthetic impacts due to construction activities in the vicinity of the Proposed Action Area would have a minor and temporary impact. Any damage due to

construction activities must be restored to pre-construction conditions. In addition, by improving DO concentrations, aquatic habitat would improve, and the recreation and aesthetic resources would not be negatively affected and would be expected to see positive impacts.

Also, during construction the Ray Behrens Boat Ramp may be closed to the public for the duration of construction activities. However, due to potential impacts to operations, infrastructure, and recreation, it is not preferred to use the Ray Behrens Boat Ramp as the primary construction access point. Launching of the necessary vessels for construction may be needed at Ray Behrens but should be able to be completed without impacting daily use of the boat ramp. Instead, an existing ramp and access off Highway J to the north of Clarence Cannon Dam was identified. This area was already largely disturbed during construction of the hydropower dam and would likely only need minor cultural surveying and surfacing to be sufficient for the proposed construction activities. A small lower staging area was also quantified during planning to ensure safe loading of construction materials; however, the need for this lower staging area will be determined during the design phase. Additionally, there is an existing gate to help ensure public safety as well as acceptable road geometry that provides amply light of sight to facilitate safe entry and exit off Highway J.

5.5 Traffic and Roadways

No Action Alternative:
No effects on traffic and roadways would result from No Action Alternative.

Alternative 1:
Under Alternative 1, there may be insignificant, though temporary, impacts to local transportation within the local area due to construction mobilization and material delivery traffic. Additionally, the boat ramp at Ray Behrens and the road needed to access it may be damaged during mobilization, regardless of where staging and access are located. If this occurs, impacts to traffic would be extended while concrete repairs take place.

Alternatives 8a & 8b:
Under Alternatives 8a and 8b, there will likely be significant, though temporary, impacts to traffic and roadways due to the delivery of stone requiring several truckloads. Additionally, the boat ramp at Ray Behrens and the road needed to access it may be damaged during mobilization, regardless of where staging and access are located. If this occurs, impacts to traffic would be extended while concrete repairs take place.

5.6 Air Quality and Noise Levels

No Action Alternative:
No effects to air quality or noise would result from the No Action Alternative.

Alternatives 1, 8a & 8b:
Under Alternatives 1, 8a and 8b, emissions from construction machinery, as well as dust would be generated during project construction. Emissions from construction machinery, and the transportation and handling of materials, would result in the release of dust into the air. The noise level would increase during project construction. The overall long-term noise level would not increase. Noise may unsettle organisms in the area. Contractors would be required to adhere to the BMPs to reduce impacts to air quality.

Noise due to construction activities in the vicinity of the Proposed Action Area would be temporary. After construction is complete, the overall noise level in the vicinity of the

Proposed Action Area would remain unchanged relative to the level which existed prior the proposed project. Common sources of noise would include construction, transportation, recreation, gun range, and agricultural activities. Noise may unsettle organisms in the area.

Therefore, impacts to air quality and noise would be minor and temporary in nature.

5.7 Socioeconomics and Demographics

No Action Alternative:
Under the No Action, periods of low DO concentrations would persist during the summer months. Additionally, stress to aquatic life and fish mortality will continue to occur during the summer months. This is not anticipated to alter socioeconomics or demographics of the surrounding area.

Alternatives 1, 8a, & 8b:
Under Alternatives 1, 8a, and 8b access to recreational areas near Clarence Cannon Dam would be limited during construction. Some visitors may avoid the area for recreational purposes, which may have a minor short-term economic impact on local business. No impacts to demographics of the surrounding area are anticipated.

5.2 Cultural and Historic Resources

5.2.1 Archaeological and Historic Preservation Act

No Action Alternative
Under the No Action, cultural and historic resource conditions are expected to remain the same and therefore, no impact to the resources are anticipated if current conditions persist. However, any potential cultural resources in the Mark Twain Lake area may be exposed, damaged, or washed away if erosion of the lake shore or re-regulation pool banks occurs. If water levels become consistently lower than Mark Twain Lake currently experiences, cultural resources in the study area may also be exposed. The status of cultural, historic, and tribal resources is expected to remain similar to existing conditions.

Alternative 1:
Under Alternative 1, potential impacts to cultural and historic resources would be where the temperature control curtain is anchored to the bottom of the lake and the shore. Depending upon the location of the anchors, an archaeological survey may be necessary to resolve any concerns.

Alternatives 8a & 8b:
Alternatives 8a and 8b will have no impacts to cultural and historic resources. Site RA303 is located adjacent to the TCW; however, that site was reported to have been destroyed by the construction of Clarence Cannon Dam in 1974. If portions of that site remain intact, it will not be impacted by these Alternatives as no ground disturbing activity is expected to take place. Based upon a 1979 aerial photographic, the access road has been utilized since that time and the staging area is located in an area that has been previously disturbed by a former building. Trees around the access road will be cut and their stumps ground down to avoid ground disturbing activities.

5.2.2 Tribal Resources

No Action Alternative:
Under the No Action, tribal resource conditions are expected to remain the same and therefore, no impact to the resources.

Alternative 1:
Under Alternative 1, potential impacts to tribal resources would be where the temperature control curtain is anchored to the bottom of the lake and the shore. Depending upon the location of the anchors, an archaeological survey may be necessary to resolve any concerns.

Alternatives 8a & 8b:
Similar to cultural and historic resources, no impacts are expected to tribal resources under Alternatives 8a and 8b. The area around the TCW has been disturbed by the construction of the dam and historic photography indicate that the access road and staging area have been previously disturbed. No ground disturbing activity will take place for tree removal.

Compliance with federal environmental protection statues and requirements are detailed in Table 13. Remaining compliance activities will be completed as construction limits and timelines develop with enough detail to properly coordinate any potential effects related to the TSP within and/or adjacent to the study area.

Table 13 Status of Environmental Compliance

Environmental Requirement	Compliance[1]
Federal Statutes	
Archaeological and Historic Preservation Act	Partial
Bald and Golden Eagle Protection Act of 1940, as amended	Partial
Clean Air Act, as amended	Full
Clean Water Act, as amended	Partial
Endangered Species Act of 1973, as amended	Partial
Fish and Wildlife Coordination Act, as amended	Full
Migratory Bird Treaty Act of 1918, as amended	Partial
National Environmental Policy Act of 1969, as amended	Partial
National Historic Preservation Act of 1966, as amended	Partial
Watershed Protection and Flood Prevention Act	Full
Farmland Protection Policy Act of 1981	N/A
Executive Orders (EOs)	
Consultation and Coordination with Indian Governments (EO 13175)	Partial
Floodplain Management (EO 11988)	Full
Safeguarding the Nation from the Impacts of Invasive Species (EO 13112)	Full
Protection and Enhancement of Environmental Quality (EO 11514)	Partial
Protection and Enhancement of the Cultural Environment (EO 11593)	Partial
Protection of Wetlands (EO 11990)	Full
Analysis of Impacts on Prime and Unique Farmland (CEQ Memorandum, 30 Aug 1976)	N/A

[1]The compliance categories used in this table were assigned according to the following definitions:
Full - All requirements of the statue, EO, or policy and related regulations have been met for the current planning stage.
Partial - Some requirements of the statue, EO, or policy and related regulation remain to be met for the current planning stage.
Noncompliance (NC) - Violation of requirement of the status, EO, or policy and related regulation.
Not Applicable (N/A) – No requirements for the statute or study area does not contain resources applicable to the law

[2]Full compliance to be achieved with the District Engineer's signing of the Finding of No Significant Impact.

6 EVALUATION AND COMPARISON OF FINAL ARRAY OF ALTERNATIVES

This chapter outlines the process and methods utilized to evaluate the final array of alternatives for the Project. The evaluation included use of Habitat Evaluation Procedures (HEP), the P&G criteria, the Guiding Principles (CEQ 2014 Principles, Requirements, and Interagency Guidelines), and development of parametric cost estimates. HEP outputs and costs were entered into IWR Planning Suite Cost Effective/Incremental Cost Assessment (CE/ICA). The three (including the No Action) retained alternatives underwent a full cost benefit analysis, using cost-effective and incremental cost analysis (CE/ICA). To perform CE/ICA, project costs and benefits both need to be quantified. The costs were developed by the USACE cost engineer. Costs developed at this stage are considered preliminary screening estimates. An abbreviated risk analysis (ARA) was held at this stage of the project to inform the contingency for each alternative.

6.1 Habitat Modeling

This assessment includes a summary of the existing biological conditions used in the evaluation, as well as a forecast for future conditions under the No Action Alternative and each action alternative. The evaluation was conducted by a multi-agency team that included representatives from the District, MDC, and the Mark Twain Lake project office. Aquatic benefits were quantified using the HEP (USFWS 1980a), a habitat-based evaluation methodology used in project planning. The procedure documents the quality and quantity of available habitat for selected wildlife species. The HEP assumes that habitat for selected wildlife species can be described by a Habitat Suitability Index (HSI). This index value (from 0.0 to 1.0) is multiplied by the area of applicable habitat to obtain Habitat Units (HUs).

Changes in HUs will occur as a habitat matures naturally or is influenced by development. These changes influence the cumulative HUs derived over the period of analysis (50 years). HUs are calculated for select target years and annualized over the period of analysis to derive a net Average Annual Habitat Unit (AAHU) quantity. By using target years, AAHUs were annualized using a linear interpolation approach, essentially drawing a straight line between target years, and then calculating the area under the curve for the resulting planning horizon benefit curve. Resulting net AAHUs are used as the output measurement to compare alternatives.

As described in the Review Policy for CAP, EP 1105-2-58 Chapter 1, Section 7(h)(3)(h), the use of approved planning models is not required for CAP Projects. No approved habitat models currently exist that isolate DO as a stand-alone weighted variable that would depict the significant beneficial change that downstream organisms would experience by reducing or removing the stress caused by low DO. Models currently available for use include DO as one of many variables that are vital to the health and success of aquatic species and communities. For this study, the Bluegill HSI Model was used to quantify habitat benefits for the initial array of alternatives. Although the Bluegill HSI Model most closely aligned with the CAP study at Clarence Cannon Dam, there are limitations in the specificity available for the inputs allowed in the model. The team discussed making changes to the model to try and capture the differences between alternatives more clearly; however, the discussed changes would require reviews and approval from the Ecosystem Restoration Planning Center of Expertise (ECO-PCX), and this was deemed unfeasible for the feasibility stage of the study.

Figure 16 shows the location of the downstream water quality gage. Data from this gage was used to inform inputs to the model.

Figure 16 Location of Water Quality Gage

Table 14 shows the AAHUs, and the net change in AAHUs compared to the No Action. The full re-regulation pool, 370 acres, was used to determine AAHUs and the net change. The table summarizes the benefits for each alternative to be carried forward for CE/ICA using IWR Planning Suite II software. Complete documentation of the habitat benefits analysis for the final array of alternatives is provided in Appendix B – Habitat Benefits and Quantification.

Table 14 Environmental Outputs

Alternatives	Area (acres)	AAHUs	Net AAHUs
No Action (FWOP)	370	59	0
Alternative 1: Temperature Control Curtain	370	81	29
Alternative 8a: Raise TCW (585)	370	79	27
Alternative 8b: Raise TCW (588)	370	81	29

6.2 Hydraulic and Hydrological Modeling

The PDT coordinated with the Portland District to carry out an initial hydraulic analysis to assess whether raising the TCW will limit flow at elevations of 600 feet and below. Based on this analysis, raising the weir to 585 is not anticipated to impact power generation when the lake is at or above the power pool elevation of 590. The PDT will need to revisit hydrological and hydraulic modeling in the PED phase to support regulatory compliance and demonstrate due diligence.

6.3 Costs Development

Costs for all alternatives were prepared using October 2025 (FY26) price levels; annualized costs include construction costs, contingency costs, adaptive management costs and O&M costs. Total Project costs were annualized based on the FY26 discount rate of 3.25% and a 50-year period of analysis. Interest During Construction (IDC) was calculated using end of year compounding based on a two-year period of construction, using the Fiscal Year 2026 discount rate of 3.25%. Table 15 shows the estimated cost of these alternatives as of

completion of the habitat analysis and for use in the comparison of alternatives, prior to selection, refinement, and developing a full cost estimate of a TSP.

Table 15 Cost Estimates for Action Alternatives

Cost Item	Alternative 1: Temperature Control Curtain	Alternative 8a: Raise TCW (585)	Alternative 8b: Raise TCW (588)
06: Fish and Wildlife Facilities	$11,029,000	$13,205,000	$21,429,000
30: Planning, Engineering and Design	$2,426,000	$2,905,000	$4,714,000
31: Construction Management	$1,103,000	$1,321,000	$2,143,000
Total First Costs	$14,558,000	$17,431,000	$28,286,000
Total Annual Costs	$805,000	$775,000	$1,385,000
Net AAHUs	29	27	29

Note: All preliminary costs used in CE/ICA are in FY26 Dollars
Total cost includes contingency applied to each alternative (38% for Raise TCW, 87% for Temperature Control Curtain)
FY26 Price Level, 3.25% discount rate

The preliminary cost estimate was used to estimate costs for construction, monitoring, adaptive management (MAM), and OMRR&R. An ARA was performed to inform the contingency for each alternative. The costs associated with implementing MAM were estimated based on currently available data, at 4% of the total project costs for the Final Array. 4% was used for the purposes of comparing alternatives (Appendix D – Monitoring and Adaptive Management). The PDT considered a more deterministic method of estimating adaptive management costs since the range of potential options would vary widely between alternatives, with significantly different costs. This PDT concluded that there was not sufficient precedent for conducting a probability-based estimate (such as coopting the ARA/CSRA methodology to calculate a value for each alternative), and using such a methodology would not change the qualitative assessment of the alternatives and selection of the TSP.

This was paired with the anticipated schedule used to estimate annualized costs. Interest was calculated during the construction phase based on the construction schedule. The annualized economic cost of each alternative was also calculated using the 50-year period of analysis and FY26 discount rate of 3.25%.

These costs, along with the environmental benefits described above in Section 5.1, were entered into the USACE software program, the Institute for Water Resources (IWR) Planning Suite II version 2.0.9 for CE/ICA.

6.4 Cost Effective and Incremental Cost Analysis

CE/ICA is used by USACE to develop cost-effective restoration projects by comparing the relative costs and benefits of alternative plans. ER 1105-2-103, Policy for Conducting Civil Works Planning Studies, calls for cost effectiveness analysis to be used to identify the least cost solution for each level of environmental output considered. The plan that reasonably

maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective, is selected and identified as the National Ecosystem Restoration (NER) Plan.

IWR Planning Suite II software was used to complete CE/ICA for the four alternatives (including the No Action), using the net AAHUs and annualized costs described in this section. CE/ICA is used when project benefits are not measured in dollars and is used to ensure the least cost alternative is identified for each possible level of environmental output, and the maximum level of output is identified for any level of investment. Cost Effectiveness evaluation is used to identify the least costly solution to achieve a range of project benefits; the Incremental Cost Analysis identifies the subset of cost-effective plans that are superior financial investments, called “Best Buys,” through analysis of the preliminary incremental costs. Best Buys are the plans that are the most efficient at producing the output variable or provide the greatest increase in AAHUs for the least increase in preliminary cost. The first Best Buy is the most efficient plan, producing output at the lowest incremental cost per unit. If a higher level of output is desired than that provided by the first Best Buy, the second Best Buy is the most efficient plan for producing additional output, and so on.

The CE/ICA analysis evaluated four possible plan combinations. Table 16, Figure 17, and Figure 18 show the resulting alternatives differentiated by cost effectiveness. From this list of alternatives, one non-cost-effective plan and two Best Buy Plans were identified.

Table 16 Array of Alternatives Differentiated by Cost Effectiveness

Alternative	Annualized Cost ($)	Annualized Output (AAHU)	Average Cost/ Output ($/AAHU)	Cost Effectiveness
No Action	$0	52	$0	Best Buy
Alternative 1: Temperature Control Curtain	$805,000	81	$10,000	Best Buy
Alternative 8a: TCW Raise (585)	$775,000	79	$10,000	Cost Effective
Alternative 8b: TCW Raise (588)	$1,389,000	81	$17,000	Non Cost-Effective

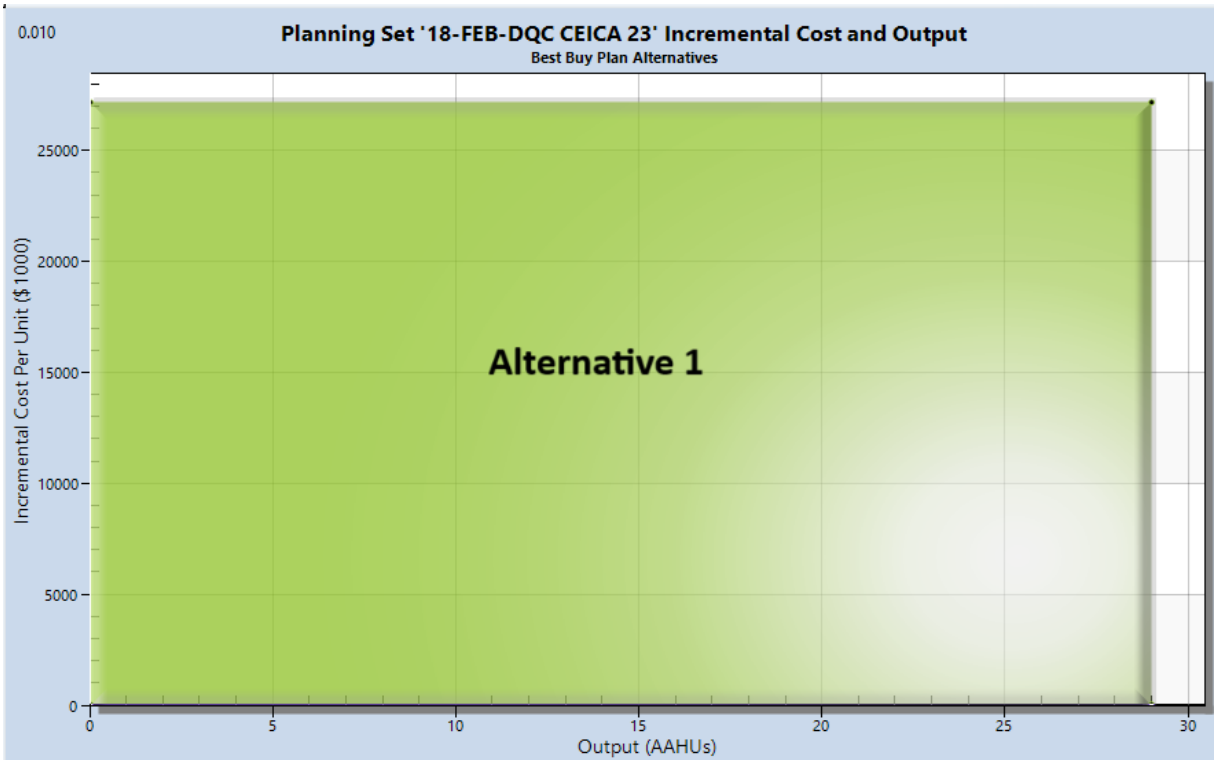


Figure 17 Best Buy Action Alternative

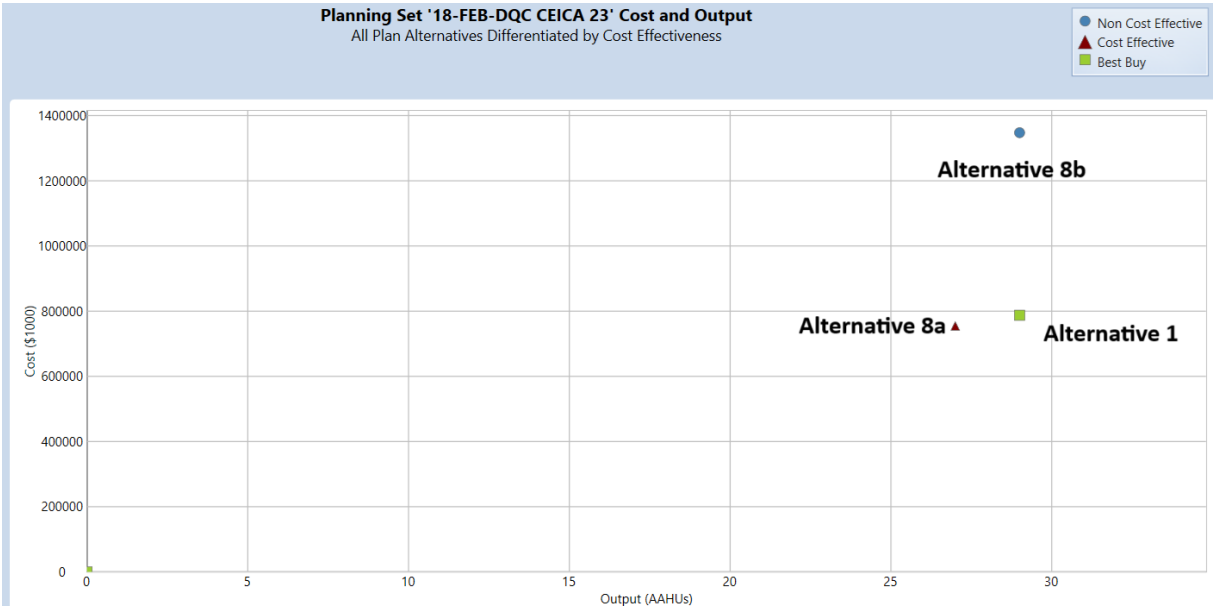


Figure 18 Array of Alternatives Differentiated by Cost Effectiveness

After reviewing the results of the CE/ICA analysis, the No Action Alternative, Alternative 1, and Alternative 8a were retained for further evaluation and comparison and are further discussed in the following sections.

Table 17 Incremental Cost Analysis of Cost Effective and Best Buy Alternatives

Alternative	Output (AAHUs)	Annualized Cost	Annualized Cost Per AAHU	Incremental Output	Incremental Cost per AAHU
No Action	52	-	-	-	-
Alternative 1: Temperature Control Curtain	81	$805,000	$10,000	29	$28,000
Alternative 8a: TCW Raise to 585	79	$775,000	$10,000	27	$29,000

1. FY26 Price Level, 3.25% Discount Rate

The Cost Effective and Best Buy alternatives provide critical information to support well-informed decisions regarding the appropriate scale of restoration features. Evaluating alternatives through increasing levels of output allows decision-makers to assess whether additional ecological benefits justify the incremental costs. All prices are in FY26 price levels.

6.4.1 Principles and Guidelines

For a full description of each P&G criteria, see Section 4.2.2.

6.4.1.1 Effectiveness

The No Action is not effective. It does not alleviate the specified problems or achieve the specified opportunities. It is included in the final array to provide a baseline against which to evaluate and compare other plans. All action plans in the final array meet the objective, are effective, and provide local benefits in the form of improved aesthetics (fewer deceased fish) and more live fish available for anglers.

6.4.1.2 Efficiency

Through CE/ICA, plans are identified as non-cost effective, cost-effective or Best Buy plans. Best Buy plans have the least incremental increase in cost per unit habitat output and were retained for consideration. The No Action and Alternative 1 were identified as Best Buy plans and fully analyzed. Alternative 8a was identified as cost effective and also analyzed. The No Action Alternative does not alleviate specified problems, nor does it realize specified opportunities. It generates no costs and has no benefits. Alternative 8a is efficient at generating AAHUs and meeting the planning objectives at a reasonable cost and with lower risks than Alternative 1.

6.4.1.3 Acceptability

The suite of habitat restoration measures and plans outlined within this report were developed, screened, and retained for further consideration with input from MDC and other stakeholders. The No Action Alternative is implementable, but provides no ecosystem improvements and is not satisfactory, as it does not meet the objective. The action alternatives in the final array of alternatives are all implementable and satisfactory to USACE and the NFS.

6.4.1.4 Completeness

All these factors were considered in the evaluation of alternatives. The No Action does not provide any action to restore degraded habitats, and the planned effects are zero net AAHUs. The No Action is a complete plan for the purpose of establishing a baseline

condition. In the final array, the action alternatives were considered “complete” plans, with no additional actions or investments outside of the federal action needed to realize planned benefits.

6.4.2 Four Accounts

Economic, social, and environmental benefits, impacts, and costs are to be identified, measured, and/or qualitatively characterized using the four Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G) accounts:

- The National Economic Development (NED) account displays changes in the economic value of the national output of goods and services.
- The Regional Economic Development (RED) account displays changes in the distribution of regional economic activity (for example, income and employment).
- The Environmental Quality (EQ) account displays non-monetary effects on ecological, cultural, and aesthetic resources.
- The Other Social Effects (OSE) account displays plan effects on social aspects such as community resilience, health, safety, displacement, energy conservation, etc.

6.4.2.1 National Economic Development Account

As defined in the Policy for Conducting Civil Works Planning Studies, ER-1105-2-103, NED contributions are increases in the net value of the national output of goods and services, expressed in monetary units. NED contributions are direct net benefits that accrue in the planning area and the rest of the Nation, including the net value of both marketed goods and services and goods and services that are not marketed. This is an ecosystem restoration project, focused on nonmonetary ecosystem benefits, so the NED account was considered qualitatively. Construction expenditures in the local area would not be considered a net benefit to the nation and are addressed in the Regional Economic Development section. Quantified effects of this account are represented as the Average Annual Cost per AAHU:

- **No Action Alternative:** $0 (No cost; No impact on NED)
- **Alternative 1 Temperature Control Curtain:** $10,000
- **Alternative 8a Raise TCW (585):** $10,000

6.4.2.2 Regional Economic Development Account

The RED account registers changes in the distribution of regional economic activity that result from each alternative plan, including changes in jobs, income, economic output, and population (ER 1105-2-103). This is an ecosystem restoration focused project, so RED was considered qualitatively. USACE and Michigan State University have developed a regional economic impact modeling tool, RECONS (Regional ECONomic System), that provides estimates of jobs and other economic measures such as labor income, value added, and sales that are supported by USACE programs, projects, and activities. The RECON model was run for the final array of action alternatives. As the costs of action alternatives varied, regional benefits would also vary.

The No Action alternative would result in no project expenditures and would have no positive or negative regional impact. Increases in recreational use could also benefit the local economy. Both action alternatives are expected to improve DO conditions and lead to fewer fish mortality events, thus improved fish habitat could draw more recreational users. The local economy could benefit from though increased spending on gas, hotels, boating equipment, and other goods and services leading to increased regional economic development. Any increased recreation is likely to be small and is not likely to vary between the action alternatives. Table 18 summarizes RECONS analysis.

Table 18 RECONS Summary

Alternative	Gross Regional Product	Full Time Equivalent Jobs
No Action	$0	0 FTE
Alternative 1: Temperature Control Curtain	$38.3 Million	254 FTE
Alternative 8a: TCW Raise to 585	$45.9 Million	304 FTE

FY 2026 Price Level, 3.25% Discount Rate

See Appendix J - Economics for the full analysis of the final array of alternatives

6.4.2.3 Environmental Quality Account

The EQ account measures effects on ecological, cultural, and aesthetic resources. For ecosystem restoration projects such as this one, contributions to the EQ account are detailed both through NEPA compliance and through calculation of net ecosystem benefits. Here, NEPA compliance is achieved by integrating an EA into this feasibility report, with a qualitative summary of environmental effects detailed in Chapter 5 of this report. A calculation of net ecosystem benefits was completed through the use of HEP and HSI models. The quantitative results of the evaluation are contained in Appendix B – Habitat Evaluation and Quantification. The credit for the EQ account is the quantified benefits resulting from the Project (AAHUs). Intangible and/or non-quantifiable environmental benefits associated with the alternatives are assumed to increase proportionally relative to the AAHU outputs associated with each alternative. In Table 19, Alternative 1 contributes 29 net AAHUs, and Alternative 8a contributes 27 net AAHUs.

The PDT used one USACE-approved (per EC 1105-2-412) habitat evaluation methodology in their analyses: Bluegill HSI model.

Table 19 Total and Net AAHUs of Final Array

Alternative	Total AAHUs	Net AAHUs	Acres Included
No Action	52	0	370
Alternative 1: Temperature Control Curtain	81	29	370
Alternative 8a: TCW Raise (585)	79	27	370

6.4.2.4 Other Social Effects Account

The OSE account evaluates plan impacts from perspectives that are not fully captured by the other three accounts. The account is intended to illustrate the effects the alternatives will have on lives of residents and the social fabric of communities in the study area. In accordance with the Policy Directive “Comprehensive Documentation of Benefits in Decision Document” (5 January 2021), the PDT used input from interagency experts and local stakeholders to assess OSE factors for the study area. OSE factors can include community impacts, health and safety, displacement, energy conservation, social connectedness, identity, leisure, recreation, etc.

OSE benefits may be slight or difficult to measure for individual projects; however, all action alternatives in the final array are expected to contribute positively and similarly to social benefits. Recreational benefits are expected to increase under all action alternatives due to the improvements in habitat health within the study area.

6.5 Comprehensive Benefits

USACE is required to comprehensively evaluate and provide a complete accounting, consideration, and documentation of the total benefits of alternatives from a full array of benefit categories including national economic development, regional economic development, environmental quality, and other social effects (Assistant Secretary of the Army for Civil Works (ASA(CW)) Memorandum, SUBJECT: POLICY DIRECTIVE – Comprehensive Documentation of Benefits in Decision Document (5 January 2021)). Alternatives are assessed to determine if they have net benefits in total and by type. Judgment was made in collaboration with partners and in consideration of other study interests and stakeholders, using available data, analysis, input from peer review, and professional judgment.

For this comprehensive benefit analysis, the No Action, Alternative 1, and Alternative 8a were evaluated. Table 20 provides that summary.

Table 20 Summary of Comprehensive Benefits across P&G accounts

Alternatives	NED	RED	EQ	OSE
No Action	$0 / Cost Effective	$0 / 0 FTE	-	No Benefits
Alternative 1: Temperature Control Curtain	$805,000 / Cost Effective	$38.3 Million / 254 FTE	29	As AAHUs increase, improved recreation opportunities are anticipated
Alternative 8a: TCW Raise to 585	$775,000 / Cost Effective	$45.9 Million /304 FTE	27	

1. FY26 Price Level, 3.25% Discount Rate

NED - Annualized Cost / Cost Effective
RED - Jobs, etc.
EQ - AAHUs gained over No Action
OSE - Recreation, Hunting, Fishing, etc.

6.6 Selection of the Tentatively Selected Plan

Federal planning for water resources development was conducted in accordance with the U.S. Water Resources Council's P&G and the ASA(CW) policy directive for comprehensive documentation of benefits.

> "For ecosystem restoration projects, a plan that reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective, shall be selected. The selected plan must be shown to be cost effective and justified to achieve the desired level of output."
>
> "All USACE planning study PDTs must evaluate and provide a complete accounting, consideration, and documentation of the total benefits of alternative plans across all benefit categories. Total benefits involve a summation of monetized and/or quantified benefits, along with a complete accounting of qualitative benefits, for project alternatives across nation and regional economic, environmental and social benefit categories."

Review of the four formulation criteria suggested by the P&G (completeness, effectiveness, efficiency, and acceptability) and resource significance (institutional, public, and technical) were used to aid in the selection of the TSP.

After evaluating and comparing the final array using the P&G criteria and a comprehensive benefits analysis, Alternative 8a: Raise TCW to 585 was identified as the NER plan, representing the best balance of maximizing ecosystem benefits at a reasonable cost. This Alternative provides a net benefit of 27 net AAHUs over the No Action and achieves the objective at the lowest incremental cost of the alternatives that meet the project objective.

Alternative 8a: Raise TCW to 585 is considered an effective plan, fully meeting the project objective and restoring habitat quality in the area. It is the most efficient alternative, with the best balance of generating AAHUs and meeting the planning objective at a reasonable cost. This Alternative is acceptable in terms of both being implementable and being satisfactory to MDC and other stakeholders. It is a complete plan, requiring no other investment outside the federal investment, and is consistent and compatible with current and future NFS plans in the watershed. Alternative 8a: Raise TCW to 585 was also identified as the Total Net Benefits Plan, which maximizes net benefits across all P&G accounts in comparison to costs, and the Least Environmentally Damaging Plan Available (LEDPA) because the curtain has the potential to trap fish between the curtain and the dam, while raising the TCW does not.

While the other action alternatives in the final array also met the proposed objective, Alternative 8a: Raise TCW to 585 reasonably maximized benefits and cost, was lower risk than the other action alternatives, and had support from the NFS. Therefore, Alternative 8a: Raise TCW to 585 was identified as the Tentatively Selected Plan (TSP).

Table 21 Table of Effects of Final Array

FEDERAL OBJECTIVES	Maximize Economic Development		Protect and Restore Natural Systems											
GUIDING PRINCIPLES	Sustainable Economic Development		Healthy & Resilient Ecosystems			Local Benefits								
P&G ACCOUNTS	NED	RED	EQ			OSE								
PLANNING OBJECTIVE COMPONENTS			Reduce occurrences of DO ↓ 5 mg/L; Decrease fish kill event frequency & size											
EVALUATION CRITERIA	Effective		Efficient	Effective			Acceptable							Complete
METRICS (QUANTITATIVE & QUALITATIVE)	Annualized Cost / Cost Effective	RED Benefits	Cost per AAHU	AAHUs	Meets Planning Objective	Local Community Benefits	Partner Satisfaction	Impacts Dam Ops or Lake Elev	Impacts Re-Reg Dam Ops or Pool Elev	Impacts to turbines	Impacts to SWPA Ops	Impacts to Cultural Resources	Env Impacts	Complete Alternative
No Action	$0 / Yes	$0	$0	52	No	No	No	Acceptable, No impacts	Unlikely or Minimal, Acceptable	Acceptable, No impacts	Unacceptable, Affects water available for generation	Acceptable, No impacts	Unacceptable, Continued fish kills	Yes
Alt 1: Temperature Control Curtain	$805,000 / Yes	$38.3 Million 254 FTE	$10,000	81	Yes	Improved Aesthetics (Fewer dead fish), Fish availability for anglers	Likely frequent O&M or replacement, Still acceptable to Partner	Operators may need to assist with MAM, Likely Acceptable	Unlikely or Minimal, Acceptable	Unlikely, Possible curtain or structural components may detach, Still acceptable	Unlikely, Possible curtain or structural components may detach, Still acceptable	Unlikely, Acceptable	Acceptable, DO increase expected, Can impact temperature of water downstream	Yes
Alt 8a: TCW Raise (585) (T, R, L)	$775,000 / Yes	$45 Million 304 FTE	$10,000	79	Yes	Aesthetics, Fish availability	Acceptable	Unlikely, Acceptable	Unlikely or Minimal, Acceptable	Acceptable	Unlikely, Acceptable	Expected Acceptable	Acceptable, DO increase expected	Yes
Alt 8b: TCW Raise (588)	$1,385,000 / No	$82.6 Million 548 FTE	$17,000	81	Yes	Aesthetics, Fish availability	Acceptable	Unlikely, Acceptable	Unlikely or Minimal, Acceptable	Acceptable	Potentially unacceptable	Expected Acceptable	Acceptable, DO increase expected	Yes

T = Total Net Benefits Plan, R = NER Plan, L = LEDPA

7 TENTATIVELY SELECTED PLAN

Based on the discussion and criteria outlined in previous chapters, Alternative 8a: Raise TCW to 585 was identified as the TSP. Project features, benefits, real estate, construction, OMRR&R, risk, and uncertainty are discussed in this chapter. The project schedule and initial cost estimates are provided. The project has been developed to a feasibility level of design.

7.1 Plan Features

The TSP includes the placement of stone on top of the existing TCW to reach the elevation of 585 feet NGVD 29 (Figure 19). The PDT coordinated with the Portland District to determine at what elevation the TCW, if raised to that height, will begin to adversely impact power generation. Based on this analysis, raising the weir to 585 is not anticipated to impact power generation when the lake is at or above the power pool elevation of 590. This elevation may be further optimized during PED, if needed.

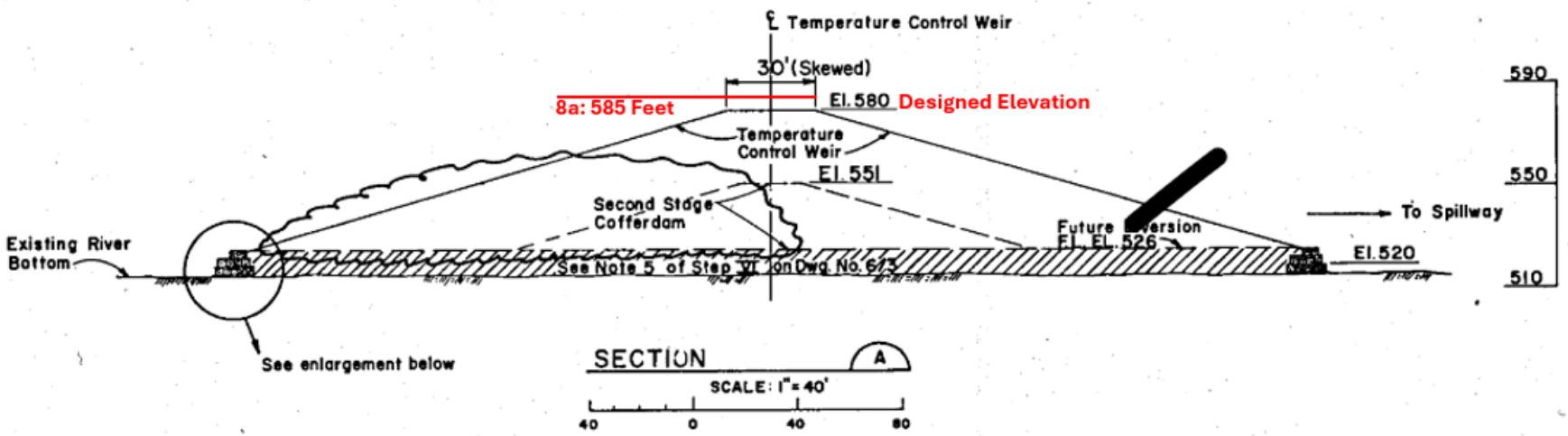


Figure 19 TSP: Raise TCW to 585

Table 22 presents the Project Implementation Schedule. The dates in the table are subject to change in the future.

Table 22 Project Implementation Schedule

Project Action	Date
PMP Approval	21 August 2023
Review Plan Approval	02 June 2025
Feasibility Cost Share Agreement (FCSA) Execution	16 May 2024
TSP Milestone	10 December 2025
Release for Public Review of Draft Report	25 February 2026
Submit Final Report to MVD	15 June 2026
Approved Final Report from MVD	30 September 2026
Initial Construction Award	Contingent On Funding
Project Physical Completion	Contingent On Funding

Details of quantities and design for the TSP can be found in Appendix F - Civil Engineering. A summary of quantities is located in Table 23.

Table 23 Summary of the Quantities for the TSP Measures

Item	Quantity	Unit
Crushed Stone	1956	Cubic Yd
Tree Clearing	0.5	Acre
Access Riprap	655	Cubic. Yd
C-Stone	103811	Tons

7.2 Cost Estimates

Table 24 presents the Project first cost. Quantities and costs will be refined during final design. A full description of the cost estimate, including all related elements, can be found in Appendix I - Cost.

Table 24 Project Design and Construction Cost Estimates (FY26 Price Level)

Account	Measure	Project First Cost
06	Fish and Wildlife Facilities	$13,200,000
30	Planning, Engineering and Design	$2,900,000
31	Construction Management	$1,300,000
	Project Cost Estimates	$17,400,000

Table 25 Cost Sharing

Item	Fed Cost (75%)	Non-Fed Cost (25%)	Total Cost (100%)
Planning, Engineering and Design	$2,179,000	$726,000	$2,900,000
Construction	$9,904,000	$3,301,000	$13,200,000
Construction Management (S&A)	$991,000	$330,000	$1,300,000
Total Project	$13,073,000	$4,358,000	$17,400,000

The annualized costs and AAHUs were used to calculate a total annual cost per AAHU (Table 26). The total cost per habitat unit is approximately $10,000. The costs used for analysis purposes include total Project costs, IDC, and annualized O&M, adaptive management, and monitoring costs.

Table 26 Total Annual Cost per Average Annual Habitat Unit

Analysis Element	Total
Project First Cost ($)	$16,900,000
IDC ($)	$554,000
Total Economic First Costs ($)	$17,500,000
Annualized Economic First Cost ($)	$711,000
Annual O&M ($)	$46,000
Annual Adaptive Management & Monitoring Costs ($)	$29,000
Total Annual Costs ($)	$775,000
AAHUs	79
Total Annual Cost/AAHU ($)	$10,000

7.3 Design Consideration

The study has been developed to a feasibility level of design. Design details are included in the Appendix F – Civil Engineering and measures were modeled to increase the likelihood of project success. As with all feasibility level studies, these details will be refined further in PED stage.

Early in PED, USACE will complete a no-rise analysis to confirm that raising the TCW will not increase flood heights or adversely affect private property or infrastructure. Based on professional judgement and high level preliminary analysis, the PDT does not anticipate rise on private lands and has made the decision to defer this analysis to PED. Additionally, USACE will revisit hydrological and hydraulic modeling to support regulatory compliance, demonstrate due diligence, and verify results from the initial hydraulic analysis conducted by the Portland District regarding potential impacts to power generation.

During PED, USACE would complete the detailed engineering and technical analysis needed to begin construction of the project as recommended in this decision document. This includes engineering design documentation and the plans and specifications. Further refinement, and any necessary changes to the TSP will occur during this phase. Recommended further analysis is discussed in in Appendix F - Civil. The following actions are anticipated during the PED phase of this project:

7.3.1 Surveys

Collection of any additional survey data will be initiated during the design phase and will be conducted as need is determined and water levels allow. Determination of the survey needs are ongoing. It is anticipated that the geotechnical PDT member will use a survey providing surface elevations of the TCW to confirm dimensions of the weir.

7.3.2 Geotechnical Explorations

Existing subsurface information at the project location is limited; however, boring data does exist for areas around the dam. From the information provided in those borings, the PDT determined

that the weir is located on bedrock. At this time, additional soil borings and testing data are not necessary to design the TSP as the weir will remain shallow founding and sitting on bedrock. Existing subsurface information will be used to determine the subsurface stratigraphy and develop engineering properties to determine settlement and stability of TSP features.

7.3.3 HTRW and Clean Water Act

HTRW and Clean Water Act compliance are not anticipated to require exploration and testing at this time, but if construction activities are not determined to fall under NWPs and/or existing environmental permits/NEPA coordination, additional information may be needed. Design estimates included a conservative estimate of the cost for conducting these activities, if necessary.

7.3.4 Hydraulics & Hydrology

Design of the TSP will require input from hydraulic engineers. Additional hydraulic modeling will need to be utilized to inform design concerns that may come up during PED. A 2D unsteady flow HEC-RAS model would be utilized.

7.3.5 Civil

7.3.5.1 Planning Level of Design

The Planning process included Civil design of features to a conceptual level, including preliminary models based on available existing conditions topography and bathymetry information. Alternative 8a and 8b, as well as several other scales of Alternative 8 were approximately modeled in OpenRoads Designer (ORD) CAD-BIM software. Volumes of stone were calculated within the ORD models for each crest elevation considered. TCW heights that are between the considered elevations were extrapolated from these models to provide an approximation of a 10% level of design. After discussion of risks associated with the current conceptual design of raising the elevation of the TCW and access and staging, it was determined that further modeling could be completed early in Design, and no further refinement would be needed to complete the report while managing the associated risks. The remaining measures will also be designed and adjusted as needed to reduce impacts, manage construction costs, and maximize potential habitat benefits.

The need for access roads and staging areas is expected and are anticipated to be constructed by the contractor during construction. The access roads and staging areas are expected to be removed, but may remain in place to facilitate Operations, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) of the project features, as well as Monitoring and Adaptive Management (MAM). The removal of access and staging will potentially be included as an optional bid item. Any staging areas will be placed to limit disturbance to existing habitats, provide appropriate access to transfer materials and equipment to and from the construction site, and/or utilize existing operational areas.

7.3.5.2 Preconstruction Engineering and Design (PED) Tasks

Civil design tasks during PED will include but are not limited to refining project scope and features, coordinating the collection of aerial imagery, bathymetric surveys, land surveys, refining or reconstructing CAD-BIM models, developing construction specifications, identifying real estate needs and constraints, coordinating with utilities, and facilitating detailed engineering analyses between disciplines.

7.4 Construction Considerations

This section provides a summary of critical construction considerations, with more detail

(construction sequence, etc.) provided in the Appendix F - Civil Engineering.

7.4.1 Environmental Commitments

7.4.1.1 Bald Eagles

Consideration would be given during design preparation to sequence construction activities in a manner that minimizes impacts to bald eagles. A 660-foot buffer would be utilized under instances of direct line of site during the active nesting season according to the National Bald Eagle Management Guidelines. Staging of equipment would not be allowed within a 660-foot buffer of a known nest. Additional coordination with the USFWS would be conducted during the design phase to account for changes in conditions in the study area relative to proposed project measures prior to or during construction.

7.4.1.2 Tree Clearing Restrictions

Removal of trees with a diameter at breast height of at least three inches will be restricted to a period between November 1st to March 31st of any given year. Should any tree removal require removal of the root ball as opposed to cutting off the tree at the stump, then the District cultural resources specialist will be contacted prior to removal.

7.4.2 Air Quality

Diesel emissions and fugitive dust during project construction may pose environmental and human health risks and should be minimized. Applicable protective measures as outlined in USEPA's "Construction Emissions Control Checklist" would be followed.

7.4.3 Permits

Laws of the United States and State of Missouri have assigned USACE and Missouri with specific and different regulatory roles designed to protect the waters within and on the State's boundaries. Protecting Missouri's waters is a cooperative effort between the applicant and regulatory agencies. USACE has verified that the project complies with the Nationwide Permit (NWP) 27 for Aquatic Ecosystem Restoration, Enhancement, and Establishment Activities (Appendix C – Clean Water Act). NWP 27 is applicable because the work involves rehabilitation of the existing TCW for the aquatic ecosystem improvement. This verification is valid until March 14, 2026, unless the District Engineer modifies, suspends, or revokes the nationwide permit authorizations in accordance with 33 CFR 330.5(d). Prior construction NWP 27 will be reevaluated.

7.4.4 Schedule Constraints

Scheduling of construction contracts would depend on availability of funds. The following documents constraints related to construction:

- Construction staging and access points to project measures would be defined during Plans and Specifications to avoid and minimize potential impacts to wetland resources.
- Tree removal will be restricted to between November 1st to March 31st of any given year.
- In accordance with Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, take of migratory birds protected under the Migratory Bird Treaty Act (MBTA) should be avoided or minimized, to the extent practicable, to avoid adverse impact on migratory bird resources.
- In-stream construction work will need to be coordinated with SWPA's hydropower generation needs. The acceptable release rates for construction work will be coordinated with the construction contractor based on construction methods, and safety.

- Rock used in the project features should not be quarried from October 15th to April 15th due to freeze thaw cycles during these months affecting the durability of the stone.

7.4.5 Access & Staging

Construction will incorporate land and water-based transportation to get the required equipment and material on site. The site can be accessed by boat from Ray Behrens Boat Ramp or the proposed temporary boat ramp on the north side of Clarence Cannon Dam. Both the proposed temporary boat ramp and the Ray Behrens Boat Ramp can be accessed from State Hwy J. The existing Hwy J is anticipated to be adequate for construction, but quantities for repairing any impacts to the unnamed local roads off of Hwy J to the respective boat ramps were quantified. Lower staging areas may be needed at boat ramps for loading or unloading equipment. Currently, it is assumed that the boat ramp at Ray Behrens Marina will be used to launch larger vessels such as the barge needed to transport C-Stone across the lake to the construction site. Loading of the barge and normal construction access is expected to take place at the temporary staging and access area(s) north of Clarence Cannon Dam as identified in the planning phase. Access will be further investigated during PED.

The final location of the staging area(s) will be determined during PED. Staging location will be determined based on distance, accessibility, right of way, and environmental considerations. All temporary staging areas are anticipated to be restored to preconstruction conditions; however, the staging areas or access roads could be left in place if it is desirable to local partners.

All areas of soil disturbance would be evaluated for historic and cultural impacts prior to construction.

Any tree clearing that would be required for access and staging would follow bat restriction dates – all clearing must occur between November 1st and March 31st of any given year.

Should any construction activities for access and staging be situated within 660 feet of any bald eagle nests, coordination would be conducted with USFWS as stated in Section 7.4.1.1.

7.5 Real Estate Considerations

All project measures are located on land owned in Fee Simple by the United States; consequently, no land acquisitions, non-standard estates, or Public Law 91-646 relocations are required. All placement materials will be excavated from within the navigational servitude, project waters, and existing topsoil within the study area. Site access will be exclusively by water, with the contractor permitted to use public boat ramps in the vicinity, provided they adhere to all local usage regulations. For additional details and a map of the study area , see Appendix L - Real Estate Plan.

7.6 O&M Consideration

O&M is the responsibility of the Sponsor in accordance with WRDA 1992, Public Law 102-580. Upon completion of the construction as determined by the District Engineer, the NFS shall operate and maintain the Project as defined in this report and in the Project's O&M Manual; 100% of all costs associated with the OMRR&R of a completed project will be borne by the NFS.

In general, operation is limited to regularly reoccurring surveys of the TCW and the forebay to ensure that the measures are performing as designed. Maintenance will include placement of supplemental rock on the TCW if degradation is found during survey of the weir or forebay.

Currently, it is assumed that 5% of the base quantity of stone used to raise the TCW will have to be added to the TCW every 10 years for normal maintenance. Maintenance requirements would be further detailed in the project's O&M Manual published after construction completion and preparation of as-built drawings, and prior to transferring the project to the NFS.

The NFS is expected to maintain the project as outlined in the Memorandum of Agreement (MOA).

Table 27 Major O&M Components, Associated Frequencies, & Costs

O&M Component	Frequency	Quantity (CY)
TCW; C-Stone	10 years	5190

7.7 Post-Construction Evaluation

Per Section 2039 of WRDA 2007, monitoring for ecosystem restoration studies will be conducted to determine Project success. "Monitoring includes the systematic collection and analysis of data that provides information useful for assessment of Project performance, determining whether ecological success has been achieved, or whether adaptive management may be needed to attain Project benefits." This section summarizes the post-construction evaluation plan, which includes performance monitoring, adaptive management, and long-term performance reporting, described in Table 28. See Appendix D - Monitoring and Adaptive Management, for a full description of post-construction evaluation, including performance monitoring, adaptive management activities, and long-term performance reporting. The appendix provides the post-construction evaluation plan, which displays several specific parameters and the levels of enhancement that the Project hopes to achieve. The monitoring plan includes the collection of water quality data and Multi-beam bathymetric survey (depth) to have the exact elevation of the TCW. Adaptive management measures include the addition or adjustment in elevation of the TCW if it is not at 585 feet and if low DO levels have been observed.

Table 28. Post-Construction Evaluation Description.

Monitoring Stage	Length of Time	Description
Post-Construction Evaluation: Performance Monitoring	10 years	For entire Project, determine the degree to which the Project is meeting the success criteria and for informing potential adaptive management decisions
Post-Construction Evaluation: Adaptive Management	10 years	Provides a process for making decisions in the face of uncertainty and learning from outcomes of management actions; may improve the performance of a designed construction measure that is not meeting performance criteria

7.8 Environmental Operating Principles (EOPs)

The EOPs outline USACE's role and responsibility to sustainably use and restore our natural resources in a world that is complex and changing. The TSP meets the intent of the EOPs. The PDT proactively considered the environmental consequences of the proposed Project, as well as the benefits of the TSP. The project would be constructed in compliance with all applicable environmental laws and regulations. The formulation of alternatives considered for implementation met all the EOP principles, including:

- foster sustainability as a way of life throughout the organization;
- proactively consider environmental consequences of all USACE activities and act accordingly;
- create mutually supporting economic and environmentally sustainable solutions;
- continue to meet our corporate responsibility and accountability under the law for activities undertaken by USACE, which may impact human and natural environments;
- consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs;
- leverage scientific, economic, and social knowledge to understand the environmental context and effects of USACE actions in a collaborative manner;
- employ an open, transparent process that respects views of individuals and groups interested in USACE activities.

7.9 Risks and Uncertainties

Areas of risk and uncertainty have been analyzed and were defined so that decisions could be made with some knowledge of the degree of reliability of the estimated benefits and costs of alternative plans. Risk is a measure of the probability and consequence of uncertain future events. It is the probability or likelihood for an outcome. Uncertainty refers to a lack of knowledge about critical elements or processes contributing to risk or natural variability in the same elements or processes.

The PDT worked to manage risk in developing measures by expanding on and referencing successful similar work completed by previous USACE, USBR, and BLM studies and projects, as well as drawing on the expertise of the ECO-PCX, ERDC, and RPEDN. The PDT used that information to identify possible risks and decrease uncertainty in plan formulation. Significant risk would be avoided by detailed modeling, proper design, appropriate selection, and correct seasonal timing of applications.

The PDT identified a number of medium and high risk items and risk management activities tied to the TSP:

1. Risk: The identified preferred staging and access location may require tree clearing and/or a cultural survey to confirm no historical properties will be impacted.
    a. Mitigation Action: In this phase, the team accepted this risk and recommends a cultural survey be conducted.
    b. Mitigation Action: Pursue any permitting or environmental consultation in PED, as required.
2. Risk: Changes in hydrometeorological factors will increase weather-related risks to project efficacy, such as an increase in flood duration/magnitude/frequency, or an increase in average temperature and the number of very hot days in a year. These changes would result in more low-DO releases downstream.
    a. Mitigation Action: The team has accepted this risk to the efficacy of the project. The project's primary purpose is to address the issue of low DO in the re-regulation pool. The hazards of this risk are directly mitigated by the design of project features.

8 PUBLIC INVOLVEMENT, COORDINATION, AND CONSULTATION

Scoping is an early and open process for determining the range of issues to be addressed and for identifying the significant issues related to a proposed action. Scoping was conducted during the planning process using a variety of communication methods with the affected public, agencies, and organizations. Scoping and coordination have been conducted with the following state and federal agencies, and other interested parties: USFWS, MDC, MoDNR, and USFWS. Input received during scoping helped USACE make holistic, informed decisions throughout the study process. Official correspondence with other agencies in included in Appendix A – Environmental Compliance and Coordination.

8.1 Coordination Meetings

This draft feasibility report reflects a collaboration of key partners and stakeholders. Numerous coordination and stakeholder meetings, as well as site visits, were conducted to discuss problems, opportunities, project goals and objectives, potential restoration measures, and expected outcomes with and without the proposed project. A scoping charrette was held on 4 December 2024, prior to the development of the study. Representatives from USACE, MDC, and SWPA attended and provided input on project objectives, potential management measures, future conditions of the site, and identified resource issues. A full copy of the Planning Charrette report is available upon request. A site visit was conducted on 21 November 2024. Additional meetings with key partners and stakeholders were held as needed, including a Habitat Benefits Workshop on 14 August 2025.

8.2 Coordination by Correspondence

The US government has a unique legal relationship with federally recognized Indian tribes based on recognition of inherent powers of tribal sovereignty and self-government per EO 13175 Consultation and Coordination with Indian Tribal Governments (November 6, 2000). Communication with federally recognized tribes that have an interest in this area was initiated with a USACE letter dated 21 January 2025, requesting the Nations to provide any information or indigenous knowledge that they would be able to share. A second letter was sent to Tribes and SHPO on 25 February 2026, stating that no historic properties will be affected. Copies of all tribal and SHPO correspondence are provided in Appendix A – Environmental Compliance and Coordination.

8.2.1 Public Review

In accordance with NEPA, the Draft IFR/EA and unsigned FONSI will be available to interested members of the public during a 30-day public review period, yet to be scheduled. The report will be on the USACE St. Louis District website at: https://www.mvs.usace.army.mil/Portals/54/docs/pm/Reports/EA/Cap1135ClarenceCannonDamFREA.pdf and a letter will be sent to interested members of the public identifying where to find the report, how to provide comments, and the date of the public meeting/open house to be held. Comments received during public review will be incorporated into the report where appropriate prior to finalizing design in Appendix A – Environmental Compliance and Coordination.

8.3 Implementation Responsibilities

This section discusses the implementation responsibilities for MDC (NFS) and USACE. The responsibility for plan implementation and construction falls to USACE. MDC would be responsible for OMRR&R related to the raising of the TCW. Performance evaluation is a USACE responsibility and can be found in Appendix D - Monitoring and Adaptive Management.

A MOA is the formal agreement that would be entered into separately by USACE and MDC before implementation of the project. The MOAs describe obligations for constructing, operation, and maintaining the implemented features of the project. The feasibility phase of the project is 50% federally funded and 50% NFS funded. OMRR&R is the responsibility of the sponsors managing the lands per WRDA 1992.

8.3.1 US Army Corps of Engineers

USACE is responsible for study management and coordination with MDC and other affected agencies. USACE will submit the feasibility report; program funds; finalize plans and specifications; complete all NEPA requirements; advertise and award a construction contract; and perform construction contract supervision and administration. USACE has agreed to continue monitoring and data collection as part of MAM.

8.3.2 Missouri Department of Conservation

MDC is the NFS and has actively participated in the planning process, providing technical expertise, data and detailed suggestions and input at every step of the process. The NFS is in support of implementation of Alternative 8a: Raise TCW to 585 as the TSP. Operations and Maintenance is the responsibility of MDC in accordance with WRDA 1992, Public Law 102-580. Annual OMRR&R costs are estimated at $46,000 per year. USACE will further specify activities in the project O&M Manual, which will be provided after construction completion of a functional portion of the project or separable element, as determined by the District Engineer to MDC as discussed in ER 1110-2-401.

Repair, rehabilitation and replacement considerations may extend outside of the typical 50-year period of analysis, as MDC is expected to maintain the project as outlined in the MOA. Rehabilitation cannot be accurately measured during design phase or construction stages. Rehabilitation is the reconstructive work that significantly exceeds the annual O&M requirements and is needed as a result of major storms or flood events. MDC has signed a FCSA indicating the agency’s willingness to proceed with the TSP through to the next phase and participate as the cost share sponsor throughout Design and Implementation of this project and assume OMRR&R responsibilities once the project is constructed and considered complete.

9 RECOMMENDATION

The TSP is Alternative 8a: Raise TCW (585), which consists of placement of additional rock on top of the existing TCW.

The estimated project first cost at the FY26 price level is $17,431,000. Upon completion, the NFS is responsible for OMRR&R at an estimated annual cost of $29,000.

The NFS will, through signing of the FCSA, agree to perform the required items of cooperation including the following:

- Contribute the non-federal share of construction costs, as follows:
    - Provide all real property interests and relocations required for construction, operation, and maintenance of the project
    - Provide any in-kind contributions
    - Provide any remaining cash contribution after consideration of the value of real property interests and relocations, and in-kind contributions
- Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) that might hinder operation and maintenance of the project or interfere with the project's proper function
- Operate, maintain, repair, rehabilitate, and replace the project or functional portion thereof at no cost to the federal government, in a manner compatible with the project's authorized purposes and in accordance with applicable federal laws and regulations and any specific directions prescribed by the federal government
- Hold and save the federal government free from all damages arising from design, construction, operation, maintenance, repair, rehabilitation, and replacement of the project, except for damages due to the fault or negligence of the federal government or its contractors.

I have weighed the outputs to be obtained from the full implementation of the CAP 1135 Clarence Cannon Dam proposed project against its estimated cost and have considered the various alternatives proposed, impacts identified, and overall scope. I recommend that the CAP 1135 Clarence Cannon Dam proposed project be implemented as generally described in this report.

The recommendations contained herein reflect the information available at this time and current department policies governing formulation of individual projects under Section 1135 of the Continuing Authorities Program. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works projects nor the perspective of higher review levels within the Executive Branch.

_____ _____

Date

ANDY J. PANNIER
COL, EN
Commanding

10 LITERATURE CITED

Explore Mark Twain Lake.2025. https://exploremarktwainlake.com/

Hall, J. S. 1962. A life history and taxonomic study of the Indiana bat, Myotis sodalis. Reading Public Museum and Art Gallery Science Publication, 12, 3-68.

Henning, D. (1975). *Archaeological Site form, Site 23RA303.* Jefferson City, MO: On file with Missouri Department of Natural Resources, State Historic Preservation Office.

McCain, K., Schmueker, S., & De Jager, N. (2018). Habit Needs Assessment II for the Upper Mississippi River Restoration Program: Linking Science to Management Perspectives. U.S. Army Corps of Engineers, Rock Island, IL.

MDC, M. D. (2020). Missouri Comprehensive Conservation Strategy.

NOAA. (2022). *Missouri State Climate Summary.* NOAA National Centers for Environmental Information.

Sparks, R. (1995). Need for Ecosystem Management of Large Rivers and Their Floodplains. BioScience. 45(3), 168-182.

Sparks, R. N. (1998). *Naturalization of the Flood Regime in Regulated Rivers: the Case of the Upper Mississippi River. BioScience. 48(9), 706-720.*

U.S. Army Corps of Engineers (USACE). 2025. Clarence Cannon and Mark Twain Lake, Salt River Missouri, Master Plan 2025, 158pp.

U.S. Census Bureau. 2025. Monroe County, Missouri https://data.census.gov/profile/Monroe_County,_Missouri?g=050XX00US29137

U.S. Census Bureau. 2025. Ralls County, Missouri https://data.census.gov/profile/Ralls_County,_Missouri?g=050XX00US29173

U.S. Environmental Protection Agency (USEPA).2025. https://www.epa.gov/criteria-air-pollutants/naaqs-table

USDA Web Soil Survey (2025) Natural Resources Conservation Service https://websoilsurvey.sc.egov.usda.gov/App/

U.S. Environmental Protection Agency (USEPA).2025. https://www.epa.gov/criteria-airpollutants/naaqs-table

U.S. Fish and Wildlife Service (USFWS).2025. Gray Bat. Wetlands Mapper. https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/ (Accessed 17 November 2025).

U.S. Fish and Wildlife Service (USFWS).2025a. Gray Bat. Environmental Conservation Online System Overview https://ecos.fws.gov/ecp/species/6329

U.S. Fish and Wildlife Service (USFWS).2025b. Indiana Bat. Environmental Conservation Online System Overview https://www.fws.gov/species/indiana-bat-myotis-sodalis

U.S. Fish and Wildlife Service (USFWS).2025c. Northen Long-Eared Bat. Environmental Conservation Online System Overview http://ecos.fws.gov/ecp/species/9045

U.S. Fish and Wildlife Service (USFWS).2025d. Tricolored Bat. Environmental Conservation Online System Overview https://ecos.fws.gov/ecp/species/10515

U.S. Fish and Wildlife Service (USFWS).2025e. Monarch Butterfly. Environmental Conservation Online System Overview https://ecos.fws.gov/ecp/species/9743

U.S. Fish and Wildlife Service (USFWS).2025f. Wester Regal Fritillary. Environmental Conservation Online System Overview https://ecos.fws.gov/ecp/species/12017

U.S. Fish and Wildlife Service (USFWS).2025g. Little Brown Bat. Environmental Conservation Online System Overview https://ecos.fws.gov/ecp/species/9051

11 LIST OF REPORT PREPARERS

Name	Discipline/Role	Years of USACE Experience
Abby Hoyt	Project Manager	10
Matt Jones	CAP Program Manager	10
Hannah Caudill	Plan Formulation	2
Natalia Ramírez Irizarry	Environmental	3
Liam Wallace	H&H; Water Control	6
Keelan Vaughn	Civil Engineer	3
Clare Kreitzman	GIS	11
Deion McCray	Real Estate	1
Ben Greeling	Environmental Quality Engineering Technical Lead	16
Evan Stewart	Economics	14
Ryan Holland	Cost Engineer	7
Heather LeCroix	Geotechnical	3
Meredith Trautt	Cultural Resources	21
Allen Mehrer	Operations	35
Timothy Eash	Operations	18
Declan Tajkowski	Mechanical Engineer	3
Nicholas Colburn	Electrical Engineer	4
Aleris Castañer-Rodríguez	Structural Engineer	15

Continuing Authorities Program (CAP) 1135

Clarence Cannon Dam at Mark Twain Lake

Appendix A: Environmental Compliance and Coordination

St. Louis District
Project Sponsor: Missouri Department of Conservation
February 2026

List of Recipients

Caddo Nation of Oklahoma

Citizen Potawatomi Nation, Oklahoma

Eastern Shawnee Tribe of Oklahoma

Forest County Potawatomi Community, Wisconsin

Hannahville Indian Community, Michigan

Ho-Chunk Nation of Wisconsin

Iowa Tribe of Kansas and Nebraska

Iowa Tribe of Oklahoma

Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas

Kickapoo Tribe of Oklahoma

Miami Tribe of Oklahoma

The Osage Nation

Peoria Tribe of Indians of Oklahoma

Prairie Band Potawatomi Nation

Sac & Fox Nation of Missouri in Kansas and Nebraska

Sac & Fox Nation, Oklahoma

Sac & Fox Tribe of the Mississippi in Iowa

United Keetoowah Band of Cherokee of Oklahoma

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Missouri Ecological Services Field Office
101 Park Deville Drive
Suite A
Columbia, MO 65203-0057
Phone: (573) 234-2132 Fax: (573) 234-2181

In Reply Refer To: 01/26/2026 18:07:03 UTC
Project Code: 2025-0025099
Project Name: CAP 1135- Clarence Cannon Dam & Mark Twain Lake, MO

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

Threatened and Endangered Species

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and may be affected by your proposed project. The species list fulfills the requirement for obtaining a Technical Assistance Letter from the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).
New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. **Note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days.** The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the IPaC system by completing the same process used to receive the enclosed list.

Consultation Technical Assistance

Refer to the Midwest Region S7 Technical Assistance website for step-by-step instructions for making species determinations and for specific guidance on the following types of projects: projects in developed areas, HUD, pipelines, buried utilities, telecommunications, and requests

for a Conditional Letter of Map Revision (CLOMR) from FEMA. Please contact the appropriate POC at Missouri Ecological Services for any additional consultation needs.

Federally Listed Bat Species

Indiana bats, gray bats, and northern long-eared bats occur throughout Missouri and the information below may help in determining if your project may affect these species.

Gray bats - Gray bats roost in caves or mines year-round and use water features and forested riparian corridors for foraging and travel. If your project will impact caves, mines, associated riparian areas, or will involve tree removal around these features – particularly within stream corridors, riparian areas, or associated upland woodlots –gray bats could be affected.
Indiana and northern long-eared bats - These species hibernate in caves or mines only during the winter. In Missouri the inactive season is considered to be October 15 to March 31 unless the project is located within a 1/2 mile of a hibernacula. During the active season in Missouri they roost in forest and woodland habitats. Suitable summer habitat for Indiana bats and northern long-eared bats consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may also include some adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields and pastures. This includes forests and woodlots containing potential roosts (i.e., live trees and/or snags ≥5 inches diameter at breast height (dbh) for Indiana bat, and ≥3 inches dbh for northern long-eared bat, that have exfoliating bark, cracks, crevices, and/or hollows), as well as linear features such as fencerows, riparian forests, and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Tree species often include, but are not limited to, shellbark or shagbark hickory, white oak, cottonwood, and maple. Individual trees may be considered suitable habitat when they exhibit the characteristics of a potential roost tree and are located within 1,000 feet (305 meters) of other forested/wooded habitat. Northern long-eared bats have also been observed roosting in human-made structures, such as buildings, barns, bridges, and bat houses; therefore, these structures should also be considered potential summer habitat and evaluated for use by bats. If your project will impact caves or mines or will involve clearing forest or woodland habitat containing suitable roosting habitat, Indiana bats or northern long-eared bats could be affected.
Examples of unsuitable habitat include:

- Individual trees that are greater than 1,000 feet from forested or wooded areas;
- Trees found in highly-developed urban areas (e.g., street trees, downtown areas);
- A pure stand of less than 3-inch dbh trees that are not mixed with larger trees; and
- A stand of eastern red cedar shrubby vegetation with no potential roost trees.

Using the IPaC Official Species List to Make No Effect and May Affect Determinations for Listed Species

1. If IPaC returns a result of “There are no listed species found within the vicinity of the project,” then project proponents can conclude the proposed activities will have **no effect** on any federally listed species under Service jurisdiction. Concurrence from the Service is not required for **No Effect** determinations. No further consultation or coordination is required. Attach this letter to the dated IPaC species list report for your records. An example "No Effect" document also can be found on the S7 Technical Assistance website.

2. If IPaC returns one or more federally listed, proposed, or candidate species as potentially present in the action area of the proposed project – other than bats (see #3 below) – then project proponents can conclude the proposed activities **may affect** those species. For assistance in determining if suitable habitat for listed, candidate, or proposed species occurs within your project area or if species may be affected by project activities, you can obtain Life History Information for Listed and Candidate Species through the Species website.
3. If IPac returns a result that one or more federally listed bat species (Indiana bat, northern long-eared bat, or gray bat) are potentially present in the action area of the proposed project, project proponents can conclude the proposed activities **may affect** these bat species **IF** one or more of the following activities are proposed:
    a. Clearing or disturbing suitable roosting habitat, as defined above, at any time of year;
    b. Any activity in or near the entrance to a cave or mine;
    c. Mining, deep excavation, or underground work within 0.5 miles of a cave or mine;
    d. Construction of one or more wind turbines; or
    e. Demolition or reconstruction of human-made structures that are known to be used by bats based on observations of roosting bats, bats emerging at dusk, or guano deposits or stains.

If none of the above activities are proposed, project proponents can conclude the proposed activities will have **no effect** on listed bat species. Concurrence from the Service is not required for **No Effect** determinations. No further consultation or coordination is required. Attach this letter to the dated IPaC species list report for your records. An example "No Effect" document also can be found on the S7 Technical Assistance website.
If any of the above activities are proposed in areas where one or more bat species may be present, project proponents can conclude the proposed activities **may affect** one or more bat species. We recommend coordinating with the Service as early as possible during project planning. If your project will involve removal of over 5 acres of suitable forest or woodland habitat, we recommend you complete a Summer Habitat Assessment prior to contacting our office to expedite the consultation process. The Summer Habitat Assessment Form is available in Appendix A of the most recent version of the Range-wide Indiana Bat Summer Survey Guidelines.

Other Trust Resources and Activities

Bald and Golden Eagles - Although the bald eagle has been removed from the endangered species list, this species and the golden eagle are protected by the Bald and Golden Eagle Act and the Migratory Bird Treaty Act. Should bald or golden eagles occur within or near the project area please contact our office for further coordination. For communication and wind energy projects, please refer to additional guidelines below.

Migratory Birds - The Migratory Bird Treaty Act (MBTA) prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Service. The Service has the responsibility under the MBTA

to proactively prevent the mortality of migratory birds whenever possible and we encourage implementation of recommendations that minimize potential impacts to migratory birds. Such measures include clearing forested habitat outside the nesting season (generally March 1 to August 31) or conducting nest surveys prior to clearing to avoid injury to eggs or nestlings.

Communication Towers - Construction of new communications towers (including radio, television, cellular, and microwave) creates a potentially significant impact on migratory birds, especially some 350 species of night-migrating birds. However, the Service has developed voluntary guidelines for minimizing impacts.

Transmission Lines - Migratory birds, especially large species with long wingspans, heavy bodies, and poor maneuverability can also collide with power lines. In addition, mortality can occur when birds, particularly hawks, eagles, kites, falcons, and owls, attempt to perch on uninsulated or unguarded power poles. To minimize these risks, please refer to guidelines developed by the Avian Power Line Interaction Committee and the Service. Implementation of these measures is especially important along sections of lines adjacent to wetlands or other areas that support large numbers of raptors and migratory birds.

Wind Energy - To minimize impacts to migratory birds and bats, wind energy projects should follow the Service's Wind Energy Guidelines. In addition, please refer to the Service's Eagle Conservation Plan Guidance, which provides guidance for conserving bald and golden eagles in the course of siting, constructing, and operating wind energy facilities.

Next Steps

Should you determine that project activities **may affect** any federally listed species or trust resources described herein, please contact our office for further coordination. Letters with requests for consultation or correspondence about your project should include the Consultation Tracking Number in the header. Electronic submission is preferred.

If you have not already done so, please contact the Missouri Department of Conservation (Policy Coordination, P. O. Box 180, Jefferson City, MO 65102) for information concerning Missouri Natural Communities and Species of Conservation Concern.
We appreciate your concern for threatened and endangered species. Please feel free to contact our office with questions or for additional information.

John Weber

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Missouri Ecological Services Field Office
101 Park Deville Drive
Suite A
Columbia, MO 65203-0057
(573) 234-2132

PROJECT SUMMARY

Project Code: 2025-0025099

Project Name: CAP 1135- Clarence Cannon Dam & Mark Twain Lake, MO

Project Type: Restoration / Enhancement of Waterbody

Project Description: Mark Twain Lake is located in northeastern Missouri on the Salt River Basin on the Salt River. Clarence Cannon Dam and the Re-regulation dam are located in Ralls County at Salt River miles 63.0 and 53.5, respectively, upstream from the confluence with the Mississippi River.
Low dissolved oxygen (DO) concentration in the re-regulation pool caused by lake water with low oxygen moving through the turbines has been a long term, significant water quality concern at Clarence Cannon Dam.

Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@39.545419100000004,-91.60053923932243,14z

Counties: Ralls County, Missouri

ENDANGERED SPECIES ACT SPECIES

There is a total of 6 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

---

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Gray Bat *Myotis grisescens* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6329 General project design guidelines: https://ipac.ecosphere.fws.gov/project/TJRBANT5B5CRPLOGSSN3CK3GNI/documents/generated/9456.pdf	Endangered
Indiana Bat *Myotis sodalis* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/5949 General project design guidelines: https://ipac.ecosphere.fws.gov/project/TJRBANT5B5CRPLOGSSN3CK3GNI/documents/generated/9456.pdf	Endangered
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045 General project design guidelines: https://ipac.ecosphere.fws.gov/project/TJRBANT5B5CRPLOGSSN3CK3GNI/documents/generated/9456.pdf	Endangered
Tricolored Bat *Perimyotis subflavus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/10515 General project design guidelines: https://ipac.ecosphere.fws.gov/project/TJRBANT5B5CRPLOGSSN3CK3GNI/documents/generated/9456.pdf	Proposed Endangered

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/9743	Proposed Threatened
Western Regal Fritillary *Argynnis idalia occidentalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/12017	Proposed Threatened

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

IPAC USER CONTACT INFORMATION

Agency: Army Corps of Engineers
Name: Natalia Ramirez Irizarry
Address: US Army Corps of Engineers 1222 Spruce St
City: Saint Louis
State: MO
Zip: 63103
Email natalia.i.ramirezirizarry@usace.army.mil
Phone: 7875190759

From:	Weber, John S
To:	Ramirez Irizarry, Natalia I CIV USARMY CEMVP (USA)
Cc:	Pherigo, Emily K; Hundley, Joshua (Josh)
Subject:	[Non-DoD Source] Re: [EXTERNAL] Requesting FWCA: CAP 1135 - Clarence Cannon Dam
Date:	Monday, September 22, 2025 9:21:19 AM
Attachments:	Outlook-aspcl2sx.png

Hello Natalia,

Thanks so much for reaching out. Mr. Josh Hundley will handle this consultation for the USACE and is cc'ed here.

Best,

John Weber
Field Supervisor
U.S. Fish & Wildlife Service
Missouri Ecological Services Field Office
Cell: 573-825-6048

From: Ramirez Irizarry, Natalia I CIV USARMY CEMVP (USA) <Natalia.I.RamirezIrizarry@usace.army.mil>
Sent: Wednesday, September 17, 2025 2:56 PM
To: Weber, John S <John_S_Weber@fws.gov>
Subject: [EXTERNAL] Requesting FWCA: CAP 1135 - Clarence Cannon Dam

This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.

Good afternoon John!

The U.S. Army Corps of Engineers, St. Louis District is requesting consultation and coordination from Fish and Wildlife on the Continuing Authorities Program (CAP) 1135 Clarence Cannon Dam at Mark Twain Lake (see image below). The recurring issue the PDT is aiming to address is the fish mortality below Clarence Canon Dam as result of low dissolved oxygen (DO).

Purpose and Need:

Low DO concentrations in the re-regulation pool caused by poorly oxygenated water moving through the turbines during operation has been a long-term, significant concern at Clarence Cannon Dam. A DO concentration of 5mg/L is generally considered the minimum threshold to sustain freshwater fish populations. Concentrations at or below 5 mg/L often occur during the summer months in the tailwater and throughout the re-regulation pool, causing stress to aquatic organisms and often leading to fish mortality. The MDC has documented numerous mortality events over the years downstream of Clarence Cannon Dam. Summary reports from MDC going back to 1994 show approximately 28,000 fish (crappie, walleye, largemouth bass, bluegill, catfish, carp, buffalo, gizzard shad, freshwater drum) have been killed as a direct result of poorly oxygenated water. The State of Missouri has requested evaluation of a long-term solution to address this issue.

Objective: Reduce regular occurrences of DO measuring below 5 mg/L to reduce stress on fish species & decrease frequency and size of kill events within the study area over the period of analysis.

A Habitat Benefit Workshop was held on August 14, 2025 using Bluegill HSI Model. The evaluation was conducted by a multi-agency team with participants from the USACE, MDC, as well as representatives from Missouri DNR, and Southwestern Power Administration (SWPA). After screening 11 alternatives, 12 measures were also screened as they were only associated with those alternatives. The study currently has three retained action alternatives:

		HSI Scores						
#	**Alternatives**	**0 yr**	**5 yrs**	**10 yrs**	**25 yrs**	**50 yrs**	**AAHUs**	**AAHUs Gained, Full Re-reg Pool** (370 acres)
	No Action (FWOP)	0.40	0.40	0.40	0.00	0.00	4.06	-
1	**Temperature Curtains**	0.40	0.65	0.32	0.00	0.00	4.32	+3.33
8	**Raising Temperature Control Weir**	0.40	0.65	0.64	0.00	0.00	6.18	+27.01
9	**Gated Selected Withdrawal System**	0.40	0.67	0.66	0.00	0.00	6.35	+29.23

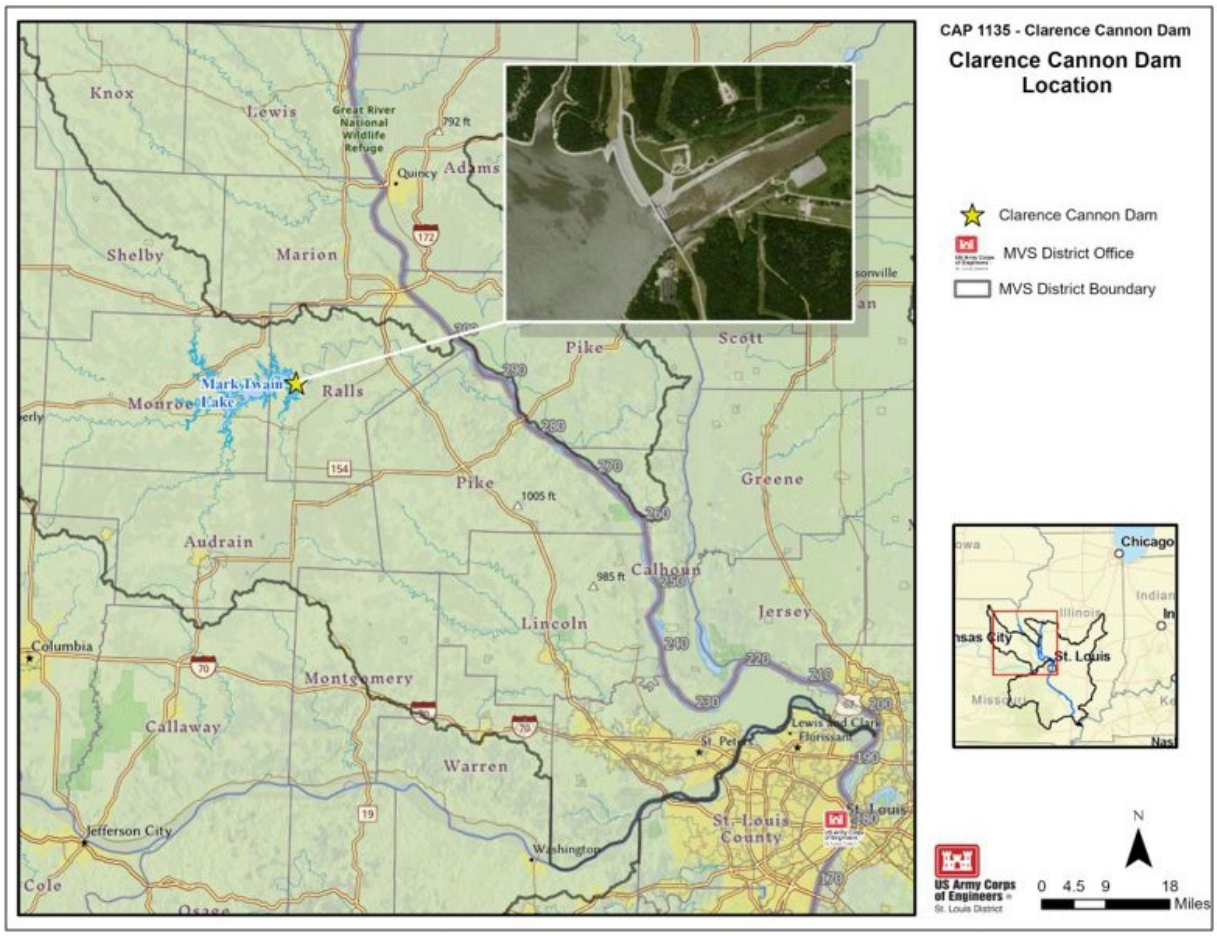
We would like to schedule a meeting between USACE, USFWS, and MDC to talk about the project, alternatives, and other general coordination actions needed in the future.

Milestone/Event:

1. **Tentatively Selected Plan Milestone**: 10 December 2025
2. **Public Review**: 10 February 2026
3. **Final Report Approval**: 16 October 2026

Please let me know if you have any question or if you need additional information. Contact me at the Environmental Compliance Section at (314)331-8033 or natalia.i.ramirezirizarry@usace.army.mil.

Thank you for your time,
Natalia



Natalia I. Ramírez Irizarry
Biologist
Regional Planning and Environmental Division-North
St. Louis District
U.S. Army Corps of Engineers

1222 Spruce St
Saint Louis, MO 63103

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Missouri Ecological Services Field Office
101 Park DeVille Drive, Suite A
Columbia, Missouri 65203-0057
Phone: (573) 234-2132 Fax: (573) 234-2181

January 29, 2026

Natalia Ramirez Irizarry
U.S. Army Corps of Engineers
1222 Spruce Street
St. Louis, MO 63103

RE: Clarence Cannon Dam CAP 1135

Dear Ms. Ramirez Irizarry:

Thank you for your January 22, 2026, email providing the updated information regarding the CAP 1135 Project at Clarence Cannon Dam, Mark Twain Lake, Missouri. The U.S. Fish and Wildlife Service (Service) has reviewed the information provided and offers the following comments under the authority of the Fish and Wildlife Coordination Act (FWCA, 16 U.S.C. 661 et seq.).

Low dissolved oxygen (DO) concentrations in the re-regulation pool caused by poorly oxygenated water moving through the turbines during operation has been a long-term, significant concern at Clarence Cannon Dam. Occurrences of low DO have caused stress to aquatic organisms and fish mortality over the years. The proposed project will help reduce the occurrence of low DO, therefore reducing the stress and mortality on aquatic organisms below the dam. Alternative 8a (Raise the Temperature Control Weir to 585 feet) was selected as the Tentative Selected Plan (TSP). The TSP aims to reduce low DO occurrences by raising the temperature control weir in Mark Twain Lake just above Clarence Cannon Dam to 585 feet.

The Service supports increasing the DO within the Salt River below Clarence Cannon Dam and supports the selection of Alternative 8a. Increasing DO in the system will have positive impacts to many aquatic organisms.

To help minimize impacts to species and habitats, the Service recommends:

- Continuing to involve the Missouri Department of Conservation (MDC) and incorporate any comments or recommendations they have;
- Using MDCs Best Management Practices (BMPs) for Construction and Development Projects Affecting Missouri Rivers and Streams (https://mdc.mo.gov/sites/default/files/2022-10/202209_Streams.pdf);
- Reducing turbidity that will enter the riverine system during construction; and

- Clearing trees during the bat inactive season (November 1 to March 31).

Thank you for the opportunity to review the CAP 1135 Project at Clarence Cannon Dam. Please let us know if there is any way we can help support USACE planning efforts. If you need any additional information or have questions on our response, please feel free to contact Josh Hundley at (573) 540-3829 or joshua_hundley@fws.gov.

Sincerely,

EMILY PHERIGO

Digitally signed by EMILY PHERIGO
Date: 2026.01.29 16:29:32 -06'00'

Emily Pherigo
Deputy/Acting Field Supervisor
Missouri Ecological Services Field Office
US Fish and Wildlife Service
office: 573-306-5864
cell: 573-864-5185
e-mail: emily_pherigo@fws.gov

Missouri Department of Conservation

Missouri Department of Conservation's Mission is to protect and manage the forest, fish, and wildlife resources of the state and to facilitate and provide opportunities for all citizens to use, enjoy and learn about these resources.

Natural Heritage Review Level Three Report: Species Listed Under the Federal Endangered Species Act

There are records of species listed under the Federal Endangered Species Act, and possibly also records for species listed Endangered by the state, or Missouri Species and/or Natural Communities of Conservation Concern within or near the the defined Project Area. Please contact the U.S. Fish and Wildlife Service and the Missouri Department of Conservation for further coordination.

Foreword: Thank you for accessing the Missouri Natural Heritage Review Website developed by the Missouri Department of Conservation with assistance from the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, Missouri Department of Transportation and NatureServe. The purpose of this report is to provide information to federal, state and local agencies, organizations, municipalities, corporations, and consultants regarding sensitive fish, wildlife, plants, natural communities, and habitats to assist in planning, designing, and permitting stages of projects.

PROJECT INFORMATION

Project Name and ID Number: Continuing Authorities Program (CAP) 1135 Clarence Cannon Dam at Mark Twain Lake #18457
Project Description: S26, T55N, R7W, 5th Principal Meridian, 39.5288, -91.5284; Clarence Cannon Dam at Mark Twain Lake and Re-regulation pool are located in Ralls County at Salt River miles 63.0 and 53.5 Low dissolved oxygen (DO) concentration in the re-regulation pool caused by lake water with low oxygen moving through the turbines has been a long term, significant water quality concern at Clarence Cannon Dam. I define the area of interest from the Clarence Cannon Dam to mixing point. However, at the Bluegill HSI Model ~370 acres of aquatic habitat were used has a project area, includes the full reregulation pool from Clarence Cannon Dam.
Project Type: Habitat Conservation and Restoration, In-stream habitat restoration (habitat improvement structures)
Contact Person: Natalia Ramirez Irizarry
Contact Information: natalia.i.ramirezirizarry@usace.army.mil or 7875190759

PRELIMINARY REPORT

Disclaimer: This NATURAL HERITAGE REVIEW REPORT identifies if a species or natural community tracked by the Natural Heritage Program is known to occur within or near the project area submitted, and shares recommendations to avoid or minimize project impacts to sensitive species or natural habitats. Incorporating information from the Natural Heritage Program into project plans is an important step in reducing impacts to Missouri's sensitive natural resources. If an occurrence record is present, or the proposed project might affect federally listed species, the user must contact the Department of Conservation or U.S. Fish and Wildlife Service for more information.

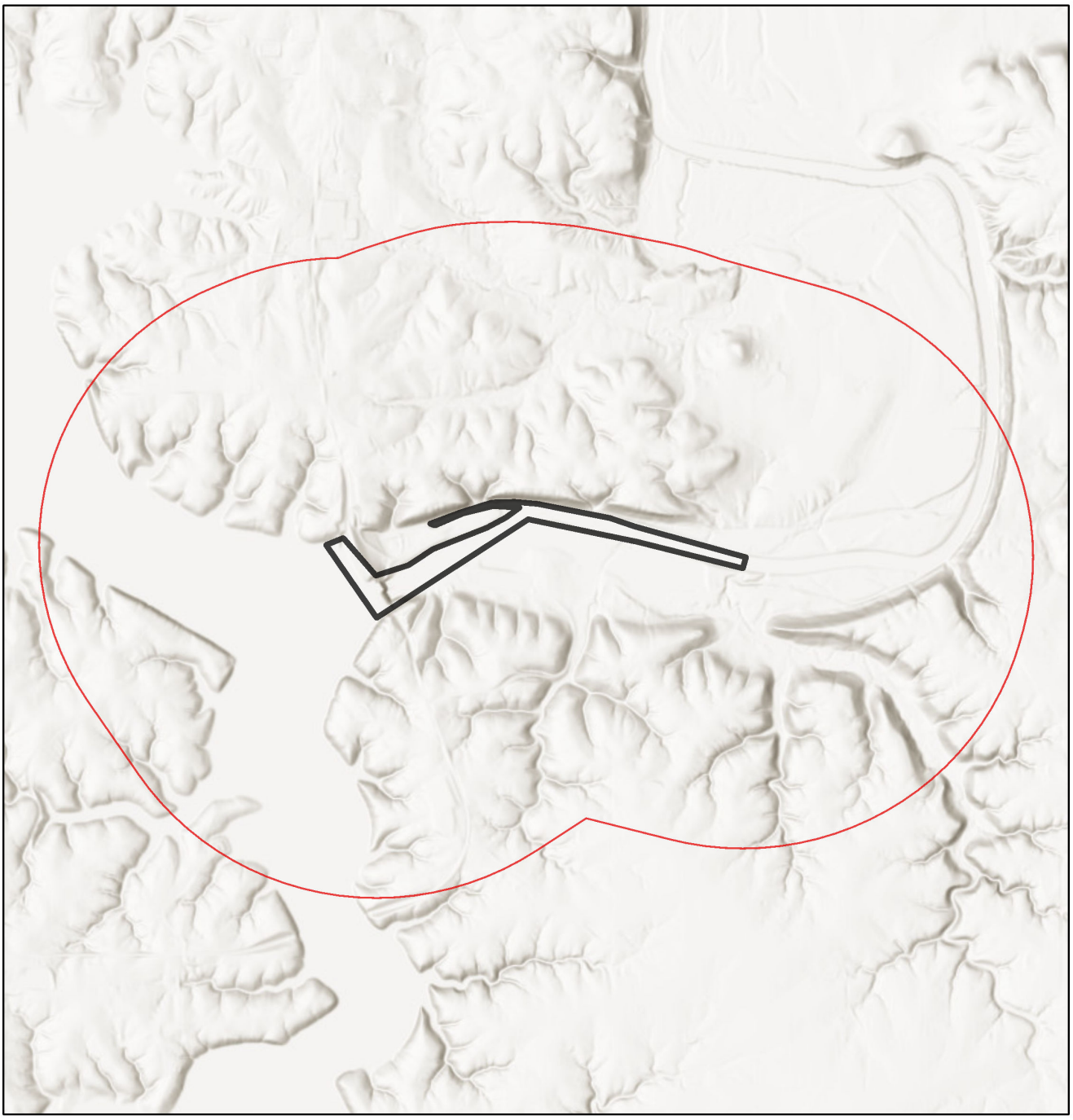
This Natural Heritage Review Report is not a site clearance letter for the project. Rather, it identifies public lands and records of sensitive resources located close to and/or potentially affected by the proposed project. If project plans or location change, this report may no longer be valid. Because land use conditions change and animals move, the existence of an occurrence record does not mean the species/habitat is still present. Therefore, reports include information about records near but not necessarily on the project site. Lack of an occurrence record does not mean that a sensitive species or natural community is not present on or near the project area. On-site verification is the responsibility of the project. However, the Natural Heritage Program is only one reference that should be used to evaluate potential adverse project impacts and additional information (e.g. wetland or soils maps, on-site inspections or surveys) should be considered. Reviewing current landscape and habitat information, and species' biological characteristics would additionally ensure that Missouri Species of Conservation Concern are appropriately identified and addressed in planning efforts.

U.S. Fish and Wildlife Service – Endangered Species Act (ESA) Coordination: Lack of a Natural Heritage Program occurrence record for federally listed species in your project area does not mean the species is not present, as the area may never have been surveyed. Presence of a Natural Heritage Program occurrence record does not mean the project will result in negative impacts. This report does not fulfill Endangered Species Act consultation with the U.S. Fish and Wildlife Service (USFWS) for listed species. Direct contact with the USFWS may be necessary to complete consultation and it is required for actions with a federal connection, such as federal funding or a federal permit; direct contact is also required if ESA concurrence is necessary. Visit IPaC: Home (fws.gov) to initiate USFWS Information for Planning and Conservation (IPaC) consultation. Contact the Columbia Missouri Ecological Field Services Office (573-234-2132, or by mail at 101 Park Deville Drive, Suite A, Columbia, MO 65203) for more information.

Transportation Projects: If the project involves the use of Federal Highway Administration transportation funds, these recommendations may not fulfill all contract requirements. Please contact the Missouri Department of Transportation at 573-526-4778 or visit Home Page | Missouri Department of Transportation (modot.org) for additional information on recommendations.

PRELIMINARY REPORT

inuing Authorities Program (CAP) 1135 Clarence Cannon Dam at Mark Twain



October 23, 2025

1:31,348

0 0.28 0.55 1.1 mi

0 0.42 0.85 1.7 km

Buffered Project Boundary

Project Boundary

Sources: Esri, Maxar, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap, and the GIS user community

Species or Communities of Conservation Concern within the Area:

There are records of species listed under the Federal Endangered Species Act, and possibly also records for species listed Endangered by the state, or Missouri Species and/or Natural Communities of Conservation Concern within or near the defined Project Area. Please contact the U.S. Fish and Wildlife Service and the Missouri Department of Conservation for further coordination.

Email (preferred): NaturalHeritageReview@mdc.mo.gov
MDC Natural Heritage Review
Science Branch
P.O. Box 180
Jefferson City, MO
65102-0180
Phone: 573-522-4115 ext. 3182

U.S. Fish and Wildlife Service
Ecological Service
101 Park Deville Drive
Suite A
Columbia, MO
65203-0007
Phone: 573-234-2132

Other Special Search Results:

The project occurs on or near public land, MARK TWAIN LAKE USACOE, please contact COE.

Project Type Recommendations:

No recommendations have been identified for this project type.

Project Location and/or Species Recommendations:

Endangered Species Act Coordination - If this project has the potential to alter habitat (e.g. tree removal, projects in karst habitat) or cause direct mortality of bats, please coordinate directly with U.S. Fish and Wildlife Service (Ecological Services, 101 Park Deville Drive, Suite A, Columbia, Missouri 65203-0007; Phone 573-234-2132 Ext. 100 for Ecological Services) for further coordination under the Endangered Species Act. Indiana bats *(Myotis sodalis*, federal- and state-listed endangered) and **Northern long-eared bats** (*Myotis septentrionalis,* federal-listed endangered) may occur near the project area. Both of these species of bats hibernate during winter months in caves and mines. During the summer months, they roost and raise young under the bark of trees in wooded areas, often riparian forests and upland forests near perennial streams. During project activities, avoid degrading stream quality and where possible leave snags standing and preserve mature forest canopy. Do not enter caves known to harbor Indiana bats or Northern long-eared bats, especially from September to April.

Bald Eagle: The project location submitted and evaluated is within the geographic range of nesting Bald Eagles in Missouri. Bald Eagles (*Haliaeetus leucocephalus*) may nest near streams or water bodies in the project area. Nests are large and fairly easy to identify. Adults begin nesting activity in late December and January and young birds leave the nest in late spring to early summer. While no longer listed as endangered, eagles continue to be protected by the federal government under the Bald and Golden Eagle Protection Act. Work managers should be alert for nesting areas within 1500 meters of project activities, and follow federal guidelines at: Do I need an eagle take permit? | U.S. Fish & Wildlife Service (fws.gov) if eagle nests are seen.

Gray Bat: The submitted project location is within the range of the Gray Myotis (i.e., Gray Bat) in Missouri. Depending on habitat conditions of your project's location, Gray Myotis (*Myotis grisescens*, federal and state-listed endangered) could occur within the project area, as they forage over streams, rivers, lakes, and reservoirs. Avoid entry or disturbance of any cave inhabited by Gray Myotis and when possible retain forest vegetation along the stream and from the cave opening to the stream. Please see Best Management Practices for Construction and Development Projects Gray bat (mo.gov).

PRELIMINARY REPORT

Karst: This county has known karst geologic features (e.g., caves, springs, and sinkholes, all characterized by subterranean water movement). Few karst features are recorded in Natural Heritage records, and ones not noted here may be encountered at the project site or affected by the project. Cave fauna (many of which are Species of Conservation Concern) are influenced by changes to water quality; please check your project site for any karst features and make every effort to protect groundwater in the project area. Additional information and specific recommendations are available at Management Recommendations for Construction and Development Projects Affecting Missouri Karst Habitat (mo.gov).

Invasive exotic species are a significant issue for fish, wildlife and agriculture in Missouri. Seeds, eggs, and larvae may be moved to new sites on boats or construction equipment. Please inspect and clean equipment thoroughly before moving between project sites. See Managing Invasive Species in Your Community | Missouri Department of Conservation (mo.gov) for more information.

- Remove any mud, soil, trash, plants or animals from equipment before leaving any water body or work area.
- Drain water from boats and machinery that have operated in water, checking motor cavities, live-well, bilge and transom wells, tracks, buckets, and any other water reservoirs.
- When possible, wash and rinse equipment thoroughly with hard spray or HOT water (>140° F, typically available at do-it-yourself car wash sites), and dry in the hot sun before using again.

Streams and Wetlands – Clean Water Act Permits: Streams and wetlands in the project area should be protected from activities that degrade habitat conditions. For example, soil erosion, water pollution, placement of fill, dredging, in-stream activities, and riparian corridor removal, can modify or diminish aquatic habitats. Streams and wetlands may be protected under the Clean Water Act and require a permit for any activities that result in fill or other modifications to the site. Conditions provided within the U.S. Army Corps of Engineers (USACE) Clean Water Act Section 404 permit (Kansas City District Regulatory Branch (army.mil)) and the Missouri Department of Natural Resources (DNR) issued Clean Water Act Section 401 Water Quality Certification (Section 401 Water Quality Certification | Missouri Department of Natural Resources (mo.gov)), if required, should help minimize impacts to the aquatic organisms and aquatic habitat within the area. Depending on your project type, additional permits may be required by the Missouri Department of Natural Resources, such as permits for stormwater, wastewater treatment facilities, and confined animal feeding operations. Visit Wastewater Permits | Missouri Department of Natural Resources (mo.gov) for more information on DNR permits. Visit both the USACE and DNR for more information on Clean Water Act permitting.

For further coordination with the Missouri Department of Conservation and the U.S. Fish and Wildlife Services, please see the contact information below:

Email (preferred): NaturalHeritageReview@mdc.mo.gov
MDC Natural Heritage Review
Science Branch
P.O. Box 180
Jefferson City, MO
65102-0180
Phone: 573-522-4115 ext. 3182

U.S. Fish and Wildlife Service
Ecological Service
101 Park Deville Drive
Suite A
Columbia, MO
65203-0007
Phone: 573-234-2132

Miscellaneous Information

FEDERAL Concerns are species/habitats protected under the Federal Endangered Species Act and that have been known near enough to the project site to warrant consideration. For these, project managers must contact the U.S. Fish and Wildlife Service Ecological Services (101 Park Deville Drive Suite A, Columbia, Missouri 65203-0007; Phone 573-234-2132; Fax 573-234-2181) for consultation.

STATE Concerns are species/habitats known to exist near enough to the project site to warrant concern and that are protected under the Wildlife Code of Missouri (RSMo 3 CSR 1 0). "State Endangered Status" is determined by the Missouri Conservation Commission under constitutional authority, with requirements expressed in the Missouri Wildlife Code, rule 3CSR 1 0-4.111. Species tracked by the Natural Heritage Program have a "State Rank" which is a numeric rank of relative rarity. Species tracked by this program and all native Missouri wildlife are protected under rule 3CSR 10-4.110 General Provisions of the Wildlife Code.

See Missouri Species and Communities of Conservation Concern Checklist (mo.gov) for a complete list of species and communities of conservation concern, and visit mdc.mo.gov/your-property/responsible-construction/species-impact-best-practices for all species-specific Best Management Practices. Detailed information about the animals and some plants mentioned may be accessed at Missouri Fish and Wildlife Information System (MOFWIS) and MDC Field Guides . Please contact the Missouri Department of Conservation to request printed copies of any materials linked in this document.

PRELIMINARY REPORT

Missouri Department of Conservation

Natural Heritage Review Report

November 11, 2025

Science Branch
P. O. Box 180
Jefferson City, MO 65102
Prepared by: Nina Fogel
NaturalHeritageReview@mdc.mo.gov
(573) 522 – 4115 ext. 3182

Natalia Ramirez Irizarry
U.S. Amy Corps of Engineers
Natalia.I.RamirezIrizarry@usace.army.mil

NHR ERT ID:	18457	**Automated Report Level:**	3
Project type:	Habitat Conservation and Restoration		
Location/Scope:	T55NR07WS23 - T55NR07WS26		
County:	Ralls		
Project Title:	Continuing Authorities Program (CAP) 1135 Clarence Cannon Dam at Mark Twain Lake		
Query received:	10/23/2025		

This report is not a site clearance letter. Rather, it identifies public lands and records of sensitive resources located close to and/or potentially affected by the proposed project. If the project plans or location changes, this report may no longer be valid. Because land use conditions change and organisms move, the existence of an occurrence record does not mean the species/habitat is still present. Therefore, reports include information about records near but not necessarily on the project site. Lack of an occurrence record does not mean that a sensitive species or natural community is not present on or near the project area. On-site verification is the responsibility of the project. These records serve as one reference and additional information (e.g. wetland or soils maps, on-site inspections or surveys) should be considered. Additional resources about the biological and habitat needs of species to avoid or minimize impacts can be found at the bottom of this report.

Level 3: Records of federal-listed (also state-listed) species or critical habitats near the project site:

Natural Heritage records identify no federal-designed critical habitats nor federal-listed species that are potentially impacted by the proposed project.

FEDERAL-LISTED species/habitats are protected under the Federal Endangered Species Act. Contact U.S. Fish & Wildlife Service (101 Park Deville Drive Suite A, Columbia, Missouri 65203; 573-234-2132 Ext. 100) for Endangered Species Act coordination and concurrence information.

Level 2: Records of state-listed (not federal-listed) endangered species AND / OR state-ranked (not state-listed endangered) species and natural communities of conservation concern. The Department tracks these species and natural communities due to population declines and/or apparent vulnerability.

Natural Heritage records identify the following state-ranked species that are potentially impacted by the proposed project:

Scientific Name	Common Name	State Rank	Proximity (miles)	Primary Habitat
Myotis lucifugus	Little Brown Myotis	S2	<3	Forest matrix, Cave, Habitat generalist

Bald eagles are known to occur within a mile of the project area.

- **Bald Eagles:** Bald Eagles (*Haliaeetus leucocephalus*) nest near streams or water bodies in the project area. Nests are large and fairly easy to identify. While no longer listed as endangered, eagles continue to be protected by the federal government under the Bald and Golden Eagle Protection Act. Work managers should be alert for nesting areas within 1500 meters of project activities, and follow federal guidelines at: Do I need an eagle take permit? | U.S. Fish & Wildlife Service (fws.gov) if eagle nests are seen.

Following USFWS Incidental Take Guidelines: To avoid the incidental take of bald eagles we recommend:

- a buffer of at least 660 feet between project activities and the nests (including active and inactive nests).
- If project activities are within 660 feet of the nest, please restrict activities to outside the nesting season. The nesting season in Missouri is January 1 – July 15.
- If these recommendations cannot be implemented, incidental take of bald eagles may occur and a permit from USFWS may be necessary.
- Do not clear nests or nest trees.

State Rank Definitions:

- **S1:** Critically imperiled in the state because of extreme rarity of or because of some factor(s) making it especially vulnerable to extirpation from the state. Typically, 5 or fewer occurrences or very few remaining individuals (<1,000).
- **S2:** Imperiled in the state because of rarity or because of some factor(s) making it very vulnerable to extirpation from the state (6 to 20 occurrences or few remaining individuals).
- **S3:** Vulnerable in the state either because rare and uncommon, or found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extirpation. Typically, 21 to 100 occurrences or between 3,000 and 10,000 individuals.
- **S4:** Uncommon but not rare, and usually widespread in the nation or state. Possible cause of long-term concern. Typically, more than 100 occurrences and more than 10,000 individuals.
- **S#S#:** Range Rank: A numeric range rank (e.g., S2S3) is used to indicate the range of uncertainty about the exact status.
- **S?:** Denotes inexact or uncertain numeric rank.
- **SU:** Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.

There are no regulatory requirements associated with state ranks, however we encourage voluntary stewardship to minimize the risk of further decline that could lead to state or federal listing.

STATE ENDANGERED species are protected under the Wildlife Code of Missouri (3CSR10-4.111). See the Missouri Species And Communities Of Conservation Concern Checklist for a complete list of species examined for this report.

General recommendations related to this project or site, or based on information about the historic range of species (unrelated to any specific Natural Heritage records):

- **Water Use, Transfer and Channel Activities:** Potential impacts to fish, forest and wildlife resources can be minimized or avoided by placing new lines in areas that have already been developed or disturbed, using existing utility line easements, or placing lines along existing roads. Maintenance activities that occur within the existing footprint of the water line are less likely to affect fish, forest, and wildlife resources. Following best management practices and Clean Water Act Permit conditions, if required, also help minimize potential for significant habitat effects. Stream and drainage crossings are concerns, and every effort should be made to avoid erosion, silt introduction, petroleum or chemical pollution, and disruption or realignment of stream banks and beds during maintenance activities. Please see Best Management Practices for Construction and Development Projects Affecting Missouri Rivers and Streams (mo.gov).
    - Revegetation is an important part of managing utility corridors and can have significant resource impacts depending on the techniques used. Revegetation of disturbed areas is recommended to minimize erosion; use native plant species compatible with the local landscape and wildlife needs. Annuals like ryegrass may be combined with native

perennials for quicker green-up. Avoid aggressive, exotic perennials such as crown vetch and *sericea lespedeza*. Maintenance of ground cover in utility corridors can have significant implications for sensitive resources. Native plant species typically require low maintenance over the long term, and provide more benefits to native wildlife. Utility corridors can provide wildlife travel corridors, food sources, and types of low-growing plant diversity sometimes rare in adjoining land. Mowing and maintenance schedules should consider nesting seasons, and diversity in plant composition.

- **Tri-colored Bats:** Tri-colored bats (*Perimyotis subflavus*, federally proposed endangered) are known to occur in Ralls County and could occur in the project area. In Missouri, most tri-colored bats hibernate in winter in the most humid and warm parts of caves. In summer, they roost in trees, in crannies about cliffs or buildings, in barns, or sometimes in high domes of caves. Tri-colored bats have been significantly impacted by White-nose syndrome. **Please contact U.S. Fish and Wildlife Service (Ecological Services, 101 Park Deville Drive, Suite A, Columbia, Missouri 65203-0007; Phone 573-234-2132 Ext. 100 for Ecological Services) for further coordination under the Endangered Species Act.**

- **Gray Bats:** Gray Bats (*Myotis grisescens*, federal and state-listed endangered) occur in Ralls County and could occur in the project area, as they forage over streams, rivers, and reservoirs. Avoid entry or disturbance of any cave inhabited by gray bats and when possible retain forest vegetation along the stream and from the gray bat cave opening to the stream. Please see Best Management Practices for Construction and Development Projects Gray bat (mo.gov).

- **Karst:** Ralls County has known karst geologic features (e.g. caves, springs, and sinkholes, all characterized by subterranean water movement). Few karst features are recorded in Natural Heritage records, and ones not noted here may be encountered at the project site or affected by the project. Cave fauna (many of which are species of conservation concern) are influenced by changes to water quality, so check your project site for any karst features and make every effort to protect groundwater in the project area. Please see Management Recommendations for Construction and Development Projects Affecting Missouri Karst Habitat (mo.gov).

- **Invasive exotic species:** These species are a significant issue for fish, wildlife and agriculture in Missouri. Seeds, eggs, larvae, and aquatic plant material may be moved on boats or construction equipment, so inspect and clean equipment thoroughly before moving between project sites.
  - Remove any mud, soil, trash, plants (or plant material) or animals from equipment before leaving any water body or work area.
  - Drain water from boats and machinery that has operated in water, checking motor cavities, live-well, bilge and transom wells, tracks, buckets, and any other water reservoirs.
  - When possible, wash and rinse equipment thoroughly with hard spray or HOT water (≥140° F, typically available at do-it-yourself carwash sites), and dry in the hot sun before using again.
  - Avoid planting invasive species including crown vetch and sericea lespedeza.

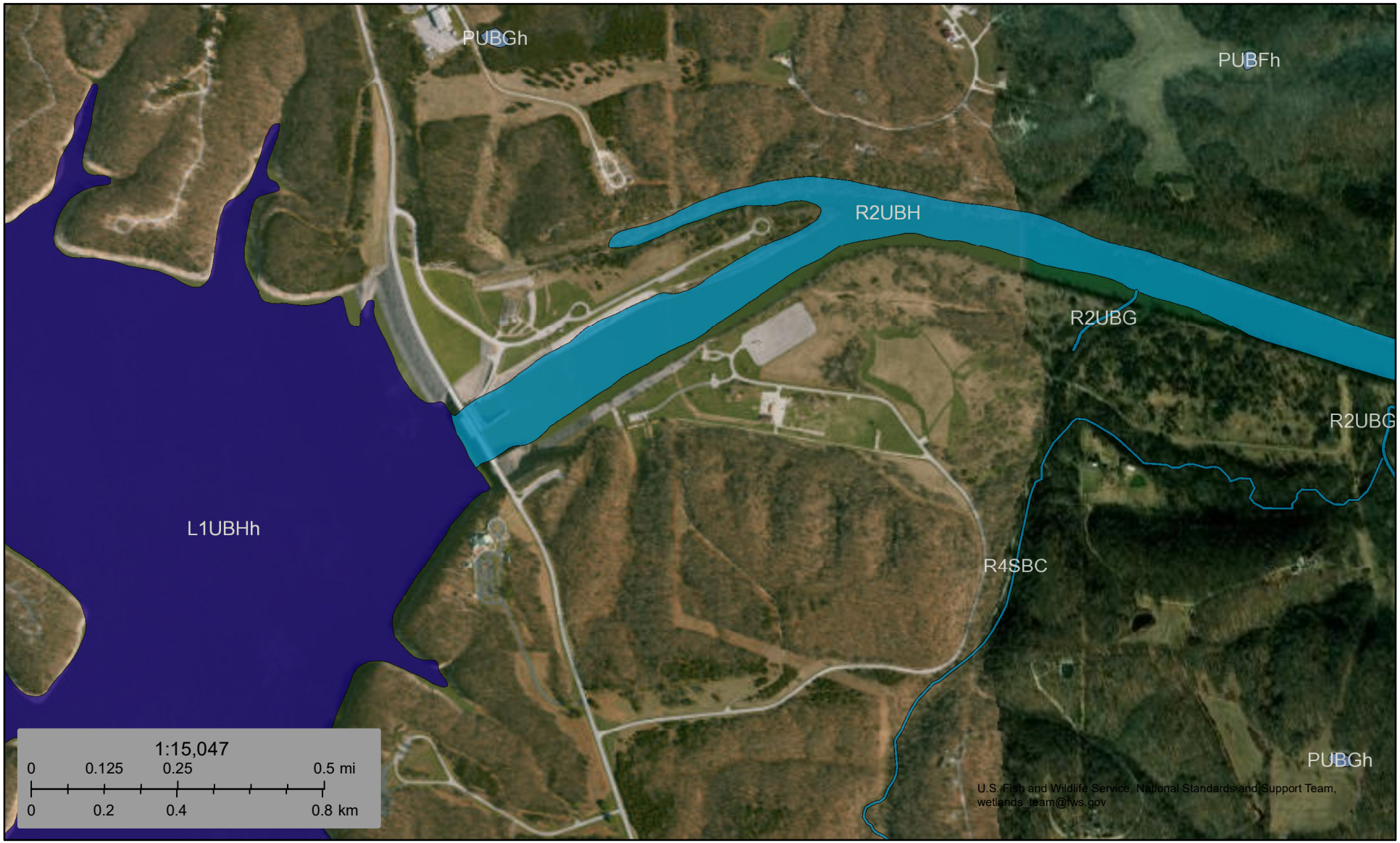
Additional information about the biological and habitat needs of species or elements to avoid or minimize impacts:

- Best Management Practices (BMPs) for species, karst, and streams, and information about the Missouri Natural Heritage Program: https://mdc.mo.gov/your-property/responsible-construction
- MDC Field Guides for species: https://mdc.mo.gov/discover-nature/field-guide
- MDC Terrestrial Natural Communities: https://mdc.mo.gov/discover-nature/habitats/statewide-habitat-systems/terrestrial-natural-communities
- Missouri Fish and Wildlife Information System (MOFWIS): https://mdc12.mdc.mo.gov/Applications/Mofwis

These recommendations are ones project managers might prudently consider based on a general understanding of species' needs and landscape conditions. Natural Heritage records largely reflect sites visited by specialists in the last 35 years. Many privately owned tracts have not been surveyed and could host remnants of species once but no longer common.

U.S. Fish and Wildlife Service
National Wetlands Inventory

CAP1135 Clarence Cannon Dam



November 17, 2025

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

National Flood Hazard Layer FIRMette

FEMA

91°38'58"W 39°31'42"N

91°38'21"W 39°31'15"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

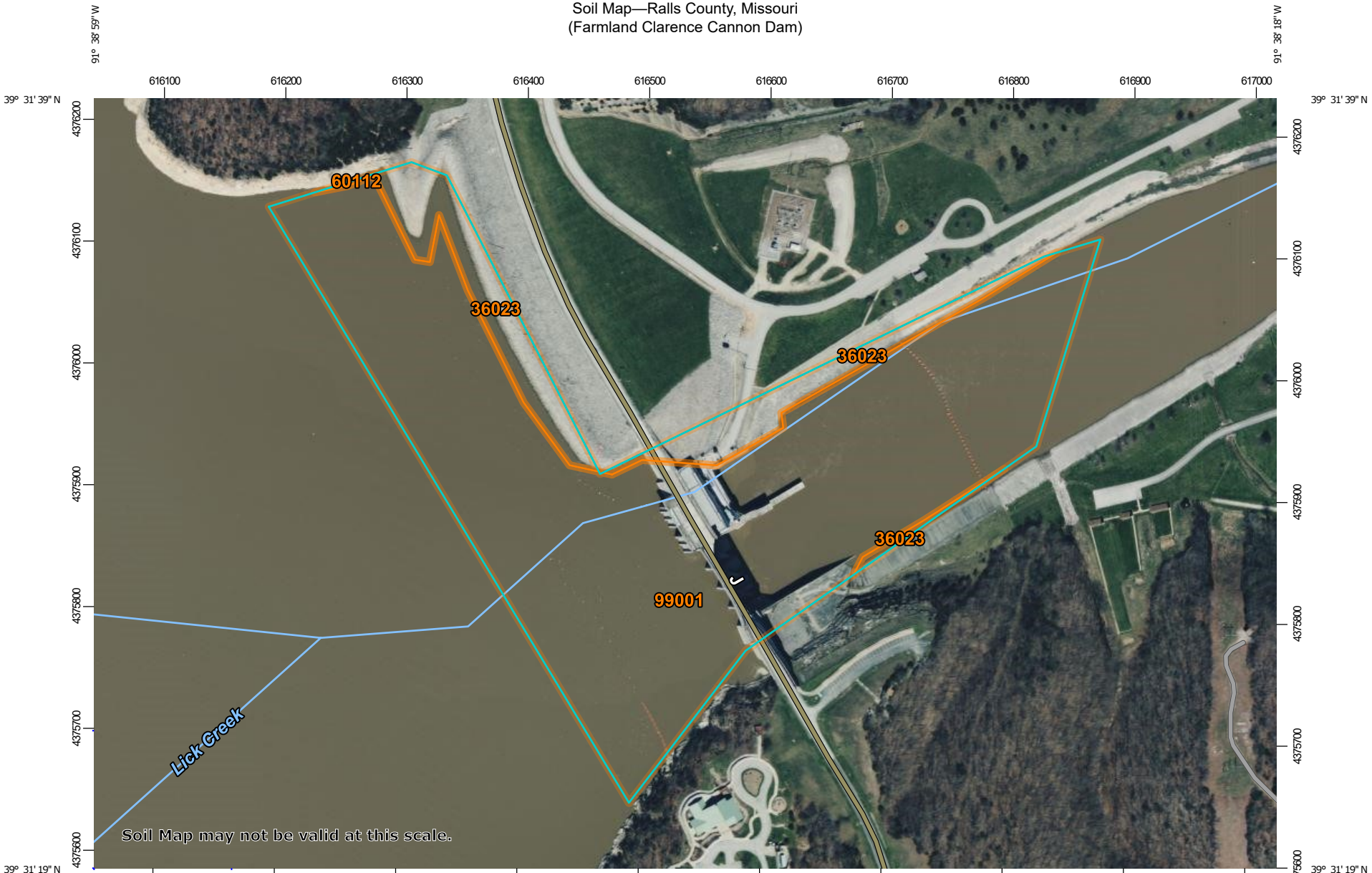
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/11/2026 at 6:32 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Soil Map—Ralls County, Missouri
(Farmland Clarence Cannon Dam)



Map Scale: 1:4,460 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Ralls County, Missouri
Survey Area Data: Version 28, Sep 2, 2025

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 8, 2020—Apr 26, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
36023	Landes fine sandy loam, 0 to 2 percent slopes, occasionally flooded	4.1	12.8%
60112	Goss very gravelly silt loam, 14 to 45 percent slopes	0.0	0.1%
99001	Water	27.8	87.1%
Totals for Area of Interest		**31.9**	**100.0%**

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, ST. LOUIS DISTRICT
1222 SPRUCE STREET
ST. LOUIS, MISSOURI 63103

January 21, 2026

Engineering and Construction Division
Curation and Archives Analysis Branch

Subject: CAP Clarence Cannon Dam, Mark Twain Lake, Ralls and Monroe Counties, Missouri

Mr. Blake Norton
Director Tribal Historic Preservation Office
Citizen Potawatomi Nation, Oklahoma
Cultural Heritage Center
1601 S. Gordon Cooper Drive
Shawnee, OK 74801

Dear Mr. Norton:

The U.S. Army Corps of Engineers (USACE), St. Louis District (District), in partnership with the Missouri Department of Conservation (MDC) is presently conducting a feasibility study with an integrated Environmental Assessment of low levels of dissolved oxygen (DO) within the water at Clarence Cannon Dam at Mark Twain Lake in Ralls and Monroe counties, Missouri (Figure 1). The study is authorized under the Continuing Authorities Program (CAP), Section 1135 of the Water Resources Act of 1986, as amended, which provides USACE the authority to modify existing USACE projects to restore the environment and construct new projects to restore areas degraded by USACE projects. The District is contacting your Tribe to initiate consultation under the National Environmental Policy Act (NEPA) and Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations 36 CFR 800.

Clarence Cannon Dam contains a hydroelectric power plant with two hydropower units (i.e., turbines), run by the Southwestern Power Administration. Located upstream of the dam is a temperature control weir (TCW) with a crest elevation of 580 feet. The re-regulation Dam, which impounds water for storage and allows for control of the volume and intensity of downstream release, is located 9.5 miles downstream of the Clarence Cannon Dam. Releases into the re-regulation pool is leading to low levels of DO within the water that causes fish mortality events and ecosystem disruption downstream of the dam. Low DO is partially driven by three-layered temperature stratification from late spring and early fall that occurs behind the TCW, with the upper layer containing highly biologically productive DO levels and the lowest layer consisting of cold, dense water with very low DO levels. When power generation is initiated, low DO water travels through the turbines and enters the re-regulation pool.

The purpose of the study is to compare the benefits, costs, impacts (positive or negative) of alternatives, and identify whether an economically justified plan exists to improve DO levels within the water. The study reviewed 15 alternatives before finally landing on four alternatives:

- No Action Alternative
- Alternative 1: Temperature Control Curtain added to TCW
- Alternative 8a: Raising TCW from 580 to 585 elevation
- Alternative 8b: Raising TCW from 580 to 588 elevation

Alternative 8a, raising the TCW from 580 to 585 elevation, was chosen as the Tentatively Selected Plan. Raising the TCW to the 585 elevation will block the poorly oxygenated water from reaching the turbine intake. Project features will include placing stone on top of the TCW, an access road, a staging area, and tree clearing around portions of the access road and staging area (Figure 2). The access road is an already constructed dirt and gravel road. A cultural resource survey is expected to take place of the staging area and potentially the tree clearing if it requires ground disturbing activities.

A review of the Missouri State Historic Preservation database found that site 23RA303 is located near the TCW (Figure 2). This site was identified in 1959 by Carl Chapman and Dale Henning during a surface survey. The site was determined to be an Archaic to Woodland village site. In 1974, archaeologists revisited the site but found that it had been completely destroyed by the construction of the dam. No other sites are located near the proposed project features.

The District is requesting that your Tribe review the maps and information about the project and notify our office if you have any information pertaining to traditional cultural places, sacred sites, or other resources of tribal concern. If you have any questions or comments, please feel free to contact me at (314) 331-8855 or contact Meredith Hawkins Trautt (Archaeologist and Tribal Liaison) at Meredith.M.Trautt@usace.army.mil or call (314) 925-5031.

Sincerely,

Jennifer L. Riordan
Chief, Curation and Archives
Analysis Branch

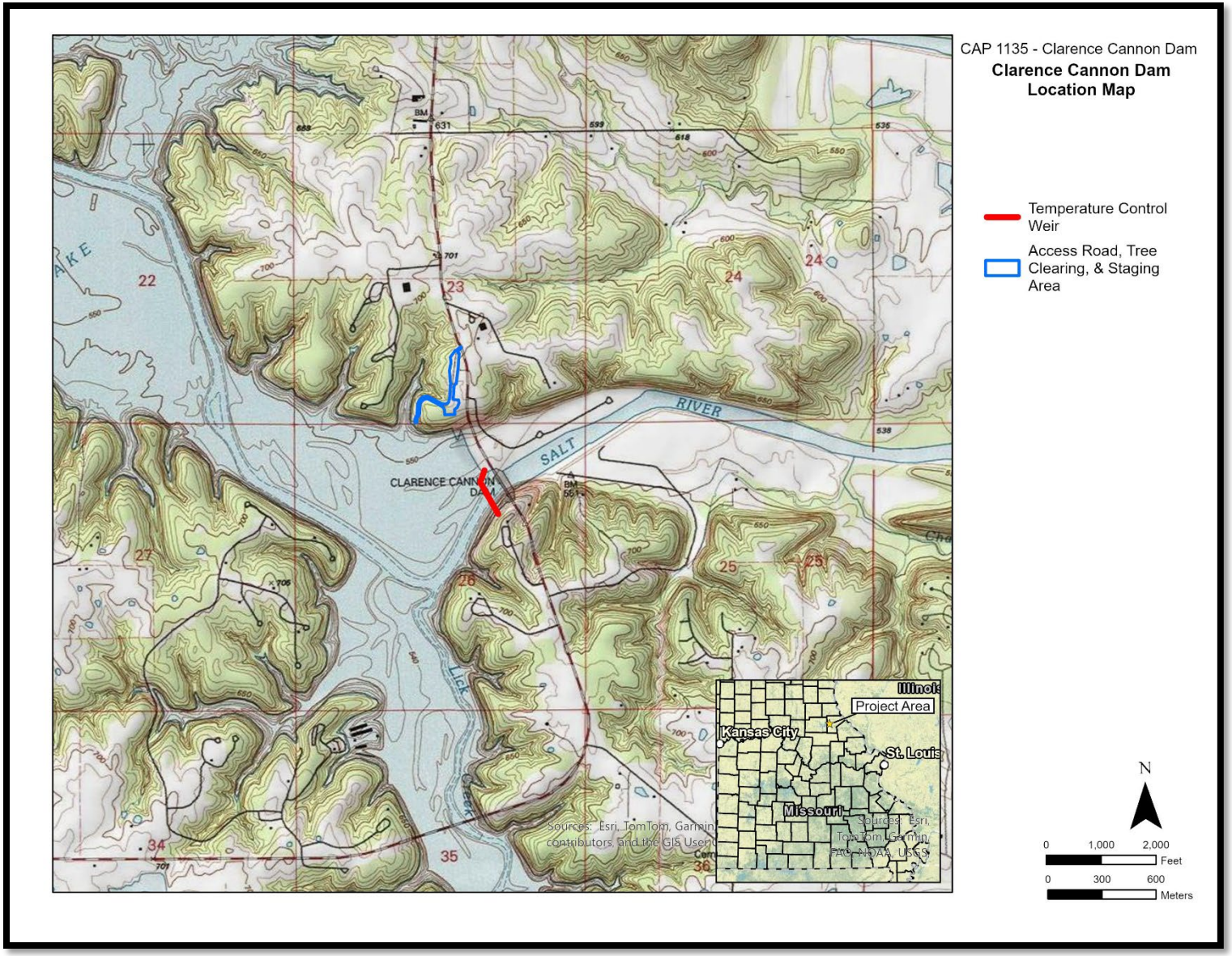


Figure 1. Location map of project area.

Figure 2. Previously identified archaeological sites near the project area.

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, ST. LOUIS DISTRICT
1222 SPRUCE STREET
ST. LOUIS, MISSOURI 63103

February 25, 2026

Engineering and Construction Division
Curation and Archives Analysis Branch

Subject: CAP Clarence Cannon Dam, Mark Twain Lake, Ralls and Monroe Counties, Missouri

Mr. Blake Norton
Director Tribal Historic Preservation Office
Citizen Potawatomi Nation, Oklahoma
Cultural Heritage Center
1601 S. Gordon Cooper Drive
Shawnee, OK 74801

Dear Mr. Norton:

The U.S. Army Corps of Engineers (USACE), St. Louis District (District), in partnership with the Missouri Department of Conservation (MDC) is presently conducting a feasibility study with an integrated Environmental Assessment regarding low levels of dissolved oxygen (DO) within the water at Clarence Cannon Dam at Mark Twain Lake in Ralls and Monroe counties, Missouri (Figure 1). The study is authorized under the Continuing Authorities Program (CAP), Section 1135 of the Water Resources Development Act of 1986, as amended, which provides USACE the authority to modify existing USACE projects to restore the environment and construct new projects to restore areas degraded by USACE projects. Your Tribe was initially contacted about this project on January 21, 2026. The District is contacting your Tribe to continue consultation for this action under Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations 36 CFR 800.

Clarence Cannon Dam contains a hydroelectric power plant with two hydropower units (i.e., turbines), run by the Southwestern Power Administration. Located upstream of the dam is a temperature control weir (TCW) with a crest elevation of 580 feet. The re-regulation dam, which impounds water for storage and allows for control of the volume and intensity of downstream release, is located 9.5 miles downstream of the Clarence Cannon Dam. Releases into the re-regulation pool is leading to low levels of DO within the water that causes fish mortality events and ecosystem disruption downstream of the dam. Low DO is partially driven by three-layered temperature stratification from late spring and early fall that occurs behind the TCW, with the upper layer containing highly biologically productive DO levels and the lowest layer consisting of cold, dense water with very low DO levels. When power generation is initiated, low DO water travels through the turbines and enters the re-regulation pool.

After reviewing 15 alternatives, the District chose to raise the elevation of the TCW from 580 feet to 585 feet as its Tentatively Select Plan (TSP). Project features for the TSP will include raising the TCW, a gravel access road, a gravel staging area, and clearing trees around the portions of the access road and staging area (Figure 2).

A review of the Missouri State Historic Preservation database found that site 23RA303 is located near the TCW (Figure 2). This site was identified in 1959 by Carl Chapman and Dale Henning during a surface survey. The site was determined to be an Archaic to Woodland village site. In 1974, archaeologists revisited the site but found that it had been completely destroyed by the construction of the dam. No other sites are located near the proposed project features.

The TCW elevation will be raised by placing stones on top of the already existing structure. Tree clearing will involve cutting down the trees and grinding down the stumps. Therefore, the only potential for ground disturbing activity would be placing the gravel on the access road and staging area. A review of historic aerials reveals that the access road was utilized as early as 1979 (Figure 3). Additionally, the 1979 aerial also showed that a building and some type of ground disturbance was located within proposed staging area.

Due to the limited ground disturbing activities that will take place in previously disturbed areas, the District has determined that no historic properties will be affected by this project.

If your Tribe has any questions, comments, or areas of concern, please contact me at (314) 331-8855 or contact Meredith Hawkins Trautt (Archaeologist and Tribal Liaison) at Meredith.M.Trautt@usace.army.mil or call (314) 925-5031.

Sincerely,

Jennifer L. Riordan
Chief, Curation and Archives
Analysis Branch

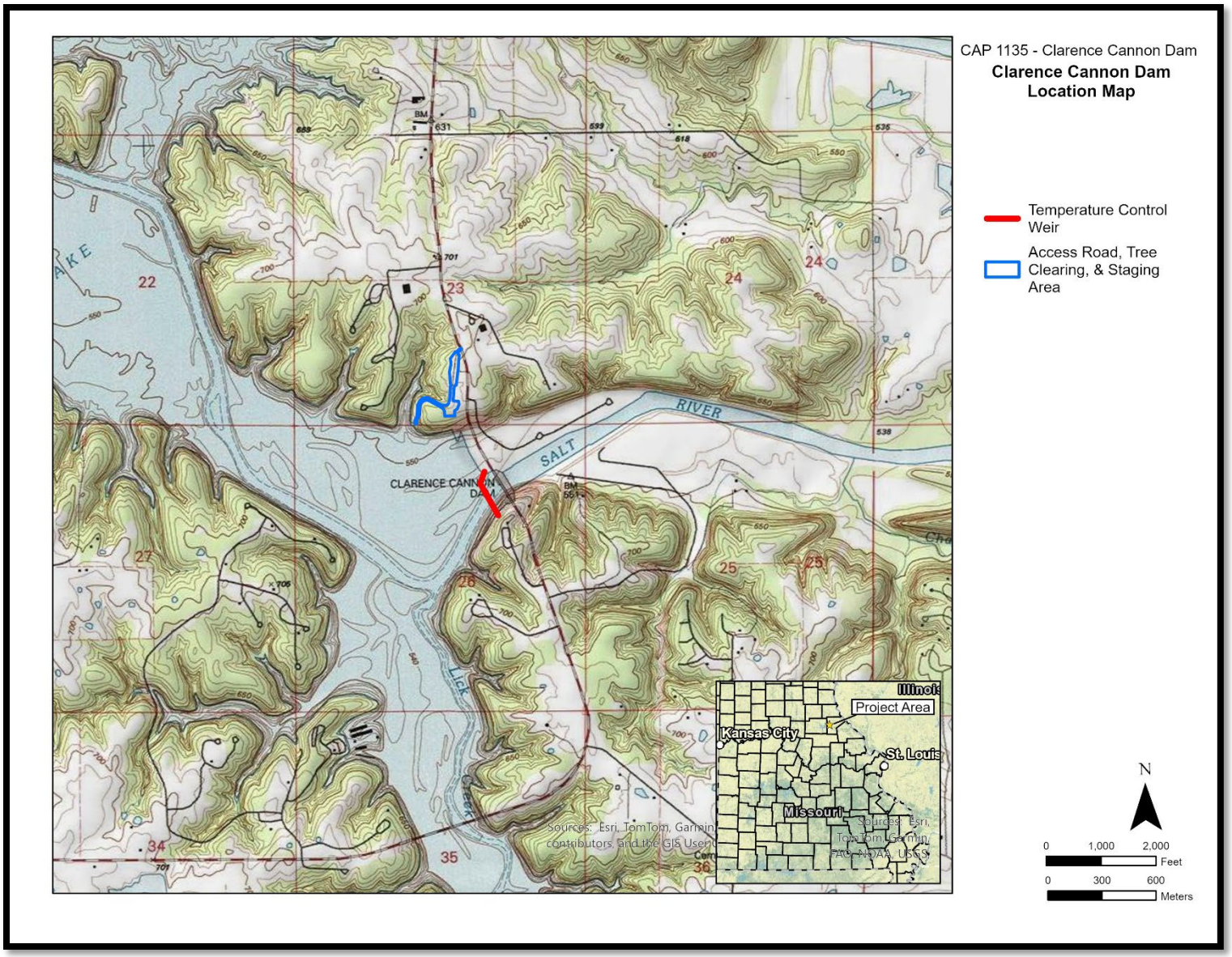


Figure 1. Location map of project area.

Figure 2. Previously identified archaeological sites near the project area.

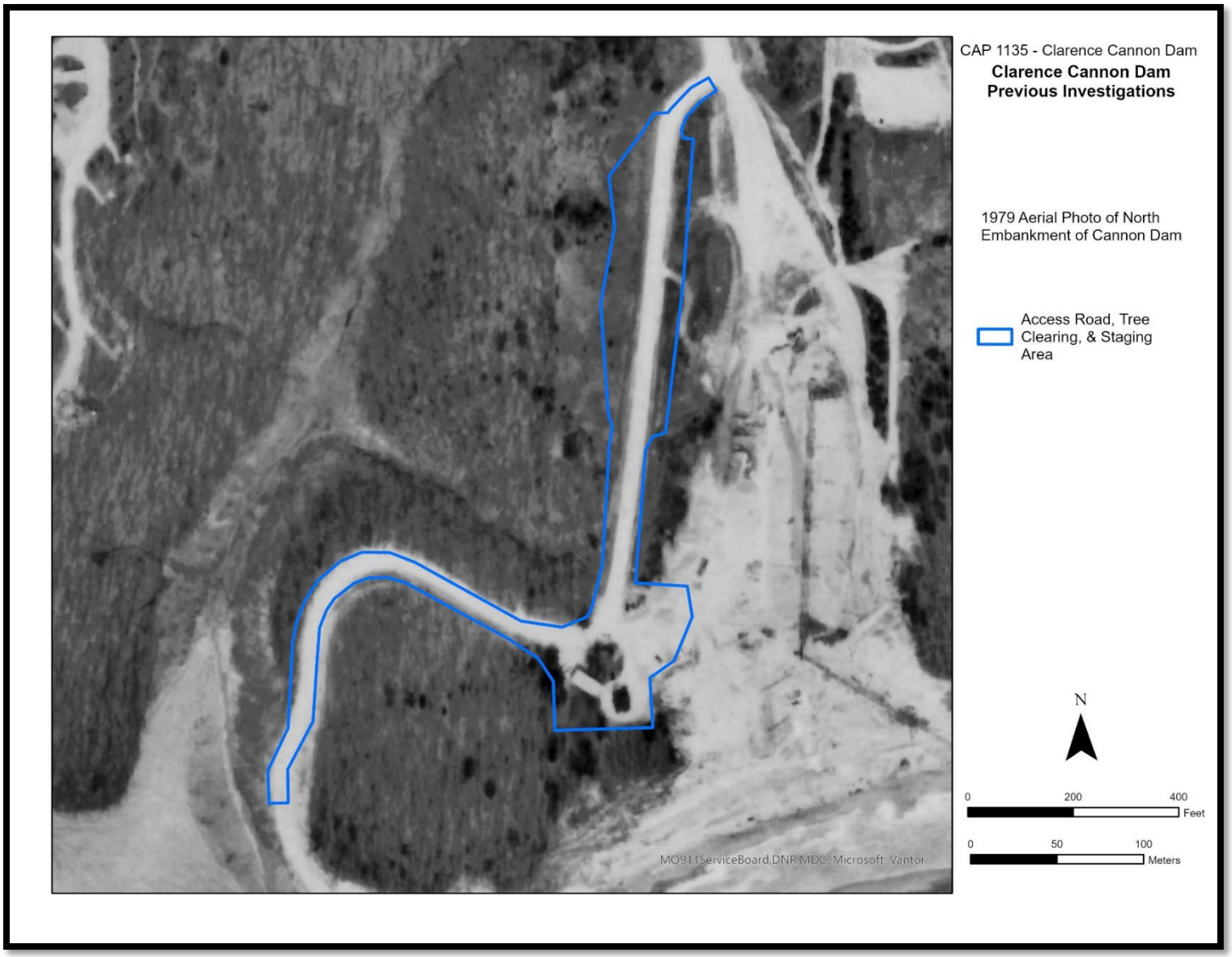


Figure 3. 1979 aerial of access road, tree clearing, and staging area.

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, ST. LOUIS DISTRICT
1222 SPRUCE STREET
ST. LOUIS, MISSOURI 63103

February 25, 2026

Engineering and Construction Division
Curation and Archives Analysis Branch

Subject: CAP Clarence Cannon Dam, Mark Twain Lake, Ralls and Monroe Counties, Missouri

Ms. Amy Rubhingh
Missouri State Historic Preservation Office
RCR Section Chief, Archaeologist
P.O. Box 176
Jefferson City, MO 65102

Dear Ms. Rubingh:

The U.S. Army Corps of Engineers (USACE), St. Louis District (District), in partnership with the Missouri Department of Conservation (MDC) is presently conducting a feasibility study with an integrated Environmental Assessment regarding low levels of dissolved oxygen (DO) within the water at Clarence Cannon Dam at Mark Twain Lake in Ralls and Monroe counties, Missouri (Figure 1). The study is authorized under the Continuing Authorities Program (CAP), Section 1135 of the Water Resources Development Act of 1986, as amended, which provides USACE the authority to modify existing USACE projects to restore the environment and construct new projects to restore areas degraded by USACE projects. The District is contacting your office to initiate consultation for this action under Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations 36 CFR 800.

Clarence Cannon Dam contains a hydroelectric power plant with two hydropower units (i.e., turbines), run by the Southwestern Power Administration. Located upstream of the dam is a temperature control weir (TCW) with a crest elevation of 580 feet. The re-regulation dam, which impounds water for storage and allows for control of the volume and intensity of downstream release, is located 9.5 miles downstream of the Clarence Cannon Dam. Releases into the re-regulation pool is leading to low levels of DO within the water that causes fish mortality events and ecosystem disruption downstream of the dam. Low DO is partially driven by three-layered temperature stratification from late spring and early fall that occurs behind the TCW, with the upper layer containing highly biologically productive DO levels and the lowest layer consisting of cold, dense water with very low DO levels. When power generation is initiated, low DO water travels through the turbines and enters the re-regulation pool.

After reviewing 15 alternatives, the District chose to raise the elevation of the TCW from 580 feet to 585 feet as its Tentatively Select Plan (TSP). Project features for the TSP will include raising the TCW, a gravel access road, a gravel staging area, and clearing trees around the portions of the access road and staging area (Figure 2).

A review of the Missouri State Historic Preservation database found that site 23RA303 is located near the TCW (Figure 2). This site was identified in 1959 by Carl Chapman and Dale Henning during a surface survey. The site was determined to be an Archaic to Woodland village

site. In 1974, archaeologists revisited the site but found that it had been completely destroyed by the construction of the dam. No other sites are located near the proposed project features.

The TCW elevation will be raised by placing stones on top of the already existing structure. Tree clearing will involve cutting down the trees and grinding down the stumps. Therefore, the only potential for ground disturbing activity would be placing the gravel on the access road and staging area. A review of historic aerials reveals that the access road was utilized as early as 1979 (Figure 3). Additionally, the 1979 aerial also showed that a building and some type of ground disturbance was located within the proposed staging area.

Due to the limited ground disturbing activities that will take place in previously disturbed areas, the District has determined that no historic properties will be affected by this project.

If your Tribe has any questions, comments, or areas of concern, please contact me Meredith Hawkins Trautt (Archaeologist) at Meredith.M.Trautt@usace.army.mil or call (314) 925-5031.

Sincerely,

Jennifer L. Riordan
Chief, Curation and Archives
Analysis Branch

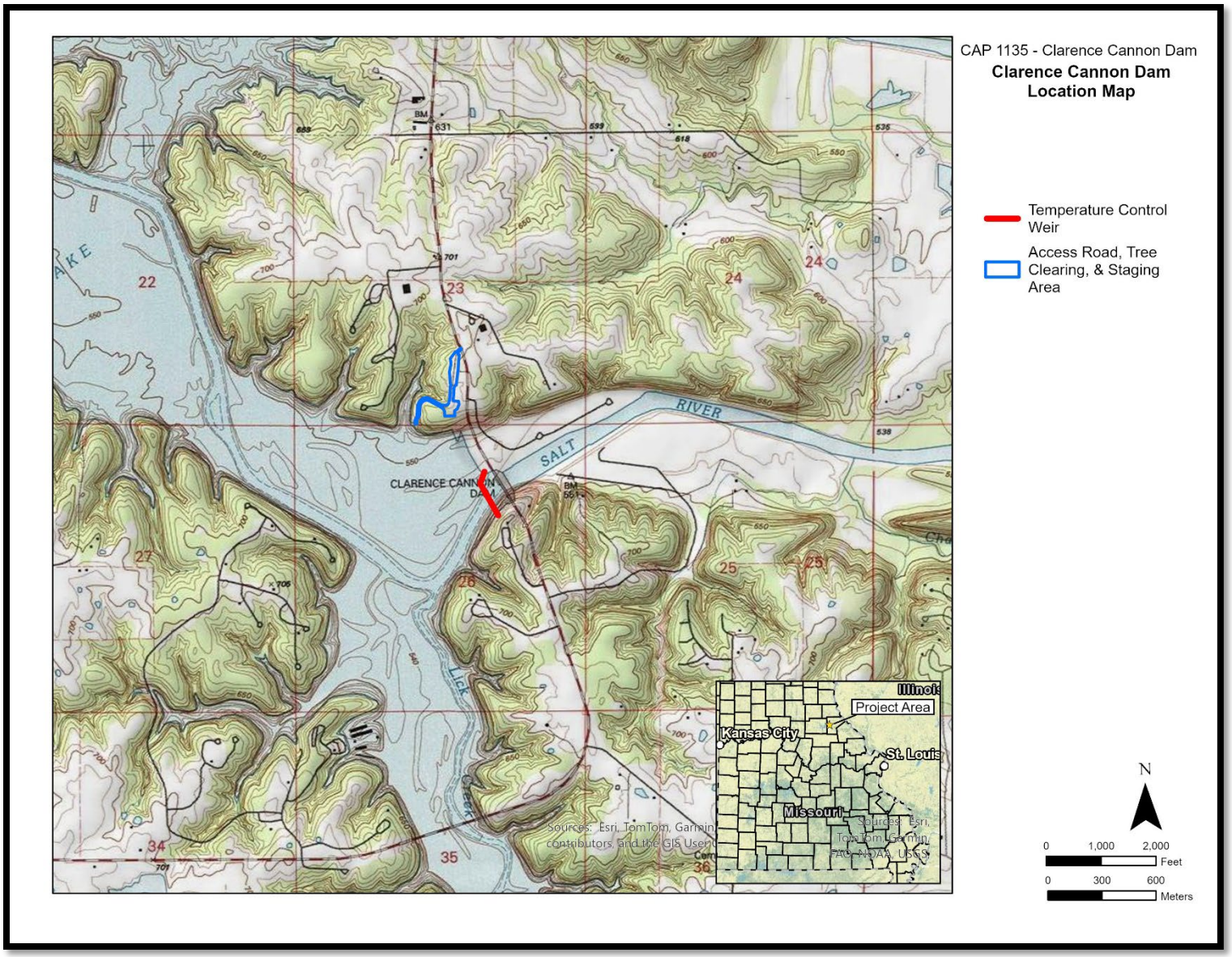


Figure 1. Location map of project area.

Figure 2. Previously identified archaeological sites near the project area.

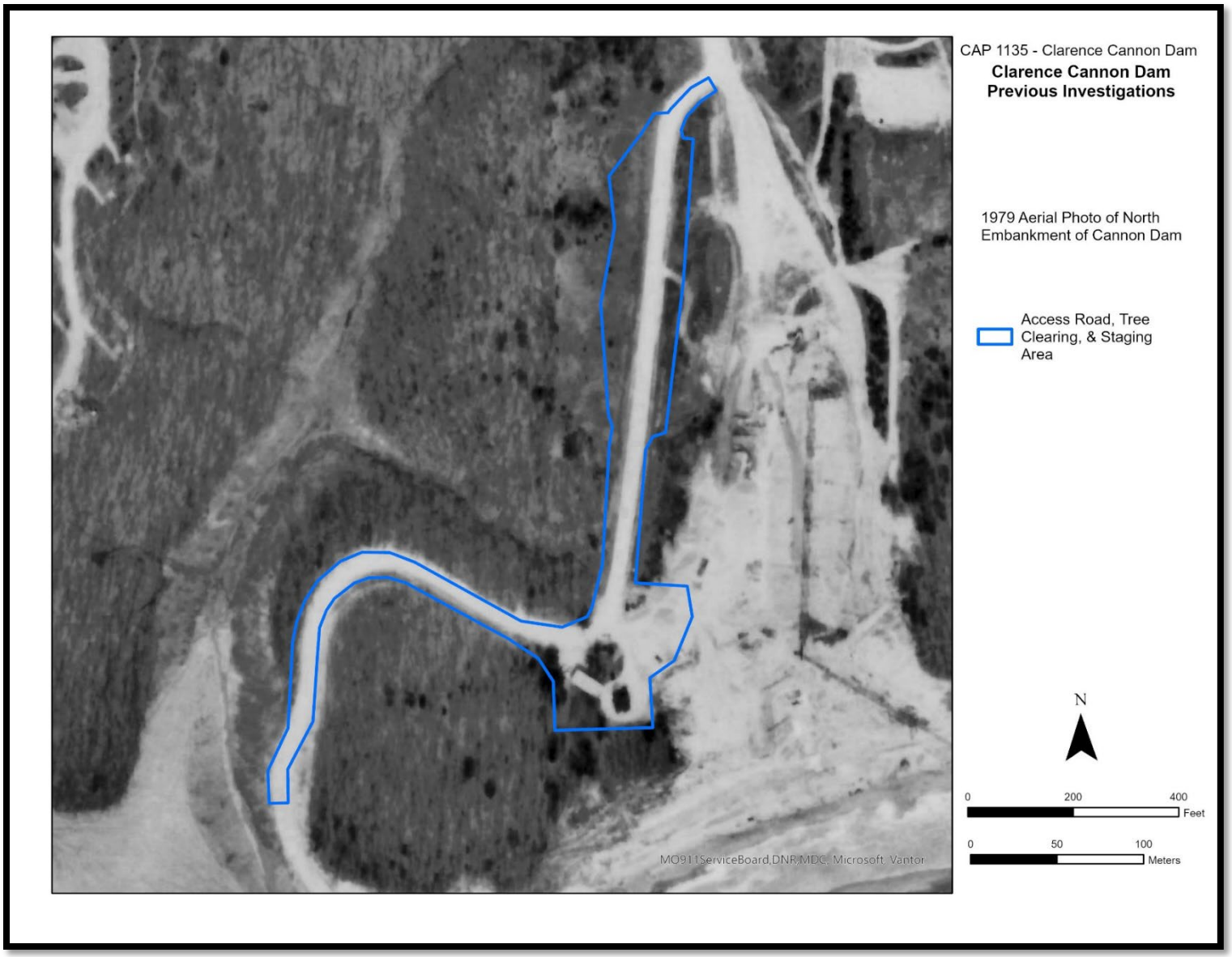


Figure 3. 1979 aerial of the access road, tree clearing, and staging area.

Continuing Authorities Program (CAP) 1135

Clarence Cannon Dam at Mark Twain Lake

Appendix B: Habitat Evaluation and Quantification

St. Louis District
Project Sponsor: Missouri Department of Conservation
March 2026

1 Introduction 3

2 Habitat Benefit Evaluation Methods 3

2.1 Quantity Component 4
2.2 Quality Component 5
2.3 Period of Analysis 6

3 Assumptions 6

3.1 Habitat Assumptions 7

4 Results 9

4.1 Total Habitat Benefits 9

5 References 11

1 Introduction

This appendix provides documentation of the habitat evaluation and quantification process that was conducted to evaluate the benefits of various alternatives for the Continuing Authorities Program (CAP) 1135 Clarence Cannon Dam at Mark Twain Lake study. The evaluation was conducted by a multi-agency team with active participants that included biologist and engineers from the St. Louis District U.S. Army Corps of Engineers (USACE), Missouri Department of Conservation (MDC), as well as representatives from Missouri Department of Natural Resources (MoDNR), and Southwestern Power Administration (SWPA); names and disciplines are included in Table 1 below.

Table 1. Team that participated in the Habitat Benefits Workshop Analysis for the CAP 1135 Clarence Cannon Dam.

Team Member	Specialty	Affiliation
Natalia I. Ramírez Irizarry	Biologist	USACE
Hannah Caudill	Plan Formulator	USACE
Ben Greeling	HTRW/Tech Lead	USACE
Keelan Vaughn	Civil Engineer	USACE
Abigail Hoyt	Project Manager	USACE
Matthew Jones	CAP Program Manager	USACE
Timothy Eash	Operations	USACE
Allen Mehrer	Operations	USACE
Rachelle Howald	Biologist/Park Ranger	USACE
Robert Voss	Environmental Supervisor	MoDNR
Matt Vitello	Policy Coordinator	MDC
Annie Hentschke	Fisheries Biologist	MDC
Brett Landwer	Aquatic Resource Scientist	MDC
Anthony Cole	Researcher	MDC
Lyneil Harris		SWPA
Jared Milford	Civil Engineer	SWPA

2 Habitat Benefit Evaluation Methods

The purpose of the habitat benefit evaluation is to evaluate and quantify, to the extent possible, environmental benefits of alternatives plans for the aquatic habitat improvements within the study area. Aquatic habitat benefits were quantified using the Habitat Evaluation Procedures (HEP)(USFWS, 1980).

Aquatic habitat benefits were quantified using the Engineering Circular 1105-2-412, *Assuring Quality of Planning Models* and the Bluegill Winter Habitat Suitability Index Model (Palesh and Anderson, 1990). This model is certified for regional use by the USACE Ecosystem Planning Center of Expertise (ECO-PCX), until September 14, 2028. Not all models have dissolved oxygen (DO) as a variable. The Habitat Suitability Index (HSI) spreadsheet calculator for the model was reviewed and recommended by

the ECO-PCX for use. Bluegill are one of the primary fish species found in Mark Twain Lake. Additionally, the ECO-PCX recommended Smallmouth Bass Model as an alternative, but that model did not show substantial habitat uplift between alternatives for the purposes of comparison.

The project delivery team (PDT) used quantity and quality of the habitat, in the form of habitat units, jointly to measure potential benefits provided by the final array of alternatives in the study area. The following sections describe how the PDT quantified habitat units and determined quality of the habitat, with and without project features.

2.1 Quantity Component

The quantity component is often measured as area (e.g., acres of habitat) or number of species. The evaluation conducted for this study area used acres to represent the quantity of the habitat. The area of projected benefit was delineated by a polygon using Google Earth Pro (Figure 1). A total of 370 acres for aquatic enhancement were identified, which includes the entire re-regulation pool. Acreages across alternatives were the same.

The benefits of each proposed project measure comprising alternatives (net AAHUs) are then determined by subtracting without-Project benefits from with-Project benefits. The effects of various habitat improvement measure combinations (alternatives) can then be evaluated by comparing the net AAHUs and costs for each alternative.

In preparation for using the HSI model, the PDT conduct a site visit and reviewed existing water quality data. During the evaluation, assumptions were developed regarding existing conditions and projected with-project conditions relative to habitat changes over time and management practices.

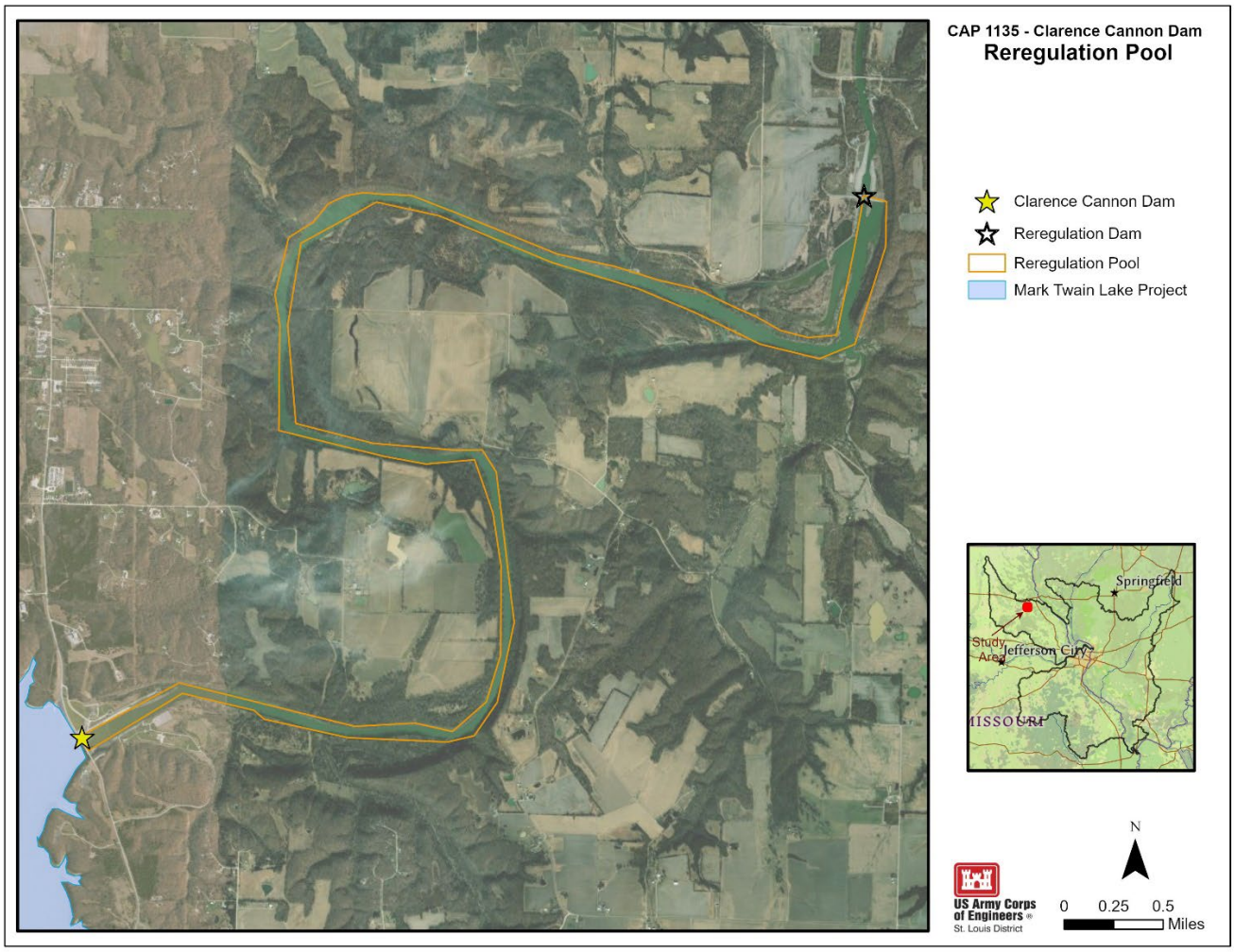


Figure 1. 370-Acres from the re-regulation pool used for habitat model.

2.2 Quality Component

The qualitative component of the analysis is rated on a 0.0 to 1.0 scale, with higher values indicating more suitable habitat for that species. The HSI for a particular habitat type is determined by selecting values that reflect present and future study area conditions from a series of abiotic and biotic metrics. Each value corresponds to a suitability index for the species. Future values are determined using management plans, historical conditions, and best professional judgment.

Habitat units are calculated for specific target years to forecast changes in habitat values over the life of the Future Without Project (FWOP) and Future With Project (FWP) conditions. When HSI scores are not available for each year of analysis, a formula requiring only target year HSI and area estimates is used (USFWS 1980):

$$\int_0^T HU\,dt = (T_2 - T_1)\,X\left[\left(\frac{A_1H_1 + A_2H_2}{3}\right) + \left(\frac{A_2H_1 + A_1H_2}{6}\right)\right]$$

Where:

$\int_0^T HU\ dt$ = *Cumulative HUs*

T_1 = first target year of time interval
T_2 = last target year of time interval
A_1 = area of available habitat at beginning of time interval
A_2 = area of available habitat at end of time interval
H_1 = habitat suitability index at the beginning of time interval
H_2 = habitat suitability index at the end of time interval
3 and 6 = constants derived from integration of HSI × Area for the interval between any two target years

This formula was developed to precisely calculate HUs when either HSI, area, or both change over a time interval, which is common when dealing with the unpredictable fluctuations found in nature. HU gains or losses are annualized by summing the cumulative HUs calculated using the above equation across all target years in the period of analysis and dividing the total (cumulative HUs) by the number of years in the life of the project (i.e., 50 years). This calculation results in the Average Annual Habitat Units (AAHUs) (USFWS 1980). The calculation of the HUs and AAHUs were completed in a Microsoft Excel spreadsheet for each model containing the formula above.

2.3 Period of Analysis

For the purpose of planning, design, and impact analysis, the period of analysis was established as 50 years. To facilitate comparison for the Bluegill HSI model, target years were established at 0 (existing conditions), 5, 25, and 50 years for both with and without project features. Those years are used to analyze HUs and characterize habitat changes over the estimated period of analysis. Target years 0, 5, and 10 capture short-term changes following construction completion, while target years 25 and 50 capture future water temperature forecast changes that would occur over a longer period of time.

USACE guidance requires that the PDT evaluate a suite of measures that can be combined in various ways, based on dependencies, to form alternatives. The approach used to assess the potential impacts at the Clarence Cannon Dam at Mark Twain Lake study area looked at benefits of project features and their combinations into alternatives and comparatively evaluated each alternative separately. This process is the iteration planning process. To determine the HUs of each alternative, the aquatic habitat affected by the respective alternatives was evaluated using the applicable HSI spreadsheet.

This appendix contains HSI summary tables and other data derived from the spreadsheet files not included in this appendix. These spreadsheets are available upon request. Please contact, Natalia I. Ramírez Irizarry, 314-331-8033, natalia.i.ramirezirizarry@usace.army.mil, for these files.

3 Assumptions

In preparation for using the HSI model, the evaluation team conducted site visits, and reviewed aerial images, long-term water quality data, published data, MDC fisheries and mussel survey, conducted several PDT meetings, and held a Habitat Benefits workshop with the partners. During the evaluation, assumptions were developed regarding existing conditions and forecasted with- and without project conditions relative to habitat changes over time and management practices.

3.1 Habitat Assumptions

The USACE – approved Bluegill HSI Model (Stuber, 1982) was used to assess the potential aquatic habitat impacts due to low DO. The bluegill (*Lepomis macrochirus*) is an important game fish in the Mississippi River drainage basin. This species occurs in deep, flowing water, as well as in sloughs, oxbow lakes, and other backwater lakes. This species is one of the primary species found in Mark Twain Lake and an important habitat variable in the model is DO.

The following assumptions were made when applying inputs to the Bluegill HSI Model. For detailed descriptions of the assumptions made for each model parameter/variable for a given alternative, the Excel spreadsheet is available upon request.

Baseline Condition:

- A DO concentration of 5mg/L is generally thought to be the minimum threshold to sustain freshwater fish population. During the summer months low DO (below 5mg/L) concentration in the re-regulation pool caused by lake water with low oxygen moving through the turbines has been a long-term, significant water quality concern at Clarence Cannon Dam. Low DO concentration are expected to continue during the period of analysis for the FWOP and would result in stress to aquatic organisms and fish mortality events.
- There are approximately 370 acres of aquatic habitat within the area of projected benefit, which includes the full re-regulation pool from Clarence Cannon Dam to the re-regulation dam.
- The winter section of the Bluegill HSI was not evaluated in depth due to low DO concentrations not historically observed during winter months.
- Existing long-term water quality data, MDC fisheries and mussels' data, and the habitat workshop with the partners, was used in the Bluegill model.

Future Without Project Condition:

- It is anticipated that the aquatic habitat will continue to degrade as a result of expected increased temperatures and decreased DO. Decreased DO levels would negatively impact sensitive aquatic organisms that cannot live in poorly oxygenated water. As a result, the diversity of aquatic organisms would decrease. Furthermore, some aquatic organisms are more generalized in their habitat needs, while others are more specialized, so a decline in habitat diversity can cause an adverse impact over time as specialist organisms are expelled from the study area. Decreased habitat diversity can cause drops in species

diversity and composition within the remaining habitat.

- All variables except for temperature remain constant.
- At Year 25, aquatic habitat degradation would be noticeable due to high water temperatures exceeding 30 º C, resulting in poor water quality and lo DO levels. Fish mortality events are expected to occur more frequently. DO and temperature are the primary variables that changed in the model. Higher water temperatures (> 30º C) and poorer water quality with low DO levels would make it unsuitable for most aquatic life.

Future With Project:

Temperature Control Curtain - According to similar completed projects at Whiskeytown Reservoir and the Lewiston Reservoir, both with Temperature Control Curtain, low DO improved. Therefore, we assumed increases in DO would be immediate.

Temperature Control Weir - It was assumed that with the Temperature Control Weir at higher elevations, low DO would improve with the proposed alternative due to a long-term water quality and temperature collection estimated. It was assumed based off water quality data there are differences between 585 and 588 elevations on the amount of time DO would improve (Table 2).

General FWP conditions:

It is anticipated aquatic habitat would improve as a result of increased DO, and increased capacity for DO would result an improved water quality. However, DO and temperature are weighted in the model and are considered to be limiting factors. Summer HSI value from years 0 – 10 would remain constant, but at years 25 – 50 an HSI of 0 occurs, due to the potential rise in water temperature (>30º C) (Table 3). The bluegill HSI determined by the model does not necessarily represent the actual population of bluegill in the study area.

It was assumed that the vegetation, turbidity, pH, stream gradient, substrate composition within the study area would not be changed by the proposed action alternatives.

According to the USFWS, USGS models, and an academic paper, 1.8º C of warming in the next 50 years is expected. It was assumed that the temperature will increase 0.4º C for each evaluated year starting in year 5.

Table 2. Estimated percentage (%) of low DO improvement between the two elevations of the Temperature Control Weir (TCW) for sample years 2017 to 2023

Metric	2017	2018	2019	2020	2021	2022	2023	Estimated % of Days with Improved DO with TCW at Higher Elevation
Approx. Pool Elevation Range (ft)	602-615	601-604	604-625	603-616	605-620	601-608	601-604	
585	47.0	57.0	25.0	63.0	30.0	94.0	100.0	60%
588	70.0	86.0	52.0	93.0	68.0	100.0	100.0	81%

4 Results

Chapter 4 of the main report, *Plan Formulation* describes each potential management measure in detail. The PDT screened out several measures after discussion with the Sponsor at the habitat benefits workshop. Some of them had negative environmental consequences, and so they were screened. Table 19 in the main report displays the proposed measures, screening criteria, and which measures were retained for inclusion in the final array of alternatives. Section 4.8 in the main report displays the measures included in each alternative.

4.1 Total Habitat Benefits

Table 3 provides a summary of the calculated HSI Scores, AAHUs and Net AAHUs (ecological lift for each target year: 0, 5, 25, and 50) for the final array of alternatives.

Table 3. Final array of alternatives with HSI Scores, AAHUs, and net AAHUs for the full re-regulation pool (370 acres).

Alt #	Alternatives	0 yr HSI Score	5 yrs HSI Score	10 yrs HSI Score	25 yrs HSI Score	50 yrs HSI Score	AAHUs	Net AAHUs
0	No Action (FWOP)	0.40	0.40	0.40	0.00	0.00	52	0
1	Temperature Control Curtain	0.40	0.67	0.66	0.00	0.00	81	29
8a	Raise Temp Control Weir (585 ft)	0.40	0.65	0.64	0.00	0.00	79	27
8b	Raise Temp Control Weir (588 ft)	0.40	0.67	0.67	0.00	0.00	81	29

5 References

Palesh, G. and D. Anderson. 1990. Modification of the habitat suitability index model for the bluegill (Lepomis macrochirus) for winter conditions for upper Mississippi River backwater habitats. U.S. Army Corps of Engineers, St. Paul District. 190 E. 5th Street, St. Paul, MN.

Stuber, R.J., G. Gebhart, and O.E. Maughan. 1982. Habitat suitability index models: Bluegill. U.S.D.I. Fish and Wildlife. FWS/OBS-82/10.8. 26 pp.

U.S. Fish and Wildlife Service. 1980. Habitat Evaluation Procedures (HEP), Ecological Services Manual. Washington, D.C. 130 pp.

MEMORANDUM FOR RECORD
SUBJECT: Department of the Army Memorandum Documenting General Permit Verification Introduction and Overview

The U.S. Army Corps of Engineers (USACE), St. Louis District (District), has prepared this Feasibility Report with Integrated Environmental Assessment (FR/EA) to present a detailed account of the planning, engineering, construction considerations, and environmental considerations that resulted in the Tentatively Selected Plan (TSP) for the Section 1135 Continuity Authority Program (CAP) Clarence Canon Dam, modifications for improvement to the environment. The FR/EA (Report) meets USACE planning guidance and National Environmental Protection Act (NEPA) requirements. The planning and decision process includes:

- Scoping (identifying problems, opportunities, objectives, and constraints)
- Identifying existing conditions and future without project conditions
- Plan formulation (identifying measures, formulating plans, evaluating and comparing plans)
- Plan selection

Evidence gathering, risk management, and stakeholder involvement occurs throughout the planning process. This report summarizes the multidisciplinary efforts of the Project Delivery Team (PDT), which includes the District, the Sponsor, and Project partners.

1.1 Activity location

Mark Twain Lake is located in northeastern Missouri on the Salt River in the Salt River Basin. Mark Twain Lake spans both Ralls and Monroe Counties, is located approximately 20 miles southwest of Hannibal, MO and 140 miles north of St. Louis, MO. The study area for CAP 1135 Clarence Cannon Dam at Mark Twain Lake and its associated re-regulation dam are located in Rall County, MO, upstream from the confluence with the Mississippi River at river miles (RM) 63 and 53.5. Section 1.3, Figure 2 and 3 of the main report, provides a project vicinity map for Clarence Cannon Dam study area location and dam features.

1.2 Description of activity requiring verification

The study area includes Clarence Cannon Dam, a hydroelectric power plant, water temperature control weir (TCW), and re-regulation dam. The TCW was constructed as a skimming weir to prevent cold, poorly oxygenated water from passing through Clarence Cannon Dam and was designed to an elevation of 580ft. However, during summer months poorly oxygenated water enters the re-regulation pool through the turbines when power generation occurs, putting stress on aquatic organisms within the pool and causing fish mortality events.

The recommended study involves placing additional stone on top of the existing TCW to raise its elevation by five feet, bringing it to 585 ft. Raising the TCW includes building the weir up higher with additional rock to decrease the frequency and duration of low dissolved oxygen (DO) releases through Clarence Cannon Dam’s turbines and/or Tainter gates. The

higher the weir is raised corresponds to higher protection from low DO water passing over the weir.

1.3 Permit authority

Table 1 Permit Authority

Authority	Regulated
Section 10 of the Rivers and Harbors Act (33 USC 403)	X
Section 404 of the Clean Water Act (33 USC 1344)	X

1.4 Applicable Permit

Nationwide Permit (NWP); 27 (Aquatic Habitat Restoration, Establishment, and Enhancement Activities)

1.5 Waiver Discussion

Does the activity require a written waiver? No

Nationwide Permit 27 does not contain provisions for waivers.**Evaluation of the Pre-Construction Notification (PCN)**

2.1 Direct and indirect effects caused by the GP activity

The direct and indirect effects are analyzed throughout the main body of the Feasibility Report with Integrated Environmental Assessment, more specifically, Sections 3 and 5 pertain to the alternatives evaluation of impacts to all relevant resources.

2.2 Coordination

2.2.1 Interagency Coordination

Missouri Department of Conservation (MDC) is the sponsor for this CAP 1135 study and has been heavily involved with the planning process. The U.S. Fish and Wildlife (USFWS) and Missouri Department of Natural Resources (MoDNR) has also been involved at early stages of the planning process.

2.2.2 Corps internal coordination

Yes, the St. Louis District Regulatory Division has reviewed the Feasibility Report with Integrated Environmental Assessment.

3.0 Mitigation

3.1 Avoidance and minimization

Provide brief description of how the activity has been designed on-site to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site:

The proposed project consists of aquatic resource restoration, enhancement, and preservation. Environmental effects evaluation is included in Section 5 of the main report.

3.2 Compensatory mitigation requirement

Is compensatory mitigation required for unavoidable impacts to jurisdictional aquatic resources to reduce the individual and cumulative adverse environmental effects to a minimal level? No

Provide rationale: No mitigation is required because the activity consists entirely of restoration activities.

4.0 Compliance with Other Laws, Policies and Requirements

4.1 Section 7(a)(2) of the Endangered Species Act (ESA)

Please refer to Section 5.6.2 of the main report, and Appendix A – Environmental Compliance and Coordination for ESA compliance. Magnuson-Stevens Fishery Conservation and Management Act (Magnuson Stevens Act), Essential Fish Habitat (EFH)

N/A, there is no essential fish habitat in this district's area of responsibility. Lead federal agency for EFH provisions of the Magnuson-Stevens Act

Has another federal agency been identified as the lead agency for complying with the EFH provisions of the Magnuson-Stevens Act with the Corps designated as a cooperating agency and has that consultation been completed? No

4.2.2 Magnuson-Stevens Act

Did the proposed project require review under the Magnuson-Stevens Act?
No

4.2.3 EFH species or complexes

Were EFH species or complexes considered? N/A

Effect determination and basis for that determination: N/A

4.2.4 National Marine Fisheries Service consultation

Consultation with the National Marine Fisheries Service was initiated and completed as required (see the attached ORM2 Summary sheet for begin date, end date and closure method of the consultation)

N/ASection 106 of the National Historic Preservation Act (NHPA)

Please refer to Section 5.2.1 of the main report, and Appendix A – Environmental Compliance and Coordination for Section 106 of the NHPA compliance.

4.4 Tribal Trust Responsibilities

Please refer to Section 5.2.2 of the main report, and Appendix A – Environmental Compliance and Coordination.

4.5 Section 401 of the Clean Water Act – Water Quality Certification (WQC)

4.5.1 Section 401 WQC requirement

Is a Section 401 WQC required, and if so, has the certification been issued or waived?

A general WQC has been granted.

If Yes, provide an explanation of the determination of the effect on neighboring jurisdiction.

N/A

4.6 Coastal Zone Management Act (CZMA)

4.6.1 CZMA consistency concurrence

Is a CZMA consistency concurrence required, and if so, has the concurrence been issued, objected, or presumed?

N/A, a CZMA consistency concurrence is not required.Wild and Scenic Rivers Act

4.7.1 National Wild and Scenic River System

Is the project located in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a “study river” for possible inclusion in the system? No

4.8 Compliance Statement

USACE has determined that it has fulfilled its responsibilities with all applicable Federal Environmental Protection Statutes and Requirements. Please refer to Table 22, in Section 5.2.2 of the main report.

5.0 Special Conditions

5.1 Special condition(s) requirement(s)

Are special conditions required to ensure minimal effects, ensure the authorized activity is not contrary to the public interest and/or ensure compliance of the activity with any of the laws above?

No The terms and conditions of the general permit are sufficient to ensure no more than minimal adverse effects, and no conditions are needed for compliance with other laws or to protect the public interest.

Determination

5.2 General Permit Statement

The activity will result in no more than minimal individual and cumulative adverse effects on the aquatic environment and will not be contrary to the public interest.

5.3 Compliance Statement

This activity, as described, complies with all terms and conditions of the permit identified below in Section 6. In summary, the project would be constructed in a way that meets all required terms and conditions of Nationwide Permit (NWP) 27, Aquatic Habitat, Restoration, Enhancement and Establishment Activities. This NWP is valid until March 14, 2026, unless District Engineer modifies, suspends, or revokes the nationwide permit authorizations in accordance with 33 CFR 330.5(d), prior construction NWP 27 will be reevaluated.

6.0 NWP 27 Terms and Conditions

No. 27. Aquatic Habitat Restoration, Enhancement, and Establishment Activities
(NWP Final Notice, 86 FR, 73576)

Activities in waters of the United States associated with the restoration, enhancement, and establishment of tidal and non-tidal wetlands and riparian areas, the restoration and enhancement of non-tidal streams and other non-tidal open waters, and the rehabilitation or enhancement of tidal streams, tidal wetlands, and tidal open waters, provided those activities result in net increases in aquatic resource functions and services.

To be authorized by this NWP, the aquatic habitat restoration, enhancement, or establishment activity must be planned, designed, and implemented so that it results in aquatic habitat that resembles an ecological reference. An ecological reference may be based on the characteristics of one or more intact aquatic habitats or riparian areas of the same type that exist in the region. An ecological reference may be based on a conceptual model developed from regional ecological knowledge of the target aquatic habitat type or riparian area.

To the extent that a Corps permit is required, activities authorized by this NWP include, but are not limited to the removal of accumulated sediments; releases of sediment from reservoirs to maintain sediment transport continuity to restore downstream habitats; the installation, removal, and maintenance of small water control structures, dikes, and berms, as well as discharges of dredged or fill material to restore appropriate stream channel configurations after small water control structures, dikes, and berms are removed; the installation of current deflectors; the enhancement, rehabilitation, or re-establishment of riffle and pool stream structure; the placement of in-stream habitat structures; modifications of the stream bed and/or banks to enhance, rehabilitate, or re-establish stream meanders; the removal of stream barriers, such as undersized culverts, fords, and grade control structures; the backfilling of artificial channels; the removal of existing drainage structures, such as drain tiles, and the filling, blocking, or reshaping of drainage ditches to restore wetland hydrology; the installation of structures or fills necessary to restore or enhance wetland or stream hydrology; the construction of small nesting islands; the construction of open water areas; the construction of oyster habitat over unvegetated bottom in tidal waters; coral restoration or relocation activities; shellfish seeding; activities needed to reestablish vegetation, including plowing or discing for seed bed preparation and the planting of appropriate wetland species; re-establishment of submerged aquatic vegetation in areas where those plant communities previously existed; re-establishment of tidal wetlands in tidal waters where those wetlands previously existed; mechanized land clearing to remove non-native invasive, exotic, or nuisance vegetation; and other related activities. Only native plant species should be planted at the site.

This NWP authorizes the relocation of non-tidal waters, including non-tidal wetlands and streams, on the project site provided there are net increases in aquatic resource functions and services.

Except for the relocation of non-tidal waters on the project site, this NWP does not authorize the conversion of a stream or natural wetlands to another aquatic habitat type (e.g., the conversion of a stream to wetland or vice versa) or uplands. Changes in wetland plant communities that occur when wetland hydrology is more fully restored during wetland rehabilitation activities are not considered a conversion to another aquatic habitat type. This NWP does not authorize stream channelization. This NWP does not authorize the relocation of tidal waters or the conversion of tidal waters, including tidal wetlands, to other aquatic uses, such as the conversion of tidal wetlands into open water impoundments.

Compensatory mitigation is not required for activities authorized by this NWP since these activities must result in net increases in aquatic resource functions and services.

Reversion. For enhancement, restoration, and establishment activities conducted: (1) In accordance with the

terms and conditions of a binding stream or wetland enhancement or restoration agreement, or a wetland establishment agreement, between the landowner and the U.S. Fish and Wildlife Service (FWS), the Natural Resources Conservation Service (NRCS), the Farm Service Agency (FSA), the National Marine Fisheries Service (NMFS), the National Ocean Service (NOS), U.S. Forest Service (USFS), or their designated state cooperating agencies; (2) as voluntary wetland restoration, enhancement, and establishment actions documented by the NRCS or USDA Technical Service Provider pursuant to NRCS Field Office Technical Guide standards; or (3) on reclaimed surface coal mine lands, in accordance with a Surface Mining Control and Reclamation Act permit issued by the Office of Surface Mining Reclamation and Enforcement (OSMRE) or the applicable state agency, this NWP also authorizes any future discharge of dredged or fill material associated with the reversion of the area to its documented prior condition and use (i.e., prior to the restoration, enhancement, or establishment activities). The reversion must occur within five years after expiration of a limited term wetland restoration or establishment agreement or permit, and is authorized in these circumstances even if the discharge of dredged or fill material occurs after this NWP expires. The five-year reversion limit does not apply to agreements without time limits reached between the landowner and the FWS, NRCS, FSA, NMFS, NOS, USFS, or an appropriate state cooperating agency. This NWP also authorizes discharges of dredged or fill material in waters of the United States for the reversion of wetlands that were restored, enhanced, or established on prior-converted cropland or on uplands, in accordance with a binding agreement between the landowner and NRCS, FSA, FWS, or their designated state cooperating agencies (even though the restoration, enhancement, or establishment activity did not require a section 404 permit). The prior condition will be documented in the original agreement or permit, and the determination of return to prior conditions will be made by the Federal agency or appropriate state agency executing the agreement or permit. Before conducting any reversion activity, the permittee or the appropriate Federal or state agency must notify the district engineer and include the documentation of the prior condition. Once an area has reverted to its prior physical condition, it will be subject to whatever the Corps Regulatory requirements are applicable to that type of land at the time. The requirement that the activity results in a net increase in aquatic resource functions and services does not apply to reversion activities meeting the above conditions. Except for the activities described above, this NWP does not authorize any future discharge of dredged or fill material associated with the reversion of the area to its prior condition. In such cases a separate permit would be required for any reversion.

Reporting. For those activities that do not require pre-construction notification, the permittee must submit to the district engineer a copy of: (1) The binding stream enhancement or restoration agreement or wetland enhancement, restoration, or establishment agreement, or a project description, including project plans and location map; (2) the NRCS or USDA Technical Service Provider documentation for the voluntary stream enhancement or restoration action or wetland restoration, enhancement, or establishment action; or (3) the SMCRA permit issued by OSMRE or the applicable state agency. The report must also include information on baseline ecological conditions on the project site, such as a delineation of wetlands, streams, and/or other aquatic habitats. These documents must be submitted to the district engineer at least 30 days prior to commencing activities in waters of the United States authorized by this NWP.

Notification: The permittee must submit a pre-construction notification to the district engineer prior to commencing any activity (see general condition 32), except for the following activities:

(1) Activities conducted on non-Federal public lands and private lands, in accordance with the terms and conditions of a binding stream enhancement or restoration agreement or wetland enhancement, restoration, or establishment agreement between the landowner and the FWS, NRCS, FSA, NMFS, NOS, USFS or their designated state cooperating agencies;

(2) Activities conducted in accordance with the terms and conditions of a binding coral restoration or relocation agreement between the project proponent and the NMFS or any of its designated state cooperating agencies;

(3) Voluntary stream or wetland restoration or enhancement action, or wetland establishment action, documented by the NRCS or USDA Technical Service Provider pursuant to Start Printed Page 73578 NRCS Field Office Technical Guide standards; or

(4) The reclamation of surface coal mine lands, in accordance with an SMCRA permit issued by the OSMRE or the applicable state agency.

However, the permittee must submit a copy of the appropriate documentation to the district engineer to fulfill the reporting requirement. (Authorities: Sections 10 and 404).

Note: This NWP can be used to authorize compensatory mitigation projects, including mitigation banks and in-lieu fee projects. However, this NWP does not authorize the reversion of an area used for a compensatory mitigation project to its prior condition, since compensatory mitigation is generally intended to be permanent.

C. Nationwide Permit General Conditions

(NWP Final Notice, 86 FR 2867-2874)

Note: To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as applicable, in addition to any regional or case-specific conditions imposed by the division engineer or district engineer. Prospective permittees should contact the appropriate Corps district office to determine if regional conditions have been imposed on an NWP. Prospective permittees should also contact the appropriate Corps district office to determine the status of Clean Water Act Section 401 water quality certification and/or Coastal Zone Management Act consistency for an NWP. Every person who may wish to obtain permit authorization under one or more NWPs, or who is currently relying on an existing or prior permit authorization under one or more NWPs, has been and is on notice that all of the provisions of 33 CFR 330.1 through 330.6 apply to every NWP authorization. Note especially 33 CFR 330.5 relating to the modification, suspension, or revocation of any NWP authorization.

1. Navigation. (a) No activity may cause more than a minimal adverse effect on navigation.

(b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.

(c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his or her authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

2. Aquatic Life Movements. No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species. If a bottomless culvert cannot be used, then the crossing should be designed and constructed to minimize adverse effects to aquatic life movements.

3. Spawning Areas. Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. Migratory Bird Breeding Areas. Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. Shellfish Beds. No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

6. Suitable Material. No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see section 307 of the Clean Water Act).

7. Water Supply Intakes. No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. Adverse Effects From Impoundments. If the activity creates an impoundment of water, adverse

effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. Management of Water Flows. To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization, storm water management activities, and temporary and permanent road crossings, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

10. Fills Within 100-Year Floodplains. The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. Equipment. Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. Soil Erosion and Sediment Controls. Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow, or during low tides.

13. Removal of Temporary Structures and Fills. Temporary structures must be removed, to the maximum extent practicable, after their use has been discontinued. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. Proper Maintenance. Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

15. Single and Complete Project. The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

16. Wild and Scenic Rivers. (a) No NWP activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status.

(b) If a proposed NWP activity will occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system while the river is in an official study status, the permittee must submit a pre-construction notification (see general condition 32). The district engineer will coordinate the PCN with the Federal agency with direct management responsibility for that river. Permittees shall not begin the NWP activity until notified by the district engineer that the Federal agency with direct management responsibility for that river has determined in writing that the proposed NWP activity will not adversely affect the Wild and Scenic River designation or study status.

(c) Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service). Information on these rivers is also available at: http://www.rivers.gov/.

17. Tribal Rights. No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

18. Endangered Species. (a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify designated critical habitat or critical habitat proposed for such designation. No activity is authorized under any NWP which "may affect" a listed species or critical habitat, unless ESA section 7

consultation addressing the consequences of the proposed activity on listed species or critical habitat has been completed. See 50 CFR 402.02 for the definition of "effects of the action" for the purposes of ESA section 7 consultation, as well as 50 CFR 402.17, which provides further explanation under ESA section 7 regarding "activities that are reasonably certain to occur" and "consequences caused by the proposed action."

(b) Federal agencies should follow their own procedures for complying with the requirements of the ESA (see 33 CFR 330.4(f)(1)). If pre-construction notification is required for the proposed activity, the Federal permittee must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will verify that the appropriate documentation has been submitted. If the appropriate documentation has not been submitted, additional ESA section 7 consultation may be necessary for the activity and the respective federal agency would be responsible for fulfilling its obligation under section 7 of the ESA.

(c) Non-federal permittees must submit a pre-construction notification to the district engineer if any listed species (or species proposed for listing) or designated critical habitat (or critical habitat proposed such designation) might be affected or is in the vicinity of the activity, or if the activity is located in designated critical habitat or critical habitat proposed for such designation, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species (or species proposed for listing) or designated critical habitat (or critical habitat proposed for such designation), the pre-construction notification must include the name(s) of the endangered or threatened species (or species proposed for listing) that might be affected by the proposed activity or that utilize the designated critical habitat (or critical habitat proposed for such designation) that might be affected by the proposed activity. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete pre-construction notification. For activities where the non-Federal applicant has identified listed species (or species proposed for listing) or designated critical habitat (or critical habitat proposed for such designation) that might be affected or is in the vicinity of the activity, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification that the proposed activity will have "no effect" on listed species (or species proposed for listing or designated critical habitat (or critical habitat proposed for such designation), or until ESA section 7 consultation or conference has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

(d) As a result of formal or informal consultation or conference with the FWS or NMFS the district engineer may add species-specific permit conditions to the NWPs.

(e) Authorization of an activity by an NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the FWS or the NMFS, the Endangered Species Act prohibits any person subject to the jurisdiction of the United States to take a listed species, where "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word "harm" in the definition of "take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.

(f) If the non-federal permittee has a valid ESA section 10(a)(1)(B) incidental take permit with an approved Habitat Conservation Plan for a project or a group of projects that includes the proposed NWP activity, the non-federal applicant should provide a copy of that ESA section 10(a)(1)(B) permit with the PCN required by paragraph (c) of this general condition. The district engineer will coordinate with the agency that issued the ESA section 10(a)(1)(B) permit to determine whether the proposed NWP activity and the associated incidental take were considered in the internal ESA section 7 consultation conducted for the ESA section 10(a)(1)(B) permit. If that coordination results in concurrence

from the agency that the proposed NWP activity and the associated incidental take were considered in the internal ESA section 7 consultation for the ESA section 10(a)(1)(B) permit, the district engineer does not need to conduct a separate ESA section 7 consultation for the proposed NWP activity. The district engineer will notify the non-federal applicant within 45 days of receipt of a complete pre-construction notification whether the ESA section 10(a)(1)(B) permit covers the proposed NWP activity or whether additional ESA section 7 consultation is required.

(g) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the FWS and NMFS or their world wide web pages at http://www.fws.gov/ or http://www.fws.gov/ipac and http://www.nmfs.noaa.gov/pr/species /esa/ respectively.

19. Migratory Birds and Bald and Golden Eagles. The permittee is responsible for ensuring that an action authorized by an NWP complies with the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. The permittee is responsible for contacting the appropriate local office of the U.S. Fish and Wildlife Service to determine what measures, if any, are necessary or appropriate to reduce adverse effects to migratory birds or eagles, including whether "incidental take" permits are necessary and available under the Migratory Bird Treaty Act or Bald and Golden Eagle Protection Act for a particular activity.

20. Historic Properties. (a) No activity is authorized under any NWP which may have the potential to cause effects to properties listed, or eligible for listing, in the National Register of Historic Places until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.

(b) Federal permittees should follow their own procedures for complying with the requirements of section 106 of the National Historic Preservation Act (see 33 CFR 330.4(g)(1)). If pre-construction notification is required for the proposed NWP activity, the Federal permittee must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will verify that the appropriate documentation has been submitted. If the appropriate documentation is not submitted, then additional consultation under section 106 may be necessary. The respective federal agency is responsible for fulfilling its obligation to comply with section 106.

(c) Non-federal permittees must submit a pre-construction notification to the district engineer if the NWP activity might have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties might have the potential to be affected by the proposed NWP activity or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of, or potential for, the presence of historic properties can be sought from the State Historic Preservation Officer, Tribal Historic Preservation Officer, or designated tribal representative, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of section 106 of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts commensurate with potential impacts, which may include background research, consultation, oral history interviews, sample field investigation, and/or field survey. Based on the information submitted in the PCN and these identification efforts, the district engineer shall determine whether the proposed NWP activity has the potential to cause effects on the historic properties. Section 106 consultation is not required when the district engineer determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR 800.3(a)). Section 106 consultation is required when the district engineer determines that the activity has the potential to cause effects on historic properties. The district engineer will conduct consultation with consulting parties identified under 36 CFR 800.2(c) when he or she makes any of the following effect determinations for the purposes of section 106 of the NHPA: No historic properties affected, no adverse effect, or adverse effect.

(d) Where the non-Federal applicant has identified historic properties on which the proposed NWP activity might have the potential to cause effects and has so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer

either that the activity has no potential to cause effects to historic properties or that NHPA section 106 consultation has been completed. For non-federal permittees, the district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA section 106 consultation is required. If NHPA section 106 consultation is required, the district engineer will notify the non-Federal applicant that he or she cannot begin the activity until section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

(e) Prospective permittees should be aware that section 110k of the NHPA (54 U.S.C. 306113) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

21. Discovery of Previously Unknown Remains and Artifacts. Permittees that discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by an NWP, they must immediately notify the district engineer of what they have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the Federal, Tribal, and state coordination required to determine if the items or remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

22. Designated Critical Resource Waters. Critical resource waters include, NOAA-managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment.

(a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, 52, 57 and 58 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.

(b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, 38, and 54, notification is required in accordance with general condition 32, for any activity proposed by permittees in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after she or he determines that the impacts to the critical resource waters will be no more than minimal.

23. Mitigation. The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that the individual and cumulative adverse environmental effects are no more than minimal:

(a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (i.e., on site).

(b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the individual and cumulative adverse environmental effects are no more than minimal.

(c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10-acre and require pre-

construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse environmental effects of the proposed activity are no more than minimal, and provides an activity-specific waiver of this requirement. For wetland losses of 1/10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in only minimal adverse environmental effects.

(d) Compensatory mitigation at a minimum one-for-one ratio will be required for all losses of stream bed that exceed 3/100-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse environmental effects of the proposed activity are no more than minimal, and provides an activity-specific waiver of this requirement. This compensatory mitigation requirement may be satisfied through the restoration or enhancement of riparian areas next to streams in accordance with paragraph (e) of this general condition. For losses of stream bed of 3/100-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in only minimal adverse environmental effects. Compensatory mitigation for losses of streams should be provided, if practicable, through stream rehabilitation, enhancement, or preservation, since streams are difficult-to-replace resources (see 33 CFR 332.3(e)(3)).

(e) Compensatory mitigation plans for NWP activities in or near streams or other open waters will normally include a requirement for the restoration or enhancement, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, the restoration or maintenance/protection of riparian areas may be the only compensatory mitigation required. If restoring riparian areas involves planting vegetation, only native species should be planted. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. If it is not possible to restore or maintain/protect a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or maintaining/protecting a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of minimization or compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

(f) Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332.

(1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in no more than minimal adverse environmental effects. For the NWPs, the preferred mechanism for providing compensatory mitigation is mitigation bank credits or in-lieu fee program credits (see 33 CFR 332.3(b)(2) and (3)). However, if an appropriate number and type of mitigation bank or in-lieu credits are not available at the time the PCN is submitted to the district engineer, the district engineer may approve the use of permittee-responsible mitigation.

(2) The amount of compensatory mitigation required by the district engineer must be sufficient to ensure that the authorized activity results in no more than minimal individual and cumulative adverse environmental effects (see 33 CFR 330.1(e)(3)). (See also 33 CFR 332.3(f).)

(3) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, aquatic resource restoration should be the first compensatory mitigation option considered for permittee-responsible mitigation.

(4) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification

request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2) through (14) must be approved by the district engineer before the permittee begins work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)). If permittee-responsible mitigation is the proposed option, and the proposed compensatory mitigation site is located on land in which another federal agency holds an easement, the district engineer will coordinate with that federal agency to determine if proposed compensatory mitigation project is compatible with the terms of the easement.

(5) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan needs to address only the baseline conditions at the impact site and the number of credits to be provided (see 33 CFR 332.4(c)(1)(ii)).

(6) Compensatory mitigation requirements (e.g., resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan (see 33 CFR 332.4(c)(1)(ii)).

(g) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1/2-acre, it cannot be used to authorize any NWP activity resulting in the loss of greater than 1/2-acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that an NWP activity already meeting the established acreage limits also satisfies the no more than minimal impact requirement for the NWPs.

(h) Permittees may propose the use of mitigation banks, in-lieu fee programs, or permittee-responsible mitigation. When developing a compensatory mitigation proposal, the permittee must consider appropriate and practicable options consistent with the framework at 33 CFR 332.3(b). For activities resulting in the loss of marine or estuarine resources, permittee-responsible mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management.

(i) Where certain functions and services of waters of the United States are permanently adversely affected by a regulated activity, such as discharges of dredged or fill material into waters of the United States that will convert a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse environmental effects of the activity to the no more than minimal level.

24. Safety of Impoundment Structures. To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state or federal, dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

25. Water Quality. (a) Where the certifying authority (state, authorized tribe, or EPA, as appropriate) has not previously certified compliance of an NWP with CWA section 401, a CWA section 401 water quality certification for the proposed discharge must be obtained or waived (see 33 CFR 330.4(c)). If the permittee cannot comply with all of the conditions of a water quality certification previously issued by certifying authority for the issuance of the NWP, then the permittee must obtain a water quality certification or waiver for the proposed discharge in order for the activity to be authorized by an NWP.

(b) If the NWP activity requires pre-construction notification and the certifying authority has not previously certified compliance of an NWP with CWA section 401, the proposed discharge is not authorized by an NWP until water quality certification is obtained or waived. If the certifying authority issues a water quality certification for the proposed discharge, the permittee must submit a copy of the certification to the district engineer. The discharge is not authorized by an NWP

until the district engineer has notified the permittee that the water quality certification requirement has been satisfied by the issuance of a water quality certification or a waiver.

(c) The district engineer or certifying authority may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

26. Coastal Zone Management. In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). If the permittee cannot comply with all of the conditions of a coastal zone management consistency concurrence previously issued by the state, then the permittee must obtain an individual coastal zone management consistency concurrence or presumption of concurrence in order for the activity to be authorized by an NWP. The district engineer or a state may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

27. Regional and Case-By-Case Conditions. The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its CWA section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

28. Use of Multiple Nationwide Permits. The use of more than one NWP for a single and complete project is authorized, subject to the following restrictions:

(a) If only one of the NWPs used to authorize the single and complete project has a specified acreage limit, the acreage loss of waters of the United States cannot exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.

(b) If one or more of the NWPs used to authorize the single and complete project has specified acreage limits, the acreage loss of waters of the United States authorized by those NWPs cannot exceed their respective specified acreage limits. For example, if a commercial development is constructed under NWP 39, and the single and complete project includes the filling of an upland ditch authorized by NWP 46, the maximum acreage loss of waters of the United States for the commercial development under NWP 39 cannot exceed 1/2-acre, and the total acreage loss of waters of United States due to the NWP 39 and 46 activities cannot exceed 1 acre.

29. Transfer of Nationwide Permit Verifications. If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature:

"When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below."

(Transferee)

(Date)

30. Compliance Certification. Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and implementation of any required compensatory mitigation. The success of any required permittee-responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include:

(a) A statement that the authorized activity was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions;

(b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a

mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(l)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and

(c) The signature of the permittee certifying the completion of the activity and mitigation.

The completed certification document must be submitted to the district engineer within 30 days of completion of the authorized activity or the implementation of any required compensatory mitigation, whichever occurs later.

31. Activities Affecting Structures or Works Built by the United States. If an NWP activity also requires review by, or permission from, the Corps pursuant to 33 U.S.C. 408 because it will alter or temporarily or permanently occupy or use a U.S. Army Corps of Engineers (USACE) federally authorized Civil Works project (a "USACE project"), the prospective permittee must submit a pre-construction notification. See paragraph (b)(10) of general condition 32. An activity that requires section 408 permission and/or review is not authorized by an NWP until the appropriate Corps office issues the section 408 permission or completes its review to alter, occupy, or use the USACE project, and the district engineer issues a written NWP verification.

32. Pre-Construction Notification. (a) Timing. Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. The request must specify the information needed to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:

(1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or

(2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or are in the vicinity of the activity, or to notify the Corps pursuant to general condition 20 that the activity might have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is "no effect" on listed species or "no potential to cause effects" on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or section 106 of the National Historic Preservation Act (see 33 CFR 330.4(g)) has been completed. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).

(b) Contents of Pre-Construction Notification: The PCN must be in writing and include the following information:

(1) Name, address and telephone numbers of the prospective permittee;

(2) Location of the proposed activity;

(3) Identify the specific NWP or NWP(s) the prospective permittee wants to use to authorize the proposed activity;

(4) (i) A description of the proposed activity; the activity's purpose; direct and indirect adverse environmental effects the activity would cause, including the anticipated amount of loss of wetlands, other special aquatic sites, and other waters expected to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; a description of any proposed mitigation measures intended to reduce

the adverse environmental effects caused by the proposed activity; and any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity, including other separate and distant crossings for linear projects that require Department of the Army authorization but do not require pre-construction notification. The description of the proposed activity and any proposed mitigation measures should be sufficiently detailed to allow the district engineer to determine that the adverse environmental effects of the activity will be no more than minimal and to determine the need for compensatory mitigation or other mitigation measures.

(ii) For linear projects where one or more single and complete crossings require pre-construction notification, the PCN must include the quantity of anticipated losses of wetlands, other special aquatic sites, and other waters for each single and complete crossing of those wetlands, other special aquatic sites, and other waters (including those single and complete crossings authorized by an NWP but do not require PCNs). This information will be used by the district engineer to evaluate the cumulative adverse environmental effects of the proposed linear project, and does not change those non-PCN NWP activities into NWP PCNs.

(iii) Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the activity and when provided results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans);

(5) The PCN must include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial and intermittent streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many wetlands, other special aquatic sites, and other waters. Furthermore, the 45-day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate;

(6) If the proposed activity will result in the loss of greater than 1/10-acre of wetlands or 3/100-acre of stream bed and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse environmental effects are no more than minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.

(7) For non-federal permittees, if any listed species (or species proposed for listing) or designated critical habitat (or critical habitat proposed for such designation) might be affected or is in the vicinity of the activity, or if the activity is located in designated critical habitat (or critical habitat proposed for such designation), the PCN must include the name(s) of those endangered or threatened species (or species proposed for listing) that might be affected by the proposed activity or utilize the designated critical habitat (or critical habitat proposed for such designation) that might be affected by the proposed activity. For NWP activities that require pre-construction notification, Federal permittees must provide documentation demonstrating compliance with the Endangered Species Act;

(8) For non-federal permittees, if the NWP activity might have the potential to cause effects to a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, the PCN must state which historic property might have the potential to be affected by the proposed activity or include a vicinity map indicating the location of the historic property. For NWP activities that require pre-construction notification, Federal permittees must provide documentation demonstrating compliance with section 106 of the National Historic Preservation Act;

(9) For an activity that will occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system while the river is in an official study status, the PCN must identify the Wild and Scenic River or the "study river" (see general condition 16); and

(10) For an NWP activity that requires permission from, or review by, the Corps pursuant to 33 U.S.C. 408 because it will alter or temporarily or permanently occupy or use a U.S. Army Corps of Engineers federally authorized civil works project, the pre-construction

notification must include a statement confirming that the project proponent has submitted a written request for section 408 permission from, or review by, the Corps office having jurisdiction over that USACE project.

(c) Form of Pre-Construction Notification: The nationwide permit pre-construction notification form (Form ENG 6082) should be used for NWP PCNs. A letter containing the required information may also be used. Applicants may provide electronic files of PCNs and supporting materials if the district engineer has established tools and procedures for electronic submittals.

(d) Agency Coordination: (1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the activity's adverse environmental effects so that they are no more than minimal.

(2) Agency coordination is required for: (i) All NWP activities that require pre-construction notification and result in the loss of greater than 1/2-acre of waters of the United States; (ii) NWP 13 activities in excess of 500 linear feet, fills greater than one cubic yard per running foot, or involve discharges of dredged or fill material into special aquatic sites; and (iii) NWP 54 activities in excess of 500 linear feet, or that extend into the waterbody more than 30 feet from the mean low water line in tidal waters or the ordinary high water mark in the Great Lakes.

(3) When agency coordination is required, the district engineer will immediately provide (e.g., via email, facsimile transmission, overnight mail, or other expeditious manner) a copy of the complete PCN to the appropriate Federal or state offices (FWS, state natural resource or water quality agency, EPA, and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will have 10 calendar days from the date the material is transmitted to notify the district engineer via telephone, facsimile transmission, or email that they intend to provide substantive, site-specific comments. The comments must explain why the agency believes the adverse environmental effects will be more than minimal. If so contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the pre-construction notification. The district engineer will fully consider agency comments received within the specified time frame concerning the proposed activity's compliance with the terms and conditions of the NWPs, including the need for mitigation to ensure that the net adverse environmental effects of the proposed activity are no more than minimal. The district engineer will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each pre-construction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.

(4) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.

(5) Applicants are encouraged to provide the Corps with either electronic files or multiple copies of pre-construction notifications to expedite agency coordination.

D. District Engineer's Decision

1. In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. If a project proponent requests authorization by a specific NWP, the district engineer should issue the NWP verification for that activity if it meets the terms and conditions of that NWP, unless he or she determines, after considering mitigation, that the proposed activity will result in more than minimal individual and cumulative adverse effects on the aquatic environment and other aspects of the public interest and exercises discretionary authority to require an individual permit for the proposed activity. For a linear project, this determination will include an evaluation of the single and complete crossings of waters of the United States that require PCNs to determine whether they

individually satisfy the terms and conditions of the NWP(s), as well as the cumulative effects caused by all of the crossings of waters of the United States authorized by an NWP. If an applicant requests a waiver of an applicable limit, as provided for in NWPs 13, 36, or 54, the district engineer will only grant the waiver upon a written determination that the NWP activity will result in only minimal individual and cumulative adverse environmental effects.

2. When making minimal adverse environmental effects determinations the district engineer will consider the direct and indirect effects caused by the NWP activity. He or she will also consider the cumulative adverse environmental effects caused by activities authorized by an NWP and whether those cumulative adverse environmental effects are no more than minimal. The district engineer will also consider site specific factors, such as the environmental setting in the vicinity of the NWP activity, the type of resource that will be affected by the NWP activity, the functions provided by the aquatic resources that will be affected by the NWP activity, the degree or magnitude to which the aquatic resources perform those functions, the extent that aquatic resource functions will be lost as a result of the NWP activity (e.g., partial or complete loss), the duration of the adverse effects (temporary or permanent), the importance of the aquatic resource functions to the region (e.g., watershed or ecoregion), and mitigation required by the district engineer. If an appropriate functional or condition assessment method is available and practicable to use, that assessment method may be used by the district engineer to assist in the minimal adverse environmental effects determination. The district engineer may add case-specific special conditions to the NWP authorization to address site-specific environmental concerns.

3. If the proposed activity requires a PCN and will result in a loss of greater than 1/10-acre of wetlands or 3/100-acre of stream bed, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for NWP activities with smaller impacts, or for impacts to other types of waters. The district engineer will consider any proposed compensatory mitigation or other mitigation measures the applicant has included in the proposal in determining whether the net adverse environmental effects of the proposed activity are no more than minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse environmental effects are no more than minimal, after considering mitigation, the district engineer will notify the permittee and include any activity-specific conditions in the NWP verification the district engineer deems necessary. Conditions for compensatory mitigation requirements must comply with the appropriate provisions at 33 CFR 332.3(k). The district engineer must approve the final mitigation plan before the permittee commences work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will expeditiously review the proposed compensatory mitigation plan. The district engineer must review the proposed compensatory mitigation plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure that the NWP activity results in no more than minimal adverse environmental effects. If the net adverse environmental effects of the NWP activity (after consideration of the mitigation proposal) are determined by the district engineer to be no more than minimal, the district engineer will provide a timely written response to the applicant. The response will state that the NWP activity can proceed under the terms and conditions of the NWP, including any activity-specific conditions added to the NWP authorization by the district engineer.

4. If the district engineer determines that the adverse environmental effects of the proposed activity are more than minimal, then the district engineer will notify the applicant either: (a) That the activity does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit; (b) that the activity is authorized under the NWP subject to the applicant's submission of a mitigation plan that would reduce the adverse environmental effects so that they are no more than minimal; or (c) that the activity is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal

adverse environmental effects, the activity will be authorized within the 45-day PCN period (unless additional time is required to comply with general conditions 18, 20, and/or 31), with activity-specific conditions that state the mitigation requirements. The authorization will include the necessary conceptual or detailed mitigation plan or a requirement that the applicant submit a mitigation plan that would reduce the adverse environmental effects so that they are no more than minimal. When compensatory mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan or has determined that prior approval of a final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation.

E. Further Information

1. District engineers have authority to determine if an activity complies with the terms and conditions of an NWP.

2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.

3. NWPs do not grant any property rights or exclusive privileges.

4. NWPs do not authorize any injury to the property or rights of others.

5. NWPs do not authorize interference with any existing or proposed Federal project (see general condition 31).

F. Definitions

Best management practices (BMPs): Policies, practices, procedures, or structures implemented to mitigate the adverse environmental effects on surface water quality resulting from development. BMPs are categorized as structural or non-structural.

Compensatory mitigation: The restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.

Currently serviceable: Useable as is or with some maintenance, but not so degraded as to essentially require reconstruction.

Direct effects: Effects that are caused by the activity and occur at the same time and place.

Discharge: The term "discharge" means any discharge of dredged or fill material into waters of the United States.

Ecological reference: A model used to plan and design an aquatic habitat and riparian area restoration, enhancement, or establishment activity under NWP 27. An ecological reference may be based on the structure, functions, and dynamics of an aquatic habitat type or a riparian area type that currently exists in the region where the proposed NWP 27 activity is located. Alternatively, an ecological reference may be based on a conceptual model for the aquatic habitat type or riparian area type to be restored, enhanced, or established as a result of the proposed NWP 27 activity. An ecological reference takes into account the range of variation of the aquatic habitat type or riparian area type in the region.

Enhancement: The manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s), but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.

Establishment (creation): The manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site. Establishment results in a gain in aquatic resource area.

High Tide Line: The line of intersection of the land with the water's surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm.

Historic Property: Any prehistoric or historic district, site (including archaeological site), building, structure,

or other object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria (36 CFR part 60).

Independent utility: A test to determine what constitutes a single and complete non-linear project in the Corps Regulatory Program. A project is considered to have independent utility if it would be constructed absent the construction of other projects in the project area. Portions of a multi-phase project that depend upon other phases of the project do not have independent utility. Phases of a project that would be constructed even if the other phases were not built can be considered as separate single and complete projects with independent utility.

Indirect effects: Effects that are caused by the activity and are later in time or farther removed in distance, but are still reasonably foreseeable.

Loss of waters of the United States: Waters of the United States that are permanently adversely affected by filling, flooding, excavation, or drainage because of the regulated activity. The loss of stream bed includes the acres of stream bed that are permanently adversely affected by filling or excavation because of the regulated activity. Permanent adverse effects include permanent discharges of dredged or fill material that change an aquatic area to dry land, increase the bottom elevation of a waterbody, or change the use of a waterbody. The acreage of loss of waters of the United States is a threshold measurement of the impact to jurisdictional waters or wetlands for determining whether a project may qualify for an NWP; it is not a net threshold that is calculated after considering compensatory mitigation that may be used to offset losses of aquatic functions and services. Waters of the United States temporarily filled, flooded, excavated, or drained, but restored to pre-construction contours and elevations after construction, are not included in the measurement of loss of waters of the United States. Impacts resulting from activities that do not require Department of the Army authorization, such as activities eligible for exemptions under section 404(f) of the Clean Water Act, are not considered when calculating the loss of waters of the United States.

Navigable waters: Waters subject to section 10 of the Rivers and Harbors Act of 1899. These waters are defined at 33 CFR part 329.

Non-tidal wetland: A non-tidal wetland is a wetland that is not subject to the ebb and flow of tidal waters. Non-tidal wetlands contiguous to tidal waters are located landward of the high tide line (i.e., spring high tide line).

Open water: For purposes of the NWPs, an open water is any area that in a year with normal patterns of precipitation has water flowing or standing above ground to the extent that an ordinary high water mark can be determined. Aquatic vegetation within the area of flowing or standing water is either non-emergent, sparse, or absent. Vegetated shallows are considered to be open waters. Examples of "open waters" include rivers, streams, lakes, and ponds.

Ordinary High Water Mark: The term ordinary high water mark means that line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

Perennial stream: A perennial stream has surface water flowing continuously year-round during a typical year.

Practicable: Available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

Pre-construction notification: A request submitted by the project proponent to the Corps for confirmation that a particular activity is authorized by nationwide permit. The request may be a permit application, letter, or similar document that includes information about the proposed work and its anticipated environmental effects. Pre-construction notification may be required by the terms and conditions of a nationwide permit, or by regional conditions. A pre-construction notification may be voluntarily submitted in cases where pre-construction notification is not required and the project proponent wants confirmation that the activity is authorized by nationwide permit.

Preservation: The removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those

aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of aquatic resource area or functions.

Re-establishment: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area and functions.

Rehabilitation: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function, but does not result in a gain in aquatic resource area.

Restoration: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided into two categories: Re-establishment and rehabilitation.

Riffle and pool complex: Riffle and pool complexes are special aquatic sites under the 404(b)(1) Guidelines. Riffle and pool complexes sometimes characterize steep gradient sections of streams. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a course substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. A slower stream velocity, a streaming flow, a smooth surface, and a finer substrate characterize pools.

Riparian areas: Riparian areas are lands next to streams, lakes, and estuarine-marine shorelines. Riparian areas are transitional between terrestrial and aquatic ecosystems, through which surface and subsurface hydrology connects riverine, lacustrine, estuarine, and marine waters with their adjacent wetlands, non-wetland waters, or uplands. Riparian areas provide a variety of ecological functions and services and help improve or maintain local water quality. (See general condition 23.)

Shellfish seeding: The placement of shellfish seed and/or suitable substrate to increase shellfish production. Shellfish seed consists of immature individual shellfish or individual shellfish attached to shells or shell fragments (i.e., spat on shell). Suitable substrate may consist of shellfish shells, shell fragments, or other appropriate materials placed into waters for shellfish habitat.

Single and complete linear project: A linear project is a project constructed for the purpose of getting people, goods, or services from a point of origin to a terminal point, which often involves multiple crossings of one or more waterbodies at separate and distant locations. The term "single and complete project" is defined as that portion of the total linear project proposed or accomplished by one owner/developer or partnership or other association of owners/developers that includes all crossings of a single water of the United States (i.e., a single waterbody) at a specific location. For linear projects crossing a single or multiple waterbodies several times at separate and distant locations, each crossing is considered a single and complete project for purposes of NWP authorization. However, individual channels in a braided stream or river, or individual arms of a large, irregularly shaped wetland or lake, etc., are not separate waterbodies, and crossings of such features cannot be considered separately.

Single and complete non-linear project: For non-linear projects, the term "single and complete project" is defined at 33 CFR 330.2(i) as the total project proposed or accomplished by one owner/developer or partnership or other association of owners/developers. A single and complete non-linear project must have independent utility (see definition of "independent utility"). Single and complete non-linear projects may not be "piecemealed" to avoid the limits in an NWP authorization.

Stormwater management: Stormwater management is the mechanism for controlling stormwater runoff for the purposes of reducing downstream erosion, water quality degradation, and flooding and mitigating the adverse effects of changes in land use on the aquatic environment.

Stormwater management facilities: Stormwater management facilities are those facilities, including but not limited to, stormwater retention and detention ponds and best management practices, which retain water for a period of time to control runoff and/or improve the quality (i.e., by reducing the concentration of nutrients, sediments, hazardous substances and other pollutants) of stormwater runoff.

Stream bed: The substrate of the stream channel between the ordinary high water marks. The substrate may be bedrock or inorganic particles that range in size from clay to boulders. Wetlands contiguous to the stream bed, but outside of the ordinary high water marks, are not considered part of the stream bed.

Stream channelization: The manipulation of a stream's course, condition, capacity, or location that causes more than minimal interruption of normal stream processes. A channelized jurisdictional stream remains a water of the United States.

Structure: An object that is arranged in a definite pattern of organization. Examples of structures include, without limitation, any pier, boat dock, boat ramp, wharf, dolphin, weir, boom, breakwater, bulkhead, revetment, riprap, jetty, artificial island, artificial reef, permanent mooring structure, power transmission line, permanently moored floating vessel, piling, aid to navigation, or any other manmade obstacle or obstruction.

Tidal wetland: A tidal wetland is a jurisdictional wetland that is inundated by tidal waters. Tidal waters rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by other waters, wind, or other effects. Tidal wetlands are located channelward of the high tide line.

Tribal lands: Any lands title to which is either: (1) Held in trust by the United States for the benefit of any Indian tribe or individual; or (2) held by any Indian tribe or individual subject to restrictions by the United States against alienation.

Tribal rights: Those rights legally accruing to a tribe or tribes by virtue of inherent sovereign authority, unextinguished aboriginal title, treaty, statute, judicial decisions, executive order or agreement, and that give rise to legally enforceable remedies.

Vegetated shallows: Vegetated shallows are special aquatic sites under the 404(b)(1) Guidelines. They are areas that are permanently inundated and under normal circumstances have rooted aquatic vegetation, such as seagrasses in marine and estuarine systems and a variety of vascular rooted plants in freshwater systems.

Waterbody: For purposes of the NWPs, a waterbody is a "water of the United States." If a wetland is adjacent to a waterbody determined to be a water of the United States, that waterbody and any adjacent wetlands are considered together as a single aquatic unit (see 33 CFR 328.4(c)(2)).

7.0 Missouri DNR 401 Certification and Guidelines for Nationwide Permits

Missouri Department of Natural Resources

CLEAN WATER ACT SECTION 401 WATER QUALITY CERTIFICATION
2021 GENERAL AND SPECIFIC CONDITIONS

Water Protection Program 10/2021

Division of Environmental Quality

Consistent with Section 401 of the Clean Water Act (CWA), 33 U.S.C. § 1341, the Missouri Department of Natural Resources (Department) has designed these precertified conditions to ensure activities carried out in Missouri pursuant to Nationwide Permits (NWPs) authorized by the U.S. Army Corps of Engineers (USACE) will comply with Missouri water quality requirements. Unless otherwise stated, these conditions are in addition to, not a replacement for, any federal requirements or conditions.

The conditions outlined in this programmatic WQC apply to those authorized projects where the project proponent has chosen to accept these conditions instead of pursuing an individual CWA Section 401 Water Quality Certification (WQC) for the following NWPs:

- Only General Conditions apply to projects authorized by NWPs 5, 6, 7, 13, 15, 16, 18, 19, 22, 23, 25, 27, 29, 30, 31, 36, 39, 40, 42, 43, 45, 46, 54, and 59.
- Both General and Specific Conditions apply to projects authorized by NWPs 3, 4, 12, 14, 20, 33, 41, 53, 57, and 58.

Alternatively, a project proponent may apply to the Department for individual WQC if it does not wish to accept the conditions outlined in this document.

NWPs 1, 2, 8, 9, 10, 11, 28, and 35 authorize projects pursuant to Section 10 of the Rivers and Harbors Act of 1899 only. These NWPs do not require CWA Section 401 WQC because they authorize activities which, in the opinion of the USACE, could not reasonably be expected to result in a discharge into waters of the United States. An activity needing only a Section 10 permit may require a WQC if that activity can reasonably be expected to result in any discharge either during construction or operation of the facility. Thus, if the USACE determines the activity is likely to result in a discharge during construction or operation, the Department has discretion to require a WQC for the Section 10 activity. The USACE may advise a Section 10 permit project proponent that it might need a WQC if there is a reasonable expectation that a discharge will occur either during the construction or operation of the project.

Pursuant to Section 644.037, RSMo, the Department shall certify without conditions NWPs as they apply to impacts on wetlands in Missouri. Because NWPs are minimal impact, Missouri does not have water quality standards specific to wetlands, and only the general criteria apply, discharges to wetlands from projects authorized by NWPs will comply with water quality requirements.

Pursuant to Section 644.038, RSMo, the Department shall certify without conditions all NWPs for impacts in all waters of the state for the construction of highways and bridges approved by the Missouri Highway and Transportation Commission. A Memorandum of Understanding between the Missouri Departments of Natural Resources and Transportation contains the requirements by which the Missouri Department of Transportation will design and construct such projects in order to protect the water quality of waters of the state. Therefore, as a result of this side agreement, the Department grants programmatic WQC for all NWPs without conditions for the construction of highways and bridges approved by the Missouri Highway and Transportation Commission, because any discharges from these projects will comply with water quality requirements.

GENERAL CONDITIONS

1. A stream's pattern, profile, and dimension, including but not limited to sinuosity, slope, and channel width, shall be maintained as much as practicable. Streambed gradient shall not be adversely impacted during project construction. No project shall accelerate bed or bank erosion. This will ensure compliance with the Missouri Water Quality Standards general criterion requiring waters to be free from physical, chemical, or hydrologic changes that would impair the natural biological community [10 CSR 20-7.031(4)(H)].

2. Channelization of streams is not allowed under this precertification. Channelization includes but is not limited to reducing the length of the channel, widening the channel for increased water storage or flow, and/or construction of hard structures which concentrate flow. Unless necessary for a stream crossing associated with infrastructure projects and contained within an associated right-of-way, construction easement, or permanent easement, bank stabilization activities only along one bank of a stream are permitted, including but not limited to bank sloping and riprapping. The redirection of flow by excavation of the opposite bank or a streambed is considered a channel modification and is not authorized by this WQC. This will ensure compliance with the Missouri Water Quality Standards general criterion requiring waters to be free from physical, chemical, or hydrologic changes that would impair the natural biological community [10 CSR 20-7.031(4)(H)].

3. No new or expanded wet stormwater retention basins or similar impoundment structures may be constructed unless they are located off-channel. In-channel dry stormwater detention basins are allowable if the stream channel is either temporarily or not adversely affected by the basin. This will ensure compliance with the Missouri Water Quality Standards general criterion requiring waters to be free from physical, chemical, or hydrologic changes that would impair the natural biological community [10 CSR 20-7.031(4)(H)].

4. Only clean, nonpolluting fill shall be used. The following materials are not suitable where contact with water is expected and shall not be used due to their potential to cause violations of the general criteria of Missouri's Water Quality Standards [10 CSR 20-7.031(4)]:
   a. Earthen fill, gravel and broken concrete where the material does not meet the Suitable Material specifications stated in the "Missouri Nationwide Permit Regional Conditions" (https://usace.contentdm.oclc.org/digital/collection/p16021coll11/id/2662/) in locations where erosive flows are expected to occur on a regular basis, such as streambanks and/or lake shorelines.
   b. Asphalt.
   c. Concrete with exposed rebar.
   d. Tires, vehicles or vehicle bodies, and construction or demolition debris are solid waste and are excluded from placement in the waters of the state. Properly sized, broken concrete without exposed rebar is allowed.
   e. Liquid concrete, including grouted riprap, if not placed in forms as part of an engineered structure.
   f. Any material containing chemicals that would result in violation of Missouri Water Quality Standards general criteria [10 CSR 20-7.031(4)] or specific criteria [10 CSR 20-7.031(5)].

5. Waste concrete or concrete rinsate shall be disposed of in a manner that does not result in discharge to any jurisdictional water ways. This will ensure compliance with the Missouri Water Quality Standards general criteria requiring waters be free from unsightly bottom deposits [10 CSR 20-7.031(4)(A)]; substances resulting in toxicity to human, animal, or aquatic life [10 CSR 20-7.031(4)(D)]; and physical, chemical, or hydrologic changes that would impair the natural biological community [10 CSR 20-7.031(4)(H)].

6. Missouri Water Quality Standards antidegradation requirements dictate all appropriate and reasonable Best Management Practices related to erosion and sediment control, project stabilization and prevention of water quality degradation are applied and maintained; for example, preserving vegetation, streambank stability and basic drainage [10 CSR 20-7.031(3)(D)]. Best Management Practices shall be properly installed prior to conducting authorized activities and maintained, repaired and/or replaced as needed during all phases of the project to limit the amount of discharge of water contaminants to waters of the state. The project shall not involve more than normal stormwater or incidental loading of sediment caused by project activities so as to comply with Missouri's general water quality criteria [10 CSR 20-7.031(4)]; https://www.sos.mo.gov/cmsimages/adrules/csr/current/10csr/10c20-7a.pdf

7. Clearing of vegetation and trees shall be the minimum necessary to accomplish the activity except for the removal of invasive or noxious species and placement of ecologically beneficial practices. This will ensure compliance with the Missouri Water Quality Standards antidegradation requirement for Best Management Practices [10 CSR 20-7.031(3)(B)].

8. Care shall be taken to keep machinery out of the water way as much as possible. If work in the water way is unavoidable, it shall be performed in a way that minimizes the duration and amount of any disturbance to banks, substrate and vegetation to prevent increases in turbidity. Fuel, oil and other petroleum products, equipment, construction materials and any solid waste shall not be stored below the ordinary high water mark at any time or in the adjacent flood-prone areas beyond normal working hours. All precautions shall be taken to avoid the release of wastes or fuel to streams and other adjacent waters as a result of this operation. This will ensure compliance with the Missouri Water Quality Standards antidegradation requirement for Best Management Practices [10 CSR 20-7.031(3)(B]) and Missouri Water Quality Standards general criteria requiring waters be free from substances preventing beneficial uses [10 CSR 20-7.031(3)(A)]; substances causing unsightly color or turbidity [10 CSR 20-7.031(4)(C)]; and physical, chemical, or hydrologic changes that would impair the natural biological community [10 CSR 20-7.031(4)(H)].

9. Petroleum products spilled into any water or on the banks where the material may enter waters of the state shall be immediately cleaned up and disposed of properly. Any such spills of petroleum shall be reported as soon as possible, but no later than 24 hours after discovery to the Department of Natural Resources' Environmental Emergency Response number at 573-634-2436 or website at http://dnr.mo.gov/env/esp/esp-eer.htm. This will ensure compliance with Missouri Environmental Improvement Authority to provide for the conservation of state water resources by the prevention of pollution and proper methods of disposal [Section 260.015, RSMo] and Missouri Water Quality Standards general criteria requiring waters be free from substances that prevent maintenance of beneficial uses; cause unsightly bottom deposits, color, turbidity or toxicity; and/or impair the natural biological community [10 CSR 20-7.031(4)(A), -(B), and -(H)].

10. All efforts shall be made to minimize exposure of unprotected soils. To the best of the project proponent's ability, project activity shall be conducted at times of little or no rainfall to limit the amount of overland flow and sediment disturbance caused by heavy equipment. This will ensure compliance with Missouri antidegradation requirements for Best Management Practices [10 CSR 20-7.031(3)(B)].

11. Programmatic WQC is denied for any NWP issued on a water that is listed for a sediment-related impairment, aquatic habitat alteration, channelization, or unknown impairment as listed in the most current Water Quality Report (Section 305(b) Report) at https://dnr.mo.gov/water/what-were-doing/water-planning/quality-standards-impaired-waters-total-maximum-daily-loads/impaired-waters. Although intended to result in minimal impacts, NWP authorizations in these waters may contribute to impairments and result in noncompliance with Missouri's general water quality criteria requiring waters be free from physical, chemical, and hydrologic changes that would impair the natural biological community [10 CSR 20-7.031(4)(H)] or exceedance of Missouri Water Quality Standards specific criteria [10 CSR 20-7.031(5)]. Since WQC General or Specific Conditions cannot be established to address all concerns from the variety of impairments and activities authorized by NWPs, individual review for WQC will be required. Requirements for individual WQC will be determined on a case-by-case basis based on the specific impairments, and additional testing, design, disposal, or BMP considerations may be required.

    To determine the location of the waters noted above, the Department's geospatial data is available upon request, and all published data is available on the Missouri Spatial Data Information Services website at msdis.missouri.edu/. Additional information to identify the project location, including stream reaches with listed impairments or special water designations, may be obtained from the Department's Water Protection Program at 573-522-4502.

12. Programmatic WQC is denied for projects authorized by NWPs 17, 21, 32, 34, 37, 38, 44, 48, 49, 50, 51, 52, 55, and 56. Although intended to result in minimal impacts, these NWPs authorize activities that may contribute to impairments and result in noncompliance with Missouri's general water quality criteria [10 CSR 20-7.031(4)], including the requirement that all waters of the state shall be free from physical, chemical, and hydrologic changes that would impair the natural biological community [10 CSR 20-7.031(4)(H)], or noncompliance with Missouri's specific water quality criteria [10 CSR 20-7.031(5)]. Because programmatic WQC General or Specific Conditions cannot be established to address all concerns from the variety of impairments and activities authorized by these NWPs, the Department requires individual review for WQC for these NWPs. Requirements for individual WQC will be determined on a case-by-case basis based on the specific projects, and additional testing, design, disposal, or BMP considerations may be required.

13. Mitigation for loss of stream resources should be in conformance with the compensatory mitigation guidance currently approved for use in Missouri, including guidance provided by the Missouri Stream Mitigation Method. Stream impacts shall require compensatory mitigation with only instream or riparian corridor credits. Compensatory mitigation shall be within the state of Missouri. This will ensure compliance with the Missouri Water Quality Standards antidegradation requirement for maintenance and protection of designated uses [10 CSR 20-7.031(3)] Mitigation guidance documents can be located online at www.nwk.usace.army.mil/Missions/RegulatoryBranch/StateofMissouri.

SPECIFIC CONDITIONS

14. Nationwide Permit 3 *Maintenance*
    a. Silt, sediment, and debris removal shall be limited to a maximum of 200 LF upstream and 200 LF downstream of structures. This will ensure compliance with the Missouri Water Quality Standards antidegradation requirement for maintenance and protection of designated uses [10 CSR 20-7.031(3)].

15. Nationwide Permit 4 *Fish and Wildlife Harvesting, Enhancement, and Attraction Devices and Activities*
    Any inorganic or extraneous debris, such as may be found on Christmas trees shall be removed to qualify as clean, nonpolluting fill. This will ensure compliance with the Missouri's Water Quality Standards general criteria that waters shall be free from unsightly bottom deposits [10 CSR 20-7.031(4)(A)] and solid waste [10 CSR 20-7.031(4)(I)].

16. Nationwide Permit 12 *Oil and Natural Gas Pipeline Activities*,
    Nationwide Permit 57 *Electric Utility Line and Telecommunications Activities*, and
    Nationwide Permit 58 *Utility Line Activities for Water and Other Substances*
    a. For project crossings that must disturb a water body, work shall be conducted in such a manner as to seal off the work area from flow and minimize sediment transport. Material resulting from the activity shall not be sidecast into waters of the state for more than one month. This will ensure compliance with the Missouri Water Quality Standards antidegradation requirement for Best Management Practices [10 CSR 20-7.031(3)(B) and general criteria requiring waters be free from substances that prevent maintenance of beneficial uses; cause unsightly color, turbidity, or toxicity; and/or impair the natural biological community [10 CSR 20-7.031(4)(B), -(C), and -(H)].
    b. If Horizontal Directional Drilling is used, drilling mud and/or other materials shall not be discharged into waters of the state. Best Management Practices shall be implemented to prevent possible discharges from reaching waters of the state. In the event materials are inadvertently discharged to waters of the state, notification to the Department of Natural Resources is required within 24 hours by calling 573-634-2436. This will ensure compliance with Missouri Water Quality Standards antidegradation requirement for Best Management Practices [10 CSR 20-7.031(3)(B)] and Missouri Environmental Improvement Authority [Section 260.015, RSMo] to provide for the conservation of state air, land and water resources by the prevention of pollution and proper methods of disposal.
    c. Project crossings shall be placed as close to perpendicular as possible and shall be limited to a maximum crossing length of no more than one and one-half times the width of the stream. This will ensure compliance with the Missouri antidegradation requirement for maintenance and protection of designated uses [10 CSR 20-7.031(3)] and Best Management Practices [10 CSR 20-7.031(3)(B)].

17. Nationwide Permit 14 *Linear Transportation Projects*
    a. The permittee shall propose and employ measures to mitigate the removal of impounded sediment (e.g., sand, gravel) in the unstable area upstream of a proposed project to prevent it from being transported downstream and/or construct a notched weir to slow the release of impounded sediment from upstream of the proposed project. This will ensure compliance with the Missouri Water Quality Standards general criteria requiring waters be free from substances causing unsightly color or turbidity [10 CSR 20-7.031(4)(C)] and physical chemical, or hydrologic changes that would impair the natural biological community [10 CSR 20-7.031(4)(H)]. Accumulated gravel may be allowed to naturally deposit into downstream plunge pool voids. Consultation with a hydrologist or other scientist is recommended if the amount of accumulated unconsolidated gravel exceeds the volume of plunge pool voids.
    b. Where this NWP is used to authorize bridge and culvert structures, stream channel work shall be limited to a maximum of 200 feet upstream and a maximum of 200 feet downstream of the bridge or culvert. For purposes of this condition, a channel modification is any activity that alters the width, depth, length and/or sinuosity of a water way. This will ensure compliance with the Missouri antidegradation requirement for maintenance and protection of designated uses [10 CSR 20-7.031(3)] and the Missouri Water Quality Standards general criterion requiring waters be free from physical, chemical, or hydrologic changes that would impair the natural biological community [10 CSR 20-7.031(4)(H)].

18. Nationwide Permit 20 *Response Operations for Oil and Hazardous Substances*
    Oil and hazardous substance releases shall be reported to the Department of Natural Resources' Environmental Emergency Response number at 573-634-2436. Continue to report updates with regard to the containment and cleanup of releases. This will ensure compliance with Missouri Environmental Improvement Authority [Section 260.015, RSMo] to provide for the conservation of state water resources by the prevention of pollution and proper methods of disposal.

19. Nationwide Permit 33 *Temporary Construction, Access and Dewatering*
    a. The use of this NWP shall be limited to impacts of six months or less in duration. This will ensure compliance with the Missouri Water Quality Standards antidegradation requirements for maintenance and protection of designated uses [10 CSR 20-7.031(3)]
    b. Any removal of accumulated sediment (e.g., sand, gravel) upstream of a proposed project shall be limited to the quantity necessary to relieve any obstruction or to protect downstream habitat. The permittee must propose and employ measures to mitigate the removal of impounded sediment in the unstable area upstream of a proposed project to prevent it from being transported downstream and/or construct a notched weir to slow the release of impounded sediment from upstream of the proposed project. This will ensure compliance with the Missouri Water Quality Standards general criteria requiring waters be free from substances causing unsightly color or turbidity [10 CSR 20-7.031(4)(C)] and physical, chemical, or hydrologic changes that would impair the natural biological community [10 CSR 20-7.031(4)(H)].

20. Nationwide Permit 41 *Reshaping Existing Drainage Ditches*
    In-channel disposal of excavated material not used for reshaping activities is prohibited. This will ensure compliance with the Missouri Water Quality Standards antidegradation requirement for Best Management Practices [10 CSR 20-7.031(3)(B) and general criteria requiring waters be free from substances that prevent maintenance of beneficial uses; cause unsightly color, turbidity or toxicity; and/or impair the natural biological community [10 CSR 20-7.031(4)(B), -(C), and -(H)].

21. Nationwide Permit 53 *Removal of Low-Head Dams*
    a. The permittee must propose and employ measures to mitigate the removal of impounded sediment (e.g., sand, gravel) in the unstable area upstream of a proposed project to prevent it from being transported downstream and/or construct a notched weir to slow the release of impounded sediment from upstream of the proposed project. This will ensure compliance with the Missouri Water Quality Standards general criteria requiring waters be free from substances causing unsightly color or turbidity [10 CSR 20-7.031(4)(C)] and physical chemical, or hydrologic changes that would impair the natural biological community [10 CSR 20-7.031(4)(H)]. Accumulated gravel may be allowed to naturally deposit into downstream plunge pool voids. Consultation with a hydrologist or other scientist is recommended if the amount of accumulated unconsolidated gravel exceeds the volume of plunge pool voids.
    b. Stream channel work shall be limited to a maximum of 100 feet upstream and a maximum of 100 feet downstream of the dam. This will ensure compliance with the Missouri Water Quality Standards antidegradation requirement for maintenance and protection of designated uses [10 CSR 20-7.031(3)] and the Missouri Water Quality Standards general criterion requiring waters to be free from physical, chemical, or hydrologic changes that would impair the natural biological community [10 CSR 20-7.031(4)(H)].
    c. Restoration of the stream channel to its former, natural state is authorized. Individual WQC is required for non-natural channel modifications. This will ensure compliance with the Missouri Water Quality Standards general criteria requiring waters be free from physical chemical, or hydrologic changes that would impair the natural biological community [10 CSR 20-7.031(4)(H)]. For purposes of this condition, a channel modification is any activity that alters the width, depth, length and/or sinuosity of a water way.

Unless the Department agrees to an alternative, requests for WQC should be sent electronically to wpsc401cert@dnr.mo.gov [Section 644.026.1(26), RSMo and 10 CSR 20-6.060(5)]. A request for WQC shall include all required information for a complete request for certification in compliance with 40 CFR Part 121. The Department may request additional information prior to providing a WQC decision to ensure Missouri water quality requirements are met, such as a response to comments from the Department, other resource agencies, and/or the public; planned compensatory mitigation; and/or an analysis of practicable alternatives.

An issued WQC, whether programmatically or individually issued, becomes part of and expires with the Section 404 and/or Section 10 permit unless explicitly stated in the WQC.

Acquisition of NWPs and the attendant WQCs shall not be construed or interpreted to imply the requirements for other permits are replaced or superseded, including Clean Water Act Section 402 National Pollutant Discharge Elimination System Permits required under Missouri Clean Water Law [Sections 644.026.1 and 644.051, RSMo] for land disturbance or return water from material deposition. Permits or any other requirements shall remain in effect. Project proponents with questions are encouraged to contact the Department of Natural Resources' regional office in the project area. A regional office map with contact information is located at https://dnr.mo.gov/about-us/division-environmental-quality/regional-office.

Some localities are covered pursuant to Municipal Separate Storm Sewer System Permits with measures to control and possibly treat stormwater. If the project is located within one of these localities, project proponents must comply with all stormwater requirements of the locality's Stormwater Management Plan and any related ordinances. This ensures compliance with CWA Section 402 National Pollutant Discharge Elimination System Permit requirements and the Missouri Clean Water Law [Chapter 644, RSMo].

The Department encourages, but does not require, permittees to consider environmentally-friendly design techniques to include stormwater management strategies that maintain or restore the original site hydrology through infiltration, evaporation, or reuse of stormwater. Designs might include using porous pavement or creating vegetated swales and/or rain gardens. More information can be found at these websites: www.epa.gov/owow/NPS/lid/ and www.lid-stormwater.net/lid_techniques.htm.

The Department encourages the use of native vegetation to protect impacted areas from future water quality concerns. Native vegetation has evolved with Missouri's geology, climate, and wildlife to occur within a region as a result of natural processes rather than human intervention. For areas where direct impacts to streams are to be avoided, the Department recommends a minimum riparian buffer strip width of 50 feet as measured from top of bank.

The Department encourages the use of Horizontal Directional Drilling for stream and wetland crossings when practicable. If properly utilized, Horizontal Directional Drilling is an alternative to more traditional, open-trench methods and can result in significant minimization and/or complete avoidance of aquatic resource impacts.

The following publication provides guidance on how to protect water quality through Best Management Practices on project sites. For more information, please read: "Protecting Water Quality: A field guide to erosion, sediment and stormwater best management practices for development sites in Missouri and Kansas" dated January 2011 and located online at https://dnr.mo.gov/document-search/protecting-water-quality-field-guide.

To help determine if a proposed activity could encounter species or sites of conservation concern within or near a project, including those that have not been recorded, the project proponent is encouraged to visit:

- Missouri Department of Conservation's "Natural Heritage Review" website at https://naturalheritagereview.mdc.mo.gov/.
- U.S. Fish and Wildlife Service's "Information, Planning and Conservation" website at http://ecos.fws.gov/ipac/.

If the proposed project encounters and will potentially affect a species of concern, please promptly report it to the Missouri Department of Conservation and the U.S. Fish and Wildlife Service.

For more information
Missouri Department of Natural Resources
Water Protection Program
P.O. Box 176
Jefferson City, MO 65102-0176
wpsc401cert@dnr.mo.gov
800-361-4827 or 573-522-4502
https://dnr.mo.gov/water

Continuing Authorities Program (CAP) 1135

Clarence Cannon Dam at Mark Twain Lake

Appendix D: Monitoring and Adaptive Management Plan

St. Louis District
Project Sponsor: Missouri Department of Conservation
March 2026

Table of Contents

1 Project Overview 3

2 Objectives 3
2.1 Objective: 3

3 Monitoring Design 4
3.1 Objective: 4

4 Assessment 5

5 Decision-Making 5

6 Contingency Plan 6

1 Project Overview

The tentatively selected plan (TSP) is intended to reduce the regular occurrence of dissolved oxygen (DO) measuring below 5 mg/L to reduce stress on aquatic species and decrease the frequency and size of fish mortality events within the study area. The key feature of the TSP includes placing rock to raise the temperature control weir (TCW) to an elevation of 585 feet.

There are uncertainties related to the physical and/or biological performance of the TSP that could affect the ability to meet the project goals and objectives. Most of the uncertainty related to the TSP revolves around the staging and access area, and the potential for water surface rise with the no-rise analysis being conducted during PED. This project will be monitored following project construction or after initial implementation to inform decision-makers whether: 1) the project is meeting performance measures and should continue as implemented, 2) the project is not meeting performance measures and should be adjusted, or 3) the project has met success criteria and no further monitoring for ecological performance is needed.

USACE Implementation Guidance for Section 1161 (Monitoring Ecosystem Restoration) of the Water Resources Development Act (WRDA) of 2016, and Section 2036 (Mitigation for Fish and Wildlife and Wetlands Losses) of the WRDA 2007 require monitoring sufficient enough to evaluate ecosystem restoration and mitigation success. USACE is required to consider adaptive management (or contingency plans) for ecosystem restoration projects and mitigation projects because they often involve uncertainty that can be reduced through an adaptive management approach. For this project, adaptive management is an appropriate management strategy because there is: 1) uncertainty regarding the outcome of the management measures, 2) an ability to monitor and evaluate the system response to management measures, 3) capacity to learn from monitoring, and 4) the ability to apply a decision to change management if needed.

2 Objectives

An important part of the monitoring and adaptive management plan is the translation of the management goals and objectives developed during the planning process into specific performance measures (sometimes called metrics), success criteria (sometimes called targets), and decision triggers (triggers for implementing a contingency plan or decision). During development of the monitoring and adaptive management plan, the PDT utilized the planning study conceptual model(s) and impact/benefit assessments to define the physical, chemical, biological, and ecological criteria that will be monitored to assess project performance.

2.1 Objective:

Reduce regular occurrences of DO measuring below 5 mg/L to reduce stress on fish species and decrease the frequency and size of fish mortality events within the study area over the period of analysis.

Performance Measures:

1. Temperature Control Weir elevation
2. DO > 5 mg/L

Success Criteria:

- Water quality in-situ real-time monitoring data collected from the site by USACE will be used to determine DO concentrations and temperatures

Monitoring Target	1 Year	5 Year	9 Year
Minimum dissolved oxygen average of 5mg/L or higher at 585 ft. elevation	>5 mg/L	>5 mg/L	>5 mg/L

Monitoring Design:

1. During PED, water quality data and multi-beam bathymetric survey (depth) would be conducted to have the TCW exact elevation.
2. Post-construction water quality data – during year 1 daily monitoring and analyze data monthly. If we met our performance measure every year until year 5, the project can closeout.
3. Multi-beam bathymetric survey (depth) would be conducted to have the TCW exact elevation – year 1 (1-year post construction), year 5 and year 9 (to check if stay at the same elevation).

Decision Trigger and Measure:

Decisions on the implementation of adaptive management actions are informed by the assessment of monitoring results. The information generated by the monitoring plan will be used by USACE and the Sponsor in consultation with other members to guide decisions on adaptive management that may be needed to ensure that the ecosystem restoration project achieves success. The decision triggers criteria by year 9 post construction with the monitoring result:

1. Low DO in the re-regulation pool have been observed
2. Fish mortality events
3. TCW elevation

3 Monitoring Design

The monitoring design for this project includes the minimum monitoring actions necessary to evaluate success of the implemented management measures. It focuses on monitoring the performance measures of the study objective to determine success. Each relevant objective and the associated performance measured are described below, along with information required by USACE guidance.

3.1 Objective:

Performance Measure: See performance measure listed in Section 2.1.

Nature Monitoring: All performance measures listed under the objective would be needed to evaluate the effectiveness of the structure. Additionally, the Sponsor would monitor for any fish mortality event caused by the low DO.

Duration: Water quality data collection would occur throughout the 9-year monitoring period. However, if the USACE Environmental Quality Section implemented a Water Quality Management Plan at Mark Twain Lake, water quality monitoring is expected to continue further into the future.

Periodicity: All water quality data collection would occur daily every 15 minutes and analyzed monthly from May – October to capture before/after summer stratification effects.

Data Analysis and Use: Water quality data collection will be used to inform differences/comparisons between pre-construction and post-construction conditions. Also, the data would be used to refine the TCW structure, if needed.

Costs: Costs associated with the implementing monitoring adaptive management measures were estimated based on currently available data and information developed during the plan formulation process as part of the feasibility study. Since uncertainties remain regarding the TSP, monitoring elements, and adaptive management opportunities, the estimated costs in Table 2 will be refined in PED during the development of the Detailed Monitoring and Adaptive Management Plan. Annual cost for water quality data collection would be $41,550.

Responsibilities: USACE will be responsible for water quality data collection and evaluation, as well as collecting bathymetric surveys to assess the TCW elevation. The Sponsor will be responsible recording fish mortality events caused by low DO. The Sponsor and USACE will be responsible for site inspections and visual observations to assist in overall project success evaluation.

Project Closeout Plan: Closeout of the Project would occur when it is determined that the Project has successfully met the Project success criteria, as described above. Success is considered achieved when the Project objective has been met, or when it is clear that the objective will be met based upon trends. Project success is based on the following:

- Success criteria met;
- Continues site inspections to determine continued Project status; and
- Continued OMRR&R into the future

4 Assessment

Evaluating the monitoring data includes a comparison of the results of the monitoring effort to predictions made in the planning process, and success criteria. The water quality data collected for the performance measures to evaluate effectiveness of the TSP would be quantitively compared to pre-construction conditions and post-construction conditions over time as well as to decision triggers.

5 Decision-Making

This section describes the process whereby the results from monitoring and assessment will be used to make decisions concerning project management. Primary components of the decision-making process include decisions to be made, decision making responsibilities, how the decision-making group operates, how they repost their decisions, and the required timing of decisions in order for potential adjustments to be effective. These components are described in Table 1.

Table 1. Decision-Making Framework

Decisions to be Made	Implement contingency measures
Decision Responsibility	Project PDT, Sponsor, & SWPA

Decisions to be Made	Implement contingency measures
Operation of Decision-Making Group	Virtual meeting would be called to discuss conditions and contingency measures
Reporting of Decisions	Decision would be documented in an MFR
Required Timing for Decisions	Within one week

Once the results of monitoring have been assessed and evaluated, the PDT, Sponsor, and SWPA can decide to: 1) continue the action with no adjustments because performance measures indicate a favorable trajectory, 2) adjust the action using a contingency plan or reformulate the plan by revisiting the planning process, or 3) decide the action is successful and complete based on meeting success criteria.

6 Contingency Plan

To address potential problems with project features, the USACE has identified some potential modifications or different measures that could be implemented. The below table includes a description of potential MAM actions, under what circumstances they would be implemented, an estimated cost for implementation, and identified responsibilities (Table 2). The costs associated with implementing the MAM plans are estimated based on currently available data. The cost estimate of the TCW raise to an elevation of 588 was 4% of the total project cost ($857,000). Mobilization for an action to modify the TCW (adding rock, reshaping, removing rock) was assumed to be approximately $739,000 per event, in FY26 dollars. These cost estimates are preliminary and will be refined during PED.

Table 2. MAM Actions

Action	Performance Indicator	Monitoring Target	Decision Trigger	Cost Estimate	Performing Party
Water Quality Monitoring	Minimum dissolved oxygen (mg/L)	> 5 mg/L	Post-construction fish mortality events observed caused by low DO	$41,550 annually	USACE
TCW Elevation Monitoring	Multi-beam bathymetric survey	585 ft elevation	If the DO is not > 5 mg/L, making sure is at the exact elevation needed	$4,500 every survey	USACE
TCW Raise to 588	-	-	If the DO is not > 5 mg/L & TCW elevation is at design height	$857,000	MDC/USACE
Mobilization	-	-	Dependent on “TCW Raise to 588” trigger	$739,000	MDC/USACE

FINDING OF NO SIGNIFICANT IMPACT

CONTINUING AUTHORITIES PROGRAM (CAP) 1135
FEASIBILITY REPORT

CLARENCE CANNON DAM AT MARK TWAIN LAKE
NEPA ID #: EAXX-202-00-B3P-1770292779

RALLS COUNTY, MISSOURI

The U.S. Army Corps of Engineers (USACE), St. Louis District (District) has conducted an environmental analysis in accordance with the National Environmental Policy Act of 1969, as amended. The draft Integrated Feasibility Report and Environmental Assessment (IFR/EA) dated **DATE OF IFR/EA**, for the CAP 1135 Clarence Cannon at Mark Twain Lake addresses the degraded aquatic ecosystem due to low levels of dissolved oxygen (DO) during summer months, opportunities, and feasibility in Ralls County, Missouri.

The Draft IFR/EA, incorporated herein by reference, evaluated various alternatives that would improve water quality conditions (DO >5mg/L) and reduce ecosystem disruption in the study area. The Tentatively Selected Plan (TSP) is the **National Ecosystem Restoration (NER) Plan** and includes:

- Adding of rock and compacted earth to the existing Temperature Control Weir (TCW) to raise the elevation to 585 feet.
- Construction would consist of placing C-stone from barges by long reach excavators.
- Implementation of Monitoring and Adaptive Management Plan (MAM). Monitoring efforts compare to predictions made in the planning process and success criteria from data collected pre- and post-construction. Monitoring will continue until the project has been determined to be successful based on the identified criteria within the MAM included in Appendix D. Monitoring is expected to last no longer than 10 years.

In addition to a “No Action” plan, three action alternatives were evaluated in the final array of alternatives: Alternative 1, 8a, and 8b. Alternative 1 consists of a Temperature Control Curtain, described as an impermeable curtain mounted in booms with flotation capacity. Alternative 8a is described above; alternative 8b also consists of raising the TCW, but to an elevation of 588 feet. Additional information about the alternatives and their analysis is provided in Section 4.3.5 of the IFR/EA incorporated herein.

For all alternatives, the potential effects were evaluated as appropriate. A summary assessment of the potential effects of the TSP are listed in Table 1:

Table 1: Summary of Potential Effects of the TSP

Resource	Insignificant effects	Insignificant effects as a result of mitigation*	Resource unaffected by action	Positive effects
Hydraulics, Hydrology and Water Control	☒	☐	☐	☐
Aquatic Organisms and Wildlife	☐	☐	☐	☒
Terrestrial Habitat	☒	☐	☐	☐
Wetlands and Water Quality	☐	☐	☐	☒
Hazardous, Toxic and Radioactive Waste	☒	☐	☐	☐
Bald and Golden Eagle	☒	☐	☐	☐
Threatened and Endangered Species	☒	☐	☐	☐
Invasive Species	☒	☐	☐	☐
Recreation and Aesthetics	☐	☐	☐	☒
Traffic and Roadways	☐	☐	☒	☐
Air Quality and Noise Levels	☒	☐	☐	☐
Socioeconomics and Demographics	☐	☐	☒	☐
Cultural and Historic Resources	☐	☐	☒	☐
Tribal Resources	☒	☐	☐	☐

All practicable and appropriate means to avoid or minimize adverse environmental effects were analyzed and incorporated into the TSP. Best management practices (BMPs) as detailed in the IFR/EA will be implemented, if appropriate, to minimize impacts. Best managements practices at the staging area shall be implemented to reduce erosion of disturbed soils and to arrest sedimentation before it enters nearby waterbodies. Any tree removal would be restricted to the winter, between 1 November to 31 March of any given year to avoid and minimize impacts to listed bat species.

No compensatory mitigation is required as part of the TSP.

Public review of the draft IFR/EA and FONSI was completed on **DATE DRAFT IFR/EA AND FONSI REVIEW PERIOD ENDED**. All comments submitted during the public review period were responded to in the Final IFR/EA and FONSI. A 30-day state and agency review of the Final IFR/EA was completed on **DATE SAR PERIOD ENDED**. **PICK OPTION BASED ON RESULTS OF STATE AND AGENCY REVIEW**.

Endangered Species Act:

Pursuant to section 7 of the Endangered Species Act of 1973, as amended, the U.S. Army Corps of Engineers determined that the TSP may affect but is not likely to adversely affect the following federally listed species or adversely modify designated

critical habitat: gray bat, Indiana bat, northern long-eared bat and tricolored bat; and no effect determination for the monarch butterfly and western regal fritillary. To protect the bats, hibernation season for tree removal is from 1 November to 31 March. The U.S. Fish and Wildlife Service (FWS) concurred with the USACEs' determination on **DATE OF CONCURRENCE LETTER**

National Historic Preservation Act:

Pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended, the USACE determined that the TSP has no potential to cause adverse effects on historic properties.

Clean Water Act Section Compliance:

Compliance with Clean Water Act Section 404, and Rivers and Harbors Act Section 10 is achieved under Nationwide Permit (NWP) 27, Aquatic Habitat Restoration, Establishment, and Enhancement Activities. Memorandum for Record (MFR) is found in Appendix C – Clean Water Act of the IFR/EA. All terms and conditions od the NWP 27 shall be implemented to minimize adverse impacts to water quality.

401 WQC OBTAINED:

A general water quality certification pursuant to the Nationwide 27 Permit under section 401 of the Clean Water Act was obtained from the Missouri DNR. All terms and conditions of the water quality certification shall be implemented in order to minimize adverse impacts on water quality.

Other Significant Environmental Compliance:

All applicable environmental laws have been considered and coordination with appropriate agencies and officials has been completed. A Draft Fish and Wildlife Coordination Act Report was obtained from the United States Fish & Wildlife Service on 29 January 2026.

NEPA Certification:

I certify that the resulting IFR/EA represents the following: the USACE's good-faith effort to prioritize documentation of the most important considerations and factors required by NEPA within the congressionally mandated timeline; that this prioritization reflects the USACE's expert judgment; the document is substantially complete; that any considerations addressed briefly or left unaddressed were, in the USACE's judgment, comparatively not of a substantive nature that meaningfully informed the consideration of environmental effects and the resulting decision on how to proceed; and that in the USACE's judgment the analysis contained therein is adequate to inform and reasonably explain the USACE's final decision regarding the proposed federal action.

Finding:

Technical, environmental, economic, and cost effectiveness criteria used in the formulation of alternative plans were those specified in the Water Resources

Council's 1983 Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. All applicable laws, executive orders, regulations, and local government plans were considered in evaluation of alternatives. Based on this report, the reviews by other Federal, State and local agencies, Tribes, input of the public, and the review by my staff, it is my determination that the TSP would not cause significant adverse effects on the quality of the human environment; therefore, preparation of an Environmental Impact Statement is not required.

_____
Date

_____
Andy J. Pannier
Coronel, U.S. Army
District Commander

Continuing Authorities Program (CAP) 1135

Clarence Cannon Dam at Mark Twain Lake

Appendix F: Civil Design

St. Louis District
Project Sponsor: Missouri Department of Conservation
March 2026

Table of Contents

1 Civil Design 3
1.1 General 3
1.2 Computer Aided Design (CAD) 3
1.3 Aerial Imagery 3
1.4 Terrain 3
1.5 Coordinate System and Units 3
1.6 General Assumptions 3
2 Site Access and Staging 4
2.1 Areas under consideration for Access and Staging 4
2.2 Planned Access Point 5
3 Construction Assumptions 6
3.1 Assumed Equipment and Methodology 6
4 Summary of Quantities 7
5 CAD Model Screenshots 9
6 References 10

List of Tables

Table 1: Staging and Access Quantities 8
Table 2: TCW Raise Quantities (C-Stone) 8
Table 3: Risk Areas 8

List of Figures

Figure 1: Access Locations and Project Area 4
Figure 2: Planned Access; Location 3 5
Figure 3: Modular Barge System 7
Figure 4: Plan View and 3D View of TCW at 585' 9
Figure 5: Plan View and 3D View of TCW at 588' 9

1 CIVIL DESIGN

1.1 General

This appendix details the methodology used to design and quantity site features that were selected for the Tentatively Selected Plan (TSP). This document serves as a technical companion to the broader feasibility report.

1.2 Computer Aided Design (CAD)

CAD models were developed in the CAD Program OpenRoads Designer (ORD, 2022 Release 2, Version 10.12.01.51) and version 4.0.40 of the USACE AEC Workspace.

1.3 Aerial Imagery

OpenRoads Designer Bing Imagery was used as the base map for civil design models.

1.4 Terrain

The terrain file used in the model was derived from a May 2025 bathymetric survey collected by the Dam Safety program of the St. Louis District. The forebay, temperature control weir (TCW), and a small portion of the lake upstream of the TCW were collected during this survey.

1.5 Coordinate System and Units

Designed features in ORD are represented in North American Datum (NAD) 1983 StatePlane Missouri East FIPS 2401, North American Vertical Datum 1988 (NAVD88) in units of US Survey Feet.

1.6 General Assumptions

1. C-Stone Revetment is appropriate for raising the weir.
    a. Unit weight: 1.75 tons per cubic yard
    b. Justification: Existing TCW designed for the approximate velocity of 5 feet per second which is below the design velocity of C-Stone. The thickness of the C-Stone is well above the minimum and has a 50% loss factor to account for underwater placement. Design velocities and loss factor will be confirmed in design.
2. Site will require access via land and water
3. All material will remain on site

2 SITE ACCESS AND STAGING

2.1 Areas under consideration for Access and Staging

Figure 1: Access Locations and Project Area

Several locations were considered as potential access and staging areas. The first area is at Ray Behrens Recreation Area Boat Ramp. This location is off of state highway J and is south of Clarence Cannon Dam. This location would result in a one mile transit from the boat ramp to the project location. This is a busy recreational area, and the public uses this ramp to launch boats and access Mark Twain Lake. Additionally, the boat ramp may not be suitable

for the construction of a lower staging area to position an excavator for loading construction material onto the required barges needed to complete project work. Alternatives to the lower staging area include operating the excavator on the boat ramp at a reduced capacity in order to maintain safe operation or requiring the construction barge to have roll-on/roll-off capabilities so that material can be brought directly onto the barge. Furthermore, impacts to the existing recreation infrastructure would incur additional costs for infrastructure repair.

The second location considered for access is the closest of the three and lies directly north of Clarence Cannon Dam. This access is off of state highway J and is approximately 1000 ft away from the project area. The issues with this location, however, include limited space and conflicts with existing instrumentation in the area. The instrumentation is a remote monitoring unit for a system of piezometers and is critical for Dam Safety. The area only has a small flat area suitable for staging that totals approximately a quarter of an acre in size. This would present construction issues due to limited space for staging that would translate to construction inefficiencies. Additionally, there is no established turn off of state highway J and the road geometry in this location could present safety issues for the public and the construction workers. This location would require the construction of a lower staging area for loading barges. The ramp down to the water is in close proximity to the embankment portion of Clarence Cannon Dam and has an approximate range of slopes between 10% and 15%.

2.2 Planned Access Point

Figure 2: Planned Access; Location 3

The third access point is approximately 1750 ft north-west of the project area. There is an established turn off of Highway J and a road to an existing ramp down into the water that is at an approximate grade of 3%. This area would require the construction of a lower staging area to load barges as well requiring tree clearing to establish a main staging area. The established turn off of highway J has appropriate road geometry for safe access of construction personnel. The road from the turn-off to the lake would require minor improvement as it appears to be minimally used and has been overgrown with small vegetation. Approximately half an acre of tree clearing will be required to establish staging here. Overall, this is the preferred access point due to safety, location, and available space. Additionally, choosing this location would limit impacts to recreational activities at Mark Twain Lake.

For this feasibility study, this location is the planned access area; however, all access and staging areas will be reevaluated during the PED phase to ensure access and staging is appropriate for the final design. It will be determined in PED if any additional stabilization or protection measures are needed, such as a non-woven geotextile under access and staging areas.

3 CONSTRUCTION ASSUMPTIONS

Construction means and methods to build the proposed structures will be left to the contractor to encourage solutions that are tailored to site specific conditions, contractor skill sets, and the contractor's resources. For the purpose of this study, assumptions were made to develop the cost estimate:

- Clearing and grubbing of areas associated with staging or access should be kept to a minimum to reduce cost and environmental impacts.
- The ramp at Ray Behrens and the proposed temporary boat ramp are assumed to be of acceptable slope and condition.
- The contractor will be required to use both land and water-based transportation to get the material and equipment to the site as well as install the feature.
- Access from both boat ramps is quantified, but not necessary for project completion if the contactor chooses to use only one point of access.
- Due to the underwater position of the TCW, stone quantities were inflated by a 50% contingency to cover any loss of material during placement, per EM 1110-2-1601.
- A lower staging area will be required if using either of the proposed temporary access points on the north side of Clarence Cannon Dam.
- It is assumed that construction of a lower staging area at the Ray Behrens boat ramp is not acceptable; Instead, a roll-on/roll-off barge with sufficient ramp for loading equipment and materials will be necessary if using Ray Behrens as the primary access and staging area.
- Mooring requirements for the barge needed for construction were not detailed in this study and are expected to be explored fully in design.
- The Ray Behrens Boat Ramp would be used for mobilization of any barges needed for construction, regardless of staging area selected. If it is deemed infeasible to use traditional barges, modular barges may be utilized. The boat ramp at Ray Behrens and the road needed to access it may be damaged during mobilization, regardless of where staging and access is located. If this occurs, impacts to traffic would be extended while concrete repairs take place.

3.1 Assumed Equipment and Methodology

It is assumed that the contractor will use a combination of land and water access. The nature

of the site and these combined methodologies would likely result in lower production rates and increased costs when compared to traditional delivery and placement methods which are not feasible for this site.

Land-based techniques will include access roads and lower staging areas, the use of cranes or long reach excavators for material placement, and trucks for material delivery.

Water-based techniques will include standard barges if possible; however, due to the limited site access it is likely that a commercially available modular barge system will be used for transporting equipment and materials to the location of the TCW for construction.

Modular barge systems can vary in size, but each piece typically ranges in length between 10 and 40 feet and are usually a fixed width between 8 and 10 feet. The height of each barge is approximately 5 feet, with a recommended draft of about 3 feet. The bearing capacity also varies, ranging from 1-30 tons at the maximum recommended draft. The contractor may use these systems with motors to move equipment around the reservoir and may anchor them to create a temporary working platform. The following figure shows and example of equipment that may be used for project construction.

Figure 3: Modular Barge System

4 SUMMARY OF QUANTITIES

Table 1: Staging and Access Quantities

Order	Item	Unit	Staging Alt. 1	Staging Alt. 2	Staging Alt. 3
1	Access Road length	Ft	3,565.30	766.00	2,054.00
2	Area of Roads	Sq. Ft	85,567.15	18,384.00	49,296.00
3	Area of Staging Area(s)	Sq. Ft	97,050.00	3,996.00	92,373.00
4	Area of Crushed Stone	Sq. Ft	182,617.15	22,380.00	141,669.00
5	Geotextile Quantity	Sq Yd	20,290.79	2,486.67	15,741.00
6	Crushed Stone for Staging and Access	Cu. Yd	3,381.80	414.44	2,623.50
7	Area to Restore	Acre	4.19	0.51	2.12
8	Clearing and Grubbing	Acre	0.25	0.00	0.47

Table 2: TCW Raise Quantities (C-Stone)

Elevation	CY	Tons	Tons (Underwater Placement)
588	64799.75	113399.6	170099.349
587	56268.13	98469.22	147703.8308
586	47736.5	83538.88	125308.3125
585	39546.9	69207.08	103810.6125
584	31564.76	55238.32	82857.48266
583	23167.7	40543.48	60815.2125
582	14978.1	26211.68	39317.5125
581	6788.5	11879.88	17819.8125
580	4310.16	7542.78	11314.17

Table 3: Risk Areas

Risk Area	Number
Boat Ramp (SF)	16339
Road off of J to Boat Ramp (SF)	65856

5 CAD MODEL SCREENSHOTS

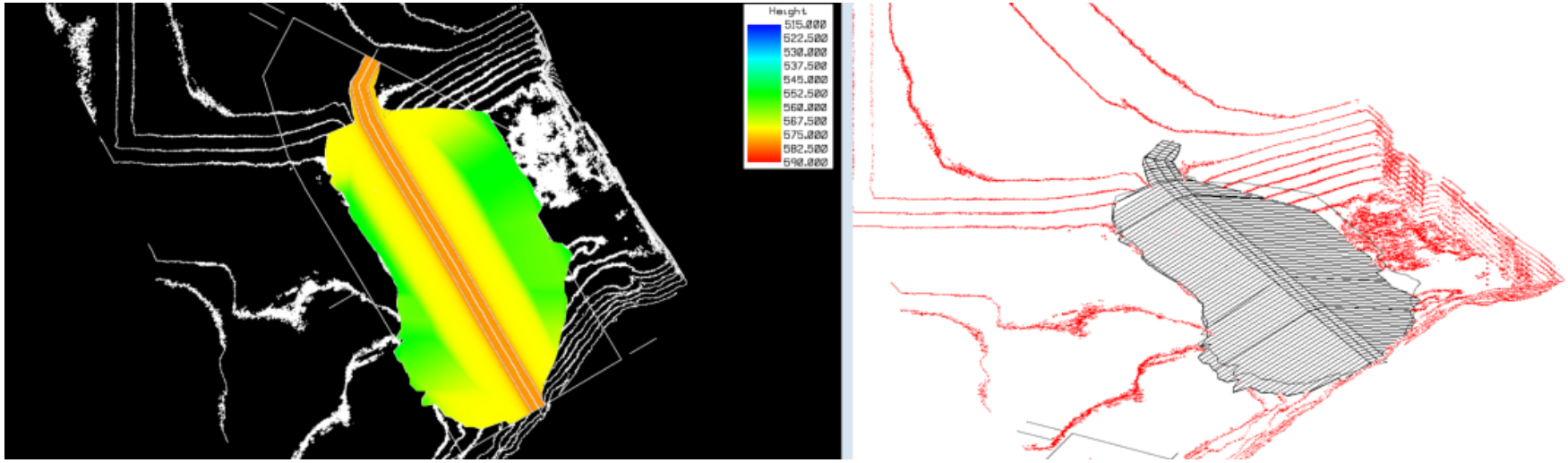


Figure 4: Plan View and 3D View of TCW at 585'

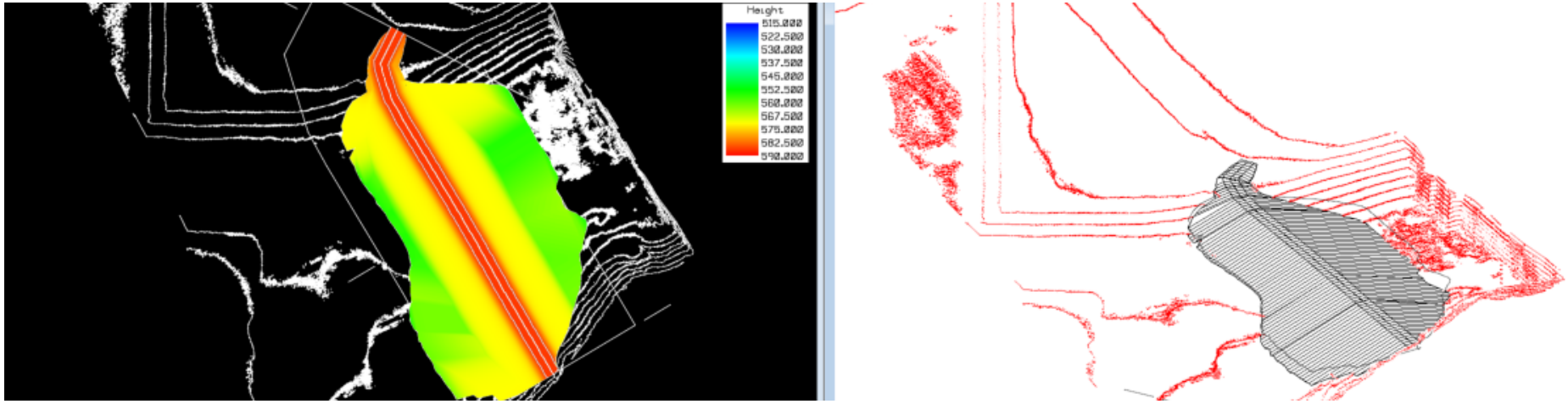


Figure 5: Plan View and 3D View of TCW at 588'

6 REFERENCES

USACE, "EM 1110-2-1601 Hydraulic Design of Flood Control Channels," Washington, DC, 1994.

Continuing Authorities Program (CAP) 1135

Clarence Cannon Dam at Mark Twain Lake

Appendix G: Structural

St. Louis District
Project Sponsor: Missouri Department of Conservation
August 2026

(NOTE: This page intentionally left blank.)

PROJECT: CAP 1135 Clarence Cannon | **Calculated by: Aleris Castaner-Rodriguez**
Subject: Temp control curtain quantities (fixed) | **Checked by: Ryan Holland**

*all prices taken from Whiskeytown Lake project were multiplied by an amplification factor of 1.33 to account for inflation since 2015.

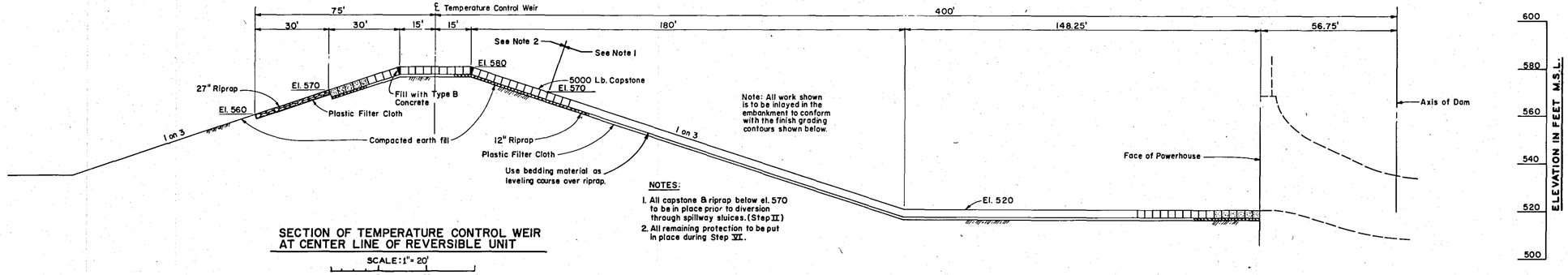
Materials	Length (ft)	Width (ft)	Dimensions	Qty.	Totals	Remarks	Unit price	Amount		Assumptions
Curtain	1000	35		1	1	60 mils Hypalon	$300	$300,000		Curtain only. $300/LF from Lakefield Group manufacturer contact.
							$931	$931,000		Installation. (From Patchwork Installation price schedule Whiskeytown)
Upper boom Buoys/Floating tanks	20	2.5	30" dia.	50	50	steel or equal	$16,946	$847,277		Fabrication only. Assumed and adapted from Whiskeytown project.
Buoys assembly (1 buoy):							$15,941	$797,042		Installation of upper boom floats. Assumed and adapted from Whiskeytown project.
bolts			0.5" x 1'-1/4"	20	1000	Hot dipped galvanized, A307, Grade A				
nuts			0.5"	20	1000	Hex, Hot dipped galvanized (HDG)				
washers				20	1000					
curtain sandwich bar	20		0.25" x 2'-1/2"	1	50	Galvanized steel				
HDPE strip	20		0.25" x 2'-1/2"	1	50	HDPE				
plugs			13" dia.	2	100	1" NPT, SCH 40 STD steel pipe, 13" diameter trumpet opening				
steel dished head			30" dia.	2	100	85% crown radius, 6% knuckle radius				
master link			1/2"	1	50	1/2" Grade 100 Master link, HDG.	$10	$500		
connection link			1/2"	3	150	1/2" Grade 30 connection link,HDG.	$10	$1,500		grainger.com, assumed
lower chain	22		1/2"	1	1100	1/2",HDG, 22' is distance of ea. curtain section between lower boom weighted tanks, 1100 LF	$34	$37,400		
vertical chain	30		1/2"	1	1364	1/2", HDG steel., 1364 LF	$34	$46,364		assumed Grade 80, hoistsdirect.com
upper chain 1	1000		3/4"	1	1000	3/4" Grade 80 long link chain, HDG, length assumed, 1000 is LF	$34	$34,000		hoistsdirect.com
upper chain 2	1000		3/4"	1	1000	3/4" Grade 80 long link chain, HDG, length assumed, 1000 is LF	$34	$34,000		hoistsdirect.com
pull cord	1000			1		cotton, plastic or other fiber 50 lbs tensile strength min.				
Foam (to fill tanks)			ft^3	98.2	4909	Foam to fill tanks, cubic feet	$6,278	$313,905	$566,446	Assumed and adapted from Whiskeytown project, for 120 tanks.
Bumpers				45	45	Assuming there is 1 bumper every 22'	$2,221	$100,945	$4,720	
Assembly:									$400,745	Assumed and adapted from Whiskeytown project, for 240 bumpers.
plate	2.33	1	2" thick	1	45	2' diameter; half circle plate, aluminum			$1,670	
hubs				2	91	welded per AWS D1.2				
shackles			7/8"	2	91	Hot dipped galv., 2 per bumper	$45	$4,091		grainger.com

bolts		1	91	1 bolt per hub			
Lower boom weighted tanks							
Assembly:							
weighted tanks		45	45	Assuming 1 tank every 22', 615 lbs min. wt.	$1,500	$68,182	price per weighted tank assumed
connection links	1/2"	2	91	Grade 30 connection links			

Stabilizing tanks					12	12 total stabilizing tanks			Assuming 1 set of 2 tanks every ~165'
Assembly:							$15,941	$191,290	Installation. Assumed and adapted from Whiskeytown project.
tank cylinder	4	4		1	12	48" diameter tank, ASTM A570, steel sheet 10 gauge wall zrc coated	$14,552	$174,624	Fabrication. Assumed and adapted from Whiskeytown project.
dished head	4	4	3/16"	2	24	48" od, 3/16" min, ASME 60 psi working pressures, ASTM A570 zrc coated			
load bar	5	0.5	1/2"	1	12	1/2"			
reinforcement pad	1	1.25	1/4"	2	24	ASTM A570 steel sheet			
threaded pipe coupling			1"	4	48	1" NPT, SCH 40 steel STD fitting			
pipe plugs			1"	4	48	1" NPT galv.			
shackles			3/4"	7	84	3/4" anchor shackle 40,000lbs min breaking strength, locknut, pin	$155	$13,020	grainger.com, assumed
chain 1	35			1	420	3/4" long link, HDG, 140 is LF	$34	$14,280	
chain 2	250			1	3000	3/4" long link, HDG, (length was assumed)	$34	$102,000	
Stabilizing tanks bottom anchorage									
Assembly:									
concrete/steel boxes	12	12	12"x12"x12"		4	4 total anchorages			
frame channel	12		12"x3", 20.7 lb/ft	4	16	ASTM A36 channel, 12"x3", 20.7 lb/ft, steel, zrc coated	$608	$9,728	metalsdepot.com
cleat angle	2.125		8"x 8"x 1/2", 26.4 lb/ft	11	44	ASTM A36 angle, 8"x 8"x 1/2", 26.4 lb/ft, steel zrc coated	$170	$7,480	
padeye connection	2.666	0.5	1" thick	2	8	ASTM A36 bar, 20.4 lb/ft, steel, zrc coated	$119	$952	
lifting strap	1.65	0.667	1/2" thick	2	8	ASTM A36 bar, 13.6 lb/ft, steel, zrc coated	$56	$448	
rebar 1	12.65		101.2	2	8	#8 rebar, ASTM A615 Grade 60, steel (2.67 lb/ft), 101.2 is LF	$5	$506	
rebar 2	11.9		571.2	12	48	#8 rebar, ASTM A615 Grade 60, steel (2.67 lb/ft)	$5	$2,856	
gusset			1/2" x 3.5"x 3.5"	4	32	2 per padeye connection, ASTMA36 bar, 5.95 lb/ft, steel, zrc coated			
concrete ballast			144 sq. ft	1	4	Standard non structural mix	$10	$40	price per unit assumed
Sand socks						Finished wt of sand sock assembly shall be 40lbs per linear foot			
Tube	10	1	0.120" thick	2	100	0.120 mils Hypalon tube (2 layers of 60 mils), 2 per floating tank, lower boom, 12" inner diam.			from same curtain material
sand		1	7.854	1	785	120 lbs/cu.ft, (ft^3)	$20	$15,708	price of dry all purpose sand assumed based on 60lbs bag (~$7)
grommets			1/2"	20	2000	6" on center, 1/2" diam. hole, Brass			
bolts	0.104		3/8"-16UNC x 1.25" long	20	2000	zinc or cad plated steel grade 2 or equal			
nuts and washers				20	2000	zinc or cad plated steel grade 2 or equal			

Shore anchors

Assembly:					2	2 shore anchors			
									assumed price based on typical price range of
concrete			3.5 cu. yds.	3.5	7	standard mix	$175	$1,225	$150-$350, $350 being for larger projects
#4 rebar			90ft	90	180	ASTM A615 grade 60 steel	$7	$63	$7 is per pound for a 20ft length
leach field rock						3/4" to 1.5" smooth round rock			typically to restore grade, as needed
shackle				1	2	3/4" shackle, bolt pin with locknut, galv. Steel	$155	$310	
pipe	5.833	0.333		1	2	pipe 4" SCH 80, galv. Steel, 5'-10"	$218	$436	midweststeelsupply.com
cap plate	0.667	0.667	8"x8", 1/2" thick	1	2	ASTM A36 steel			
end cap	0.375	0.375	4.5" diam., 1/2" thick	1	2	ASTM A242 steel, high strength low alloy grade, 50k psi min yield strength			
Attachment eye				1	2	ASTM A242 steel, high strength low alloy grade, 50k psi min yield strength			
							Total	$4,051,172	

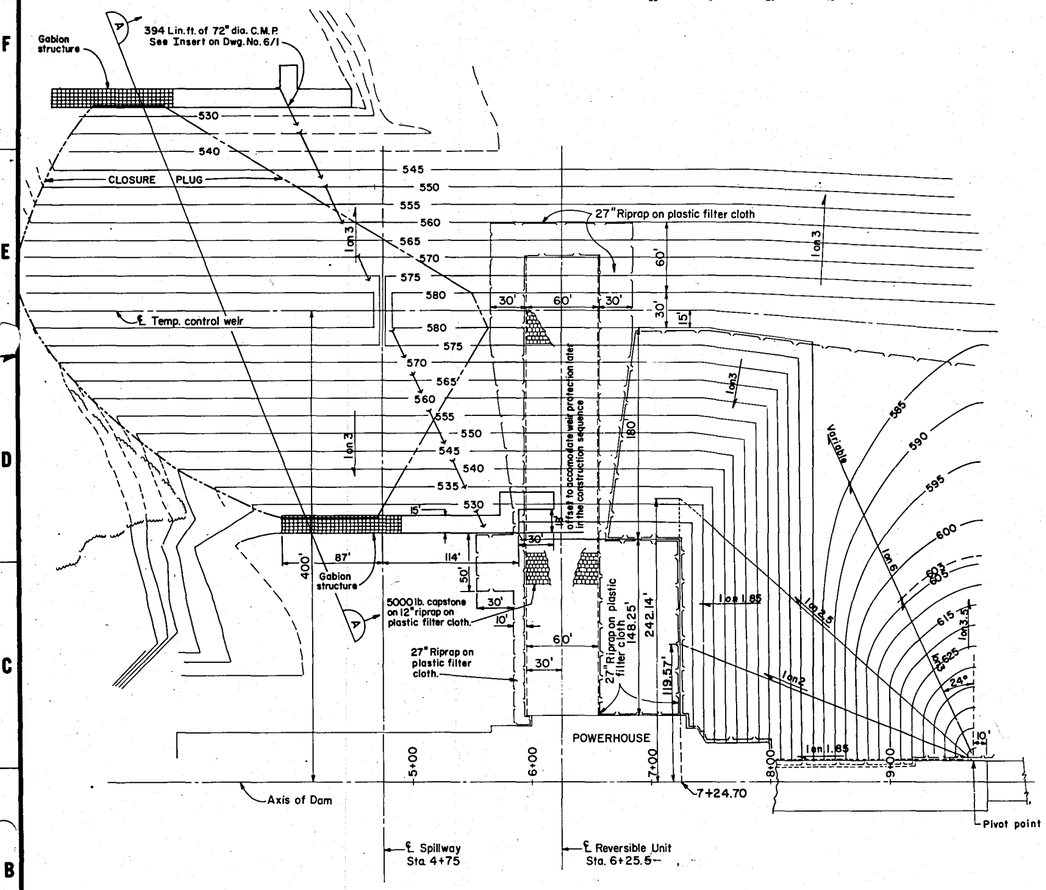


NOTES:

1. All capstone & riprap below el. 570 to be in place prior to diversion through spillway sluices. (Step II)
2. All remaining protection to be put in place during Step VI.

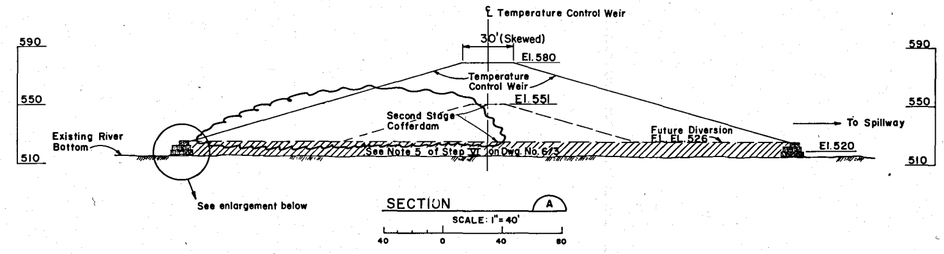
SECTION OF TEMPERATURE CONTROL WEIR AT CENTER LINE OF REVERSIBLE UNIT

SCALE: 1" = 20'



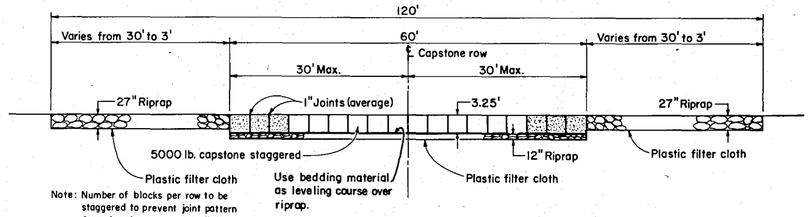
PLAN
TEMPERATURE CONTROL WEIR SHOWING SCOUR PROTECTION

SCALE: 1" = 50'



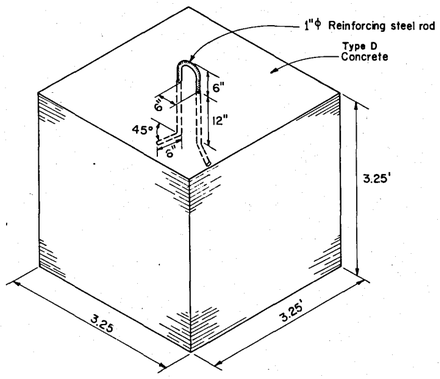
SECTION A

SCALE: 1" = 40'



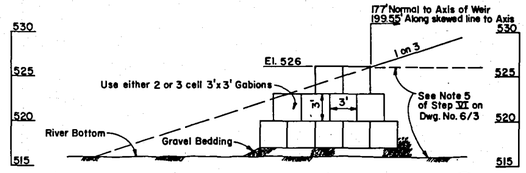
SECTION OF CAPSTONE PROJECTION

SCALE: 1" = 10'



DETAIL OF CAPSTONE

NOT TO SCALE



ENLARGEMENT OF SECTION (A)

NOT TO SCALE

SYMBOL	DESCRIPTION	DATE	APPROVED
4	Changed per Change Order Directive 2X	6/26/75	G.L.D
3	Changed per Change Order Directive 2B	9/20/74	G.L.D.
2	Revised per Modification No.	9/17/73	G.L.D.
1	Revised per Amendment No. 2	3/12/73	W.C.S.

REVISIONS

DESIGNED BY: R.L. CHILDS
DRAWN BY: C.A. MUICK
CHECKED BY: D.J. HAUDRICH
DATE: 27 NOV., 1972

SUBMITTED: Wm. C. Shawhan
HEAD, GENERAL ENGR. SECTION
APPROVED: L. J. Bauman
CHIEF, DESIGN BRANCH
APPROVED FOR THE DIST. ENGR.
CHIEF, ENGINEERING DIVISION

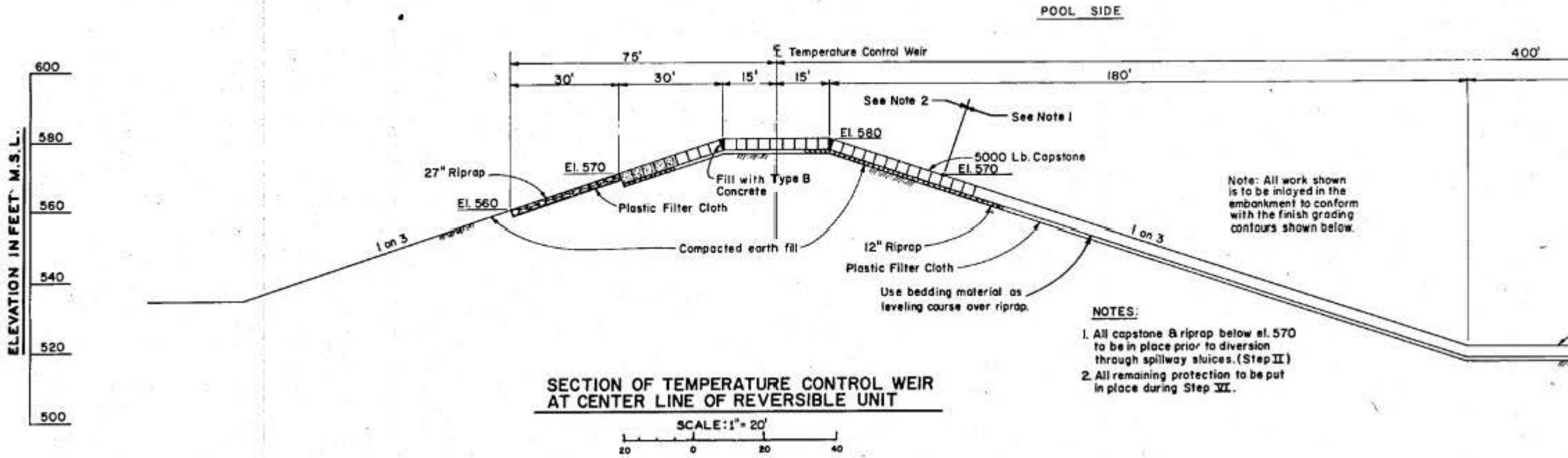
U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

UPPER MISSISSIPPI RIVER BASIN - SALT RIVER, MISSOURI.
CLARENCE CANNON RESERVOIR
MAIN DAM AND SPILLWAY
EMBANKMENT

TEMPERATURE CONTROL FACILITY PLAN AND CROSS-SECTIONS

SIZE	CODE IDENT. NO.	DRAWING NO.
F	DACW 43	S-CC 42/104

SCALE AS SHOWN | INV. NO. DACW 43-73-B-0018 | SHEET 16 OF 29


POOL SIDE
75'
℄ Temperature Control Weir
400'
30'
30'
15'
15'
180'
See Note 2
See Note 1
El. 580
5000 Lb. Capstone
El. 570
27" Riprap
El. 570
Fill with Type B Concrete
El. 560
Plastic Filter Cloth
1 on 3
Compacted earth fill
12" Riprap
Plastic Filter Cloth
Use bedding material as leveling course over riprap.
1 on 3
Note: All work shown is to be inlayed in the embankment to conform with the finish grading contours shown below.
ELEVATION IN FEET M.S.L.
600
580
560
540
520
500
NOTES:
1. All capstone & riprap below el. 570 to be in place prior to diversion through spillway sluices. (Step II)
2. All remaining protection to be put in place during Step VI.
SECTION OF TEMPERATURE CONTROL WEIR AT CENTER LINE OF REVERSIBLE UNIT
SCALE: 1" = 20'
20
0
20
40

RECLAMATION

Managing Water in the West

Contract No. R16PC00134
Solicitation No. R16PS00869
Specifications No. 20-C0852

Whiskeytown Lake
Spring Creek Temperature Control Curtain

Trinity River Division
Central Valley Project, California

U.S. Department of the Interior
Bureau of Reclamation

TABLE OF CONTENTS

SECTION A - Solicitation, Offer and Award Form (SF 1442)

SECTION B - Pricing Schedule

SECTION C - Specifications/Appendices

SECTION D - Packaging and Marking

SECTION E - Inspection and Acceptance

SECTION F - Deliveries or Performance

SECTION G - Contract Administration Data

SECTION H - Special Contract Requirements

SECTION I - Contract Clauses

SECTION J - List of Documents, Exhibits, and Other Attachments

SOLICITATION, OFFER, AND AWARD (Construction, Alteration, or Repair)	1. SOLICITATION NO.	2. TYPE OF SOLICITATION	3. DATE ISSUED	PAGE OF PAGES	
	R16PS00869	☐ SEALED BID (IFB) ☒ NEGOTIATED (RFP)	07/05/2016	1	3

IMPORTANT -- The "offer" section on the reverse must be fully completed by offeror.

4. CONTRACT NO.	5. REQUISITION/PURCHASE REQUEST NO.	6. PROJECT NO.
R16PC00134	0040267112	20-C0852

7. ISSUED BY	CODE	8. ADDRESS OFFER TO
Bureau of Reclamation Mid-Pacific Region Regional Office Division of Acquisition Services 2800 Cottage Way, Room E-1815 Sacramento CA 95825-1898	R20	Bureau of Reclamation - Mid-Pacific Regional Office 2800 Cottage Way, Rm E-1815, Federal Building, Sacramento, California 95825-1898

9. FOR INFORMATION CALL:	a. NAME	b. TELEPHONE NO. *(Include area code) (NO COLLECT CALLS)*
	Erim Celik	916-978-5549

SOLICITATION

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and "bidder."

10. THE GOVERNMENT REQUIRES PERFORMANCE OF THE WORK DESCRIBED IN THESE DOCUMENTS *(Title, identifying no., date)*

A. Title: Whiskeytown Lake Spring Creek Temperature Control Curtain

B. Work Site Location: Work is located 10 miles west of city of Redding and in the Whiskeytown National Recreational Area, Shasta County.

C. Site Visit Information: See Section L, FAR 52.236-27, Site Visit (Construction)Alt 1

D. Estimated Price Range: The estimated cost of construction is between $1,000,000.00 and $5,000,000.00

E. Set-Aside Information: This requirement is restricted to Service-Disabled Veteran-Owned Small Business concerns under NAICS 237990 with the applicable size standard of $36.50 million. FAR Clause 52.219-27, "Notice of Service-Disabled Veteran-Owned Small Business Set-Aside" applies to this requirement.

11. The Contractor shall begin performance 7 calendar days and complete it within 425 calendar days after receiving ☐ award, ☒ notice to proceed. The performance period is ☒ mandatory ☐ negotiable. (See Section F, FAR 52.211-10.)

12a. THE CONTRACTOR MUST FURNISH ANY REQUIRED PERFORMANCE AND PAYMENT BONDS? ☒ YES ☐ NO
(If "YES", indicate within how many calendar days after award in Item 12b.)

12b. CALENDAR DAYS: 10

13. ADDITIONAL SOLICITATION REQUIREMENTS:

a. Sealed offers in original and 0 copies to perform the work required are due at the place specified in Item 8 by 1400 *(hour)* local time 08/04/2016 *(date)*. If this is a sealed bid solicitation, offers will be publicly opened at that time. Sealed envelopes containing offers shall be marked to show the offeror's name and address, the solicitation number, and the date and time offers are due.

b. An offer guarantee ☒ is, ☐ is not required.

c. All offers are subject to the (1) work requirements, and (2) other provisions and clauses incorporated in the solicitation in full text or by reference.

d. Offers providing less than 90 calendar days for Government acceptance after the date offers are due will not be considered and will be rejected.

OFFER *(Must be fully completed by offeror)*

14. NAME AND ADDRESS OF OFFEROR *(Include ZIP Code)*	15. TELEPHONE NO. *(Include area code)*
BCI Construction USA, Inc. 4154 Luther Fowler Rd. Pace FL 32571	850-659-2593
	16. REMITTANCE ADDRESS *(Include only if different than item 14.)* 45 Empire Dr. Belleville IL 62220
CODE FACILITY CODE	

17. The offeror agrees to perform the work required at the prices specified below in strict accordance with the terms of this solicitation, if this offer is accepted by the Government in writing within _____ calendar days after the date offers are due. *(Insert any number equal to or greater than the minimum requirement stated in item 13d. Failure to insert any number means the offeror accepts the minimum in item 13d.)*

AMOUNTS ▶ $1,945,494 Accordance with clarification received from Joan Guenther on 8/18/2016 and attached Schedule B, the verified offer amount is $1,945,494.99.

18. The offeror agrees to furnish any required performance and payment bonds.

19. ACKNOWLEDGEMENT OF AMENDMENTS
(The offeror acknowledges receipt of amendments to the solicitation – give number and date of each)

AMENDMENT NO.	0001	0002								
DATE	8/3/16	8/10/16								

20a. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER *(Type or print)*	20b. SIGNATURE	20c. OFFER DATE
Joan Guenther Secretary	Joan Guenther	8/16/16

AWARD *(To be completed by Government)*

21. ITEMS ACCEPTED

Continued...

22. AMOUNT	23. ACCOUNTING AND APPROPRIATION DATA
$1,945,494.99	See SF1442 Page 3 of 3

24. SUBMIT INVOICES TO ADDRESS SHOWN IN *(4 copies unless otherwise specified)* ▶	ITEM	25. OTHER THAN FULL AND OPEN COMPETITION PURSUANT TO
	See Section G	☐ 10 U.S.C. 2304(c) ( ) ☐ 41 U.S.C. 253(c) ( )

26. ADMINISTERED BY CODE R20	27. PAYMENT WILL BE MADE BY
Bureau of Reclamation Mid-Pacific Region Regional Office Division of Acquisition Services 2800 Cottage Way, Room E-1815 Sacramento CA 95825-1898	Invoice Processing Platform System US Department of Treasury, IAW Section G.

CONTRACTING OFFICER WILL COMPLETE ITEM 28 OR 29 AS APPLICABLE

☐ 28. NEGOTIATED AGREEMENT

(Contractor is required to sign this document and return 0 *copies to issuing office.)*

Contractor agrees to furnish and deliver all items or perform all work requirements identified on this form and any continuation sheets for the consideration stated in this contract. The rights and obligations of the parties to this contract shall be governed by (a) this contract award, (b) the solicitation, and (c) the clauses, representations,

☒ 29. AWARD

(Contractor is not required to sign this document.)

Your offer on this solicitation is hereby accepted as to the items listed. This award consummates the contract, which consists of (a) the Government solicitation and your offer, and (b) this contract award. No further contractual document is necessary.

30a. NAME AND TITLE OF CONTRACTOR OR PERSON AUTHORIZED TO SIGN *(Type or print)*		31a. NAME OF CONTRACTING OFFICER *(Type or print)* Erim Celik	
30b. SIGNATURE	30c. DATE	31b. UNITED STATES OF AMERICA BY	31c. DATE 9/8/2016

NAME OF OFFEROR OR CONTRACTOR
BCI CONSTRUCTION USA, INC.

ITEM NO. (A)	SUPPLIES/SERVICES (B)	QUANTITY (C)	UNIT (D)	UNIT PRICE (E)	AMOUNT (F)
	Legacy Doc #: BOR Payment Terms: AC14 Account Assignment: W G/L Account: 6100.254B0 Business Area: R000 Commitment Item: 254B00 Cost Center: RR02000000 Functional Area: R19100000.000000 Fund: 16XR0680A5 Fund Center: RR02000000 Order: R3309972 PR Acct Assign Line: 01 FOB: Destination				
00010	Whiskeytown Lake, Spring Creek Temperature Control Curtain (Price Schedule CLINS 1 - 8) See following continuation pages Obligated Amount: $1,945,494.99 The total amount of award: $1,945,494.99. The obligation for this award is shown in box 22.	1	AU	$1,945,494.99	$1,945,494.99

CONTINUATION OF
SECTION B – SUPPLIES OR SERVICES AND PRICES

WHISKEYTOWN LAKE
SPRING CREEK
TEMPERATURE CONTROL CURTAIN

B.1 PRICE SCHEDULE

(a) Offers will be considered for award on the following Price Schedule, but no offer will be considered for award on only a part of the Price Schedule.

(b) Offers are subject to the terms and conditions of this solicitation.

(c) Quantities in the Price Schedule are estimated quantities for comparison of offers only. Except as provided in the contract clause at FAR 52.211-18, Variation in Estimated Quantity, no claim shall be made against the Government for overruns or underruns. The contract clause at FAR 52.211-18, Variation in Estimated Quantity does not apply to lump sum items.

(d) See the contract clause at WBR 1452.232-81, Payment for Mobilization and Preparatory Work, for CLIN 1.

(e) Definitions:

(1) CLIN ï Contract Line Item Number.

(2) AU- Activity Unit: AU ï Activity Unit is used solely for the purposes of allowing progress payments under the Department of Interiorôs Financial & Business Management System (FBMS). This line represents the total value for the pricing proposal.

PRICE SCHEDULE

CLIN	Section	Supplies or Services	Quantity and Unit	Unit Price	Amount
1	WBR 1452.232 -81	Mobilization and Preparatory Work	For the lump sum of		$
2	05 50 00	Reconditioning of Tanks and Floats	For the lump sum of		$
3	05 50 00	Replacement and Installation of Chains, Shackles, Load Bar Ends, and End Bumpers	For the lump sum of		
4	06 50 10	Patchwork Installation	200 ln. ft.	$	$
5	35 51 10	Stabilizing Tank Fabrication	3	$	$
6	35 51 10	Upper Boom Floating Tank Fabrication	2	$	$
7	35 51 10	Installation of Tank Filler Material and Reflective Tape	For the lump sum of		$
8	35 51 10	Installation of Tanks, Floats	For the lump sum of		$

TOTAL FOR PRICE SCHEDULE $_____

END OF SUPPLIES OR SERVICES AND PRICES

This page intentionally left blank.

SECTION C - DESCRIPTION / SPECIFICATIONS

TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

01 11 00 Summary of Work
01 14 10 Use of Site
01 32 20 Construction Program
01 33 00 Submittals
01 35 10 Safety Data Sheets
01 35 20 Safety and Health
01 35 22 First Aid and Medical Services
01 35 27 Underwater Work
01 35 30 Contractor's Onsite Safety Personnel
01 42 10 Reference Standards
01 46 00 Quality Procedures
01 51 00 Temporary Utilities
01 55 00 Vehicular Access and Parking
01 55 20 Traffic Control
01 56 15 Protection of Existing Utilities
01 56 32 Temporary Safety Fence
01 57 20 Environmental Controls
01 57 30 Water Pollution Control
01 74 00 Cleaning and Waste Management
01 78 30 Project Record Documents

DIVISION 05 - METALS

05 50 00 Metal Fabrications

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

06 50 10 Temperature Curtain

DIVISION 35 - WATERWAY AND MARINE CONSTRUCTION

35 51 10 Tanks and Floats

DIVISION 52 - DRAWINGS

52 00 00 Drawings

END OF CONTENTS

This page intentionally left blank.

SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 LOCATION

A. Work is located approximately 10 miles west of Redding California in the Whiskeytown National Recreational Area, Shasta County, California.

1.02 PRINCIPAL COMPONENTS OF WORK

A. Conduct Patchwork Repair:

1. Rubber Temperature Control Curtain in Whiskeytown Reservoir. Approximately:
    a. Approximately 200 ln ft. of torn curtain length.

B. Refurbish or Replace:

1. Temperature Curtain Surface Stabilizing Tanks:
    a. All load bar ends.
    b. Damaged anti-corrosion coating.
    c. Fabricate and replace 3 tanks.
    d. Drain tanks and inject filler material.
    e. Attach reflective tape on reservoir side of all stabilizing tanks.
2. Upper Boom Floating Tanks:
    a. Drain floats and inject filler material.
    b. Fabricate and install End Bumpers.
    c. Damaged anti-corrosion coating.
    d. Fabricate and replace 2 tanks.
    e. Attach reflective tape on reservoir side of all upper boom floating tanks.
3. Temperature Curtain support connection system.
    a. Replace chain between Surface Stabilizing Tanks, Upper Boom Floating Tanks, and Anchors.
    b. Replace shackles between Surface Stabilizing Tanks, Upper Boom Floating Tanks, and Anchors.

C. Install all Fabricated, Refurbished, and/ or Repaired components

1.03 SPECIFICATIONS REQUIREMENTS

A. Requirements in Division 1, General Requirements, apply to Divisions 2 through 53.

B. Imperative statements in these specifications are Contractor requirements, unless otherwise stated.

C. Where specifications are written in streamlined form, words “shall be” are included by inference where a colon (:) is used within sentence or phrase.

1.04 DEFINITIONS

A. When specifications use a word or term defined in Federal Acquisition Regulations (FAR), definition of the word or term shall be in accordance with FAR sections in effect at the time solicitation was issued.

1.05 ACRONYMS

A. The following acronyms apply to specifications Divisions 1 through 53:

1. CO: Contracting Officer.
2. COR: Contracting Officer’s Representative.
3. OGR: Onsite Government Representative.
4. CE: Construction Engineer

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 14 10
USE OF SITE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (Reclamation)

1. Technical Memorandum No. 86-68220-07-05, Inspection and Cleaning Manual for Equipment and Vehicles to Prevent the Spread of Invasive Species

a. Available online at: http://www.usbr.gov/mussels/prevention/docs/EquipmentInspectionandCleaningManual2012.pdf

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 14 10-1, Land Use and Landscape Rehabilitation Plan:

1. For each Contractor use area on Parks Service land.

a. Show use location and extent of impact. Uses include but are not limited to the following:

1) Buildings and service areas including offices, shops, warehouses, storage areas, fuel and oil storage areas, and fabrication yards.

2) Parking areas, temporary roads, and haul routes.

3) Utilities including air, power, and water lines; fire hydrants; and compressor station.

4) First-aid facilities.

5) Areas for processing, storing, and disposing of waste materials from construction operations.

6) Temporary fences.

b. Describe methods to preserve, protect, and repair, vegetation (such as trees, shrubs, and grass) and other landscape features on or adjacent to jobsite, which are not to be removed and which do not interfere with work required under this contract. Include methods to mark work area limits, protect disturbed areas, and prevent erosion.

c. Describe methods to protect, and repair if damaged, existing improvements and utilities at or near jobsite.

d. Describe methods for removing temporary structures and facilities, cleanup, and rehabilitating site after completion of construction activities.

2. Submit revised drawings of changes in use of Reclamation land made during design and erection stages or after use of Reclamation land is in operation.

1.04 PROJECT CONDITIONS

A. Reclamation land as shown on drawings may be used for required construction facilities.

1. Contractor may use existing outcropping or beach to access work.
2. The curtain shall be installed next to the existing outcropping off Hwy 299.
3. Clearing, grubbing and minor grading may be required to access curtain installation point.
4. Actual limits will be outlined in the field by the COR during bidders site visit.

B. Elevation of Whiskeytown Lake is subject to change. At lower levels, sunken debris can pose a risk to damaging equipment. It is the contractor's responsibility to be aware of sunken or surfaced debris. Contact OGR for projected lake elevations during construction.

C. Patching of curtain must be during the month of October from 0800 – 1700 due to intake operations.

D. When private land is used for construction facilities, or other construction purposes, make necessary arrangements associated with use of private land. Provide copy of agreement to COR.

E. Location, construction, operation, maintenance, and removal of construction facilities on Reclamation land will be subject to approval of COR.

F. Do not interfere with work of other contractors or Reclamation in vicinity, or with reservations made by Reclamation for use of such land.

G. Housing for construction personnel will not be permitted on Reclamation land, except housing for guards or watchmen as may be approved by COR.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 CLEANING

A. Construction equipment:

1. Before bringing on site, clean construction equipment to remove dirt, vegetation, and other organic material to prevent introduction of noxious weeds, and invasive plant and animal species.
2. Contractor cleaning procedures shall result in equipment being cleaned as well or better than the procedures described in the Inspection and Cleaning Manual.
3. COR will inspect construction equipment following procedures described in Cleaning Manual before allowing equipment onsite.

3.02 RESTORATION

A. Restore Contractor use areas to pre-construction condition.

END OF SECTION

This page intentionally left blank.

SECTION 01 32 20
CONSTRUCTION PROGRAM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Developing Baseline Schedule: Include in lump sum price offered in the Price Schedule for mobilization and preparatory work.

2. Updating and Using Construction Program: Include as an element of Contractor's overhead.

1.02 DEFINITIONS

A. Schedule: The Critical Path Method (CPM) of planning and scheduling a construction project where activities are arranged based on activity relationships and network calculations determine when activities can be performed and the critical path of the project.

B. Project Calendar(s): Cross reference of numerical work days with calendar days. The project calendar serves as the basis for the day/date conversion and assigns work days and non-workdays.

1.03 REFERENCE STANDARDS

A. Associated General Contractors of America (AGC)

1. AGC Manual-04 Construction Planning and Scheduling Manual

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

1. Furnish database files in format compatible with Oracle Primavera P6 Professional Project Management (release 6.2 or newer) or Microsoft Project (2010 or newer).

2. Upon request, provide information and data used to develop and maintain the Construction Program to the CO.

B. RSN 01 32 20-1, Baseline Schedule:

1. Include:

a. Construction Program/Schedule database.

b. Definition of project calendars.

c. Gantt chart (Bar chart) for project.

d. Activity report including all logic constraints consisting of predecessors, successors, and constraint dates.

C. RSN 01 32 20-2, Updated Schedule:

1. Include:

a. Construction Program database with updated activity and milestone data.

b. Definition of project calendars if revised from baseline calendars.

c. Gantt chart for project.

d. Narrative report specifically stating status of project.

1) If negative float exists, cite specific actions and conditions which caused the "behind schedule" condition and provide proposed course of action to complete the project within the specified delivery time.

2) List of Contractor-initiated changes to the current schedule stating the reason for the action taken and any unresolved issues relating to the Construction Program. Government reserves the right to reject Contractor-initiated changes to the current schedule which negatively impact any Government action which was initiated on the basis of the current schedule.

1.05 SCHEDULE

A. Develop, maintain, and use approved Construction Program to plan, monitor, report, and evaluate accomplishment of work.

B. Prepare construction schedules using Critical Path Method outlined in AGC Manual.

C. Failure to include any element of the work will not release Contractor from completing all required work under the contract.

D. Construction Program:

1. Prepare detailed activity network for accomplishing required work organized by work breakdown structure.

2. Prepare schedule based on required sequence and interdependence of activities.

3. Activities except for Award shall have predecessor activities. Activities except for Contract Complete shall have successor activities.

4. Include work of subcontractors, Government interfaces, and contract milestones.

5. Include contract title, contract number, and Contractor's name on each sheet.

6. Adjust Construction Program/schedule for seasonal weather conditions.

7. Define activities to a level of detail resulting in their durations being no greater than 20 workdays unless otherwise accepted by CO.

    a. Durations for administrative activities (e.g., submittals and reviews, fabrication, manufacturing), or other specific activities identified in the contract will not be subject to the workday limitation.

8. Use durations in units of whole workdays.

9. Include activities for Government reviews and approvals of submittals that are critical to the project completion data.

10. Update schedule with changes directed by contract modifications or approved changes to sequencing.

E. Baseline Schedule:

1. Represents Contractor's as-planned approach to accomplishing the work.

2. Include planned start and completion dates for features of work.

F. Updated Schedule:

1. Enter actual progress.

2. Assign a unique project file name for each schedule update.

G. Contract Change or Delay:

1. Submit a time impact evaluation within 14 days of contract change or delay, showing effects of change order or delay on the progress schedule.

2. Time extensions for performance will be considered only to the extent that the Contractor's current scheduled milestone dates exceed the contract milestone dates.

H. Float is not for the exclusive use by or benefit of either the Government or the Contractor.

I. If in the opinion of the CO, the Contractor falls behind the approved schedule, the Contractor shall take steps necessary to improve its progress, including those that may be required by the CO.

1. The CO may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction plant, and to submit for approval any supplementary schedule or schedules in chart form as the Contracting Officer deems necessary to demonstrate how the approved rate of progress will be regained.

2. Costs for actions required to improve progress will be the responsibility of the Contractor.

1.06 FAILURE TO COMPLY

A. Failure to comply with the requirements of this section shall be grounds for a determination by the CO that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the specified time.

B. The CO may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of this contract.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 33 00
SUBMITTALS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the price schedule for other items of work.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME Y14.1-12	Decimal Inch Drawing Sheet Size and Format

B. National Institute of Building Sciences (NIBS)

1.	NIBS NCS-11	United States National CAD Standards, Version 5

1.03 DEFINITIONS

A. Days: Calendar days.

B. Required Submittal Number (RSN): Identifies items to be submitted together as a complete submittal.

1.04 SUBMITTAL REQUIREMENTS

A. In case of conflict between requirements of this section and requirements included elsewhere in these specifications, requirements included elsewhere take precedence.

B. General:

1. Prepare in English.
2. Label with contract number and title, and RSN.
3. Measurement Units: US Customary Units.

C. Drawings:

1. Minimum Identification in Title Block:
    a. Contract number and title.
    b. Contractor’s or supplier’s title and drawing number.
    c. Date.

2. Reserve 3- by 3-inch space next to title block for review stamps.
3. Size: D size (22 inches by 34 inches) as defined by ASME Y14.1.
4. Draw to scale using computer drafting or drafting equipment, unless otherwise specified.
    a. Computer drafted drawings:
        1) In accordance with NIBS NCS.
        2) Electronic file format: Compatible with AUTOCAD, Version 2010 or later.
    b. Drawing prepared with drafting equipment, when allowed: Lettering shall be neat.
5. Drawings designated as “Government Format” in specifications.
    a. Computer drafted.
    b. Government will provide an electronic AutoCAD format template.
    c. Title block and sheet format:
        1) As shown on standard drawing 40-D-7102.
        2) Government will provide template.
        3) Government will provide specific title block information to be used.
6. Final Drawings:
    a. Computer drafted.
    b. Government will provide an electronic AutoCAD format template.
    c. Show as-built changes, including revision dates made during installation. Indicate changes by clouding.
    d. As-built drawings shall use the Government Drawing Format found on DWG 40-D-7102.
7. Electronic Files: On CD or DVD discs.

D. Product Data:

1. Mark manufacturer's data for commercial products or equipment, such as catalog cut sheets.
    a. Identify manufacturer's name, type, model, size, and characteristics.
    b. Illustrate that product or equipment meets requirements of specifications.
    c. Mark items to be furnished in a manner that will photocopy (no highlighter).
    d. Strike through items that do not apply.

E. Certifications:

1. Certifications by a Registered Professional: Signed and sealed by a California registered professional.
2. Manufacturer's Certifications: Signed by authorized representative of manufacturer.

F. Manuals:

1. Copies:
   a. Printed copies: Bound and indexed.
   b. Electronic copies: Adobe pdf on CD or DVD discs.
      1) Bookmark longer files to assist in navigating file.
2. Contents:
   a. Parts identification lists, lists of special tools, and accessories.
   b. Schematics and wiring diagrams.
   c. Detailed instructions for installing, operating, lubricating, and maintaining equipment.
   d. As-built drawings, photographs, and test records or reports if required by the specifications.

G. Photographs:

1. Prints: Professional quality 8-inch by 10-inch color for each listed view.
   a. Identify with adhesive labels on back.
      1) Include contract number, name of equipment and view title.
      2) Do not type directly on back of photograph.
2. Include negatives, or digital files on CD or DVD in .jpeg or similar format.

1.05 SUBMITTALS PROCEDURES

A. Submit only checked submittals. Submittals without evidence of Contractor's approval will be returned for resubmission.

B. Submit complete sets of required materials for each RSN as specified in "Submittals Required" column in Table 01 33 00A - List of Submittals. A complete set includes all listed items for RSNs with multiple parts.

C. Submit sets specified in "Sets to be sent:" columns in Table 01 33 00A - List of Submittals.

D. Include the following information in transmittal letters.

1. Contract number and title.
2. RSN for each attached submittal.

3. Responsible code.
4. Number of sets for each RSN.
5. Identify submittal as initial or resubmittal.

E. Resubmittal of submittals not approved.

1. Mark changes such that they are readily identifiable and show revision date.
2. Describe reasons for significant changes in transmittal letter.
3. Resubmit returned submittals within 7 days after receiving the comments, unless otherwise directed.
4. Requirements for initial submittals apply to resubmittals.

F. More than one RSN may be submitted under a transmittal letter, provided the responsible code is the same.

1.06 REVIEW OF SUBMITTALS

A. Time Required:

1. Submittal review will require 21 days for review of each submittal or resubmittal, unless otherwise specified.
2. For submittals and resubmittals: Time required for review of each submittal or resubmittal begins when complete sets of materials required for a particular RSN are received and extends through return mailing postmark date.

B. Time in Excess of Specified:

1. The CO may extend the contract completion date to allow additional time for completing work affected by excess review time.
    a. The time extension will be to the extent that excess review time caused delay to the contract completion date.
    b. The time extension will not exceed the time used in excess of the specified number of days for review of submittals or resubmittals.
    c. Concurrent days of excess review time resulting from review of two or more separate submittals or resubmittals will be counted only once in extending the contract completion date.
2. No time extension will be allowed if the Contractor fails to make complete action submittals in sequence and within time periods specified.
3. Adjustment for delay will be made only to the extent that:
    a. Approval was required under the contract.
    b. Requests for approval were properly and timely submitted and were approved.

4. Adjustment will be subject to terms of paragraphs (b) and (c) of the clause at FAR 52.242-14, Suspension of Work; however, no such delay shall be deemed to be a "suspension order" as the term is used in that clause.

C. Return of Submittals:

1. With the exception of RSNs 01 32 20-1, 01 32 20-2, and 01 35 20-1one set of submittals will be returned either approved, approved subject to identified changes, or not approved. RSNs 01 32 20-1, 01 32 20-2, and 01 35 20-1 will be returned either accepted, accepted to identified changes, or not accepted.

a. Revise and resubmit submittals not approved or not accepted.

1.07 HARD COPY TRANSMITTALS

A. Addresses for codes listed in Table 01 33 00A - List of Submittals.

1. Construction Engineer (CE), Bureau of Reclamation, P.O. Box 988, Willows, CA 95988-0988. Street address for express mail delivery: MP Construction Office, 1140 West Wood St., Willows, CA 95988.

2. Regional Engineer, Bureau of Reclamation, 2800 Cottage Way, Sacramento CA 95825-1898, Attention: MP-210.

3. Onsite Government Representative (OGR)- Address will be furnished after award of contract.

4. Northern California Area Office (AM), Bureau of Reclamation, Attn NC-100, 16349 Shasta Dam Blvd, Shasta Lake, CA 96019.

B. If submittal is to be sent via hardcopy, send original transmittal letter with appropriate number of sets to office listed in "Responsible Code" column in Table 01 33 00A - List of Submittals.

C. Send copy of transmittal letter with appropriate number of sets to offices that are not the responsible code, but show "Sets to be sent" in Table 01 33 00A - List of Submittals.

D. When "Sets to be sent" is 0, send a copy of transmittal letter to that office.

E. Submittals required by the specifications, but not listed in Table 01 33 00A - List of Submittals.

1. Submit in accordance with this section.

2. Submit to Construction Engineer unless otherwise specified.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

Table 01 33 00A. - List of Submittals

* CE indicates Construction Engineer, OGR indicates Onsite Government Representative, AM indicates Area Manager, and RE indicates Regional Engineer.

RSN	Clause or Section Title	Submittals required	Due date or delivery time	Respon-sible code	No. of sets to be sent to: *			
					CE	OGR	AM	RE
01 14 10-1	Use of Site	Land Use and Landscape Rehabilitation Plan	At least 28 days before use of Government land	CE	3	1	1	1
01 32 20-1	Construction Program	Baseline Schedule	Within 10 days after receipt of Award of Contract	CE	3	1	1	1
01 32 20-2	Construction Program	Updated Schedule	With monthly requests for progress payments	CE	3	1	1	1
01 35 10-1	Safety Data Sheets	Complete LHM and SDS	Submitted for acceptance at least 14 days before jobsite delivery of hazardous material	CE	3	1	1	1
01 35 10-2	Safety Data Sheets	Updated LHM and SDS	Submitted for acceptance at least 14 days before jobsite delivery of hazardous material not previously listed	CE	3	1	1	1
01 35 20-1	Safety and Health	Safety Program	Submitted and accepted before commencing onsite mobilization. See section 3 of RSHS	CE	3	1	1	1
01 35 20-2	Safety and Health	Monthly Accident Summary Report	Submitted for acceptance at least once each month	CE	3	1	1	1
01 35 27-1	Underwater Work	Comprehensive Diving Plan	At least 30 days before commencing mobilization or fabricating curtain or floats whichever is first	CE	3	1	1	1
01 35 27-2	Underwater Work	Daily Diving Plan	Daily while diving	CE	3	1	1	1
01 35 27-3	Underwater Work	Video Recordings	Within 14 days of completion of work	CE	3	1	1	1
01 35 27-4	Underwater Work	Anchor Inspection	At least 21 days before commencing on site repair work	CE	3	1	1	1
01 35 30-1	Contractor‘s Onsite Safety Personnel	Resume	Submitted for acceptance prior to employment	CE	3	1	1	1
01 35 30-2	Contractor’s Onsite Safety Personnel	Safety Inspection Reports	Submitted for acceptance at least once each week	CE	3	1	1	1

Table 01 33 00A. - List of Submittals

* CE indicates Construction Engineer, OGR indicates Onsite Government Representative, AM indicates Area Manager, and RE indicates Regional Engineer.

RSN	Clause or Section Title	Submittals required	Due date or delivery time	Respon-sible code	No. of sets to be sent to: *			
					CE	OGR	AM	RE
01 55 00-1	Vehicular Access and Parking	Initial Digital Recording of National Park Service Parking Lot	At least 21 days before commencing on site construction work	CE	3	1	1	1
01 55 00-2	Vehicular Access and Parking	Post Digital Recording of National Park Service Parking Lot	No more than 14 days after completing on-site work	CE	3	1	1	1
01 55 00-3	Vehicular Access and Parking	Post Repair Digital Recording of National Park Service Parking Lot	No more than 14 days after completing repair work	CE	3	1	1	1
01 55 20-1	Traffic Control	Traffic Control Plan	At least 28 days prior to mobilization	CE	3	1	1	1
01 57 30-1	Water Pollution Control	Spill Prevention, Control, and Countermeasure (SPCC) Plan	At least 28 days before delivery or storage of oil	CE	3	1	1	1
01 74 00-1	Cleaning and Waste Management	Waste Production and Disposal Plan	Within 7 days of waste disposal	CE	3	1	1	1
01 74 00-2	Cleaning and Waste Management	Waste Production and Disposal Records	Within 7 days of waste disposal	CE	3	1	1	1
01 78 30-1	Project Record Documents	Progress As-built Drawings	Within 14 days of completion of a particular structure or work is completed	CE	3	1	1	1
01 78 30-2	Project Record Documents	Final As-built Drawings	Within 14 days of completion of work	CE	3	1	1	1
01 78 30-3	Project Record Documents	As-built Record of Materials	Within 14 days of completion of work	CE	3	1	1	1
01 78 30-4	Project Record Documents	Warranties	Within 14 days of completion of work	CE	3	1	1	1
05 50 00-1	Metal Fabrications	Approval Data	At least 28 days prior to reconditioning work	RE	1	1	1	3
05 50 00-2	Metal Fabrications	Stabilizing Tank Load Bar	At least 28 days prior to replacement work	RE	1	1	1	3
05 50 00-3	Metal Fabrications	Upper Boom Floating Tank End Bumper	At least 28 days prior to replacement work	RE	1	1	1	3
05 50 00-4	Metal Fabrications	Replacement Metalwork	At least 28 days prior to replacement work	RE	1	1	1	3
06 50 10-1	Temperature Curtain	Curtain Repair Plan	At least 28 days prior to fabricating curtain	CE	3	1	1	1

Table 01 33 00A. - List of Submittals

* CE indicates Construction Engineer, OGR indicates Onsite Government Representative, AM indicates Area Manager, and RE indicates Regional Engineer.

RSN	Clause or Section Title	Submittals required	Due date or delivery time	Respon-sible code	No. of sets to be sent to: *			
					CE	OGR	AM	RE
06 50 10-2	Temperature Curtain	Curtain Repair Drawings	At least 28 days prior to fabricating curtain	RE	1	1	1	3
35 51 10-1	Tanks and Floats	Equipment Procedures	At least 35 days before fabricating stabilizing tanks	CE	3	1	1	1
35 51 10-2	Tanks and Floats	Approval Data	At least 35 days before fabricating stabilizing tanks	RE	1	1	1	3
35 51 10-3	Tanks and Floats	Filler Material	At least 35 days before injecting filler material	CE	3	1	1	1
35 51 10-4	Tanks and Floats	Reflective Tape	At least 35 days before attaching reflective tape	RE	1	1	1	3

END OF SECTION

This page intentionally left blank.

SECTION 01 35 10
SAFETY DATA SHEETS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work.

1.02 DEFINITIONS

A. LHM: List of Hazardous Materials.

B. SDS: Safety Data Sheet.

1. Referred to as Material Safety Data Sheets in the clause at 52.223-3, Hazardous Material Identifications and Material Safety Data - Alternate 1.

1.03 APPLICATION

A. For the purposes of this contract, “delivered under this contract” in paragraph (b) of the clause at FAR 52.223-3, Hazardous Material Identification and Material Safety Data - Alternate 1, includes:

1. Materials delivered to Government.

2. Materials incorporated into work.

3. Materials used by the Contractor during contract performance at the jobsite.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 35 10-1, Complete LHM and SDS.

C. RSN 01 35 10-2, Updated LHM and SDS:

1. Comply with paragraph (e) of clause at FAR 52.223-3, Hazardous Material Identification and Material Safety Data - Alternate 1.

1.05 DELIVERY

A. Do not deliver hazardous materials to jobsite which are not included on original or previously updated LHM and SDS before receipt of updated LHM and SDS by COR.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 35 20
SAFETY AND HEALTH

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost: Include in prices offered in the Price Schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (Reclamation)

1. Reclamation Safety and Health Standards (RSHS), including revisions posted at http://www.usbr.gov/ssle/safety/RSHS/rshs.html.

B. Occupational Safety and Health Administration (OSHA)

1. 29 CFR Part 1910 OSHA General Industry Standards
2. 29 CFR Part 1926 OSHA Construction Industry Regulations
3. Available online at: https://www.osha.gov/.

C. Applicable State Safety and Health Regulations – CAL/OSHA

1. California Code of Regulations (CCR) Title 8
2. Available online at: https://www.dir.ca.gov/title8/index/T8index.asp.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 35 20-1, Safety Program:

1. Written Safety Program in accordance with Section 3 of the RSHS.
2. Cover all aspects of on site and applicable off site operations and activities associated with this contract.
3. Program must follow the format of the outline in Appendix B of Reclamation RSHS (included at end of this section).
4. Will not be accepted for review by the COR unless it addresses, in order, lettered and numbered per Appendix B, a narrative for each applicable item in the outline.
    a. For items in the outline that do not apply to this contract write “Not Applicable to Contract” next to the number/letter.
5. Provide a list of Job Hazard Analyses (JHA) for all major or distinct phases of work that will be submitted throughout the project.

6. A generic Company Safety Plan is not acceptable. The Safety Program must be site specific for this contract.

7. The Contractor's Safety Program must be submitted and accepted by Reclamation prior to commencing on site work.

C. RSN 01 35 20-2, Monthly Accident Summary Report:

1. Form 7-2218 or other acceptable form in accordance with paragraph 3.8 of RSHS.

1.04 SAFETY AND HEALTH

A. Do not allow Contractor employees (including subcontractors), Government personnel, or the Public to be exposed to, or work under, conditions which are unsanitary, physically hazardous, or a potential exposure danger to their health or safety during performance of the contract.

B. Under no circumstances will onsite work, including mobilization, be permitted until the Safety Program has been accepted by the COR.

C. Fully participate in a Contractor Safety Program Review meeting, according to RSHS Section 3.4.1, prior to mobilization. If applicable, include subcontractor management representatives.

D. The minimum work crew at any time on the construction site shall consist of no less than two people and shall be in accordance with other contractual obligations.

E. Develop Job Hazard Analysis for each distinct phase of work under the contract.

1. Work shall not begin on the phase of work until a JHA is acceptable to OGR and shared with all construction employees.

2. Activities involving hazardous materials shall have the appropriate Safety Data Sheet(s) attached to the JHA.

F. In addition to requirements of the clause at FAR 52.236-13 "Accident Prevention", fully comply with RSHS.

1. One copy of RSHS, in digital format, will be provided at no charge for use in connection with the specifications.

2. Construction Safety and Health Standards promulgated by the Secretary of Labor may be obtained from any regional or area office of the Occupational Safety and Health Administration of the U.S. Department of Labor.

G. Be cognizant of and ensure compliance with requirements set forth in paragraphs above.

1. Contractor's responsibility applies to all operations, including those of the Contractor's Subcontractors.

2. When violations of safety and health requirements contained in these specifications or referenced standards are called to the Contractor's attention by

the CO, COR or the OGR, immediately correct the condition to which attention has been directed.

3. Either oral or written notice shall be deemed sufficient.

H. When the Contractor fails or refuses to promptly correct a compliance directive, the CO or the COR may issue an order to stop all or any part of the work.

1. When satisfactory corrective action is taken, an order to resume work will be issued.

2. The Contractor shall not be entitled to extension of time, nor to claim for damage or to additional compensation by reason of either the directive or the stop order.

3. Failure of the CO, COR or the OGR to order discontinuance of any or all of the Contractor's operations shall not relieve the Contractor of the responsibility for the safety of personnel and property.

I. Maintain an accurate record of, and report to the COR in the manner prescribed by the CO for all near misses, accidents or incidents, occupational diseases, traumatic injury, cases of death to Contractor employees (including subcontractors), Government personnel, or the Public, and any property damage occurring during the performance of work under this contract.

J. The rights and remedies of the Government provided in this section are in addition to any other rights and remedies provided by law or under this contract.

1. In the event there is a conflict between requirements contained in RSHS, specification paragraphs, Contractor's approved Safety Program, referenced safety and health codes, and standards, or the U.S. Department of Labor Construction Safety and Health Standards, promulgated under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 327 et seq.), as amended, the more protective requirement having jurisdiction shall prevail.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

This page intentionally left blank.

SECTION 01 35 22

FIRST AID AND MEDICAL SERVICES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (USBR)

1.	RSHS	RSHS Reclamation Safety and Health Standards, including revisions posted at http://www.usbr.gov/ssle/safety/RSHS/rshs.html

1.03 FIRST-AID AND MEDICAL SERVICES

A. Provide first-aid kits in accordance with RSHS Section 5.

B. Communications: Provide a direct line of communication, via radio or mobile telephone, with local medical services.

C. Ambulance Service: Arrange for dependable ambulance service in accordance with RSHS Section 5.

1.04 AVAILABILITY

A. Make first-aid facilities and services available for providing emergency aid to employees and subcontractor employees.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

This page intentionally left blank.

SECTION 01 35 27
UNDERWATER WORK

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost: Include cost of performing underwater work in prices offered in Price Schedule for items that require underwater work.

1.02 REFERENCE STANDARDS

A. Association of Diving Contractors International (ADCI)

1. ADCI Standards — Consensus Standards for Commercial Diving and Underwater Operations, 6th Edition

B. Bureau of Reclamation (Reclamation)

1. Reclamation Safety and Health Standards (RSHS), including revisions posted at http://www.usbr.gov/ssle/safety/RSHS/rshs.html

C. Applicable State Safety and Health Regulations – CAL/OSHA

1. California Code of Regulations (CCR) Title 8
2. Available online at: https://www.dir.ca.gov/title8/index/T8index.asp.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 35 27-1, Comprehensive Diving Plan:

1. May be incorporated into safety program.
2. Describe diving equipment, procedures, and work sequence for underwater work.
3. Include company safe diving practices manual.
4. Safe diving plan:
   a. Address specific underwater tasks required to accomplish work.
   b. Identify specific hazards associated with these tasks.
   c. Identify methods to mitigate hazards.
   d. Include diving schedule and table to be used for underwater work. Include profiles, mixed gas table, and altitude corrections.
5. Names and roles of dive crew.

6. Documentation:
    a. Certificate of training as required by RSHS.

C. RSN 01 35 27-2 Daily Diving Plan:
1. List of work activities to be accomplished.

D. RSN 01 35 27-3, Video Recordings:
1. DVD format.
2. High resolution.
3. Enclose each recording in protective case.
4. Label:
    a. Contract number and title.
    b. Contractor's name.
    c. Date the recording was made.
5. Preface video recording with label information.
6. Include brief written description of work shown on recording.

E. RSN 01 35 27-4, Anchor Inspection:
1. Conduct appropriate underwater work to report on:
    a. Condition of current lake anchors

1.04 PROJECT CONDITIONS

A. Conform to requirements of RSHS, Cal/OSHA Title 8 and ADCI Standards.
1. In event of conflict between standards, more stringent or restrictive standard shall apply.

B. Do not deliver diving equipment to jobsite until Comprehensive Diving Plan has been approved by COR.

C. Diving Equipment:
1. Diving helmets:
    a. Equip with lighting.
    b. Helmet-mounted underwater camera: Capable of providing clear images of underwater work at all times.
    c. Two-way communication system between divers and surface: Always operational.
2. SCUBA diving: Not permitted, except for dives not involving physical work, for example video inspections.

D. Typical Non-Precipitant Diving Conditions:

1. Visibility: Approximately 15 feet.
2. Dive depth: Up to 140 feet depending on lake levels.
3. Flows: Varies depending on operation of Spring Creek Powerplant.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 DIVING OPERATIONS

A. Diving operations that may be performed by Contractor include, but are not limited to following work:

1. Jobsite survey.
2. Installation of curtain floats and temperature control curtain.
3. Connection of chains and shackles.

3.02 RECORDS

A. Obtain as-built dimensions and elevations of existing facilities and new construction.

B. Video record underwater surveying, construction, inspection, testing, and adjusting. Monitor in real-time at surface.

1. Show actual construction methods and equipment used to accomplish work.

END OF SECTION

This page intentionally left blank.

SECTION 01 35 30

CONTRACTOR'S ONSITE SAFETY PERSONNEL

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost: Include in prices offered in the Price Schedule for other items of work.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 35 30-1, Resume:

1. Contractor's Onsite Safety Representative
2. Safety Professional.

C. RSN 01 35 30-2, Safety Inspection Reports:

1. Include a list of noted deficiencies, their abatement dates, and follow-up action for all jobsite activities.
2. Base inspection report on findings of jobsite walk-through with Government personnel.

1.03 QUALIFICATIONS

A. Contractor's Onsite Safety Representative:

1. Competent person, can be supervisory employee, with appropriate level of safety related training and experience. Safety responsibility may be adjunct, collateral or ancillary to their duties. Their main job duties may be leadership, supervision, or management in a craft, trade, or technical specialty.
2. Has completed at a minimum an OSHA recognized 30 hour Construction Safety Training program and has a minimum of 3 years of experience on similar projects in size and complexity to this contract. Experience should include dealing with the day to day operations and functionality of equipment operations not just occasional safety inspection site visits.

B. Safety Professional:

1. Holds professional status in the safety field by virtue of education, training, certification and experience. Responsibility must be the prevention of harm to people, property, and the environment, rather than responsibility for responding to harmful events. Examples of appropriate qualifications include:
    a. Holds Safety certification from organizations accredited by the National Commission for Certifying Agencies (NCCA), the Council of Engineering

and Scientific Specialty Boards (CESB), or a nationally recognized accrediting body which uses certification criteria equal to or greater than that of the NCCA or CESB.

b. Holds current certification as Certified Safety Professional (CSP), Associate Safety Professional (ASP), Occupational Health and Safety Technologist (OHST), Construction Health & Safety Technician (CHST) or equivalent with safety experience of a progressive nature on similar projects in size and complexity to this contract.

c. Holds a degree in Occupational Safety and Health: Major study – safety or occupational health related fields.

d. The effectiveness of the Contractor's Safety Professional in the administering and implementation of the safety program will be subject to continued review and approval by the Contracting Officer.

1.04 APPLICATION

A. Designate the Contractor's Onsite Safety Representative prior to start of construction, and employ Safety Professional for part-time on the job.

1. Safety Professional requirements may be met by retaining appropriate level of services of an acceptable safety consultant.

B. Contractor's Onsite Safety Representative authorities, duties, and responsibilities:

1. Responsible for day to day implementation of the Contractor's Safety Program
2. Full authorization to correct unsafe acts on the spot.
3. Prepare safety inspection reports.
4. Onsite during any and all construction activities.

C. Safety Professional duties, and responsibilities:

1. Review and approve, by signature the Contractor's Safety Program prior to submittal.
2. Visit the site on an as-needed basis, but at a minimum of once per week.

1.05 QUALITY ASSURANCE

A. Contractor's Onsite Safety Representative:

1. The effectiveness of the Contractor's Onsite Safety Representative in prosecuting the safety program will be subject to continued review and approval by the CO.
2. Should the Contractor's safety effort be considered inadequate, the CO has the option to require the Contractor to employ a full-time qualified Safety Professional at no cost to the Government.

B. Safety Program:

1. The effectiveness of the Contractor's Safety Program will be subject to continued review and approval by the CO.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

This page intentionally left blank.

SECTION 01 42 10

REFERENCE STANDARDS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost: Include in prices offered in the Price Schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Referenced editions of standard specifications, codes, and manuals form a part of this specification to the extent referenced.

B. These specifications take precedence when conflicting requirements occur between specifications and referenced standard.

1.03 JOBSITE REFERENCE STANDARDS

A. Maintain at fabrication site, access to referenced standard specifications, codes, and manuals required for work in progress at fabrication site. Make available for use by the Government.

B. Maintain onsite, access to referenced standard specifications, codes, and manuals required for onsite work in progress. Make available for use by the Government.

1.04 AVAILABILITY

A. Code of Federal Regulation (CFR):

1. Available online, authorized by the National Archives and Records Administration (NARA) and the Government Printing Office (GPO), at www.gpoaccess.gov/cfr/index.html.

B. Federal Specifications, Standards, and Commercial Item Descriptions:

1. Copies of Federal Specifications, Standards, and Commercial Item Descriptions may be obtained from GSA Federal Supply Service, see the provision at FAR 52.211-1, Availability of Specifications Listed in the GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29.

C. Bureau of Reclamation Documents:

1. Reclamation Safety and Health Standards (RSHS), including revisions, may be downloaded at http://www.usbr.gov/ssle/safety/RSHS/rshs.html.

2. Bureau of Reclamation Standard Specifications are designated with an M-number. Copies of individual standards may be obtained from Bureau of

Reclamation, Attn 86-68170, PO Box 25007, Denver CO 80225-0007. Specify standard(s) needed when requesting a copy.

3. Bureau of Reclamation manuals and other publications including significant scientific, technical, and engineering works are available from the National Technical Information Service (NTIS). Information regarding availability and pricing may be obtained by contacting NTIS at the following address:

United States Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161
Telephone: (703)487-4650 or 1-800-553-6847

4. Bureau of Reclamation was officially named Water and Power Resources Service for a short period. References to Water and Power Resources Service or any derivative form are synonymous with Bureau of Reclamation.

D. Industrial and Governmental Documents:

1. When a reference has a joint designation (e.g. ANSI/IEEE) these specifications generally cite the proponent organization (e.g. IEEE).

2. Addresses for obtaining industrial and governmental (other than Federal and Bureau of Reclamation specifications and standards) specifications, standards, and codes are listed in Table 01 42 10A - Addresses for Specifications, Standards, and Codes.

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol St., NW, Suite 249 Washington, DC 20001 www.aashto.org	(202) 624-5800 (800) 231-3475
AGC	Associated General Contractors of America 333 John Carlyle Street, Suite 200 Alexandria VA 22314 www.agc.org	(703) 548-3118
AISC	American Institute of Steel Construction One East Wacker Dr., Suite 3100 Chicago, IL 60601-2001 www.aisc.org	(312) 670-2400
ANSI	American National Standards Institute 1819 L. Street, N.W. Washington, DC 20036 www.ansi.org	(202) 293-8020
APA/EWA	APA-The Engineered Wood Association P.O. Box 11700 Tacoma, WA 98411-0700 www.apawood.org	(253) 565-6600
ASME	American Society of Mechanical Engineers 3 Park Ave. New York, NY 10016-5990 www.asme.org	(800) 843-2763
ASTM	ASTM International PO Box C700 100 Barr Harbor Dr. West Conshohocken, PA 19428-2959 www.astm.org	(610) 832-9585
AWS	American Welding Society 550 NW LeJeune Rd. Miami, FL 33126 www.amweld.org	(800) 443-9353 (305) 443-9353
IEEE	Institute of Electrical and Electronics Engineers 3 Park Ave.,17th Floor New York, NY 10016-5997 www.ieee.org	(212) 419-7900

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
NACE	NACE International 1440 South Creek Drive Houston, TX 77084 www.nace.org	(281) 228-6200
NEMA	National Electrical Manufacturers Association 1300 N 17th St., Suite 1847 Rosslyn, VA 22209 www.nema.org	(703) 841-3200
NFPA	National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincy, MA 02269-9101 www.nfpa.org	(800) 344-3555 (617) 770-3000
NIBS	National Institute of Building Sciences 1090 Vermont Ave., NW, Suite 700 Washington, DC 20005-4905 www.nibs.org	(202) 289-7800
SSPC	SSPC: The Society for Protective Coatings 40 24th St., 6th Floor Pittsburgh, PA 15222-4656 www.sspc.org	(800) 837-8303 (412) 281-2331
UL	Underwriters Laboratories Inc. 333 Pfingsten Rd. Northbrook, IL 60062-2096 www.ul.com	(847) 272-8800

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 46 00

QUALITY PROCEDURES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost: Include in prices offered in the Price Schedule for other items of work.

1.02 DEFINITIONS

A. Government Contract Quality Assurance: (from FAR 46.101) Various functions, including inspection, performed by the Government to determine whether a contractor has fulfilled the contract obligations pertaining to quality and quantity.

B. Contractor Quality Assurance / Quality Control (QA/QC): Activities performed by the Contractor to ensure work conforms to contract requirements.

1. The clause at FAR 52.246-12 - Inspection of Construction, requires the Contractor to establish an inspection system to ensure quality.

2. Contractor QA/QC includes activities in addition to specified Contractor Quality Testing to ensure work conforms to contract requirements.

C. Contractor Quality Testing: Specified tests shall be performed by the Contractor.

1. The Government will evaluate results of these tests when determining acceptability of work.

2. The Contractor may use the test results as part of Contractor QA/QC.

a. The Government anticipates that these tests will be part of the Contractor's QA/QC program, however the tests do not relieve the Contractor of maintaining adequate quality system in accordance with the clause at FAR 52.246-12 - Inspection of Construction.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

This page intentionally left blank.

SECTION 01 51 00
TEMPORARY UTILITIES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost: Include in prices offered in the Price Schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE C2-12 National Electrical Safety Code (NESC)

1.03 TEMPORARY ELECTRICITY

A. Provide electric power required for construction.

B. Provide generators, transmission lines, distribution circuits, transformers, and other electrical equipment and facilities required for obtaining power and distributing power to points of use.

C. Comply with IEEE C2 clearances and spacing for temporary communications and supply lines.

1.04 TEMPORARY WATER

A. Water from Whiskeytown Lake will be available for construction purposes.

B. Use water which meets specified requirements for water used in concrete and other permanent work.

C. Provide means of conveying water to points of use.

1.05 TELEPHONE

A. Land lines will not be available for Contractor use during construction. Cell service is readily available at site, but individual carrier’s reception should be verified.

1.06 SANITARY FACILITIES

A. Contractor personnel may use on-site restrooms.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 REMOVAL

A. Remove temporary equipment and facilities upon completion of work under this contract.

END OF SECTION

SECTION 01 55 00
VEHICULAR ACCESS AND PARKING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost: Include in prices offered in the Price Schedule for other items of work.

1.02 REGULATORY REQUIREMENTS

A. Meet requirements established by jurisdictional authority for use of existing roadways and haul routes; including seasonal or other limitations or restrictions, payment of excess size and weight fees, and posting of bonds conditioned upon repair of damage.

B. Comply with applicable regulations for haul routes over public highways, roads, or bridges.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 55 00-1, Initial Digital Recording of National Park Service Parking Lot.

C. RSN 01 55 00-2, Post Digital Recording of National Park Service Parking Lot.

D. RSN 01 55 00-3, Post Repair Digital Recording of National Park Service Parking Lot.

1.04 SITE CONDITIONS

A. Rights-of-way for access to work from existing roads will be established by Government.

1. In accordance with clause at FAR 52.236-10, Operations and Storage Areas, use only established roadways, parking areas, and haul routes; or temporary roadways, parking areas, or haul routes constructed by Contractor when and as authorized by CO.

2. Subject to clause at FAR 52.249-10, Default (Fixed-Price Construction), unavailability of transportation facilities or limitations thereon shall not become a basis for claims for damages or extension of time for completion of work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials to maintain and repair existing roadways, parking areas, and haul routes: In accordance with requirements of jurisdictional authority.

PART 3 EXECUTION

3.01 EXAMINATION

A. Investigate condition of available public or private roads for clearances, restrictions, bridge-load limits, bond requirements, and other limitations that affect or may affect access and transportation operations to and from jobsite.

3.02 RECORDS

A. Make preconstruction, post construction and post repair digital recordings of parking lot, staging area, and boat ramps.

1. DVD format with a minimum 720p resolution.
2. Label:
    a. Contract number and title.
    b. Contractor’s name.
    c. Date recording is made.
    d. Preface video with this information.

B. COR will be present during recording. Notify COR at least 3 days prior to recording.

3.03 ESTABLISHED ROADWAYS AND PARKING AREAS

A. Established roadways and parking areas are available for Contractor's use subject to existing restrictions and approval of the COR.

3.04 HAUL ROUTES

A. Use existing available public highways, roads, or bridges as haul routes subject to applicable local regulations.

B. Minimize interference with or congestion of local traffic.

C. Provide barricades, flaggers, and other necessary precautions for safety of public where haul routes cross public highways or roads.

3.05 MAINTENANCE

A. Maintain roadways, parking areas, and haul routes in a sound, smooth condition.

3.06 REPAIR

A. Promptly repair ruts, broken pavement, potholes, low areas with standing water, and other deficiencies to maintain road surfacing and drainage in original or specified condition.

END OF SECTION

This page intentionally left blank.

SECTION 01 55 20
TRAFFIC CONTROL

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost: Include in prices offered in the Price Schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Federal Highway Administration, Department of Transportation

1. California MUTCD, 2014 Edition — California Manual on Uniform Traffic Control Device

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 55 20-1, Traffic Control Plan.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 TRAFFIC CONTROL

A. Meet requirements of Part 6 of California MUTCD.

B. Provide cones, delineators, concrete safety barriers, barricades, flasher lights, danger signals, signs, and other temporary traffic control devices as required to protect work and public safety.

C. Provide flaggers and guards as required to prevent accidents and damage or injury to passing traffic.

D. Do not begin work along public or private roads until proper traffic control devices for warning, channeling, and protecting motorists are in place in accordance with approved traffic control plan.

E. Maintain traffic flow and conduct construction operations to minimize obstruction and inconvenience to public traffic.

F. Maintain convenient access to driveways and buildings along line of work.

G. Protect roads closed to traffic with effective barricades and warning signs. Illuminate barricades and obstructions from sunset to sunrise.

H. Remove traffic control devices when no longer needed.

END OF SECTION

SECTION 01 56 15
PROTECTION OF EXISTING UTILITIES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost: Include in prices offered in the Price Schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (Reclamation)

1. Reclamation Safety and Health Standards (RSHS), including revisions posted at http://www.usbr.gov/ssle/safety/RSHS/rshs.html.

B. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE C2-2012 National Electrical Safety Code (NESC)

1.03 PROJECT CONDITIONS

A. Drawings included in these specifications do not show all utilities existing at the jobsite.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 INTERFERENCE WITH OPERATION OR MAINTENANCE

A. Do not interfere with operation or maintenance service on utilities, existing on date offers are received. Provide for access to utilities in a manner satisfactory to owners and operators and the Government.

B. Provide required temporary structures; make necessary repairs, replacements, or similar operations; and furnish indemnity or other bonds.

END OF SECTION

This page intentionally left blank.

SECTION 01 56 32
TEMPORARY SAFETY FENCE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost: Include in prices offered in Price Schedule for other items of work.

PART 2 PRODUCTS

2.01 SAFETY FENCE

A. Fence:
   1. High-density polyethylene grid.
   2. Minimum height: 48-inch.
   3. Color: Safety orange.
   4. Recovered Material Content:
      a. 90 to 100 percent.
   5. Postconsumer Content:
      a. 60 to 100 percent.

B. Posts: Steel fence posts.

PART 3 EXECUTION

3.01 INSTALLATION

A. Erect fence around work areas at location approved by the COR.

B. Space posts 10 feet, maximum, on center.

C. Secure grid to posts.

3.02 MAINTENANCE AND REMOVAL

A. Maintain fence until work in area is complete and accepted by the COR.

B. Remove fence when no longer required.

END OF SECTION

This page intentionally left blank.

SECTION 01 57 20
ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work, except as specified.

2. Costs for damages and work stoppage are the Contractor's responsibility.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (Reclamation)

1. Reclamation Safety and Health Standards (RSHS), including revisions posted at http://www.usbr.gov/ssle/safety/RSHS/rshs.html.

1.03 REGULATORY REQUIREMENTS

A. Comply with Federal, State, and local laws and regulations.

B. Comply with RSHS.

C. Conform to most stringent requirement in cases of conflict between specifications, regulatory requirements, and RSHS.

D. Contractor shall be responsible for damages resulting from dust originating from Contractor operations in accordance with clause at FAR 52.236-7, Permits and Responsibilities.

E. The CO may stop construction activity in violation of Federal, State, or local laws and additional expenses resulting from work stoppage will be responsibility of Contractor.

1.04 AIR POLLUTION CONTROL

A. Use reasonably available methods and devices to prevent, control, and otherwise minimize atmospheric emissions or discharges of air contaminants.

B. Do not operate equipment and vehicles that show excessive exhaust gas emissions until corrective repairs or adjustments reduce such emissions to acceptable levels.

1.05 LIGHT CONTROL

A. Direct stationary floodlights shall shine downward at an angle less than horizontal.

B. Shield floodlights so that floodlights will not be a nuisance to surrounding areas.

C. Correct lighting control problems when they occur as approved by the COR.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 57 30
WATER POLLUTION CONTROL

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost: Include in prices offered in the Price Schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (Reclamation)

1. Reclamation Safety and Health Standards (RSHS), including revisions posted at http://www.usbr.gov/ssle/safety/RSHS/rshs.html

B. California Code of Regulations (CCR)

1.	CCR Title 22	Social Security

C. Code of Federal Regulations (CFR)

1.	40 CFR, Part 112	Oil Pollution Prevention

D. Public Law

1.	Sections 311, 402, and 404	Clean Water Act (Public Law 92-500, as amended)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 57 30-1, Spill Prevention, Control, and Countermeasure (SPCC) Plan:

1. Submit when SPCC Plan is required in accordance with 40 CFR, Part 112.
    a. SPCC Plan is required where release of oil and oil products could reasonably be expected to enter into or upon navigable waters of the United States or adjoining shorelines in quantities that may be harmful (40 CFR, Part 110), and aggregate on site oil storage capacity is over 1,320 gallons. Only containers with capacity of 55 gallons and greater are included in determining on site aggregate storage capacity.
2. Reviewed and certified by a registered professional engineer in accordance with 40 CFR, Part 112, as required by section 311 of the Clean Water Act (Public Law 92-500 as amended).

1.04 REGULATORY REQUIREMENTS

A. Construction Safety Standards:

1. Comply with sanitation and potable water requirements of section 7 of RSHS.

B. Laws, Regulations, and Permits:

1. Perform construction operations to comply, and ensure subcontractors comply, with:

a. Applicable Federal, State, and local laws, orders, regulations, and Water Quality Standards concerning control and abatement of water pollution; and terms and conditions of applicable permits issued by permit issuing authority.

b. If conflict occurs between Federal, State, and local laws, regulations, and requirements, the most stringent shall apply.

C. Contractor Violations:

1. If noncompliance should occur, immediately (verbally) report noncompliance to the CO. Submit specific written information within 2 days.

2. Violation of applicable Federal, State, or local laws, orders, regulations, or Water Quality Standards may result in the CO stopping site activity until compliance is ensured.

3. The Contractor shall not be entitled to extension of time, claim for damage, or additional compensation by reason of such a work stoppage.

4. Corrective measures required to bring activities into compliance shall be at the Contractor's expense.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 POLLUTION CONTROLS

A. Control pollutants by use of sediment and erosion controls, wastewater and stormwater management controls, construction site management practices, and other controls including State and local control requirements.

B. Sediment and Erosion Controls:

1. Establish methods for controlling sediment and erosion which address vegetative practices, structural control, silt fences, straw dikes, sediment controls, and operator controls as appropriate.

2. Institute stormwater management measures as required, including velocity dissipaters, and solid waste controls which address controls for building materials and offsite tracking of sediment.

C. Wastewater and Stormwater Management Controls:

1. Pollution prevention measures:

a. Use methods of dewatering, unwatering, excavating, or stockpiling earth and rock materials which include prevention measures to control silting and erosion, and which will intercept and settle any runoff of sediment-ladened waters.

b. Prevent wastewater from general construction activities such as drainwater collection, aggregate processing, concrete batching, drilling, grouting, or other construction operations, from entering flowing or dry watercourses without the use of approved turbidity control methods.

c. Divert stormwater runoff from upslope areas away from disturbed areas.

2. Turbidity prevention measures:

a. Use methods for prevention of excess turbidity which include, but are not restricted to, intercepting ditches, settling ponds, gravel filter entrapment dikes, flocculating processes, recirculation, combinations thereof, or other approved methods that are not harmful to aquatic life.

b. Wastewaters discharged into surface waters shall meet conditions of section 402, the National Pollutant Discharge Elimination System (NPDES) permit.

D. Construction Site Management:

1. Contractor construction operations:

a. Perform construction activities by methods that will prevent entrance, or accidental spillage, of solid matter, contaminants, debris, or other pollutants or wastes into streams, flowing or dry watercourses, lakes, wetlands, reservoirs, or underground water sources.

1) Pollutants and wastes include, but are not restricted to: refuse, garbage, cement, sanitary waste, industrial waste, hazardous materials, radioactive substances, oil and other petroleum products, aggregate processing tailings, mineral salts, and thermal pollution.

2. Stockpiled or deposited materials:

a. Do not stockpile or deposit excavated materials or other construction materials, near or on, stream banks, lake shorelines, or other watercourse perimeters where they can be washed away by high water or storm runoff, or can in any way encroach upon the watercourse.

3. Petroleum product storage tanks management:

a. Place oil or other petroleum product storage tanks at least 20 feet from streams, flowing or dry watercourses, lakes, wetlands, reservoirs, and any other water source.

b. Do not use underground storage tanks.

c. Construct storage area dikes at least 12 inches high or graded and sloped to permit safe containment of leaks and spills equal to storage tank capacity located in the area plus sufficient freeboard to contain the 25-year rainstorm.

1) Line diked areas with an impermeable barrier at least 50 mils thick.

d. Areas for refueling operations: Lined with impermeable barrier at least 10 mils thick covered with 2 to 4 inches of soil.

END OF SECTION

SECTION 01 74 00

CLEANING AND WASTE MANAGEMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work except as specified.
2. Cost of environmental site assessments are the Contractor's responsibility.

1.02 DEFINITIONS

A. Hazardous waste: Defined as hazardous by 40 CFR 261.3; or by other Federal, State, or local laws or regulations.

1.03 REFERENCE STANDARDS

A. Bureau of Reclamation (Reclamation)

1. Reclamation Safety and Health Standards (RSHS), including revisions posted at http://www.usbr.gov/ssle/safety/RSHS/rshs.html

B. California Code of Regulations (CCR)

1.	California Code of Regulations, Title 22 Division 4.5 (CCR)	Social Security

C. Code of Federal Regulations (CFR)

1.	40 CFR 261.3	Definition of Hazardous Waste
2.	49 CFR 171-179	Transportation - Hazardous Waste Regulations

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 74 00-1, Waste Production and Disposal Plan:

1. For each type of waste, list estimated quantity and planned disposal location.
2. Submit this documentation with certification from the designated Environmental Consultant.
3. Submit the following for the designated Environmental Consultant:
   a. Resume.

C. RSN 01 74 00-2, Waste Production and Disposal Records:

1. For each type of waste, list quantity and disposal location.
2. Include certifications that waste was properly disposed.
3. Hazardous wastes manifests.

1.05 QUALIFICATIONS

A. Environmental Consultant: Minimum 2 years' experience in conducting environmental site assessments for similar construction.

1.06 REGULATORY REQUIREMENTS

A. Comply with Federal, State, and local laws and regulations.

B. Comply with RSHS.

C. Conform to most stringent requirement in cases of conflict between specifications, regulatory requirements, and RSHS.

1.07 PROJECT CONDITIONS

A. Report waste materials discovered at jobsite to COR and CO in writing within 48 hours.

1. Cease work in areas where waste may be hazardous until waste materials are investigated by the Government.
2. If waste is hazardous, the CO may order delays in time of performance or changes in work, or both.
3. If such delays or changes are ordered, an equitable adjustment will be made in the contract in accordance with applicable clauses of the contract.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 PROGRESS CLEANING

A. Keep work and storage areas free from accumulations of waste materials and rubbish.

3.02 FINAL CLEANUP

A. Remove temporary plant facilities, buildings, concrete footings and slabs, rubbish, unused materials, concrete forms, and other similar materials which are not part of permanent work.

B. Sweep paved areas and rake clean landscaped areas.

3.03 DISPOSAL

A. Nonhazardous waste materials:

1. Reuse at jobsite or reuse or recycle waste materials removed from jobsite whenever possible.
2. Dispose of materials not reused at jobsite by removal from jobsite.
3. Dispose of nonhazardous waste materials that are not reused or recycled at appropriately permitted disposal facilities.

B. Hazardous Waste Disposal:

1. Dispose by removal from jobsite.
2. Recycle hazardous waste whenever possible.
3. Dispose of hazardous waste materials that are not recycled at appropriately permitted treatment or disposal facilities.
4. Transport hazardous waste in accordance with 49 CFR 171-179 and 22 CCR, Division 4.5

C. Certification: Certify that wastes are disposed of in accordance with Federal, State, and local regulations.

3.04 SITE ASSESSMENT

A. Upon completion of work, perform site assessment at following areas for work done under these specifications:

1. Hazardous waste accumulation areas.
2. Petroleum dispensing and storage areas where aggregate storage of petroleum at jobsite was over 110 gallons.
3. Hazardous material storage areas.

B. Employ qualified environmental consultant to perform assessments.

C. Demonstrate and document by appropriate analytical sampling that site contamination is less than State action cleanup levels.

3.05 RECORDS

A. Keep records of types and amounts of waste materials produced.

B. Keep records of waste material disposal.

END OF SECTION

This page intentionally left blank.

SECTION 01 78 30
PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost: Include in prices offered in the Price Schedule for other items of work.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 78 30-1, Progress As-built Drawings:

1. As-built drawings for a particular structure or work.
2. Copies of As-built drawings maintained on site. Colored copies are not required.

C. RSN 01 78 30-2, Final As-built Drawings:

1. Contractor certified As-Built drawings reflecting the as-built conditions.

D. RSN 01 78 30-3, As-built Record of Materials:

1. Record of materials used to complete a structure or work.

E. RSN 01 78 30-4, Warranties.

1.03 RECORD DRAWINGS

A. Maintain 2 sets of full-size prints of contract drawings marked to show accurate and complete records of as-built conditions. Keep drawings at the jobsite and mark as work progresses. Update drawings weekly.

1. Mark and dimension to show variations between actual construction and that indicated or specified in contract documents.
    a. Include buried or concealed construction and utilities.
    b. Include existing items, topographic features, and utility lines revealed during construction which differ from those shown on contract drawings.
2. Mark to define construction actually provided where choice of materials or methods is permitted in specifications, or where variations in scope or character of work from that of the original contract are authorized.

B. Use standard drafting practice to represent changes and include supplementary notes, legends, and details necessary to clearly portray as-built construction.

C. Mark as-built drawings in the following colors:

1. Red - Additions to original drawings.
2. Green - Deletions to original drawings.
3. Blue - Notations necessary for explanation of as-built markings.

D. Allow the Government to review the drawings at all times.

E. Upon completion of work, sign marked prints as certified correct.

1. Sign and date each drawing as certified correct. Do not include or certify Information Only drawings.
2. If no revisions were necessary to illustrate as-built conditions, mark the drawing with “No Changes.”

1.04 AS-BUILT RECORD OF MATERIALS

A. Where several manufacturers' brands, types, or classes of items have been used in the project, designate specific areas where each item was used. Key designations to the areas and spaces depicted on contract drawings.

B. Provide record of materials used in the following format:

As-Built Record of Materials				
Specification Section	Materials Designation	Manufacturer	Materials Used (manufacturer's designation)	Where Used

1.05 WARRANTIES

A. Provide warranties in accordance with the clause at FAR 52.246-21 "Warranty of Construction" the specifications, and this section.

B. Warranty of Construction

1. Submit data concerning warranty of construction, required by the clause at FAR 52.246-21 "Warranty of Construction” including the warranty period (dates), and warranty contacts with names, addresses, and telephone numbers. Also, post this data, under glass, at a location as directed by the CO.

C. Other Warranties

1. For other warranties, including those warranties for equipment specified by the CO on a brand name and model basis, provide the following:
2. Warranty List

a. Bound and indexed notebook containing written warranties obtained, required, or furnished under the contract. Prepare complete list of warranted products, equipment, materials, processes, and other warranted items. Fully execute and deliver this list to the CO prior to final acceptance of contract work. Provide the list in the following format:

WARRANTY LIST			
Specification Section	Warranted Item	Warranty Period Dates	Point of Contact

3. Equipment Warranty Tags

a. At installation, tag each warranted item with a durable, oil- and water-resistant tag approved by the CO.

1) Attach tag with copper wire and spray with a clear silicone waterproof coating.

2) Leave date of acceptance and inspector's signature blank until project is accepted.

3) Provide tags showing the following information:

WARRANTY TAG	
Type of Item	
Warranty Period	[Period] or [Form ___ To ____]
Contract No.	
Inspector's Signature	
Date Accepted	
Construction Contractor	
Name	
Address	
Telephone	
Warranty Contact	
Name	
Address	

Telephone	

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Reconditioning of Tanks and Floats:

1. Payment: Lump sum price offered in the Price Schedule.
    a. All Surface Stabilizing Tanks
    b. All Upper Boom Floating Tanks

B. Replacement and Installation of Chains, Shackles, Load Bar Ends, and End Bumpers:

1. Payment: Lump sum price offered in the Price Schedule.
    a. Chains: 10,400 ft. (including contingencies)
        1) Upper boom floating tank to Upper boom floating tank: 375 ft.
        2) Upper boom floating tank to Stabilizing Tanks: 770 ft.
        3) Stabilizing Tanks to Lake Anchor: 8559 ft.
        4) Chain Bridle: 200 ft.
        5) Shore Anchor Connection: 130 ft.
    b. Shackles: 640 (including contingencies)
        1) Upper boom floating tanks to Upper boom floating tank: 480
        2) Upper boom floating tanks to Lake Anchors:132
        3) Shore Anchors: 6
        4) All existing shackles shall be property of the government
    c. Load Bar Ends: 40
    d. End Bumpers: ***240***
        1) Repair to end bumpers is on hole that connects to the Upper Chain. It is not the intent to replace the whole end bumper.

C. Cost: Include cost miscellaneous metalwork in applicable item in the Price Schedule.

1.02 DEFINITIONS

A. Miscellaneous metalwork: Shown on the drawings or specified elsewhere in this Section, but not specified in other Sections.

1.03 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A36/A36M-14	Carbon Structural Steel
2.	ASTM A53/A53M-12	Pipe, Steel, Black and Hot-dipped, Zinc-Coated Welded and Seamless
3.	ASTM A123/A123M-13	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
4.	ASTM A153/A153M-09	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
5.	ASTM A307-14	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
6.	ASTM A325-14	Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength
7.	ASTM A385/A385M-11	Providing High-Quality Zinc Coatings (Hot-Dip)
8.	ASTM A500/A500M-13	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
9.	ASTM A563-07a(2014)	Carbon and Alloy Steel Nuts
10.	ASTM A586-04a(2014)	Zinc-Coated Parallel and Helical Steel Wire Structural Strand
11.	ASTM A780/A780M-09	Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
12.	ASTM F436-11	Hardened Steel Washers
13.	ASTM F844-07a(2013)	Washers, Steel, Plain (Flat), Unhardened for General Use

B. American Welding Society, Inc. (AWS)

1.	AWS D1.1/D1.1M-10	Structural Welding Code - Steel

C. Federal Specifications (FS)

1.	FS RR-C-271F	Chains and Attachments, Welded and Weldless

D. Society of Protective Coatings (SSPC)/NACE International (NACE)

1.	NACE 3/SSPC-SP6-07	Joint Surface Preparation Standard - NACE No. 3/ SSPC-SP6 - Commercial Blast Cleaning

2.	NACE 4/SSPC-SP7-07	Joint Surface Preparation Standard - NACE No. 4/ SSPC-SP7 - Brush-Off Blast Cleaning

1.04 SUBMITTALS

A. Submit the following accordance with Section 01 33 00 – Submittals.

B. RSN 05 50 00-1, Approval Data:

1. Reconditioning area, plan, and related equipment information for:

a. Stabilizing Tanks

b. Upper Boom Floating Tanks

C. RSN 05 50 00-2, Stabilizing Tank Load Bar:

1. Shop drawings, weld plan, data sheets, and related information for:

a. Replacing load bar ends on Stabilizing Tanks

D. RSN 05 50 00-3, Upper Boom Floating Tank End Bumper:

1. Shop drawings, weld plan, data sheets, and related information for:

a. Replacing end bumpers on Upper Boom Floating Tanks

E. RSN 05 50 00-4, Replacement Metalwork:

1. Material specifications, data sheets, and related information for:

a. Chains

b. Shackles

1.05 QUALIFICATIONS

A. Qualify welders in accordance with AWS D1.1 using procedures, materials, and equipment of the type required for the work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect from corrosion, deformation, and other types of damage.

B. Store items in an enclosed area free from contact with soil and weather.

PART 2 PRODUCTS

2.01 MATERIALS

A. Bolts, Nuts, And Washers:

1. Eyebolts: Forged steel, ASTM A668, class C.

2. Nuts: ASTM A563.
3. Capscrews: FS FF-S-85.
4. Washers:
    a. For use with ASTM A325 bolts: ASTM F436
    b. Unhardened for general use: ASTM F844.
5. Bolts:
    a. ASTM A307, except anchor bolts and studbolts.
    b. Anchor bolts as shown on drawings
    c. ASTM A36 steel
    d. Length of bolt threads: ASME B18.2.1.
    e. Thread class: 2 free-fit, American National coarse-thread series.
6. Studbolts:
    a. Suitable for end welding to steel with automatically timed stud-welding equipment.

B. Chain:
1. FS RR-C-271, type 1, class 1, 2, or 4.
2. Hot Dipped Galvanized steel.
3. Size, quantities, locations, and breaking strength as shown in the Cross Section of Lake Anchor and Bottom Float detail on drawing 416-214-5376.

C. Shackles
1. 7/8 inch anchor shackle, with locknut and pin.
2. Hot Dipped Galvanized steel.
3. Quantities, locations, and breaking strength as shown in the Cross Section of Lake Anchor and Bottom Float detail on drawing 416-214-5376.

2.02 FABRICATION

A. If straightening is necessary, use methods that will not injure the metal.

B. After shop work completion and before galvanizing, if required, clean material of rust, loose scale, dirt, oil, grease, slag from welded areas, and other foreign substances.

C. Galvanizing:
1. Galvanize items of metalwork as specified or shown on drawings. Use hot-dip galvanizing, where required after fabrication, in accordance with ASTM A123 and A385.

2. Galvanize bolts, nuts, washers, and locknuts in accordance with ASTM A153. Remove excess spelter by centrifugal spinning.

3. Galvanizing Repair:

   a. Redip material with damaged galvanizing unless damage is local and can be repaired by two component epoxy zinc primer.

   b. If the galvanized coating becomes damaged after being dipped twice, the material will be rejected.

   c. Where local repair is authorized:

      1) Repair damaged galvanized surfaces in accordance with ASTM A780, except repair materials containing cadmium or lead are not permitted.

PART 3 EXECUTION

3.01 PREPARATION

A. Where locations and dimensions of miscellaneous metalwork shown on drawings are dependent upon existing equipment and/or equipment furnished, confirm locations and dimensions prior to fabrication of miscellaneous metalwork.

3.02 INSTALLATION

A. Chains: Attach to Temperature Control Curtain and Lake Anchor as shown on the Drawing 416-214-5376.

B. Shackles: Attach to Temperature Control curtain floatation system as shown on drawings.

C. Load Bar ends: Repair in accordance to approved drawings. See drawing 416-214-5361.

D. End Bumpers: Repair in accordance to approved plan. See drawing 416-214-5359.

E. Galvanizing Repair:

1. Recoat all surfaces for Stabilizing Tanks and Upper Boom Floating Tanks per coating instruction shown on the Drawings.

END OF SECTION

This page intentionally left blank.

SECTION 06 50 10
TEMPERATURE CURTAIN

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Patchwork Installation.

1. Payment: Linear foot price offered in the schedule for applicable curtain material.
    a. Curtain material purchase.
    b. Patchwork repair.
    c. Miscellaneous metal work.
    d. Other items to repair curtain.
2. See Section J for curtain separation locations and approximate dimensions.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM D413-98(2013)	Rubber Property—Adhesion to Flexible Substrate
2.	ASTM D751-06(2011)	Coated Fabrics
3.	ASTM D1149-02(2012)	Rubber Deterioration-Cracking in an Ozone Controlled Environment
4.	ASTM D2136-02(2012)	Coated Fabrics—Low-Temperature Bend Test

B. Federal Test Method (FTMS)

1.	FTM 101C Method 2031(2005)	Test Procedure's for Packing Materials

1.03 SUBMITTALS

A. Submit the following accordance with Section 01 33 00 - Submittals.

B. RSN 06 50 10-1, Curtain Repair Plan:

1. Qualifications of repair company
    a. Name and address
    b. Documentation of previous experience with underwater geomembrane work.
        1) Names of facility owner(s).

2) Person to contact at facilities who can discuss projects listed.

3) Project manager, designer, manufacturer, fabricator (if any).

4) Locations, thicknesses, and area in square feet of geomembrane installed.

5) Dates of installation.

2. Manufacturer's instructions for delivery, storage, and handling of curtain materials.

3. Details of curtain patchwork repair.

a. Work schedule.

b. Location, size, orientation, and identification (including smooth or textured) of patching regions.

c. Sequencing of repair.

d. Equipment and procedures for patchwork handling and installation.

C. RSN 06 50 10-2, Curtain Repair Drawings:

1. All areas of patchwork repair and installation plan.

2. Include locations and details of pockets, loops, through holes, grommets, seams and any other feature that is to be fabricated into the curtain panels.

3. Include dimensions of patchwork repair sections.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Ship, handle, store, and care for curtain composite, in accordance with manufacturer's instructions.

B. Store curtain composite onsite in accordance with manufacturer's instructions.

C. Protect from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat or cold, direct sunlight or other damage.

PART 2 PRODUCTS

2.01 CURTAIN MATERIAL

A. M-423, 3 Ply CSPE, as manufactured by Burke Industries www.burkeind.com, or equal with the following essential characteristics:

1. 60 mil, 3-ply synthetic rubber.

2. In accordance with Table 06 50 10B - Curtain Physical Properties.

Table 06 50 10B - Curtain Physical Properties

Property	Test Method	Minimum Specification	Typical Average Values
Thickness	ASTM D751	58	60 mil
Break Strength (lbf)	ASTM D751 Grab Method	300	350
Elongation of Break Fabric (%)	ASTM D751	75	105
Tearing Strength (lbf)	ASTM D751 Tongue Tear	80	100
Hydrostatic Resistance (psi)	ASTM D751 Method A	400	450
Puncture Resistance (pounds)	FTMS 101B Method 2031	250	300
Bonded Seam Strength (pounds)	ASTM D751 Modified (12 in./min)	270	90% of parent material
Ply Adhesion (lbs./in. width)	ASTM D413 Machine Method, Type A (12 in./min)	8 lbs.	10
Ozone Resistance	ASTM Dll49 (1/8-inch bent lop, 100 pphm, 104 F, 7 days	No affect	Pass
Low Temperature	ASTM D2136, 1/8" Mandrel 4 hrs @ -40 deg F.	Pass	Pass

2.02 SOURCE QUALITY ASSURANCE

A. The Government may inspect and obtain samples for testing during manufacture/fabrication at beginning of production and subsequently.

PART 3 EXECUTION

3.01 PATCHWORK REPAIR

A. Repair field seams and other torn areas along temperature curtain by bolting pre-cut curtain material patches as specified. For vertical tears the vertical bolt spacing shall be a maximum of 6 inches and the horizontal spacing from tear to bolt shall be a minimum of 6 inches. See drawing 416-214-5383 for past repair method.

B. Tear (separations) repairs shall be patched on both sides of existing curtain.

C. Create a 1-inch diameter circular hole at the ends of all torn areas along temperature curtain to prevent further tear propagation. Ensure all protrusions, jagged edges, or other abnormalities are smoothed out. Cut holes' horizontal centerline must be at least 3-inches away from the horizontal centerline of end-most grommets used in the patching process.

D. Torn (separated) areas along temperature curtain with a length of 6-inches or less do not need to be patched as per 3.01 A.

3.02 CURTAIN ADJUSTMENT

A. Final acceptance of the installed temperature curtain system will require final adjustments of up to 17 (ea.) lake anchor chains.

1. Acceptance determined by OGR.

a. These minor adjustments to the lake anchor chains are necessary to ensure that the curtain forces are evenly distributed to each lake anchor based on operational observation.

b. The installed curtain system will be tested for functionality during power plant operations.

END OF SECTION

SECTION 35 51 10
TANKS AND FLOATS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Stabilizing Tank Fabrication:

1. Payment: Price per tank offered in Price Schedule.
    a. Factory fabrication of 3 stabilizing tanks.
    b. Transportation to site.

B. Upper Boom Floating Tank Fabrication:

1. Payment: Price per float offered in Price Schedule.
    a. Factory fabrication of 2 upper boom floating tanks.
    b. Transportation to site.

C. Installation of Tank Filler Material and Reflective Tape

1. Payment: Lump sum price offered in the Price Schedule.
    a. Injection of filler material in 120 upper boom floating tanks and 22 stabilizing tanks.
    b. Attachment of reflective tape on 120 upper boom floating tanks and 22 stabilizing tanks.

D. Installation of Tanks and Floats

1. Payment: Lump sum price offered in the Price Schedule.
    a. Install Stabilizing Tanks.
    b. Install Upper Boom Floating Tanks.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A36/A36M-14	Carbon Structural Steel
2.	ASTM A135/A135M-09(2014)	Electric-Resistance-Welded Steel Pipe
3.	ASTM A153/A153M-09	Zinc Coating (Hot-Dip) on Iron and Steel Hardware

4.	ASTM A449-14	Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
5.	ASTM A586-04A(2014)	Zinc-Coated Parallel and Helical Steel Wire Structural Strand
6.	ASTM A1011/A1011-14	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

B. American Welding Society, Inc. (AWS)

1.	AWS D1.1/D1.1M-10	Structural Welding Code – Steel

C. American Water Works Association (AWWA)

1.	AWWA C200-12	Steel Water Pipe 6 Inch (150mm) and Larger

1.03 SUBMITTALS

A. Submit the following accordance with Section 01 33 00 - Submittals.

B. RSN 35 51 10-1, Equipment Procedures:

1. Equipment and procedures for:
    a. Stabilizing Tank handling.
    b. Upper Boom Floating Tank handling.

C. RSN 35 51 10-2, Approval Data:

1. Shop drawings showing all dimensions, fabrication instructions, and installation plan:
    a. Fabricated Stabilizing Tanks
    c. Fabricated Upper Boom Floating tanks

D. RSN 35 51 10-3, Filler Material:

1. Polyurethane Foam, 2 lbs. density, closed cell, or equal.
2. Manufacturer’s product data:
    a. Include complete descriptions and specifications for materials, construction, and finish.
    b. Include manufacturer’s product data sheets showing all material used meets specifications.
    c. Installation method.

E. RSN 35 51 10-4, Reflective Tape:

1. Rigid reflective tape with a width of 2-inches.
2. Color to be 7-inches White/ 11-inches Red.
3. Reflective tape must be applicable with and adhere to equipment under in-water scenarios.
4. Manufacturer's product data:
    a. Include complete descriptions and specifications for materials, construction, and finish.
    b. Include manufacturer's product data sheets showing all material used meets specifications.
    c. Installation method.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Ship, handle, store, and care for tanks in accordance with fabricators instructions.

PART 2 PRODUCTS

2.01 SURFACE STABILIZING TANKS

A. Sizes, dimensions, and materials shown on drawing 416-214-5361.

2.02 UPPER BOOM FLOATING TANKS

A. Sizes, dimensions, and materials shown on drawing 416-214-5359.

2.03 FABRICATION

A. Straighten, clean and remove sharp kinks prior to working on material. Do not injure the metal or cause local yielding while straightening.

B. Shearing and cutting: Smooth edges and deburr all edges.

C. Holes:
1. Only holes shown on the drawings shall be allowed unless approved by the COR.
2. Punch full size holes in structural steel less than 13/16-inch.
3. Drill holes greater than 13/16-inch.
4. Remove burrs from drilling with a chamfer of 1/16-inch.
5. Cylindrical and perpendicular to member.

D. Accuracy:

06 60 10A-Fabrication Accuracy

Process	Allowable Tolerance
Cutting by torch	+/- 1/4-inch DIMS over 24 inch +/- 1/8-inch DIMS under 24 inches
Cutting by saw	+/- 1/8-inch DIMS over 24 inch +/- 1/16-inch DIMS under 24 inches
Locating welded parts	+/- 1/8-inch DIMS under 2 feet. +/- 1/4-inch DIMS 2 feet to 10 feet +/- 1/2-inch DIMS over 10 feet.
Locating drilled holes	+/- 1/16-inch.

E. Welding:

1. In accordance with AWS D1.1
2. Subject to government inspection.

F. Galvanize bolts, screws, nuts, washers, and headed concrete anchors in accordance with ASTM A 153. Remove excess spelter by centrifugal spin.

G. Coatings:

1. Coat steel components with two or more coats of zinc dust coating containing 95 percent or more zinc dust in the dry-film state.
2. Finished dry film thickness.

2.04 SOURCE QUALITY CONTROL

A. Leak check tank with 3 psi air and soap water test as defined on drawing 416-214-5361.

B. Test 100 percent of the tank surface.

C. Repair leaks with welds and retest.

D. COR may witness testing. Notify COR 7 days prior to testing.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with approved plan and as shown on drawings.

B. Reflective Tape:

1. Install reflective tape across reservoir facing surface of 120 upper boom floating tanks and 22 stabilizing tanks.

2. Attached tape must be above water, visible, and consistent in placement area for all like features for respective tanks.

3. Attached tape must span the entire frontal, straight surface of the tank.

END OF SECTION

This page intentionally left blank.

SECTION 52 00 00

DRAWINGS

PART 1 GENERAL

1.01 DISCREPANCIES, ERRORS, OR OMISSIONS

A. Inform the CO of discrepancies discovered on drawings in accordance with clause at FAR 52.236-21, Specifications and Drawings for Construction.

B. In accordance with clause at FAR 52.236-21, Specifications and Drawings for Construction, in case of discrepancies, written specifications take precedence over drawings unless otherwise specified.

1.02 PROJECT CONDITIONS

A. Where there are differences as determined by the CO between details and dimensions shown on drawings and details and dimensions of existing features at jobsite, use details and dimensions of existing features at jobsite.

1.03 SPECIFICATION DRAWINGS

A. Some drawings show details of fabrication or other details and specifications which are not a part of work under this contract. Disregard specifications and details shown on these drawings which are not applicable to work under this contract.

B. Reference drawings referred to on specification drawings and not considered necessary for contract purposes are not included in specifications.

1.04 EXISTING INSTALLATION DRAWINGS

A. Drawings marked "Existing Installation" show existing condition of installations to be modified under this contract. The revised versions of these drawings show the required modifications to be performed under this contract.

1.05 INFORMATION DRAWINGS

A. Drawings marked "For Information Only" in the drawing list are included to show existing features about which knowledge is required to perform work under this contract. These drawings do not show work to be performed under this contract.

B. If there are differences as determined by the CO between details and dimensions shown on these drawings and those of existing features at jobsite, use details and dimensions of existing features at jobsite.

1.06 STANDARD DRAWINGS

A. Standard drawings may show details which are not a part of work under this contract. Disregard details shown on these drawings which are not applicable to work under this contract.

1.07 COPIES OF DRAWINGS

A. One set of full-size (22 inches by 34 inches) drawings, except standard drawings, will be furnished to the Contractor.

B. Upon request, additional half-size (11 inches by 17 inches) copies of standard drawings will be furnished to the Contractor.

1.08 LIST OF DRAWINGS

A. Drawings listed in Table 52 00 00A - List of Drawings, are made a part of Section C - Description/Specifications.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

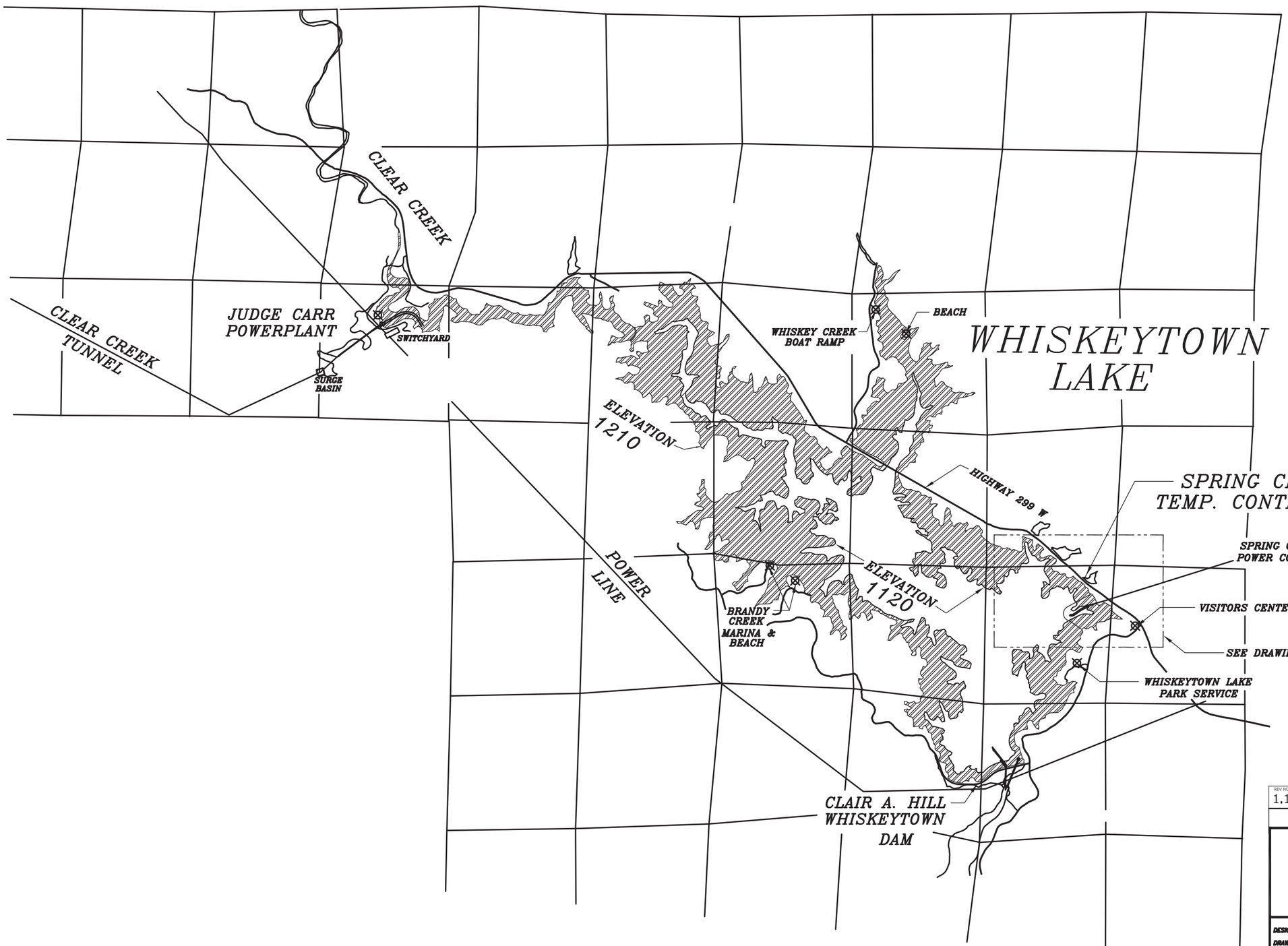
Not Used

Table 52 00 00A - List of Drawings

Sheet No.	Drawing No.	Title
General:		
1	416-214-5350	Vicinity Map
2	416-214-5352	Spring Creek Intake Location Map
3	416-214-5354	General Plan & Topo. No. 1
4	416-214-5355	General Plan & Topo. No. 2
5	416-214-5356	General Plan & Topo. No. 3
6	416-214-5376	Lake Anchor System; Installation Details
7	416-214-5387	General Plan & Topo. All 3 Parts
Mechanical:		
8	416-214-5359	Upper Boom Floating Tanks Details and Assembly
9	416-214-5361	Surface Stabilizing Tanks Details and Assembly
10	416-214-5381	Fabric Details No. 1a
11	416-214-5382	Fabric Details No. 1b
12	416-214-5383	Fabric Details No. 1c
For Information Only:		
13	416-214-5377	Shore Anchor Details
14	416-214-5357	Lake Anchor Details
15	40-D-7102	Government Drawing Format - Drawing Border, Sample Title Block and Signature Lines

END OF SECTION

This page intentionally left blank.



REV NO.		
1.1		REMOVED OAK BOTTOM TEMPERATURE CURTIAN REFERENCES

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
TRINITY RIVER DIVISION – CALIFORNIA

WHISKEYTOWN LAKE

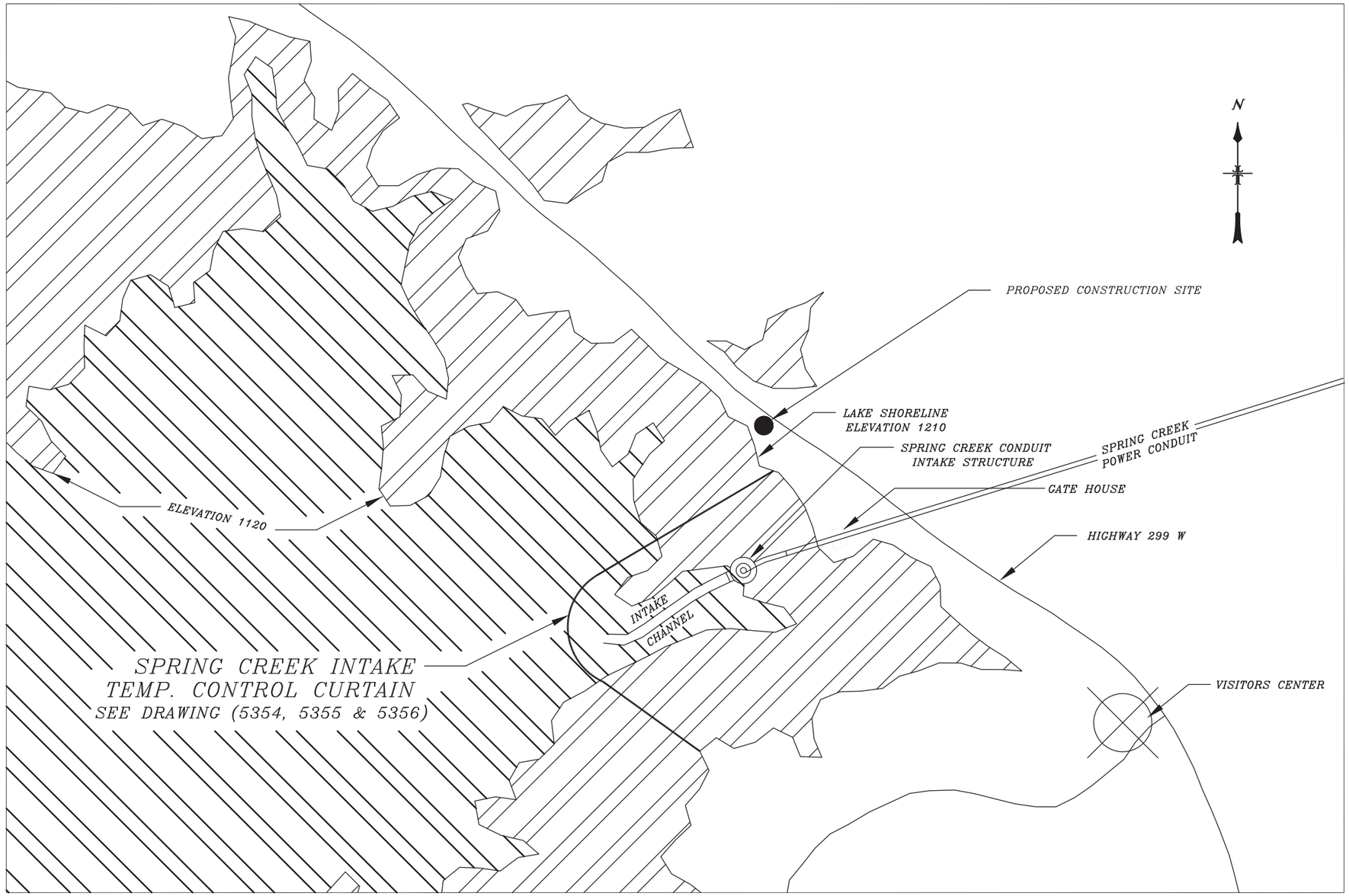
TEMPERATURE CONTROL CURTAINS

VICINITY MAP

DESIGNED	Greg O'Haver	TECH. APPR.	Dave Poore
DRAWN	Orville P Knox	SUBMITTED	Bill Gibbons
CHECKED	Greg O'Haver	APPROVED	J.Paul Carpener Project Superintendent

CADD SYSTEM AutoCAD R/14.01	CADD FILENAME 4160244.DWG	DATE & TIME PLOTTED December 3,1992 at 0610
REDDING, CALIFORNIA SHEET 1 OF 1	December 2,1992	416-214-5350

Plot Scale 1=12



REV NO		
2	2016-02-11 208 JONATHAN ROGADO	CHANGED TO INCLUDE ONLY SPRING CREEK INTAKE
02-02-94	AS BUILT CHANGES ADDED	Greg O'Haver

ALWAYS THINK **SAFETY**

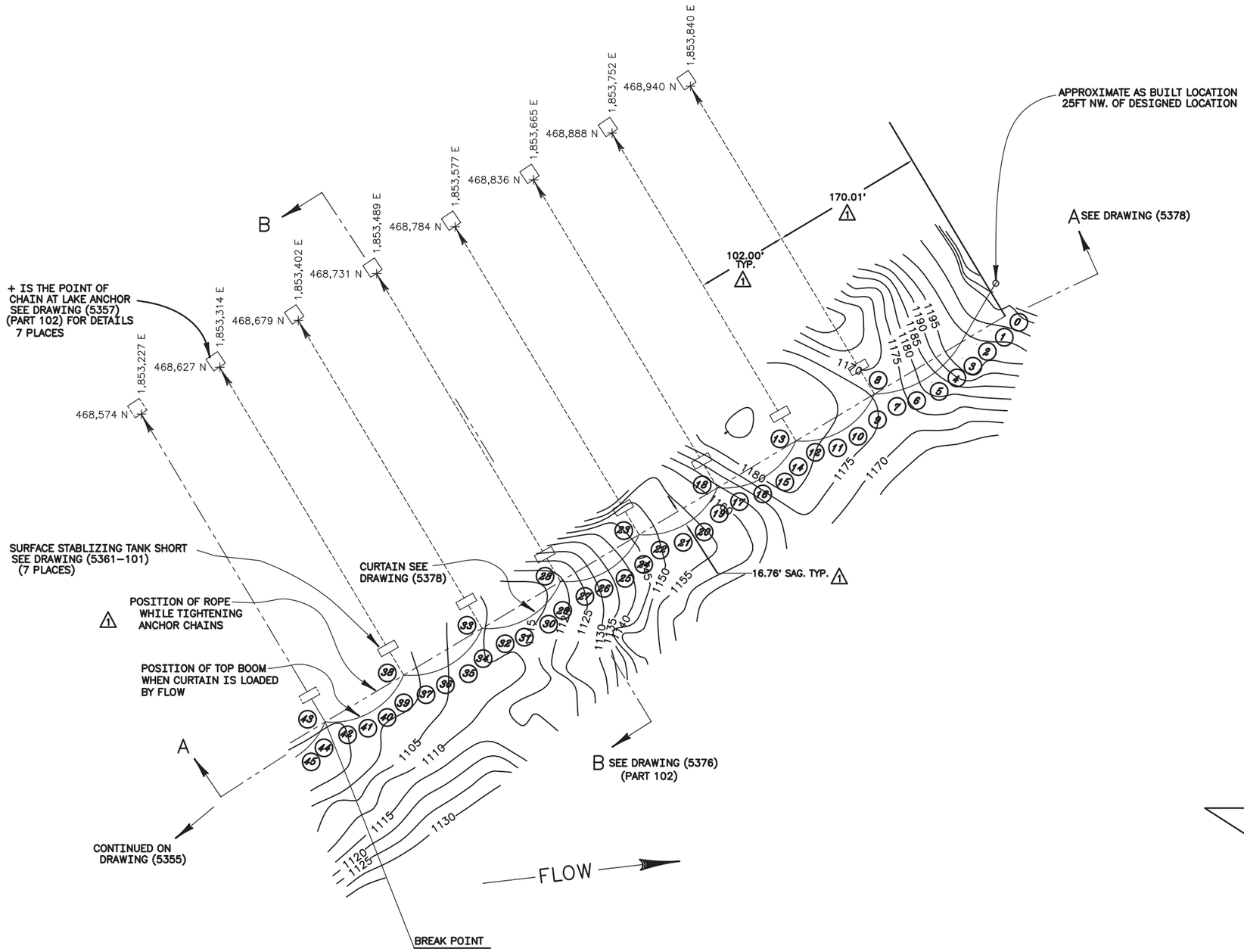
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
TRINITY RIVER DIVISION - CALIFORNIA

WHISKEYTOWN LAKE
TEMPERATURE CONTROL CURTAINS
SPRING CREEK INTAKE
LOCATION MAP

DESIGNED	Greg O'Haver	TECH. APPR.	
DRAWN	Orville P Knox	SUBMITTED	Bill Gibbons
CHECKED	Dave Poore	APPROVED	J.Paul Capener Project Superintendent

CADD SYSTEM AutoCAD R/14.01	CADD FILENAME 41601te.DWG	DATE & TIME PLOTTED January 22, 1993 at 1500
REDDING, CALIFORNIA SHEET 1 OF	December 3,1992	416-214-5352

Plot Scale 1=12



N

LEGEND

(13) BUOY NUMBERS

NOTES:
⚠ HOLD THESE DIMENSIONS (BY INSTALLING A ROPE TEMPORARILY) WHILE TIGHTENING ALL ANCHOR CHAINS WHEN LAKE SURFACE ELEV. = 1208

REFERENCE DRAWINGS

GENERAL PLAN & TOPO. No.2	416-214-5355
GENERAL PLAN & TOPO. No.3	416-214-5356
GENERAL PLAN & TOPO. ALL 3 PARTS	416-214-5387
VIEW ALONG CURTAIN SECTION No.1	416-214-5378
VIEW ALONG CURTAIN SECTION No.2	416-214-5379
VIEW ALONG CURTAIN SECTION No.3	416-214-5380

100 0 100 200 300
SCALE OF FEET

FOR INFORMATION ONLY

02-08-94	AS BUILT CHANGES ADDED	Greg O'Haver

ALWAYS THINK SAFETY

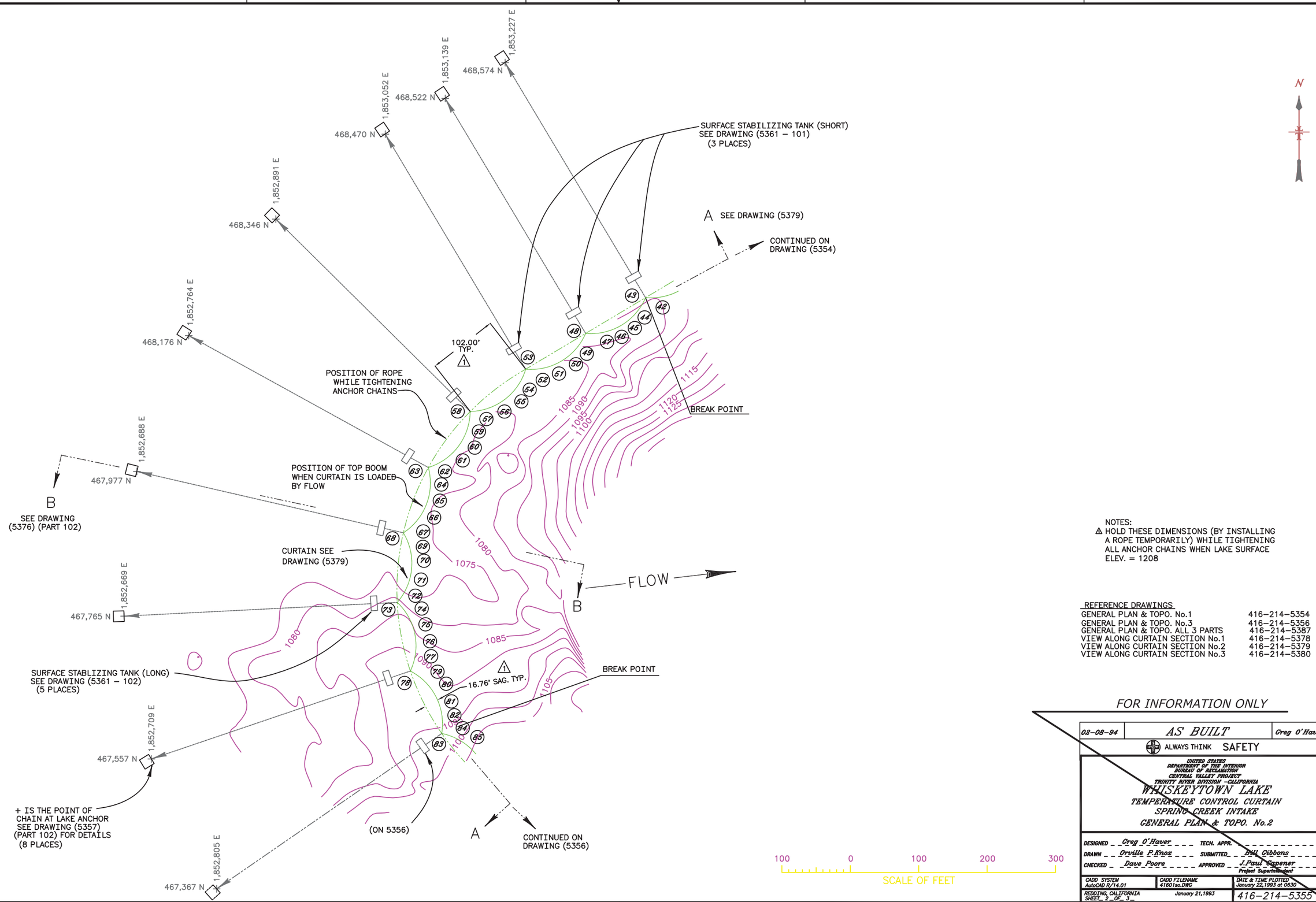
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT - CALIFORNIA
TRINITY RIVER DIVISION

WHISKEYTOWN LAKE
TEMPERATURE CONTROL CURTAIN
SPRING CREEK INTAKE
GENERAL PLAN & TOPO. No.1

DESIGNED	Greg O'Haver	TECH. APPR.	
DRAWN	Orville P Knox	SUBMITTED	Bill Gibbons Project Superintendent
CHECKED	Dave Poore	APPROVED	J.Paul Papener

CADD SYSTEM AutoCAD R/14.01	CADD FILENAME 41601ss.DWG	DATE & TIME PLOTTED January 21,1993 at 1350
REDDING, CALIFORNIA SHEET 1 OF 3	January 21,1993	416-214-5354

Plot Scale 1=6



NOTES:
⚠1 HOLD THESE DIMENSIONS (BY INSTALLING A ROPE TEMPORARILY) WHILE TIGHTENING ALL ANCHOR CHAINS WHEN LAKE SURFACE ELEV. = 1208

REFERENCE DRAWINGS

GENERAL PLAN & TOPO. No.1	416–214–5354
GENERAL PLAN & TOPO. No.3	416–214–5356
GENERAL PLAN & TOPO. ALL 3 PARTS	416–214–5387
VIEW ALONG CURTAIN SECTION No.1	416–214–5378
VIEW ALONG CURTAIN SECTION No.2	416–214–5379
VIEW ALONG CURTAIN SECTION No.3	416–214–5380

100 0 100 200 300
SCALE OF FEET

FOR INFORMATION ONLY

02-08-94	AS BUILT	Greg O'Haver

ALWAYS THINK SAFETY

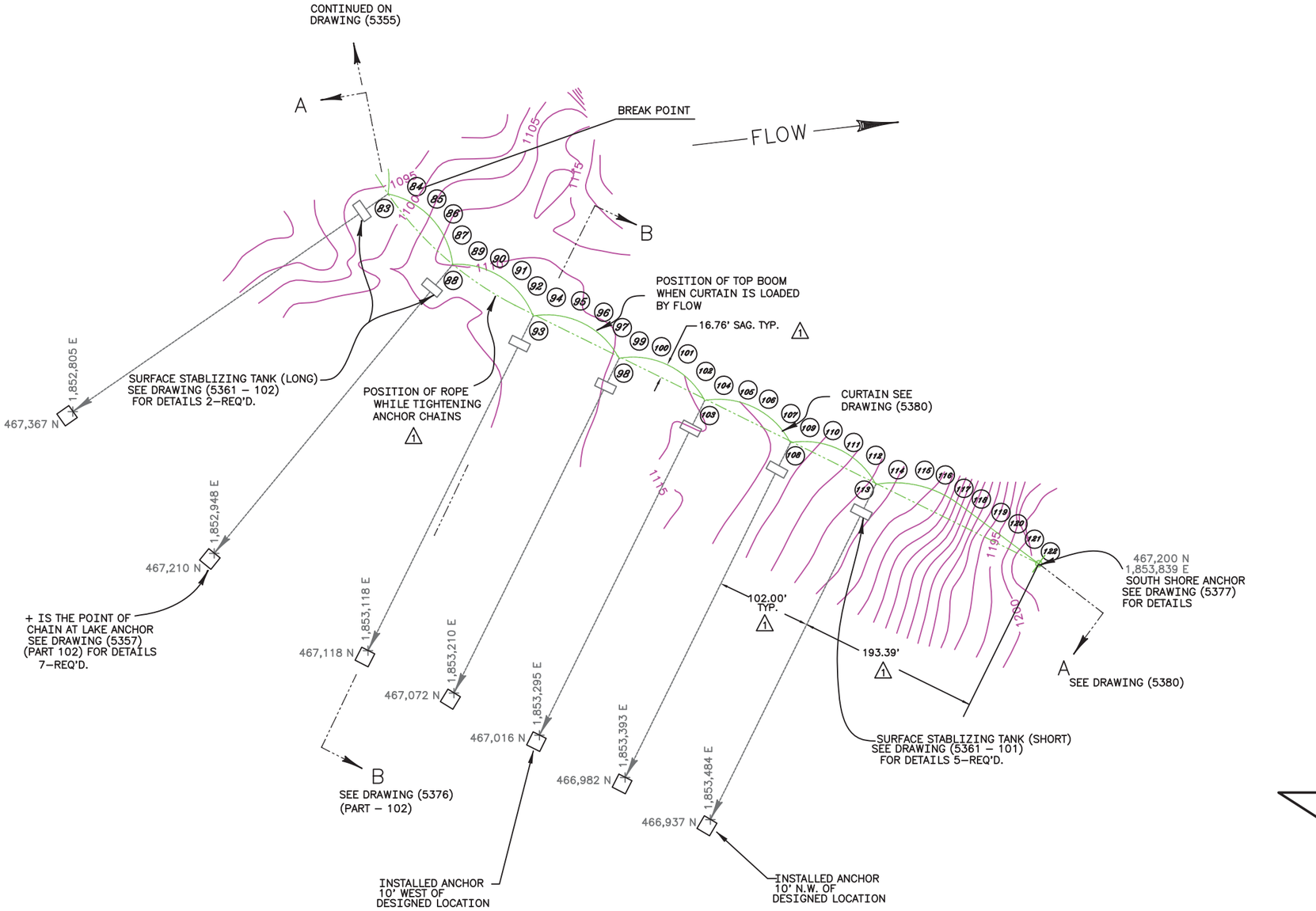
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
TRINITY RIVER DIVISION -CALIFORNIA

WHISKEYTOWN LAKE
TEMPERATURE CONTROL CURTAIN
SPRING CREEK INTAKE
GENERAL PLAN & TOPO. No.2

DESIGNED	Greg O'Haver	TECH. APPR.	
DRAWN	Orville P.Knox	SUBMITTED	Bill Gibbons
CHECKED	Dave Poore	APPROVED	J.Paul Gagner, Project Superintendent

CADD SYSTEM	CADD FILENAME	DATE & TIME PLOTTED
AutoCAD R/14.01	41601as.DWG	January 22,1993 at 0630
REDDING, CALIFORNIA SHEET 2 OF 3	January 21,1993	416–214–5355

Plot Scale 1=12



NOTES:
⚠ HOLD THESE DIMENSIONS (BY INSTALLING A ROPE TEMPORARILY) WHILE TIGHTENING ALL ANCHOR CHAINS WHEN LAKE SURFACE ELEV. = 1208

REFERENCE DRAWINGS

GENERAL PLAN & TOPO. No.1	416–214–5354
GENERAL PLAN & TOPO. No.2	416–214–5355
GENERAL PLAN & TOPO. ALL 3 PARTS	416–214–5387
VIEW ALONG CURTAIN SECTION No.1	416–214–5378
VIEW ALONG CURTAIN SECTION No.2	416–214–5379
VIEW ALONG CURTAIN SECTION No.3	416–214–5380

FOR INFORMATION ONLY

02-08-94	AS BUILT CHANGES ADDED	Greg O'Haver

ALWAYS THINK SAFETY

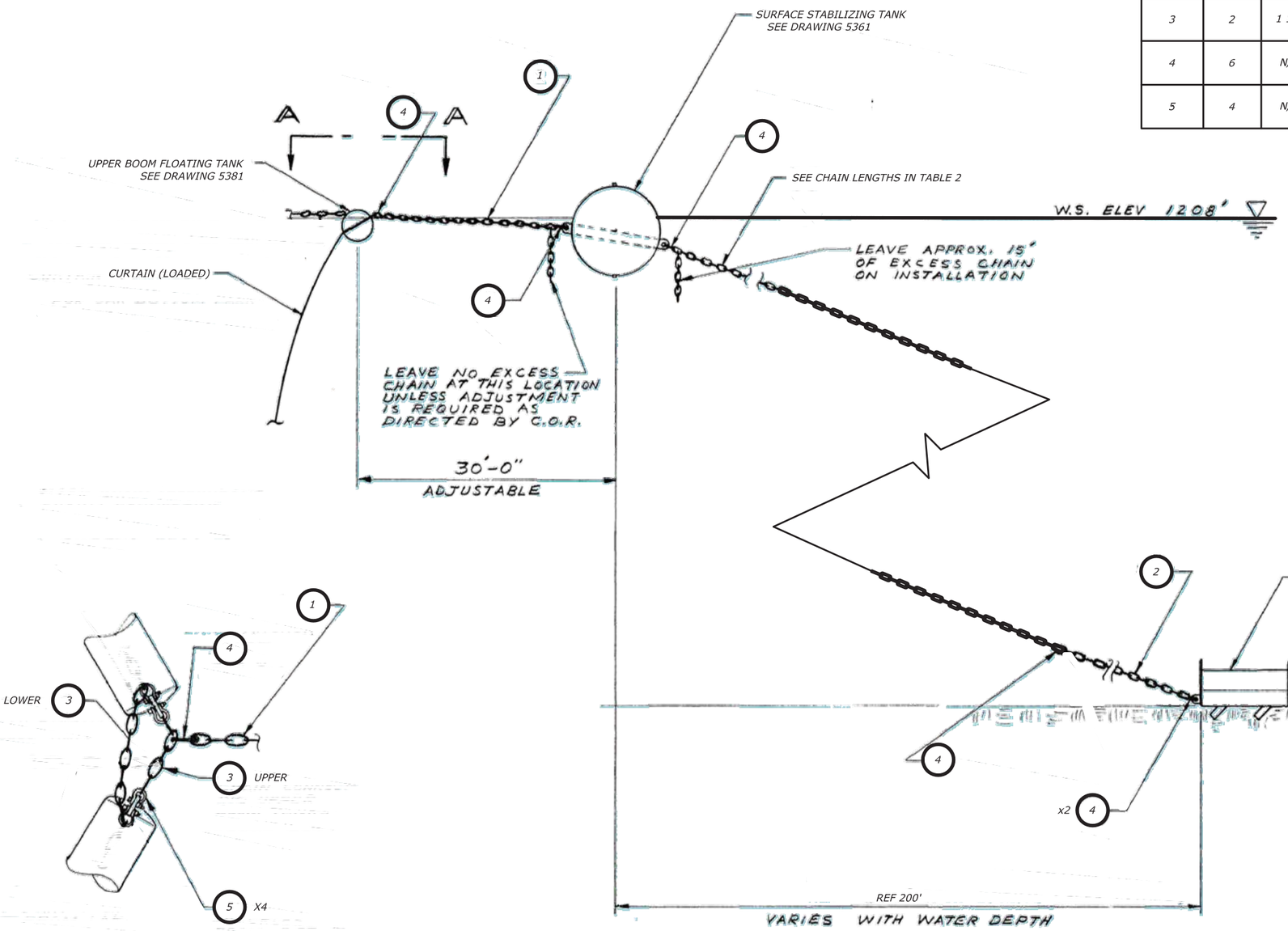
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
TRINITY RIVER DIVISION – CALIFORNIA

WHISKEYTOWN LAKE
TEMPERATURE CONTROL CURTAIN
SPRING CREEK INTAKE
GENERAL PLAN & TOPO. No.3

DESIGNED	Greg O'Haver	TECH. APPR.	
DRAWN	Orville P Knox	SUBMITTED	Bill Gibbons
CHECKED	Dave Poore	APPROVED	J.Paul Gagner, Project Superintendent

CADD SYSTEM AutoCAD R/14.01	CADD FILENAME 41601sm.DWG	DATE & TIME PLOTTED January 22,1993 at 0530
REDDING, CALIFORNIA SHEET 3 OF 3	January 21,1993	416–214–5356

Plot Scale 1=12



VIEW A-A

PLAN VIEW SHOWING SPRING CREEK INTAKE ANCHOR CHAIN CONNECTIONS AT UPPER BOOM TANKS

VIEW B-B

FROM SHEETS 5354, 5355, 5356

TABLE 1: LIST OF MATERIALS

PART NO.	QTY.	LENGTH (FT)	TOTAL FOR 22 LAKE ANCHOR ASSEMBLIES	DESCRIPTION	MATERIAL SPEC.
1	1	35	770 Ft	CHAIN, CURTAIN BUY TO STABILIZING TANK	3/4" CHAIN LONG LINK, HARDEN STEEL, 70,000 LB TENSILE MINIMUM, GALVINIZED
2	2	10	440	CHAIN, BRIDLE FOR LAKE ANCHOR (2 LEGS AT 60 DEG)	3/4" CHAIN LONG LINK, HARDEN STEEL, 70,000 LB TENSILE MINIMUM, GALVINIZED
3	2	1 1/2	180	CHAIN, CURTAIN BUOY TO CURTAIN BUOY	3/4" CHAIN LONG LINK, HARDEN STEEL, 70,000 LB TENSILE MINIMUM, GALVINIZED
4	6	N/A	132	SHACKLE, CURTAIN BUOY CHAIN TO LAKE ANCHOR	3/4' ANCHOR SHACKLE 70,000 LB MIM. BREAKING STRENGTH, GALVANIZED STEEL, LOCKNUT, PIN
5	4	N/A	480	SHACKLE, CURTAIN BUOY TO CURTAIN BUOY	3/4' ANCHOR SHACKLE 70,000 LB MIM. BREAKING STRENGTH, GALVANIZED STEEL, LOCKNUT, PIN

TABLE 2: LENGTHS OF ANCHOR CHAINS

ITEM NO.	ANCHOR NO.	LENGTH (FT)
1	8	376
2	13	384
3	18	386 1/2
4	23	387 1/2
5	28	386
6	33	385
7	38	386
8	43	390
9	48	391
10	53	393
11	58	395
12	63	398
13	68	399
14	73	399
15	78	399
16	83	397
17	88	389
18	93	387
19	98	386
20	103	385
21	108	381
22	113	379
	TOTAL LENGTH	8559

REFERENCES

GENERAL PLAN & TOPO. NO. 1	416-214-5354
GENERAL PLAN & TOPO. NO. 2	416-214-5355
GENERAL PLAN & TOPO. NO. 3	416-214-5356
SURFACE STABILIZING TANKS	416-214-5361
FABRIC DETAIL NO. 1a AS-BUILD	416-214-5381
LAKE ANCHOR DETAILS	416-214-5357

REV NO		
3	2016-02-16 208 JONATHAN ROGADO	MODIFIED TO REFLECT ONLY SPRING CREEK INTAKE TEMPERATURE CURTAIN DETAILS
2	208	UPDATE WITH MODIFIED OAK BOTTOM DESIGN
2-8-94	AS BUILT CHANGES ADDED	Greg O'Haver

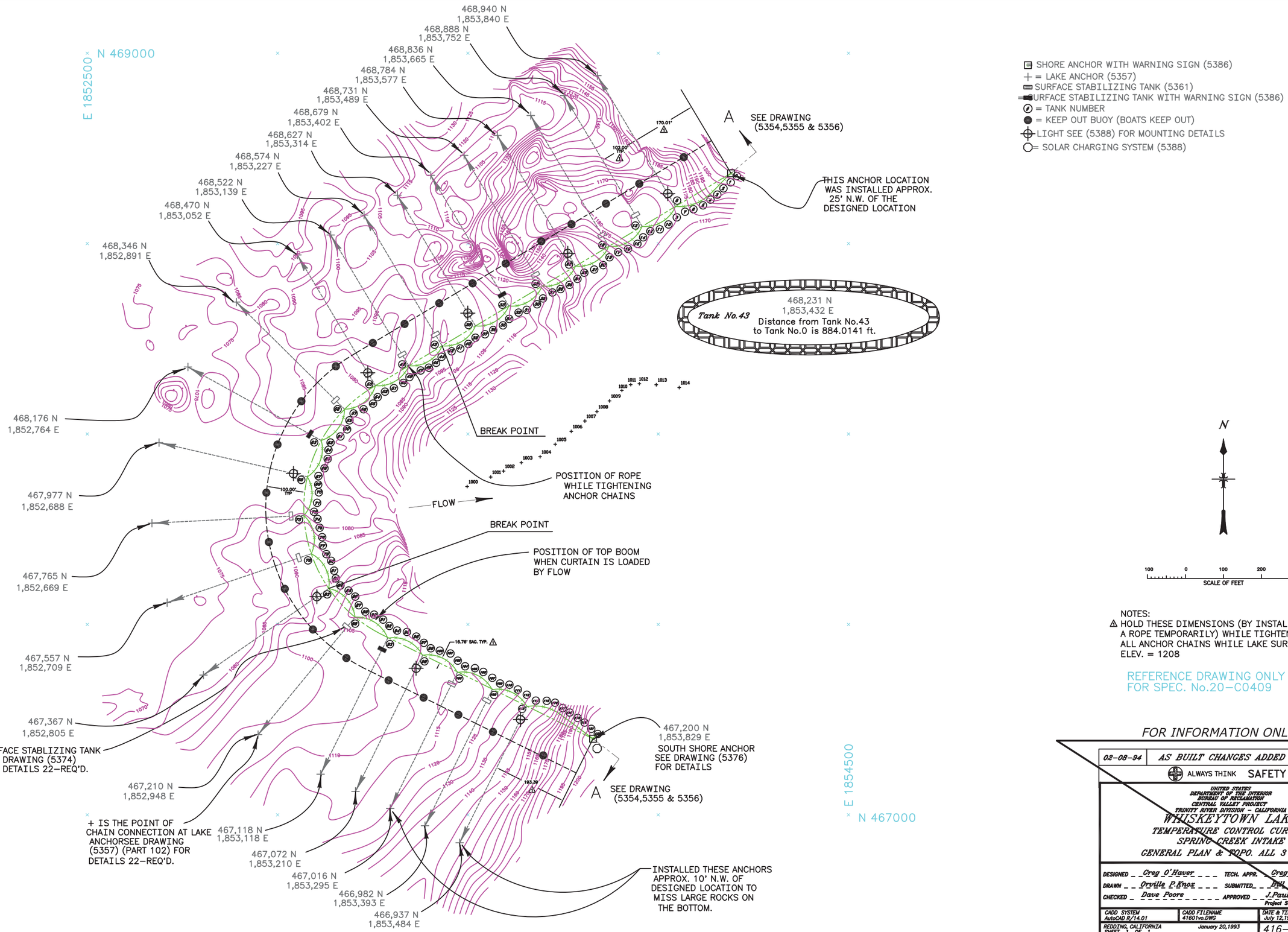
ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
TRINITY RIVER DIVISION

WHISKEYTOWN LAKE
SPRING CREEK INTAKE
TEMPERATURE CONTROL CURTAIN
LAKE ANCHOR SYSTEM; INSTALLATION DETAILS

DESIGNED Greg O'Haver FIELD APPROVAL David W. Boe
DRAWN Greg O'Haver TECHNICAL APPROVAL
CHECKED David W. Boe APPROVED Paul Taylor

REDDING, CA 12-22-92 416-214-5376



NOTES:
⚠ HOLD THESE DIMENSIONS (BY INSTALLING A ROPE TEMPORARILY) WHILE TIGHTENING ALL ANCHOR CHAINS WHILE LAKE SURFACE ELEV. = 1208

REFERENCE DRAWING ONLY
FOR SPEC. No.20-C0409

FOR INFORMATION ONLY

02-08-94	AS BUILT CHANGES ADDED	Greg O'Haver

ALWAYS THINK SAFETY

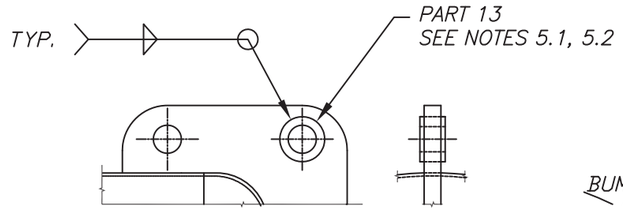
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
TRINITY RIVER DIVISION - CALIFORNIA

WHISKEYTOWN LAKE
TEMPERATURE CONTROL CURTAIN
SPRING CREEK INTAKE
GENERAL PLAN & TOPO. ALL 3 PARTS

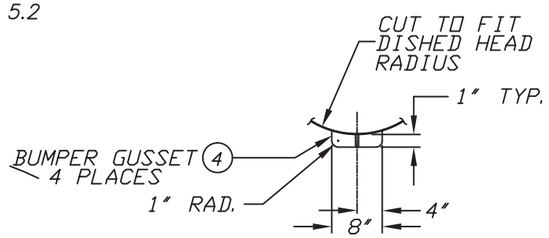
DESIGNED	Greg O'Haver	TECH. APPR.	Greg O'Haver
DRAWN	Orville P.Knox	SUBMITTED	Phil Gibbons
CHECKED	Dave Poore	APPROVED	J.Paul Gagener, Project Superintendent

CADD SYSTEM AutoCAD R/14.01	CADD FILENAME 41601vo.DWG	DATE & TIME PLOTTED July 12,1993 at 0953
REDDING, CALIFORNIA SHEET 1 OF 1	January 20,1993	416-214-5387

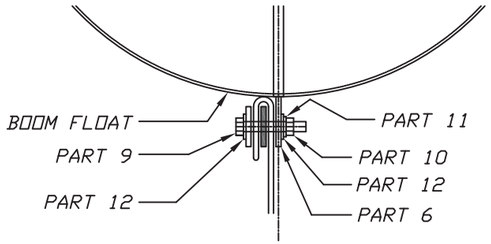
Plot Scale = Fit



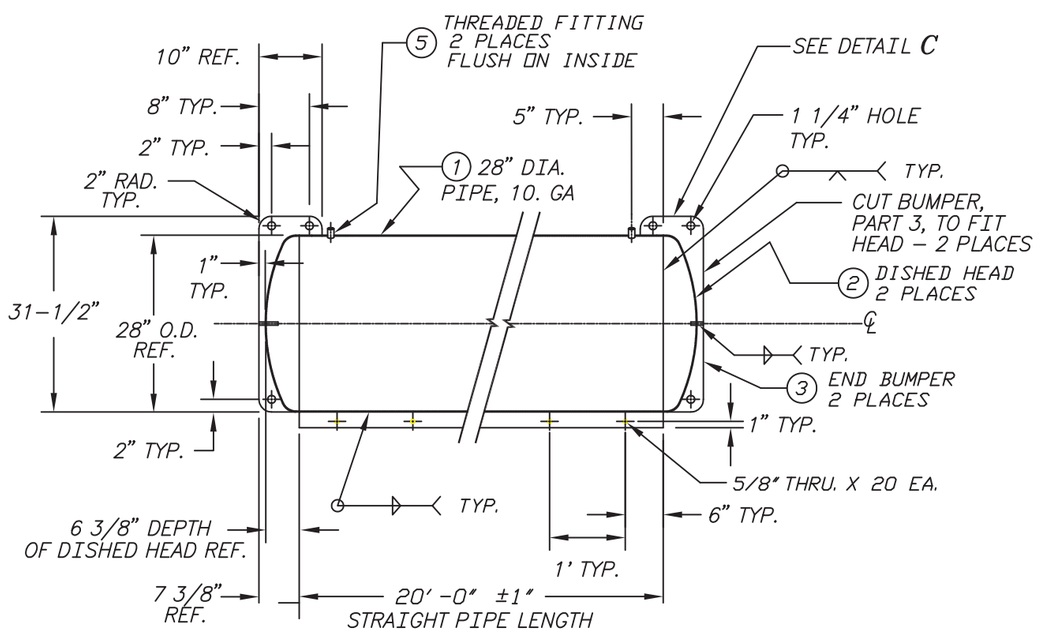
DETAIL **C** NTS
END BUMPER REPAIR

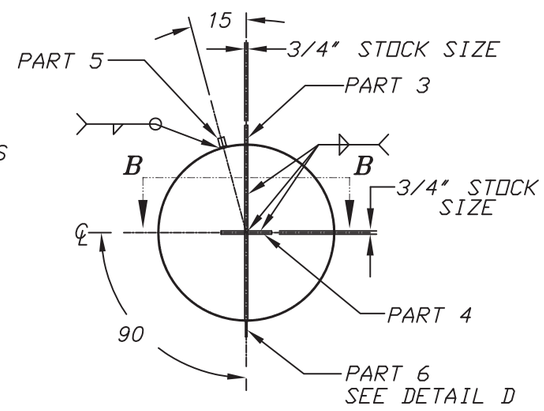


DETAIL **B–B** NTS
PIPE TO HEAD
WELDING DETAIL



DETAIL **D** NTS
END BUMPER REPAIR





LIST OF MATERIALS FOR 1 TANK

PART No.	QTY. REQ'D.	DESCRIPTION	MATERIAL SPEC.
1	1	28" O.D. STEEL PIPE, 10 GAUGE WALLED, GALVANIZED OR ZRC COATED	ASTM A135 ELECTRIC RESISTANCE WELDED STEEL PIPE OR EQUAL
2	2	28" DIA. STEEL DISHED HEAD, 3/16" THICK SEE SPECS.	ASME 60 PSI WORKING PRESSURE, ASTM A579 STEEL OR EQUAL, ZRC COATED, 3/16" GA. MIN.
3	2	END BUMPER, STEEL PLATE 3/4" THICK 5" X 31" SHAPED AS SHOWN	ASTM A36 CARBON STEEL ZRC COATED
4	4	BUMPER GUSSET, STEEL PLATE 3/4" THICK, 2" X 3 3/4" SHAPED AS SHOWN	ASTM A36 CARBON STEEL ZRC COATED
5	2	THREADED PIPE COUPLING 1" NPT	SCH. 40 STEEL STANDARD FITTING ZRC COATED
6	1	FIN, CURTAIN FLOAT, 1/4" X 2-1/2" X 20'	GALVANIZED STEEL
7	1	STRIP, 1/4" X 2" X 20' (CONTINUOUS)	HDPE
8	1	SANDWICH BAR, 1/4" X 2" X 20'	GALVANIZED STEEL
9	20	BOLT, 1/2"-13 X 1-3/4"	GALVANIZED STEEL
10	20	NUT, 1/2"-13	GALVANIZED STEEL
11	20	LOCK WASHER, 1/2"	GALVANIZED STEEL
12	40	WASHER, 1/2"	GALVANIZED STEEL
13	120	REPAIR CYLINDER, END BUMPER	STEEL, ZRC COATED

NOTES:

1. ALL WELDING SHALL CONFORM WITH A. W. S. STANDARDS
2. TANKS INTERIOR & EXTERIOR SHALL BE COATED WITH ZINC RICH COATING, 2 COATS. ALL WELDS AND DAMAGED ZINC COATING SHALL BE TOUCHED UP WITH ZRC, 2 COATS EXCEPT INTERIOR WELDS WHICH CAN NOT BE REACHED.
3. TEST COMPLETED TANKS PER SPECS. USING AIR & SOAP BUBBLE COMPOUND OVER ENTIRE TANK EXTERIOR, OR BY HYDROSTATIC METHODS. ALL LEAKS SHALL BE REPAIRED & TESTED AGAIN.
4. TOTAL QUANTITIES REQ'D.:
   - 4.1 UPPER BOOM FLOATING TANK, NEW = 2 EACH
   - 4.2 UPPER BOOM FLOATING TANK, RECONDITIONED = 118 EACH
   - 4.3 REPAIR CYLINDER, END BUMPER = 120 EACH
5. UPPER BOOM FLOATING TANK RECONDITIONING
   - 5.1 CUT END BUMPER TO FIT REPAIR CYLINDER AND CHAMFER I.D.
   - 5.2 WELD FILL ANY VOIDS NOT FILLED BY REPAIR CYLINDER.
   - 5.3 REPAINT TANK EXTERIOR, ZRC PAINT OR EQUAL (2 COATS)
6. DRY WEIGHT OF TANK SHALL NOT EXCEED 970 lb.

REFERENCE DRAWINGS

VIEW ALONG CURTAIN SECTION NO. 1	416-214-5381
VIEW ALONG CURTAIN SECTION NO. 2	416-214-5382
VIEW ALONG CURTAIN SECTION NO. 3	416-214-5383
20' CURTAIN SECTION, INSTALLATION DETAILS	416-214-5366

REV NO		
2	2016-02-24 208 JONATHAN ROGADO	UPDATED STANDARDS, ADDED DETAILS FOR CURTAIN FIN AND END BUMPER REPAIR

02-08-94 — AS BUILT — Greg O'Haver

ALWAYS THINK SAFETY

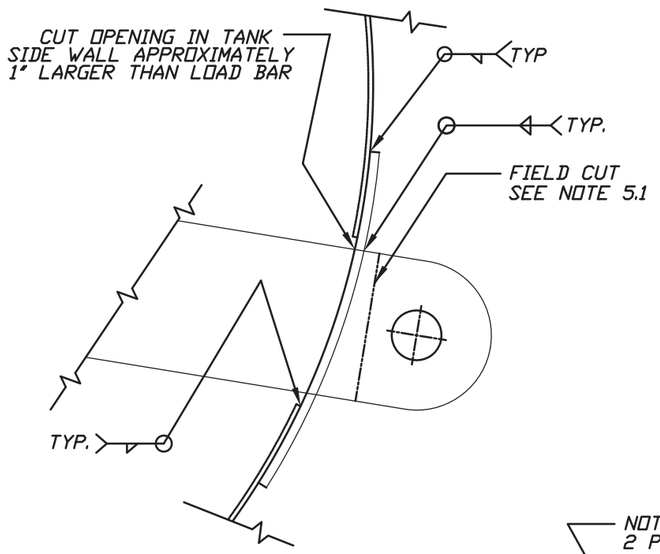
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
TRINITY RIVER DIVISION – CALIFORNIA

WHISKEYTOWN LAKE
TEMPERATURE CONTROL CURTAIN
SPRING CREEK INTAKE
UPPER BOOM FLOATING TANKS
DETAILS AND ASSEMBLY

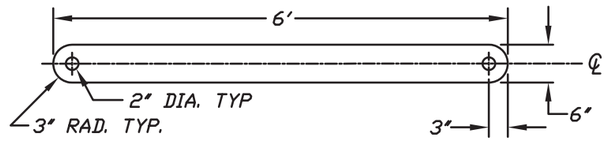
DESIGNED	Greg O'Haver	TECH. APPR.	
DRAWN	Orville P.Knox	SUBMITTED	Bill Gibbons
CHECKED	Dave Poore	APPROVED	J.Paul Capener, Project Superintendent

CADD SYSTEM AutoCAD R/14.01	CADD FILENAME 41601sv.DWG	DATE & TIME PLOTTED January 25, 1993 0515
REDDING, CALIFORNIA SHEET 1 OF	December 3,1992	416-214-5359

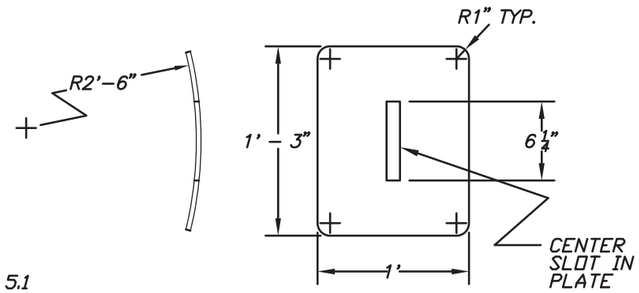
Plot Scale 1=12



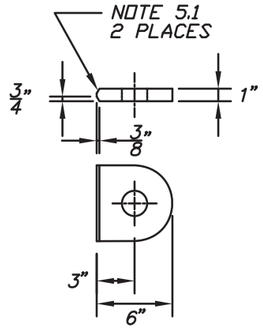
SECTION A-A



LOAD BAR
PART No.4



REINFORCEMENT PAD
PART No.5



LOAD BAR END
PART No.8

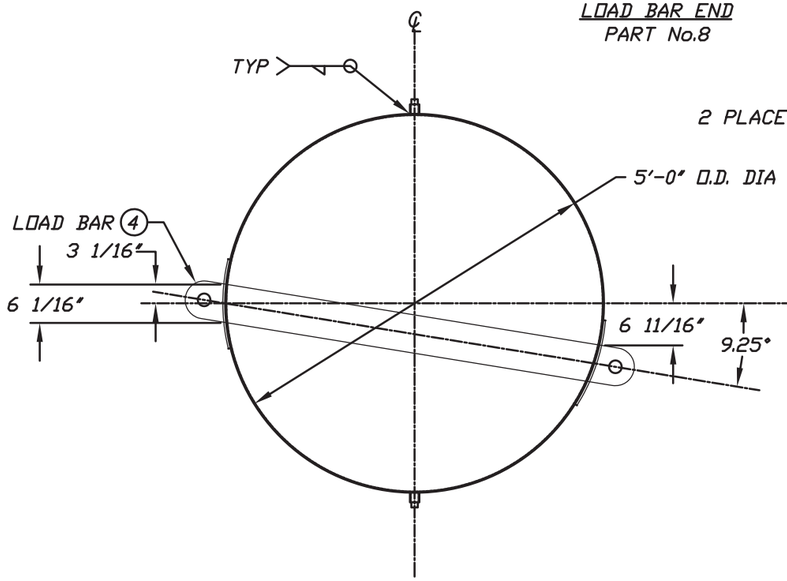
LIST OF MATERIALS FOR 1 TANK			
PART NO.	QTY. REQ'D.	DESCRIPTION	MATERIAL SPEC.
1	0	60" O.D. TANK CYLINDER 6 ft. LONG	ASTM A-570 STEEL SHEET 3/16" WALL, ZRC COATED
2	1	60" O.D. TANK CYLINDER 8 ft. LONG	ASTM A-570 STEEL SHEET 3/16" WALL, ZRC COATED
3	2	60" DIA. STEEL DISHED HEAD SEE SPECS.	ASME 60 PSI WORKING PRESSURE ASTM - A570 STEEL OR EQUAL ZRC COATED, 3/16" MIN.
4	1	LOAD BAR	6" X 72" X 1" ASTM A-36 STEEL BAR
5	2	REINFORCEMENT PAD	ASTM A-570 STEEL PLATE 3/8" THICK
6	4	THREADED PIPE COUPLING 1" NPT	SCH. 40 STEEL STANDARD FITTING
7	4	PIPE PLUG	1" NPT GALVANIZED TO FIT PART 6
8	2	LOAD BAR END (FOR FIELD REPAIR)	6" X 6" X 1" ASTM A-36 STEEL BAR

REFERENCE DRAWINGS

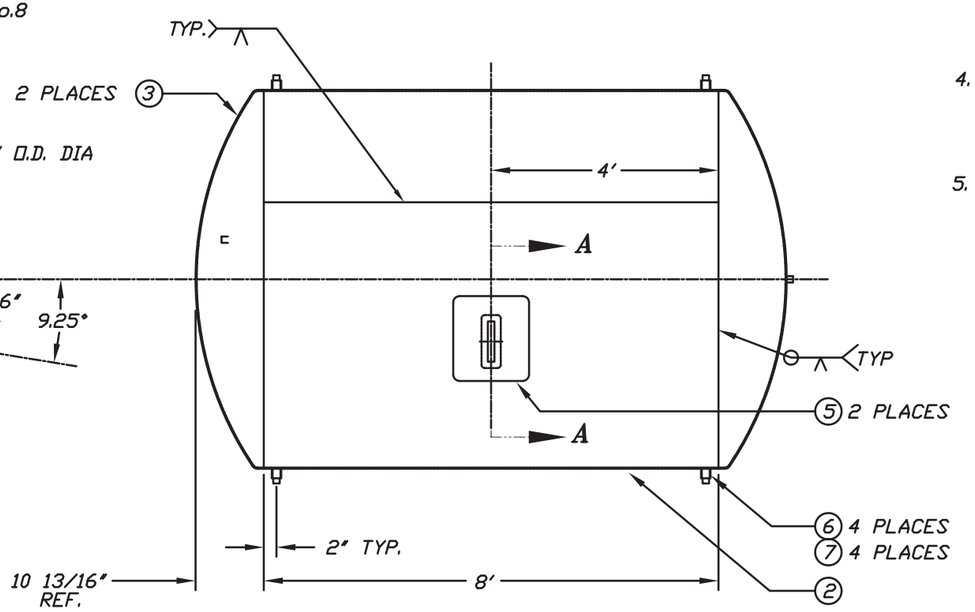
VIEW ALONG CURTAIN SECTION NO. 1	416-214-5378
VIEW ALONG CURTAIN SECTION NO.2	416-214-5379
VIEW ALONG CURTAIN SECTION NO.3	416-214-5380
CURTAIN LAKE ANCHOR SYSTEM DETAILS	416-214-5376

NOTES:

1. ALL WELDING SHALL CONFORM WITH A.W.S. STANDARDS
2. TANKS INTERIOR & EXTERIOR SHALL BE COATED WITH ZINC RICH COATING, 2 COATS. ALL WELDS AND DAMAGED ZINC COATING SHALL BE TOUCHED UP WITH ZRC, 2 COATS EXCEPT INTERIOR WELDS WICH CAN NOT BE REACHED.
3. TEST COMPLETED TANKS PER SPECS. USING AIR & SOAP BUBBLE COMPOUND OVER ENTIRE TANK EXTERIOR, OR BY HYDROSTATIC METHODS. ALL LEAKS SHALL BE REPAIRED & TESTED AGAIN.
4. TOTAL QUANTITIES REQ'D.:
   - 4.1 STABILIZING TANK, NEW (PART 2) = 3 EACH
   - 4.2 STABILIZING TANK, RECONDITIONED = 20 EACH
   - 4.3 LOAD BAR ENDS (PART 8) = 40 EACH
5. STABILIZING TANK RECONDITIONING
   - 5.1 REPLACE ALL LOAD BAR ENDS, FULL PENETRATION WELD
   - 5.2 REPAINT TANK EXTERIOR, ZRC PAINT OR EQUAL (2 COATS) OVER CROSS SECTIONAL AREA.



END VIEW



SIDE VIEW

REV NO.		
2.1	2016-02-16 208 JONATHAN ROGADO	ADDED LOAD BAR DETAIL, REINFORCEMENT PAD DETAIL, LOAD BAR END DETAIL, UPDATED QUANTITIES, ADDED NOTES
08-08-94	AS BUILT	Greg O'Haver

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
TRINITY RIVER DIVISION - CALIFORNIA

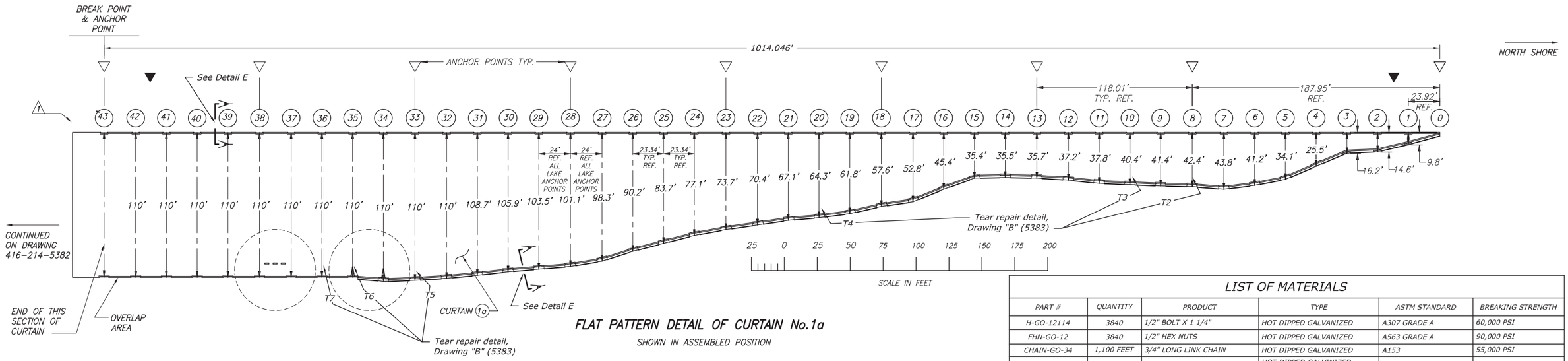
WHISKEYTOWN LAKE

TEMPERATURE CONTROL CURTAIN
SPRING CREEK INTAKE
SURFACE STABILIZING TANKS
DETAILS AND ASSEMBLY

DESIGNED	Greg O'Haver	TECH. APPR.	
DRAWN	Orville P.Knox	SUBMITTED	Bill Gibbons
CHECKED	Dave Poore	APPROVED	J.Paul Copeyer, Project Superintendent

CADD SYSTEM AutoCAD R/14.01	CADD FILENAME 41601b.DWG	DATE & TIME PLOTTED January 25, 1993 at 0530
REDDING, CALIFORNIA SHEET 1 OF 1	December 7,1992	416-214-5361

Plot Scale 1=12



FLAT PATTERN DETAIL OF CURTAIN No.1a

SHOWN IN ASSEMBLED POSITION

LIST OF MATERIALS

PART #	QUANTITY	PRODUCT	TYPE	ASTM STANDARD	BREAKING STRENGTH
H-GO-12114	3840	1/2" BOLT X 1 1/4"	HOT DIPPED GALVANIZED	A307 GRADE A	60,000 PSI
FHN-GO-12	3840	1/2" HEX NUTS	HOT DIPPED GALVANIZED	A563 GRADE A	90,000 PSI
CHAIN-GO-34	1,100 FEET	3/4" LONG LINK CHAIN	HOT DIPPED GALVANIZED	A153	55,000 PSI
SPAS-GO-78	254	7/8" SHACKLES	HOT DIPPED GALVINIZED WITH PIN	FED STAND RRC27ID	65,000 PSI
LW-GO-12	30	1/2" LOCK WASHER	HOT DIPPED GALVINIZED	A307 GRADE A	N/A
EXISTING	120	1/4" X 2-1/2" X 20'	HDPE BAR MATERIAL	N/A	N/A
EXISTING	120	1/4" X 2-1/2" X 20'	METAL ZINC RECOATED BAR	N/A	N/A
N/A	980	3/8" X 2-1/2" X 2'	HOT DIPPED BARS	N/A	N/A
N/A	2400 LF	10" SUR35 PIPE	FILLED WITH CONCRETE	N/A	N/A
N/A	N/A	CURTAIN	POLYPROPYLENE	N/A	N/A

*** ALL BOLT CONNECTIONS TO BE TORQUED TO A MINIMUM OF 40 ft/lbs**

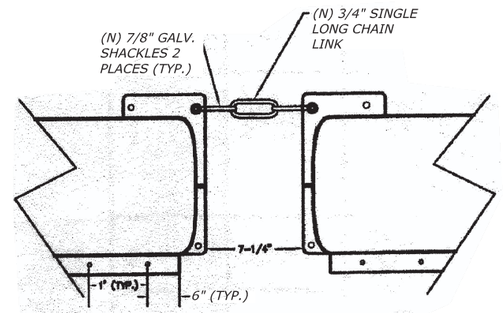
NOTES

1. ALL SEAMS SHALL BE HEAT WELDED 4"± 1/2" WIDE MINIMUM EXCEPT AS NOTED. (SEE SPECS.)
2. CURTAIN SHALL BE CONSTRUCTED IN FACTORY COMPLETE & READY FOR INSTALLATION EXCEPT FOR SAND SOCKS WHICH SHALL BE INSTALLED IN THE FIELD. NO FIELD WELDS SHALL BE PERMITTED.
3. PACKAGE CURTAIN SUCH THAT IT CAN BE DEPLOYED FROM THE END SHOWN WITHOUT MOVING THE CURTAIN–PACKAGE ONCE IT HAS BEEN PLACED FOR ASSEMBLY.

REFERENCE DRAWINGS

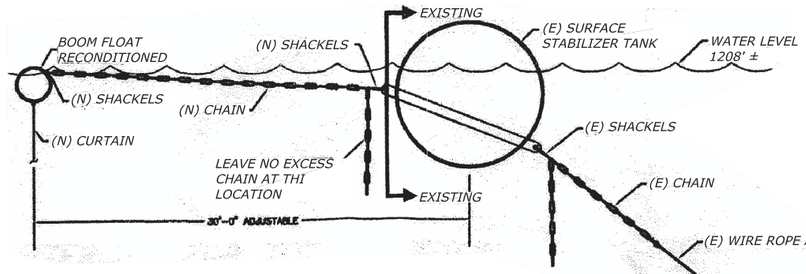
FABRIC DETAILS NO.1b	416–214–5382
FABRIC DETAILS NO.1c	416–214–5383
VIEW ALONG CURTAIN SECTION NO. 1	416–214–5378

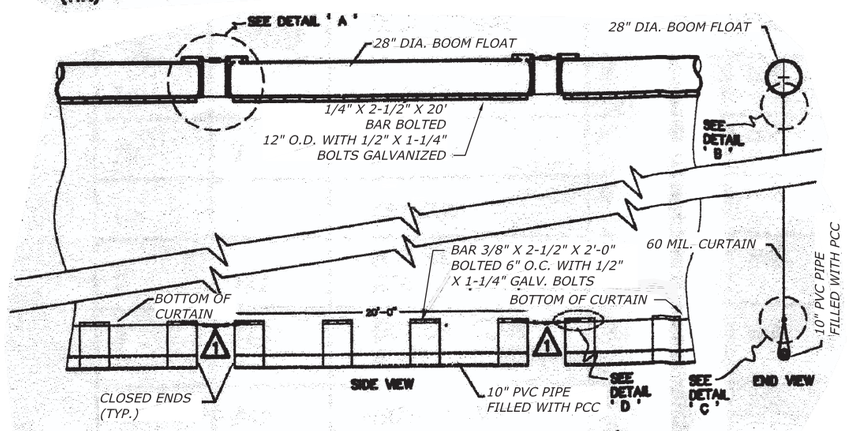
INFORMATION ONLY



(N) = NEW
(E) = EXISTING
(TYP.)

DETAIL ' A '
n.t.s.



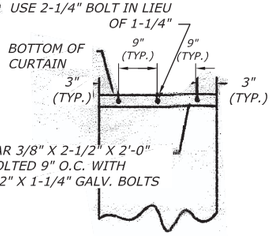


(N) = NEW
(E) = EXISTING
(TYP.)

DETAIL E
BOOM FLOAT AND CURTAIN WEIGHT TYPICAL SECTION PLAN VIEW
n.t.s.

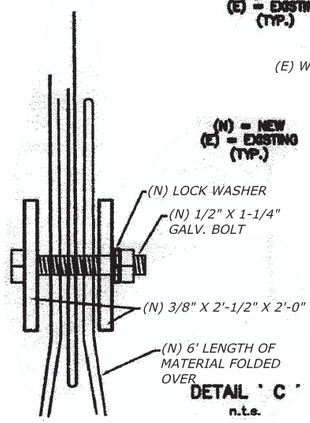
1 ADD WEIGHT STABILITY CHAINS 1/4 INCH - GRADE 43

1 WEIGHT STABILITY CHAIN ATTACHMENT POINT USE 2-1/4" BOLT IN LIEU OF 1-1/4"

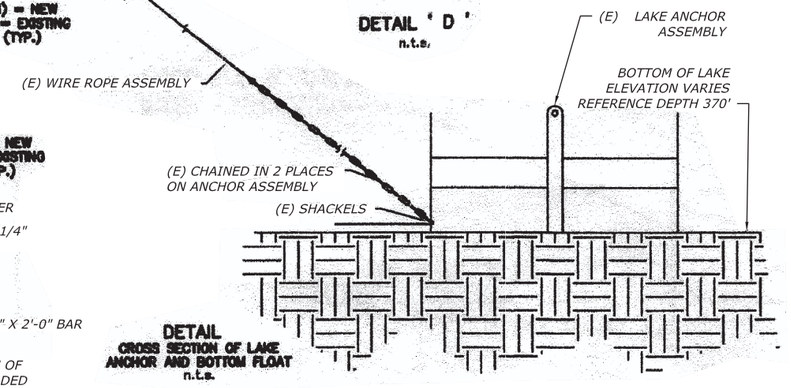


DETAIL ' D '
n.t.s.

(N) = NEW
(E) = EXISTING
(TYP.)



DETAIL ' C '
n.t.s.



DETAIL
CROSS SECTION OF LAKE ANCHOR AND BOTTOM FLOAT
n.t.s.

REV. NO	DATE / BY	DESCRIPTION
4.1	2016-06-17 208	MODIFIED FOR SPRING CREEK TEMPERATURE CURTAIN REPAIR SPECIFICATION
REV. NO 3	10-29-2014 208 MAS	AS–BUILT. SPECIFICATION NO. 20–C0762
REV. NO 2	2010–01–25 208 ALLEN LINDAUER	UPDATED TO CURRENT DRAFTING STANDARDS & CHANGED DRAWING TO REFLECT CURRENT PROJECT.
REV. NO 1	1994–02–08 GREG O'HAVER	AS–BUILT

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
TRINITY RIVER DIVISION

WHISKEYTOWN LAKE

SPRING CREEK INTAKE
TEMPERATURE CONTROL CURTAIN

FABRIC DETAILS NO. 1A

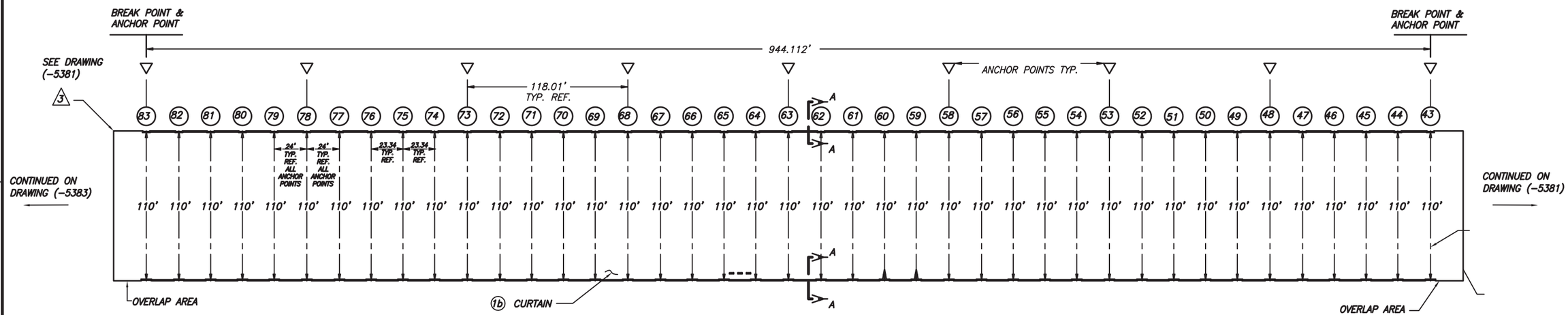
DESIGNED	Greg O'Haver	TECH. APPR.	Dave Poore
DRAWN	Orville P. Knox	SUBMITTED	Bill Gibbons
CHECKED	Dave Poore	APPROVED	J. Paul Capener, Project Superintendent

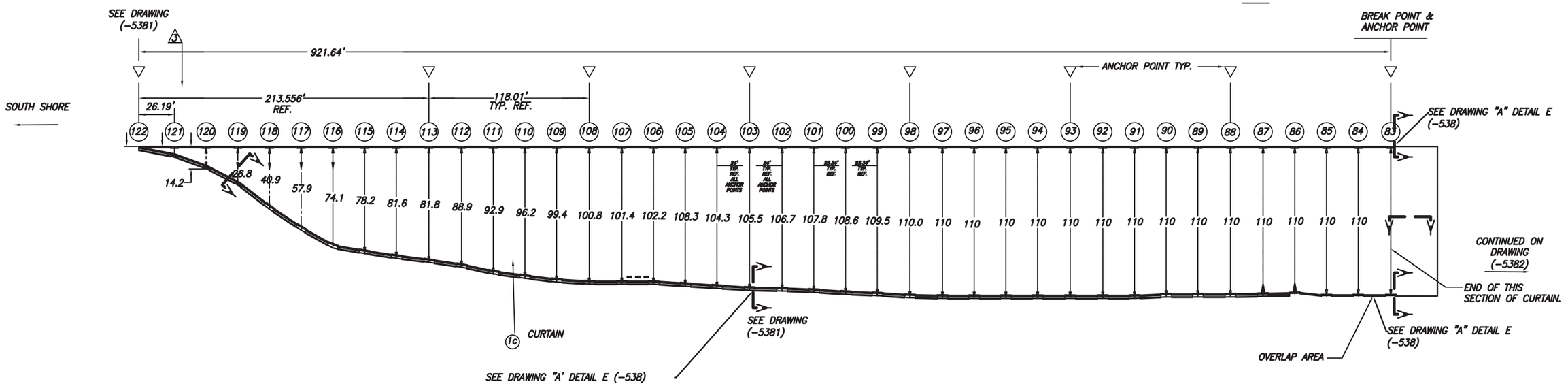
REDDING, CA
SHEET 1 OF 1
416-214-5381

DATE AND TIME PLOTTED
JUNE 22, 2016 14:58
PLOTTED BY
MPERIGNY

CAD SYSTEM
AutoCAD Rel. 20.0s
CAD FILENAME
416-214-5381-RD-1.DWG

416-214-5382


BREAK POINT & ANCHOR POINT
944.112'
BREAK POINT & ANCHOR POINT
SEE DRAWING (-5381)
3
118.01' TYP. REF.
ANCHOR POINTS TYP.
83 82 81 80 79 78 77 76 75 74 73 72 71 70 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54 53 52 51 50 49 48 47 46 45 44 43
A
A
24' TYP. REF. ALL ANCHOR POINTS
24' TYP. REF. ALL ANCHOR POINTS
23.34 TYP. REF.
23.34 TYP. REF.
CONTINUED ON DRAWING (-5383)
110' 110' 110'



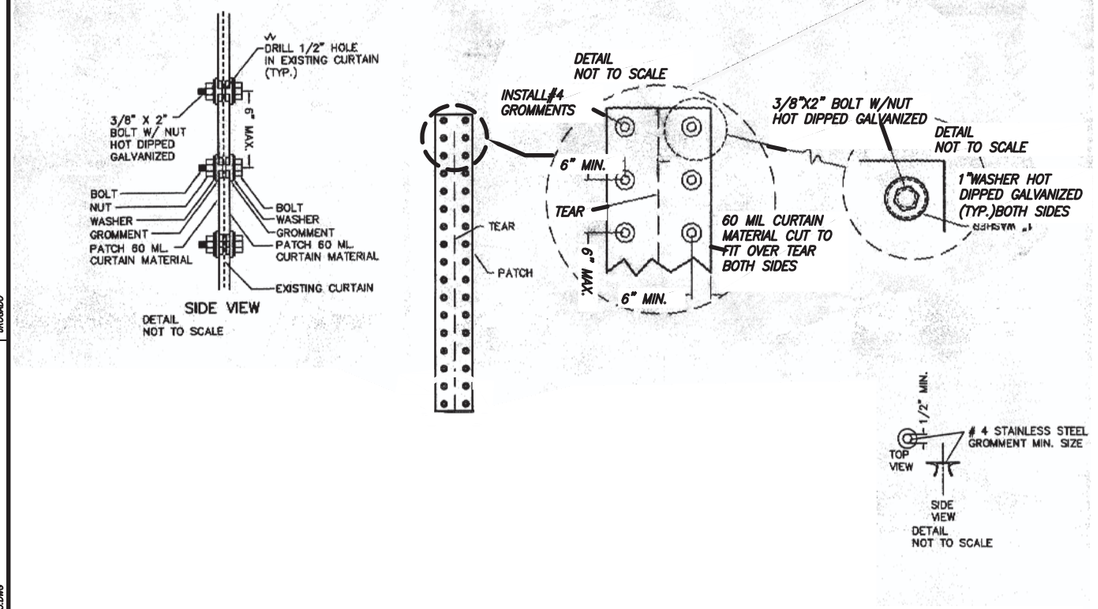
FLAT PATTERN DETAIL OF CURTAIN NO. 1c

SHOWN IN ASSEMBLED POSITION

25 50 75 100 125 150 175 200

SCALE IN FEET

TYPICAL CURTAIN REPAIR SECTION



NOTE

SEE DRAWING (-5381) FOR LIST OF MATERIALS

REFERENCE DRAWINGS

FABRIC DETAILS NO. 1a	416-214-5381
FABRIC DETAILS NO. 1b	416-214-5382
VIEW ALONG CURTAIN SECTION NO. 3	416-214-5380

INFORMATION ONLY

REV NO 4	2016-02-16 208 JONATHAN ROGADO	CHANGED TO ADD REPAIR INFORMATION FOR CONTRACT
REV NO 3	2014-10-29 214 M.A.S	UPDATED TO CURRENT DRAFTING STANDARDS & CHANGED DRAWING TO REFLECT CURRENT PROJECT.
REV NO 2	2010-01-25 208 ALLEN LINDAUER	UPDATED TO CURRENT DRAFTING STANDARDS & CHANGED DRAWING TO REFLECT CURRENT PROJECT.
REV NO 1	1994-02-08 GREG O'HAVER	AS-BUILT

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

CENTRAL VALLEY PROJECT
TRINITY RIVER DIVISION

WHISKEYTOWN LAKE
TEMPERATURE CONTROL CURTAIN
SPRING CREEK INTAKE
FABRIC DETAILS NO. 1c

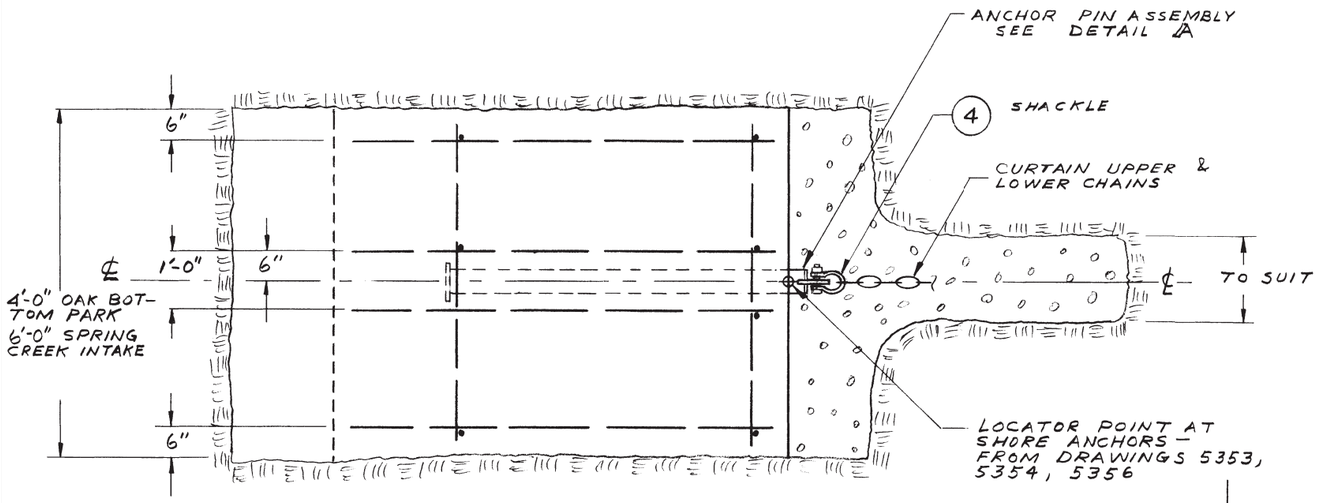
DESIGNED	Greg O'Haver	TECH. APPR.	Dave Poore
DRAWN	Orville P. Knox	SUBMITTED	Bill Gibbons Project Superintendent
CHECKED	Dave Poore	APPROVED	J. Paul Capener

REDDING, CA. 1993-01-19 **416-214-5383**

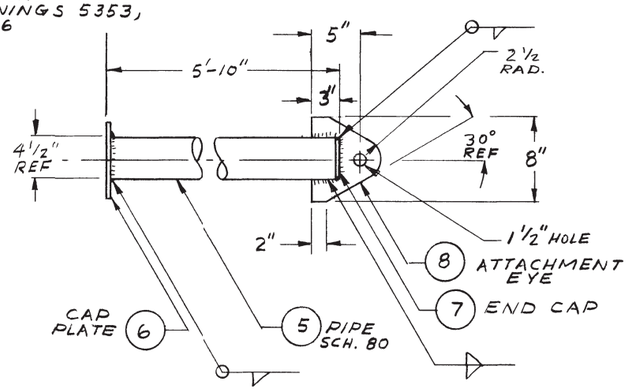
DATE AND TIME PLOTTED
FEBRUARY 24, 2016 15:29
PLOTTED BY
JROGADO

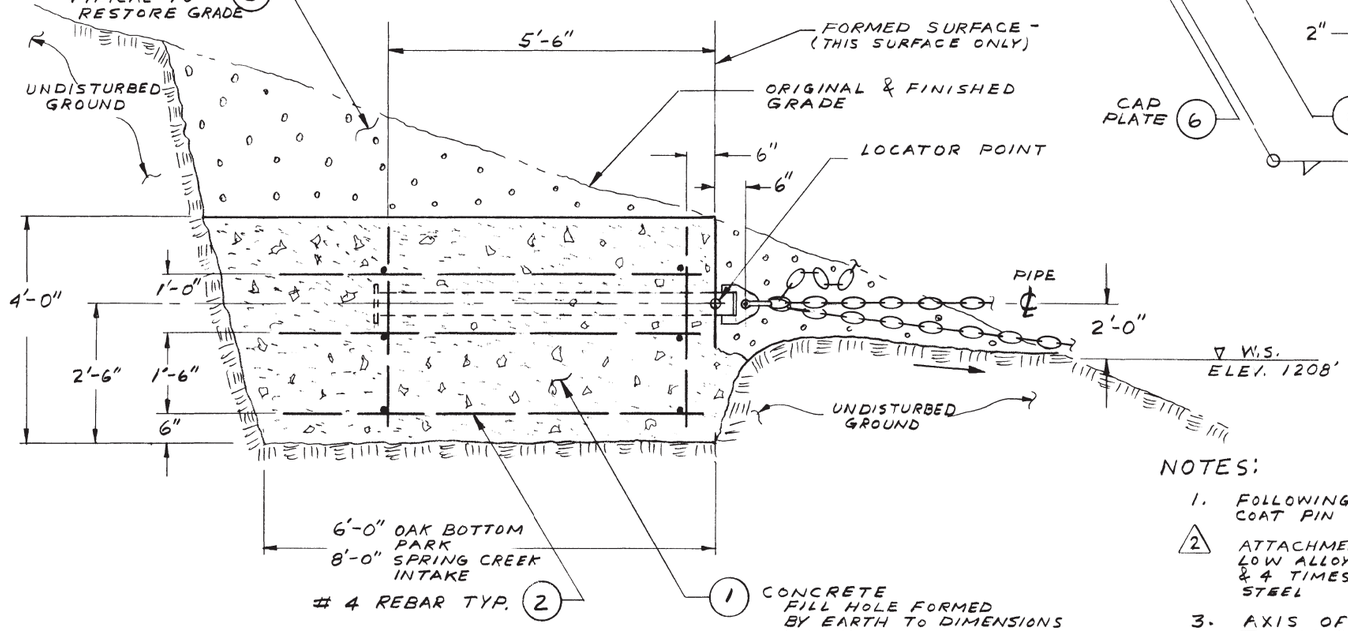
CAD SYSTEM
AutoCAD Rel. 20.0s
CAD FILENAME
416-214-5383-RD-3.DWG

LIST OF MATERIALS				
PART NO.	QTY. REQ'D. OAK BOTTOM	QTY. REQ'D. SPRING CREEK	DESCRIPTION	MATERIAL SPEC
1	3.5 CU. YDS.	7.2 CU. YDS.	CONCRETE	STANDARD MIX SEE SPECS.
2	90 FT	120 FT	#4 REBAR	ASTM A615 GRADE 60 STEEL
3	AS REQ'D.	AS REQ'D.	LEACH FIELD ROCK	3/4" TO 1 1/2" SMOOTH ROUND ROCK
4a	1		3/4" SHACKLE, BOLT PIN WITH LOCKNUT	GALV. STEEL SEE SPECS.
4b		1	7/8" SHACKLE, BOLT PIN WITH LOCKNUT	GALV. STEEL SEE SPECS.
5	1	1	PIPE 4" SCH. 80	GALV. STEEL
6	1	1	CAP PLATE 8"x8" 1/2" THICK	ASTM A36 STEEL
2 7	1	1	END CAP 4 1/2" DIA. 1/2" THICK	ASTM A242 STEEL
2 8	1	1	ATTACHMENT EYE 1" THICK & AS SHOWN	ASTM A242 STEEL OR EQUAL 50,000 PSI Y.



TOP VIEW





SIDE VIEW

0 1 2 3 4 5

SCALE: FT.

REFERENCE DRAWINGS:

OAK BOTTOM PARK GENERAL PLAN	416-214-5353
SPRING CREEK INTAKE " "	-5354
SPRING CREEK INTAKE " "	-5356

NOTES:

1. FOLLOWING FABRICATION OF ANCHOR PIN ASSEMBLY, COAT PIN WITH 3 COATS OF ZRC PER SPECS.
2. ATTACHMENT EYE & END CAP SHALL BE HIGH STRENGTH-LOW ALLOY GRADE, 50,000 PSI MINIMUM YEILD STRENGTH, & 4 TIMES THE CORROSION RESISTANCE OF STRUCTURAL STEEL
3. AXIS OF PIN & ℄ OF ANCHOR SHALL BE ORIENTED TO ALIGN WITH DIRECTION OF CURTAIN CHAINS WHEN CURTAIN IS LOADED BY FLOW AS SHOWN ON REFERENCE DRAWINGS 5354 & 5356 SPRING CREEK INTAKE. AT OAK BOTTOM PARK, PIN & ℄ SHALL POINT TO THE OPPOSITE SHORE ANCHOR.

FOR INFORMATION ONLY

2-8-94	AS BUILT CHANGES ADDED	Greg O'Haver

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

WHISKEYTOWN LAKE
TEMPERATURE CONTROL CURTAIN
OAK BOTTOM PARK & SPRING CREEK INTAKE
SHORE ANCHOR DETAILS

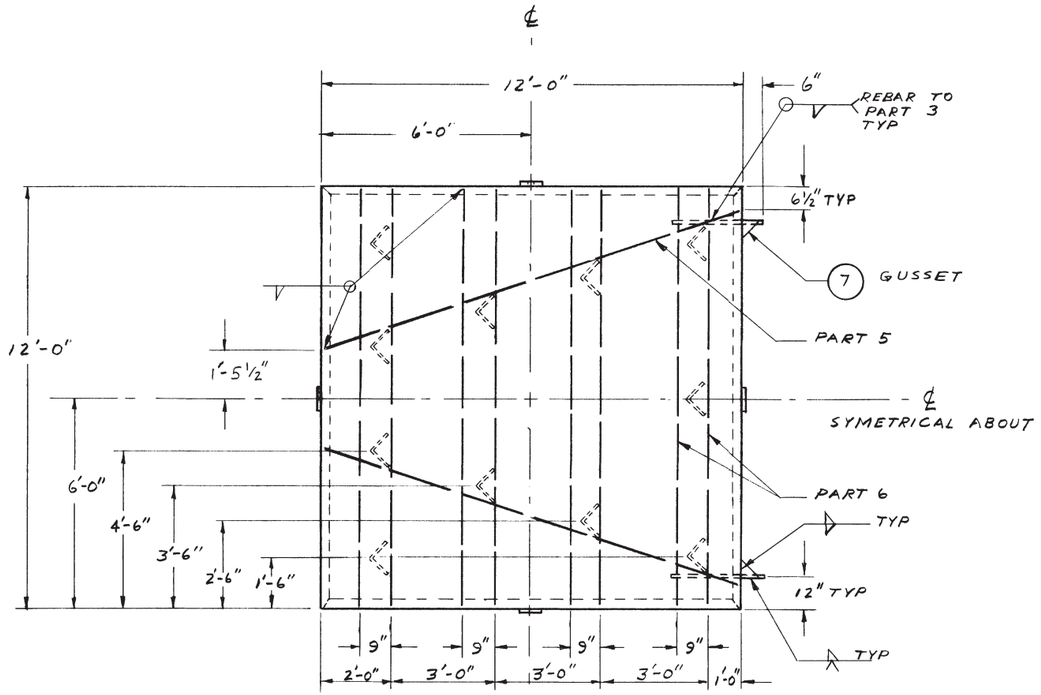
DESIGNED Greg O'Haver FIELD APPROVAL David A. Boyle
DRAWN Greg O'Haver TECHNICAL APPROVAL
CHECKED David A. Boyle APPROVED J. Rusch

REDDING, CA. 1-21-93 416-214-5377

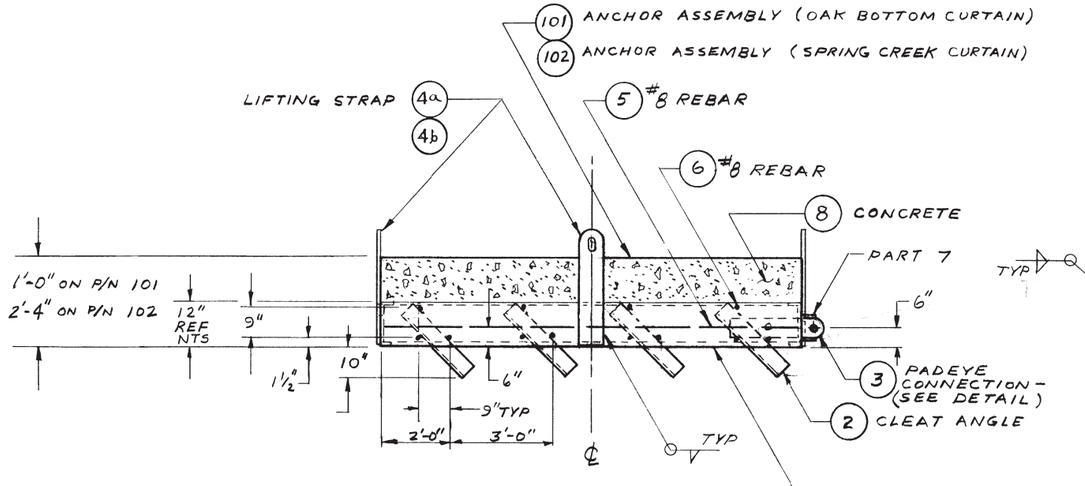
Drawing Scale 1"=1"
Plot Scale 1=1
Spec. No. 20-C0409

RASTER IMAGE FILE 8

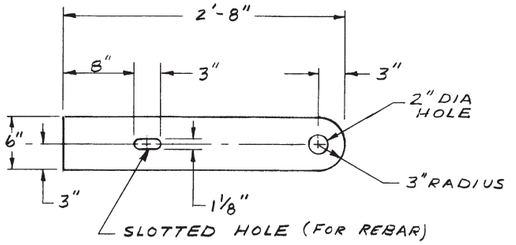
416-214-005357



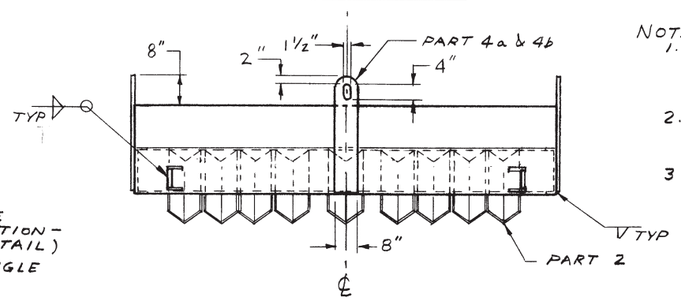
TOP VIEW



SIDE VIEW



DETAIL PART 3 NTS



FRONT VIEW

0 1 2 3 4 5
SCALE FT.

LIST OF MATERIALS EACH ANCHOR

PART NO.	QTY. REQ'D ON 101	QTY. REQ'D ON 102	DESCRIPTION	MATERIAL SPEC.
101			ANCHOR ASSEMBLY (OAK BOTTOM)	
102			ANCHOR ASSEMBLY (SPRING CREEK INTAKE)	
1	4	4	FRAME CHANNEL 12" 12 FT. LONG, STEEL	ASTM A-36 CHANNEL 12" x 3" 20.7 Lb/FT ZRC COATED
2	11	11	CLEAT ANGLE 8" 25½" LONG, STEEL	ASTM A-36 ANGLE 8" x 8" x ½", 26.4 Lb/FT ZRC COATED
3	2	2	PADEYE CONNECTION 1" STEEL x 6" x 2'-8" LONG	ASTM A-36 BAR 1" x 6" 20.4 Lb/FT. ZRC COATED
4a	4		LIFTING STRAP ½" STEEL x 8" x 19¾" LONG	ASTM A-36 BAR ½" x 8", 13.6 Lb/FT. ZRC COATED
4b		4	LIFTING STRAP ½" STEEL x 8" x 35¾" LONG	ASTM A-36 BAR ½" x 8" 13.6 Lb/FT. ZRC COATED
5	2	2	#8 REBAR 12'-7¾" LONG	ASTM A-615 GRADE 60 STEEL
6	12	12	#8 REBAR 11'-11⅜" LONG	ASTM A-615 GRADE 60 STEEL
7	4	4	GUSSET ½" x 3½" x 3½" STEEL	ASTM A-36 BAR ½" x 3½" 5.95 Lb/FT. ZRC COATED
8a	144 FT³		CONCRETE BALLAST	STANDARD NON-STRUCT. MIX (5 SACK APPROX.) SEE SPECS.
8b		336 FT³	CONCRETE BALLAST	STANDARD NON-STRUCT. MIX (5 SACK APPROX.) SEE SPECS.

NOTES:
1. MAXIMUM WEIGHT OF 101 ANCHOR SHALL NOT EXCEED 24,000 Lb., MINIMUM WT. = 23,000Lb MAXIMUM WEIGHT OF 102 ANCHOR SHALL NOT EXCEED 50,500 Lb., MINIMUM WT. = 50,000Lb
2. QUANTITIES REQ'D.: PART NO. 101 = 4 SEE DWG. 5353 PART NO. 102 = 22 SEE DWGS. 5354 TO 5356
3. CONSTRUCTION NOTE - BUILD ANCHOR UPSIDE-DOWN & WELD ON PARTS 4 LAST AFTER TURNING ASSEMBLY UPRIGHT.

FOR INFORMATION ONLY

2-8-94	AS BUILT CHANGES ADDED	Greg O'Haver

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
WHISKEYTOWN LAKE

TEMPERATURE CONTROL CURTAINS, SPRING CREEK INTAKE, & OAK BOTTOM PARK, LAKE ANCHOR DETAILS

DESIGNED Greg O'Haver FIELD APPROVAL David W. Poore
DRAWN Greg O'Haver TECHNICAL APPROVAL
CHECKED David W. Poore APPROVED

REDDING, CA. 12-21-92 | 416-214-5357
Spec. No. 20-C0409

FOR OFFICIAL USE ONLY

Drawing Scale 1"=1"
Plot Scale 1=1
Spec. No. 20-C0409

R16PC00134

SPRING CREEK TEMPERATURE CONTROL CURTAIN TEARS

Notes: All measurements are in feet, unless noted (in red). All rips are less than 1 foot wide.
All tears start from the top of the curtain.
Panel numbers correspond to the buoy numbers from drawings 416-214-5354 thru 5356.

Panel	Tear Length	As-Found Length	Date Repaired
107-108	6"		
104-107	None		
103-104	6"		
93-103	None		
92-93	1"		
89-92	None		
88-89	17'		
86-87	3'		
85-86	3'		
84-85	6'		
83-84	2'		
80-83	None		
79-80	2'		
78-79	2'		
77-78	6"		
74-77	None		
73-74	8'		
72-73	1'		
59-71	None		
54-59	None		
53-54	3'		
52-53	3'3"		
44-52	None		
43-44	5'		
42-43	8'		
40-41	6"		
38-39	1'		
37-38	6'		
36-37	2 tears: 4', 3'		
33-36	None		
32-33	4'6"		
33	7'6"		
29-33	None		
28	6'6"		
27	18'		
26	7'		
24-25	2'		
23-24	11'		
22-23	2 tears: 14', 4'		
21-22	7'		

R16PC00134

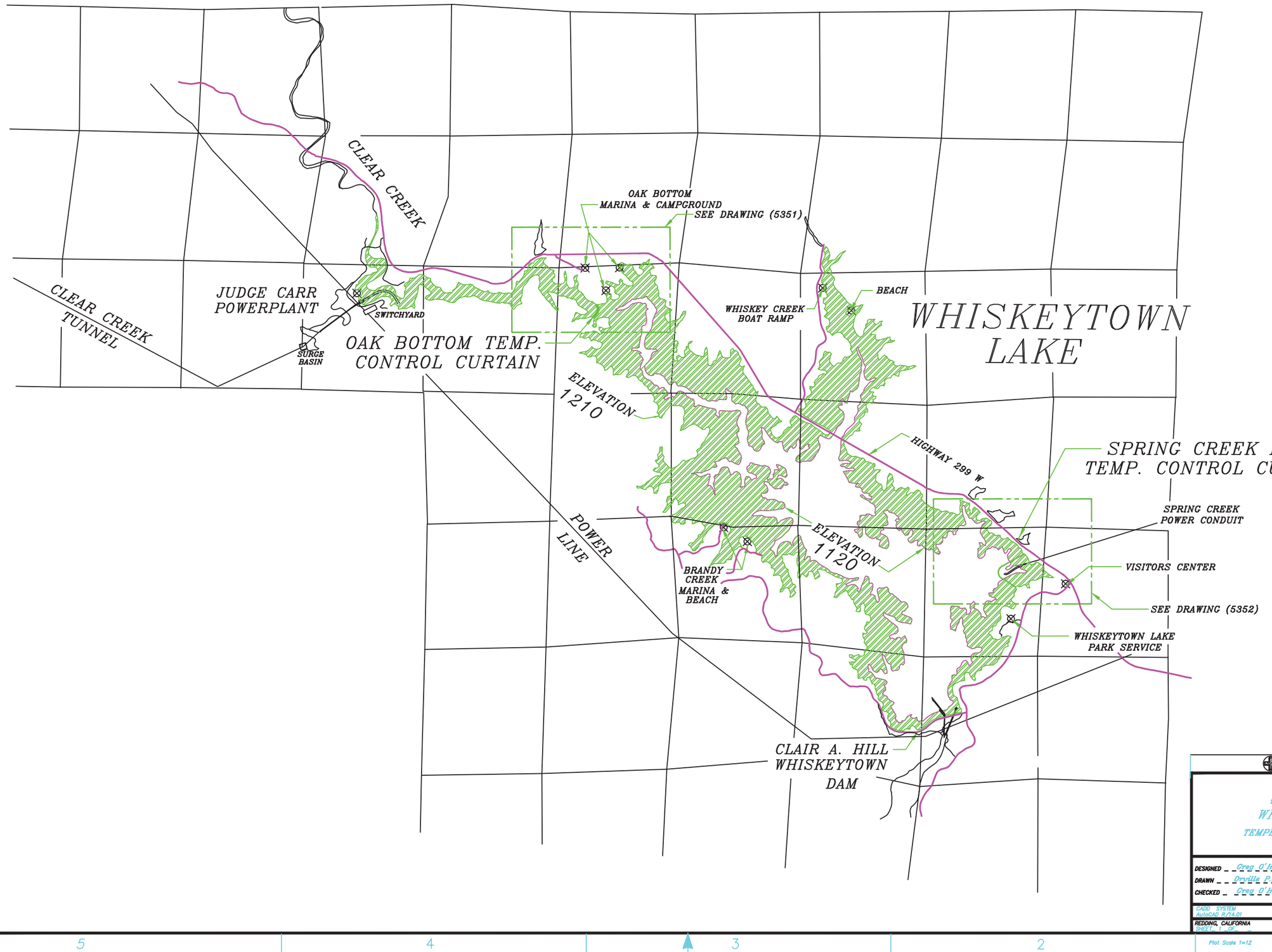
SPRING CREEK TEMPERATURE CONTROL CURTAIN TEARS

Notes: All measurements are in feet, unless noted (in red). All rips are less than 1 foot wide.
All tears start from the top of the curtain.
Panel numbers correspond to the buoy numbers from drawings 416-214-5354 thru 5356.

Panel	Tear Length	As-Found Length	Date Repaired
19-21	None		
18-19	2'		
17-18	8'		
16-17	1'		
14-15	1'		
13	2'		
11-12	6"		
4-11	None		
3-4	5 tears: 2" each		
2	1'		
1	2 tears: 2' each		

416-214-5350

COMPUTER DRAFTED



ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
TRINITY RIVER DIVISION - CALIFORNIA

WHISKEYTOWN LAKE

TEMPERATURE CONTROL CURTAINS

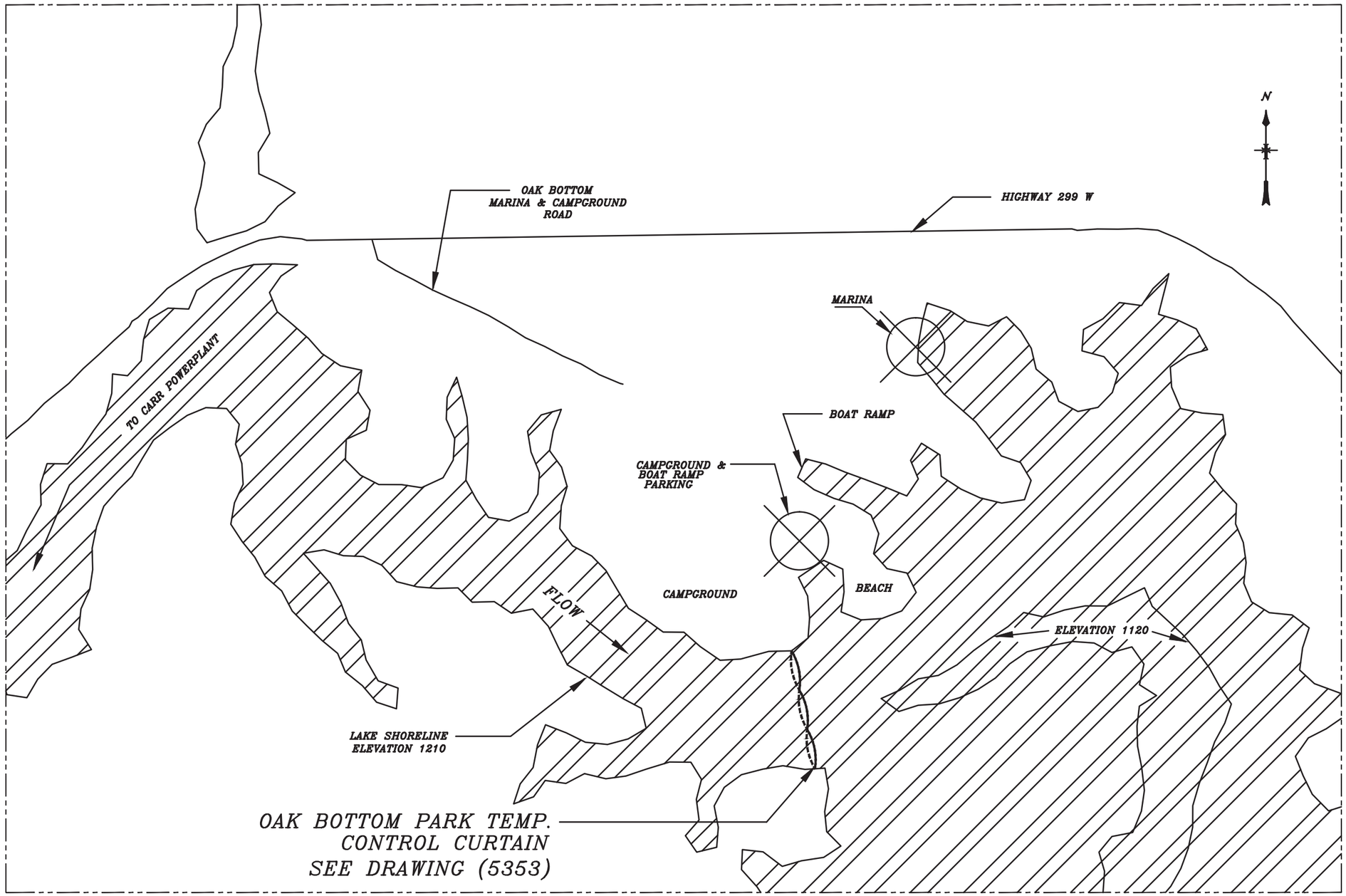
LOCATION MAP

DESIGNED	Greg O'Haver	TECH. APPR.	Dave Poore
DRAWN	Orville P.Knox	SUBMITTED	Bill Gibbons
CHECKED	Greg O'Haver	APPROVED	J.Paul Copenar, Project Superintendent

CADD SYSTEM: AutoCAD R/14.01	CADD FILENAME: 4160244.DWG	DATE & TIME PLOTTED: December 3,1992 at 0610
REDDING, CALIFORNIA: SHEET 1 OF	December 2,1992	416-214-5350

Plot Scale 1=12

Draft



REV NO.		
2	208	UPDATED LOCATION OF CAMPGROUND AND BOAT RAMP.
02-08-94	AS BUILT	Greg O'Haver

ALWAYS THINK **SAFETY**

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
TRINITY RIVER DIVISION -CALIFORNIA

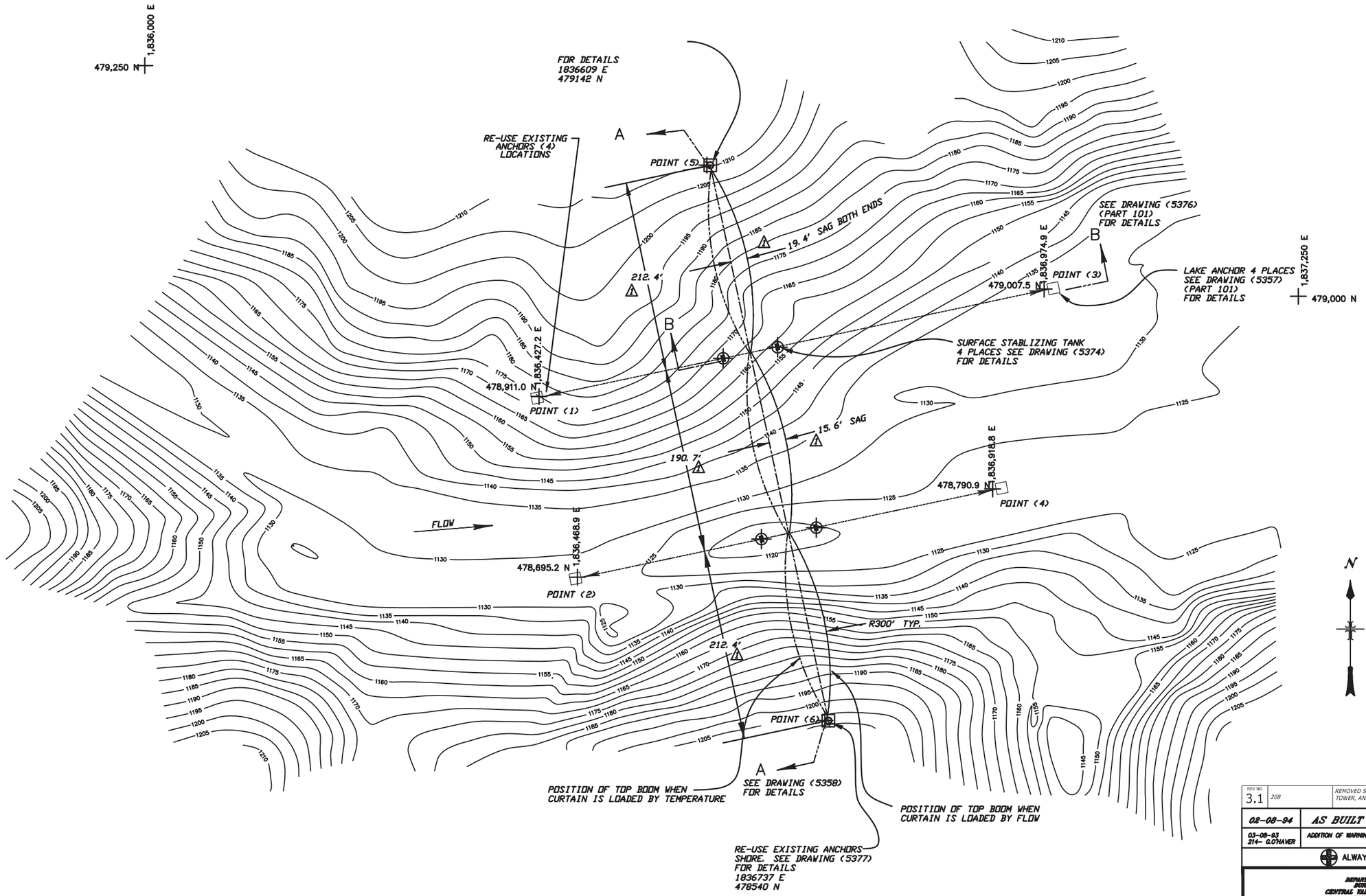
WHISKEYTOWN LAKE
TEMPERATURE CONTROL CURTAINS
OAK BOTTOM PARK
LOCATION MAP

DESIGNED	Greg O'Haver	TECH. APPR.	
DRAWN	Orville P.Knox	SUBMITTED	Bill Gibbons
CHECKED	Dave Poore	APPROVED	J.Paul Capener, Project Superintendent

CADD SYSTEM AutoCAD R/14.01	CADD FILENAME 41601tn.DWG	DATE & TIME PLOTTED January 21, 1993 at 1530
REDDING, CALIFORNIA SHEET 1 OF 1	December 2,1992	416-214-5351

Plot Scale 1=12

Draft



□ = SHORE ANCHOR
⊞ = LAKE ANCHOR (5357)
⊕ = SURFACE STABILIZING TANK

NOTES:

⚠ HOLD THESE DIMENSIONS (BY INSTALLING A ROPE TEMPORARILY) WHILE TIGHTENING ALL ANCHOR CHAINS WHEN LAKE SURFACE ELEV. = 1208.

50 0 50 100 150
SCALE OF FEET

REV NO		
3.1	208	REMOVED SOLAR CHARGING SYSTEM AND TOWER, AND RED AND GREEN LIGHTS
08-08-94	AS BUILT CHANGES ADDED	Greg O'Haver
03-08-03 214- G.O'HAVER	ADDITION OF WARNING SIGNS & BUOYS BY: O.P.K. SO-106	

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT - CALIFORNIA
TRINITY RIVER DIVISION

WHISKEYTOWN LAKE
TEMPERATURE CONTROL CURTAIN
OAK BOTTOM PARK
GENERAL PLAN WITH TOPOGRAPHY

DESIGNED	Greg O'Haver	TECH. APPR.	Greg O'Haver
DRAWN	Orville P.Knox	SUBMITTED	Phil Gibbons
CHECKED	Dave Pogre	APPROVED	J.Paul Copener Project Superintendent

CADD SYSTEM AutoCAD R/14.01	CADD FILENAME 41601tg.DWG	DATE & TIME PLOTTED March 8,1993 at 0700
REDDING, CALIFORNIA SHEET 1 OF 1	December 22,1992	416-214-5353

Draft

USE OF SITE

0 100' 200'

RECLAMATION
Managing Water in the West

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
TRINITY RIVER DIVISION

WHISKEYTOWN LAKE

OAK BOTTOM PARK

Kylee Moore
DESIGNED
James Litts
DRAWN
Ankur Bhattacharya
CHECKED
TECH. APPR.
APPROVED
ADMIN APPROVAL -

SACRAMENTO, CA

TEMPERATURE CONTROL CURTAIN

USE OF SITE

416-208-60004

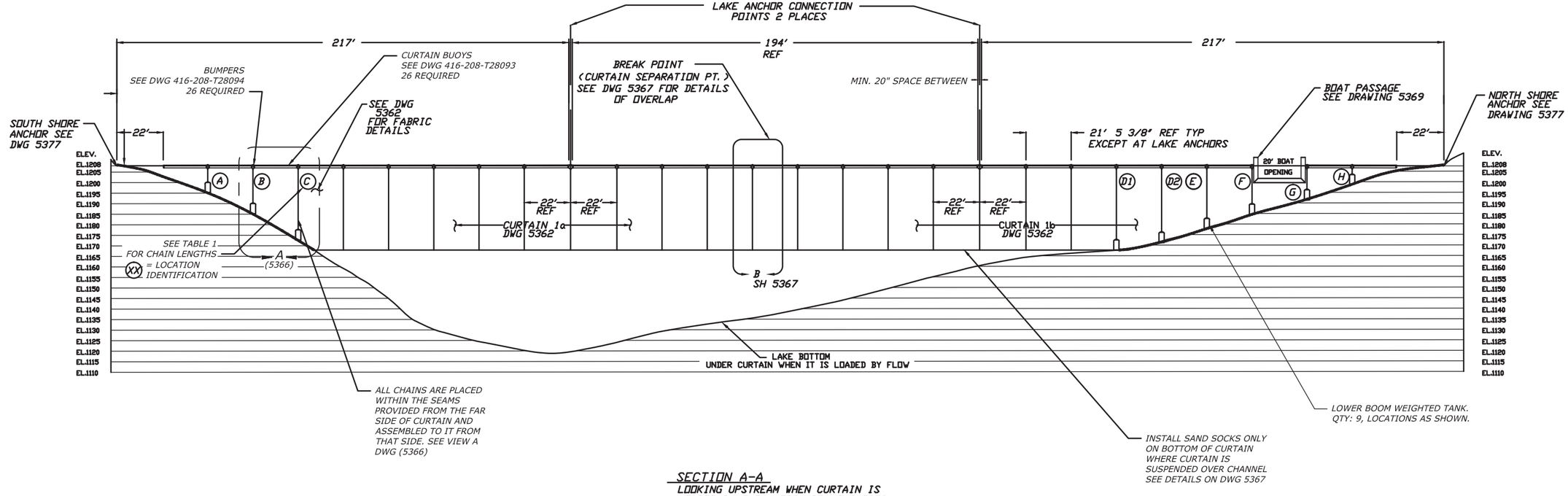
SHEET 1

DATE AND TIME PLOTTED
JULY 6, 2015 13:38
PLOTTED BY
MPERIGNY

CAD SYSTEM
AutoCAD Rel. 20.0s
CAD FILENAME
416-208-T2711S-AD-1.DWG

Draft

416-214-5358



SECTION A-A
LOOKING UPSTREAM WHEN CURTAIN IS LOADED BY FLOW (FROM DRAWING 5353)

TABLE 1

DESIGN LENGTHS FOR VERTICAL CURTAIN CHAINS		
LOCATION	VERTICAL CHAIN LENGTH	QTY REQ'D
A	6'-6"	1
B	17'-6"	1
C	31'-6"	1
D	32'-6"	2
E	24'-6"	1
F	11'-6"	1
G	4'-0"	1
H	1'-6"	1

REFERENCE DRAWINGS

GENERAL PLAN	416-214-5353
LOWER BOOM TANK DETAILS	416-214-5364
CURTAIN FABRIC DETAILS	416-214-5362
CURTAIN SECTION INSTALLATION DETAILS	416-214-5366
CURTAIN BREAK POINT DETAILS	416-214-5367
BOAT PASSAGE DETAILS	416-214-5369
SHORE ANCHOR DETAILS	416-214-5377
CURTAIN BUOY DETAILS	416-208-T28093
BUMPER DETAILS	416-208-T28094

50 0 50 100 150
SCALE IN FEET

REV NO		
2.1	208	MODIFIED TO INCLUDE BUMPERS, CURTAIN BUOYS, AND REMOVE AIR HOSES.
2-8-94	AS BUILT	Greg O'Haver

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT - CALIFORNIA
TRINITY RIVER DIVISION

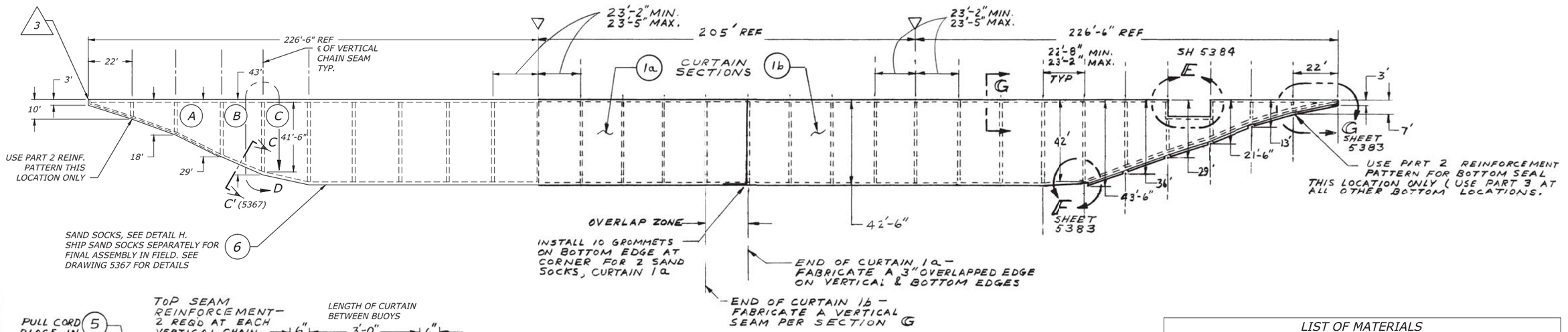
WHISKEYTOWN LAKE
TEMPERATURE CONTROL CURTAIN
OAK BOTTOM PARK
SECTION VIEW ALONG CURTAIN

DESIGNED	Greg O'Haver	TECH. APPR.	
DRAWN	Orville P. Knox	SUBMITTED	Bill Gibbons, Project Superintendent
CHECKED	Dave Coore	APPROVED	J. Paul Cameron, Area Manager

CADD SYSTEM AutoCAD Release 11/386	CADD FILENAME 5358.DWG	DATE & TIME PLOTTED January 23, 1993 1430
REDDING, CALIFORNIA SHEET 1 OF 1	December 22,1992	416-214-5358

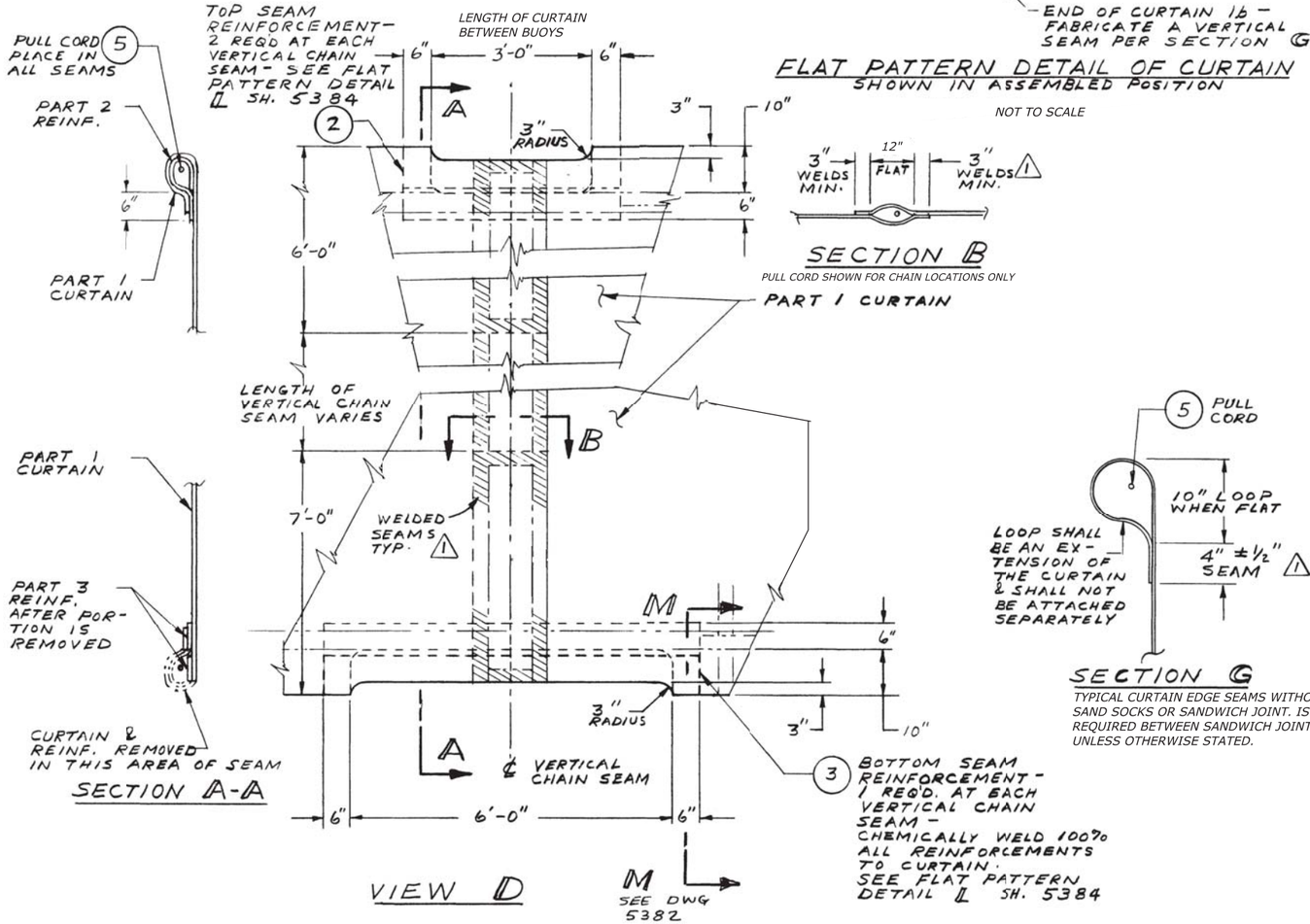
PLOT SCALE 1=12

Draft



FLAT PATTERN DETAIL OF CURTAIN
SHOWN IN ASSEMBLED POSITION

NOT TO SCALE



SECTION B
PULL CORD SHOWN FOR CHAIN LOCATIONS ONLY

PART 1 CURTAIN

SECTION G
TYPICAL CURTAIN EDGE SEAMS WITHOUT SAND SOCKS OR SANDWICH JOINT. IS NOT REQUIRED BETWEEN SANDWICH JOINTS, UNLESS OTHERWISE STATED.

LIST OF MATERIALS

PART No.	QTY REQ'D	DESCRIPTION	MATERIAL SPECS.
1a	1	CURTAIN SECTION	HYPALON, 60 MILS THICK - SEE SPECS.
1b	1	CURTAIN SECTION	HYPALON, 60 MILS THICK - SEE SPECS.
2	9	TOP SEAM REINFORCEMENT	HYPALON, 60 MILS THICK - SEE SPECS.
3	9	BOTTOM SEAM REINFORCEMENT	HYPALON, 60 MILS THICK - SEE SPECS.
5	AS REQ'D	PULL CORD	COTTON, PLASTIC OR OTHER FIBER 50 LB TENSILE STR. MIN.
6	84	SAND SOCK, SEE DWG 5367	DRY SAND FILLED 120 MIL HYPALON TUBE, SEE SPECS.
7	210	NUT, BOLT & 2 WASHERS, 3/8"-16 UNC x 1 1/4" LONG	ZINC OR CADMIUM PLATED STEEL, GRADE 2 OR EQUAL
8	AS REQ'D	GROMMET 1/2" DIA. HOLE	BRASS

REFERENCE DRAWINGS :

SECTION VIEW ALONG CURTAIN 416-214-5358
GENERAL PLAN WITH TOPO. 416-214-5353

NOTES

1. ALL SEAMS SHALL BE HEAT WELDED 4" ± 1/2" WIDE EXCEPT AS NOTED. ADHESIVE WELDING SHALL BE PERMITTED AT REINFORCEMENTS (PART NOS 2 & 3) TO CURTAIN; AND AT RAW EDGE OVERLAPS.

3. RECOMMEND CURTAIN IS DEPLOYED FROM THE END SHOWN, HAVING ALL SEAMS FACING UP.

REV NO		
2.1		UPDATED FLAT PATTERN DETAIL OF CURTAIN AND LIST OF MATERIALS TO REFLECT ADDITION OF BUMPERS AND CURTAIN BUOYS
2-8-94	AS BUILT CHANGES ADDED	Greg O'Haver

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
WHISKEYTOWN LAKE

TEMPERATURE CONTROL CURTAIN, OAK BOTTOM PARK ; HYPALON FABRIC DETAILS & FLAT PATTERN

DESIGNED Greg O'Haver — FIELD APPROVAL David W. Parris
DRAWN Greg O'Haver — TECHNICAL APPROVAL
CHECKED David W. Parris — APPROVED

REDDING, CA. 12-30-92 | 416-214-5362

Draft

TWO 3/4" CHAIN LINK, 27,000 lb. WORKING LOAD PRIMARY AND SECONDARY CHAINS, THROUGH BUOYS AND BUMPER. SEE DETAIL C

9 PRIMARY CHAIN

10 SECONDARY CHAIN

SLACK AMOUNT OF SECONDARY CHAIN TO BE OBSERVED & APPROVED BY THE C.O.R.

UPPER BOOM FLOATING TANK (416-208-60005)

3/4" CHAIN, 27,500 LB.WORKING LOAD SEE DETAIL C

A

A

TOP OF CURTAIN THREAD THROUGH SANDWICH JOINT (416-208-60005)

W.S.

5

7' REF

ABOUT 3' OF CURTAIN-SLACK WILL EXIST WHEN VERTICAL SUPPORT CHAINS ARE TIGHT AT DESIGN LENGTHS SHOWN ON DWG. 5358 TABLE 1

1/2" CHAIN TYP.

4

CONNECTING LINK

2

LOWER BOOM WEIGHTED TANK. CONTRACTOR WILL PROVIDE DESIGN PER SPECS. MINIMUM UNDERWATER WEIGHT TO BE 615 POUNDS.

SIDE VIEW

CURTAIN NOT LOADED

3/4" chain

3/4" chain

PRIMARY CHAIN CONNECTED TO THIS BOLT. SECONDARY CHAIN BYPASSES THIS BOLT.

PRIMARY CHAIN BYPASSES THIS BOLT. SECONDARY CHAIN CONNECTED TO THIS BOLT.

VIEW A (5358)

ELEVATION LOOKING UPSTREAM AT OAK BOTTOM

ONE CURTAIN MODULE SHOWN NOT TO SCALE

DETAIL C

SECTION VIEW OF BUMPER WITH CHAINS. NOT TO SCALE.

SECONDARY CHAIN SHALL HAVE MORE SLACK AS COMPARED TO PRIMARY CHAIN.

LIST OF MATERIALS FOR ONE COMPLETE OAK BOTTOM CURTAIN

PART NO.	QTY. REQ'D	DESCRIPTION	MATERIAL SPEC.
1	9	1/2" GRADE 100 MASTER LINK	HOT DIPPED GALVANIZED STEEL, SEE SPECS
2	44	1/2" GRADE 30 CONNECTION LINK	"
4	9	1/2" CHAIN WITH LENGTH TO MATCH CURTAIN FLAT PATTERN	"
5	9	1/2" CHAIN LENGTH TO MATCH TABLE 1, DWG 5358	"
7	45	7/8" SHACKLE	"
8	28	BUMPER ASSEMBLIES	SEE DRAWING 416-208-60006
9	658'	3/4" GRADE 80 LONG-LINK CHAIN	HOT DIPPED GALVANIZED
10	724'	3/4" GRADE 80 LONG-LINK CHAIN	"

7 TYP QTY: 2 PER BUMPER WITH CHAIN

1

2

CURTAIN

SECTION A-A

REFERENCE DRAWINGS

OAK BOTTOM SECTION VIEW ALONG CURTAIN_____ 416-214-5358
CURTAIN BUOY DETAILS_____ 416-208-60005
CURTAIN FABRIC DETAILS_____ 416-214-5362

REV NO		
2.1	208	UPDATED WITH MODIFIED OAK BOTTOM DESIGN
2-8-94	AS BUILT CHANGES ADDED	Greg O'Haver

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
WHISKEYTOWN LAKE

TEMPERATURE CONTROL CURTAIN,
OAK BOTTOM PARK,
20' CURTAIN SECTION,
INSTALLATION DETAILS

DESIGNED Greg O'Haver FIELD APPROVAL Bill Goldsmith
DRAWN Greg O'Haver TECHNICAL APPROVAL Darrell Poore
CHECKED ____ APPROVED J. Kurt Eggemeier

REDDING, CA 12-10-92 | 416-214-5366

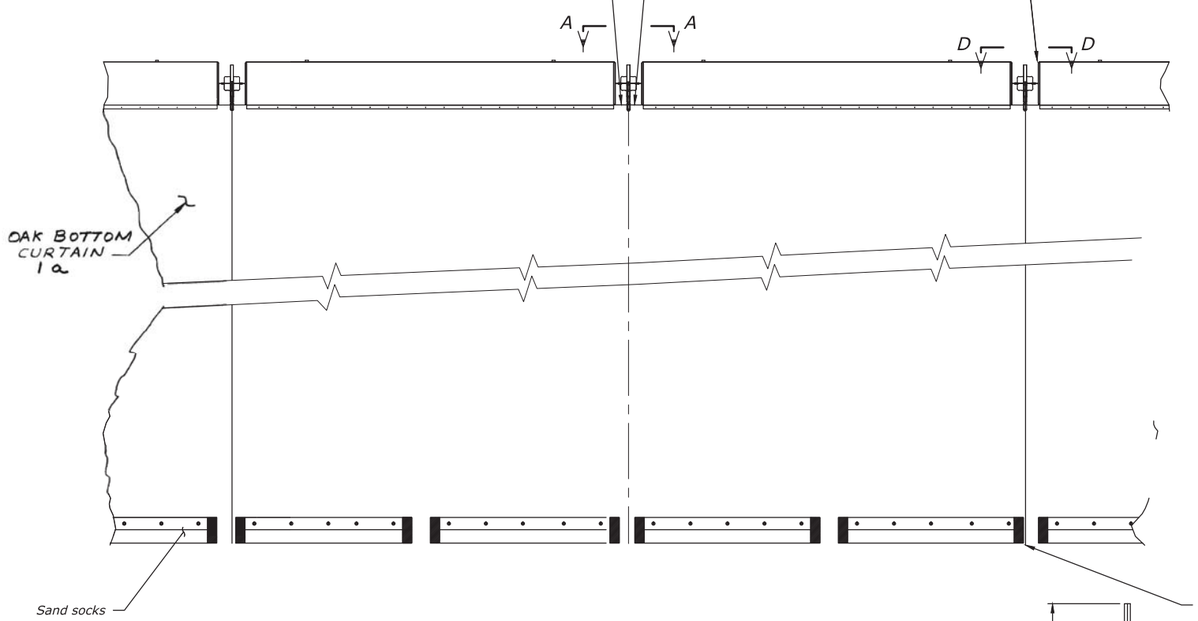
Spec. No. 20-C0409

Draft

CONNECT CURTAINS AT THIS LOCATION PER DWG 5366 DETAIL C (THE CURTAINS ARE CONNECTED AT THE TOP OF THE CURTAIN ONLY - NO CONNECTIONS SHALL BE MADE BETWEEN THE CURTAINS AT THE LOWER CHAINS AND HOSES).

22'± OVERLAP AT OAK BOTTOM CURTAIN, OVERLAP CURTAIN 1a ON NEAR SIDE OF CURTAIN 1b (DOWNSTREAM SIDE) △1

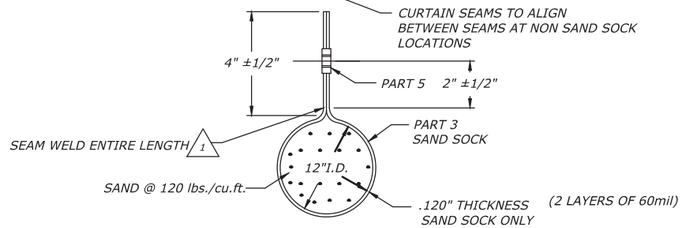
ATTACH CURTAIN 1a & ITS OVERLAP CHAIN, TO CURTAIN 1b TOP CHAIN AT THESE 2 POINTS ON THE ANCHOR SHACKLES OF THE BUMPERS (5)



VIEW B

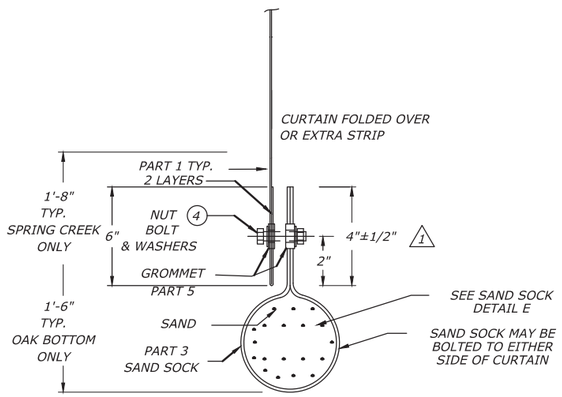
(FROM SHEETS 5358, 5378, 79 & 80, LOOKING UPSTREAM AT OAK BOTTOM)

0 2' 4' 8'



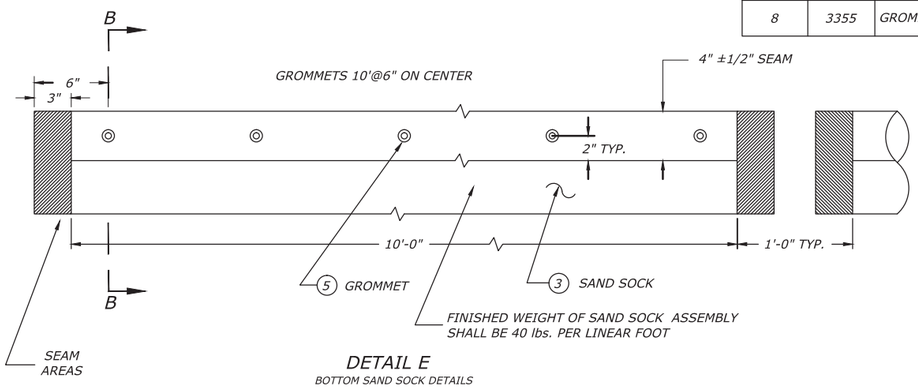
SECTION B-B

NOT TO SCALE



SECTION C-C

NOT TO SCALE



DETAIL E

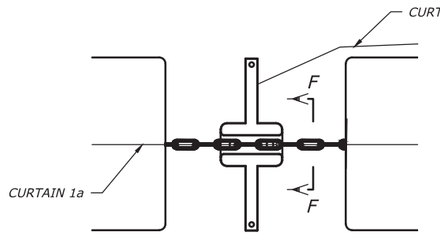
BOTTOM SAND SOCK DETAILS

NOT TO SCALE

LIST OF MATERIALS

FOR ONE CURTAIN BREAK POINT

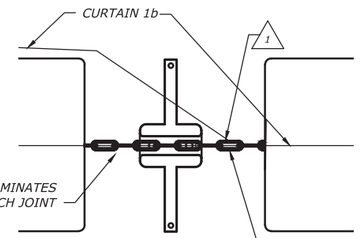
PART NO.	QTY. REQ'D	DESCRIPTION	MATERIAL SPEC.
1	2	3/4" GRADE 30 CONNECTING LINK	HOT DIPPED GALVANIZED STEEL, SEE SPECS
2	1	3/4" GRADE 100 MASTER LINK	HOT DIPPED GALVANIZED STEEL, SEE SPECS



SECTION A-A

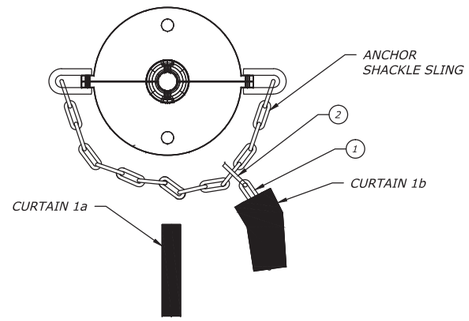
NOT TO SCALE

3/4" CHAIN SEAMED INTO TOP OF CURTAIN 1b FROM ATTACHMENT POINT SHOWN IN SECTION D-D TO ANCHOR SHACKLE SHOE SHOWN IN SECTION F-F



SECTION D-D

NOT TO SCALE



SECTION F-F

NOT TO SCALE

LIST OF MATERIALS

FOR SAND SOCKS

PART NO.	QTY. REQ'D	DESCRIPTION	MATERIAL SPEC.
6	241	SAND SOCK	DRY SAND FILLED .120mil. HYPALON TUBE
7	1085 2170	NUT, BOLT & WASHERS 3/8"-16UNC x 1 1/4" LONG	ZINC OR CAD PLATED STEEL GRADE 2 OR EQUAL
8	3355	GROMMET 1/2"-DIA. HOLE	BRASS

REFERENCE DRAWINGS

OAK BOTTOM PARK, SECTION VIEW ALONG CURTAIN_____416-214-5358

NOTES

△1 ALL SEAMS SHALL BE HEAT WELDED 4"± 1/2" WIDE MINIMUM EXCEPT AS NOTED. (SEE SPECS.)

REV NO		
2.1	208	UPDATED WITH NEW DESIGN. REMOVED SPRING CREEK INTAKE REFERENCES
7-8-94	AS BUILT CHANGES ADDED	Greg O'Haver

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
TRINITY RIVER DIVISION

WHISKEYTOWN LAKE

OAK BOTTOM PARK

TEMPERATURE CONTROL CURTAIN

BREAK POINT AND SAND SOCK DETAILS

DESIGNED Greg O'Haver FIELD APPROVAL Greg O'Haver
DRAWN Greg O'Haver TECHNICAL APPROVAL
CHECKED David W. Pore APPROVED J. Paul Capone

REDDING, CA 12-10-92 | 416-214-5367

Spec. No. 20-C0409

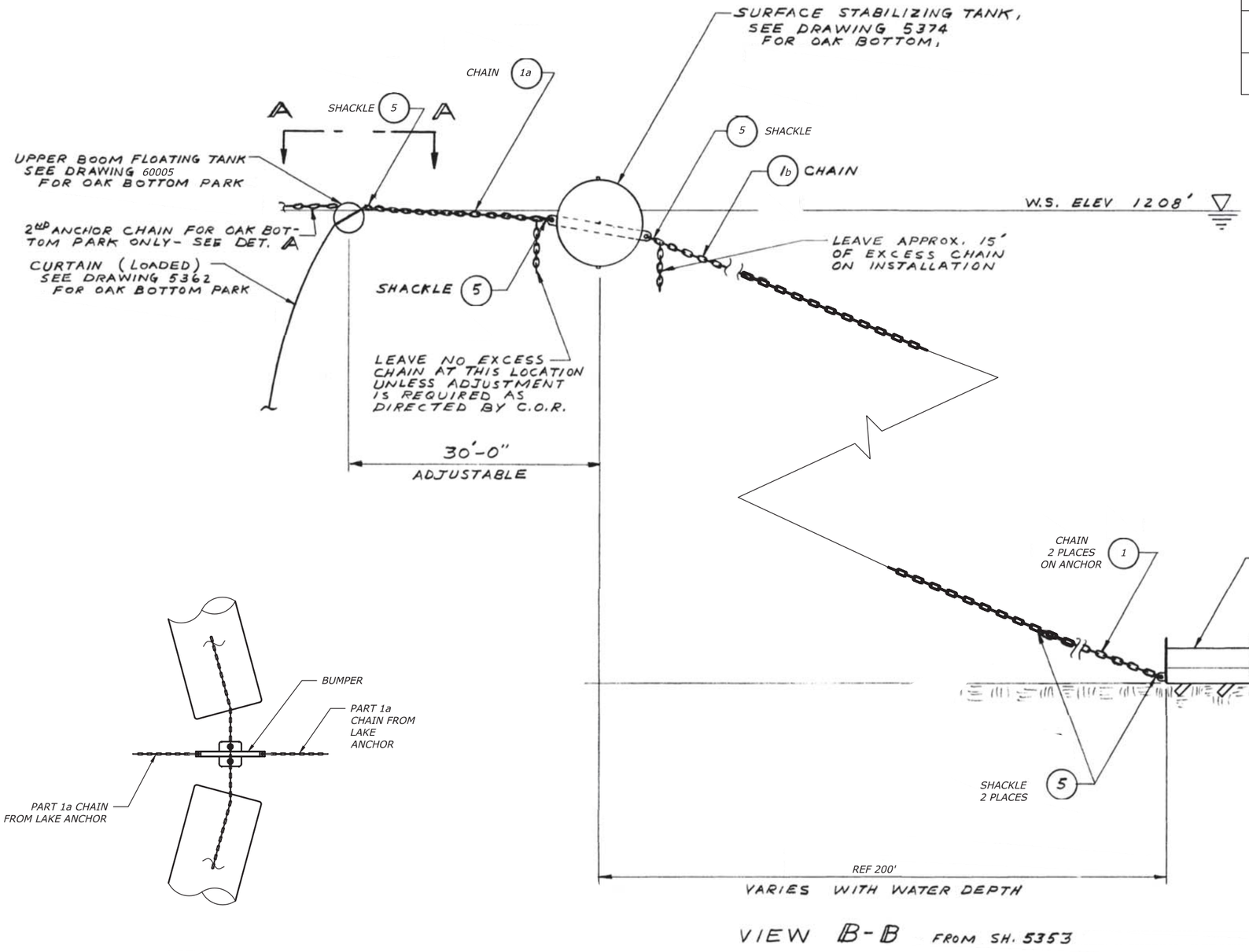
Draft

LIST OF MATERIALS (ONE ANCHOR INSTL.)

PART NO.	QTY. ON 101	QTY. ON 102	DESCRIPTION	MATERIAL SPEC.
101			LAKE ANCHOR INSTALLATION-OAK BOTTOM	
1a	4		3/4" CHAIN, LONG LINK, 35' LENGTH	HOT DIPPED GALVANIZED STEEL, SEE SPECS.
1b	4		3/4" CHAIN, LONG LINK, LENGTH PER TABLE 2	HOT DIPPED GALVANIZED STEEL, SEE SPECS.
5	7		3/4" ANCHOR SHACKLE 40,000 LB MIN. BREAKING STRENGTH, LOCKNUT, PIN	GALVANIZED STEEL, SEE SPECS

TABLE 2
LENGTHS OF ANCHOR CABLES/CHAINS

LOCATION	LENGTH FEET
OAK BOTTOM PARK	
ANCHOR NO. 1	213
" NO. 2	230
" NO. 3	325
" NO. 4	230



VIEW A

PLAN VIEW SHOWING OAK BOTTOM PARK ANCHOR CHAIN CONNECTIONS TO BUMPERS AT UPPER BOOM TANKS

REV NO		
2.1	208	UPDATE WITH MODIFIED OAK BOTTOM DESIGN
2-8-94	AS BUILT CHANGES ADDED	Greg O'Haver

ALWAYS THINK SAFETY

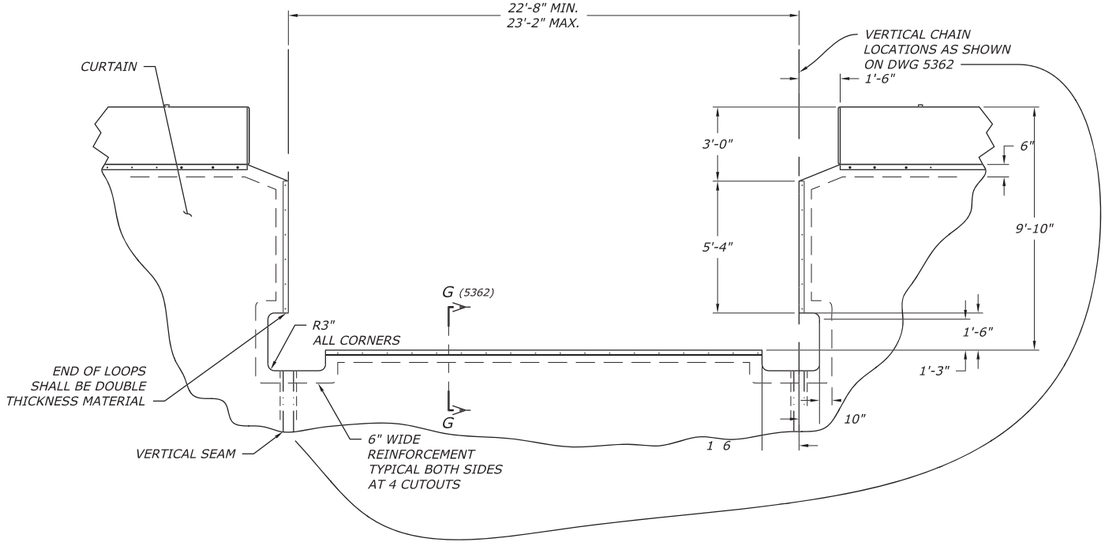
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
TRINITY RIVER DIVISION

WHISKEYTOWN LAKE
OAK BOTTOM PARK
TEMPERATURE CONTROL CURTAIN
LAKE ANCHOR SYSTEM; INSTALLATION DETAILS

DESIGNED Greg O'Haver FIELD APPROVAL David W. Pore
DRAWN Greg O'Haver TECHNICAL APPROVAL
CHECKED David W Pore APPROVED J. Paul Tagney

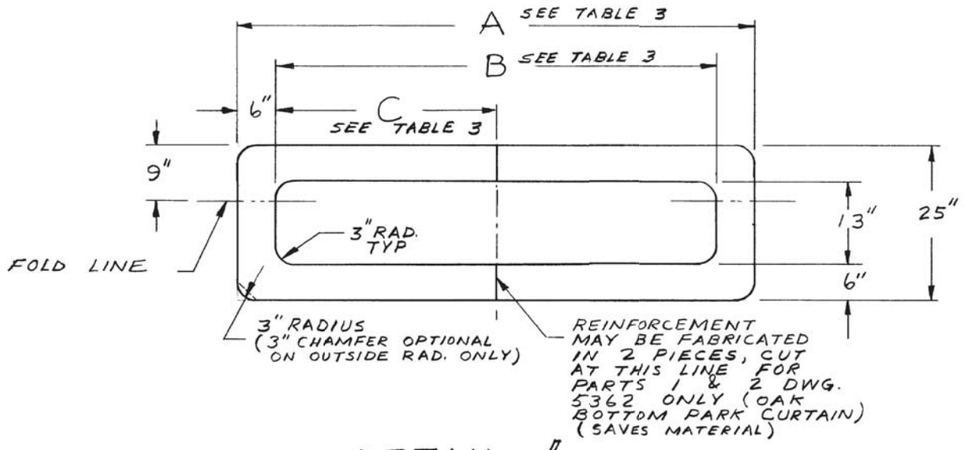
REDDING, CA. 12-22-92 | 416-214-5376

Draft



DETAIL E (5362)

0 3' 6'



DETAIL L

TABLE 3
SEAM REINFORCEMENT
DIMENSIONS (SEE DET. L)

PART NO.	QUANTITY REQ'D.	DIMENSION IN FEET		
		A	B	C
5362 - 2	9	4 FT.	3FT.	1 ½ FT.
5362 - 3	9	7	6	3
5381 - 2	45	4	3	1 ½
5381 - 3	41	9	8	4
5382 - 2	41	4	3	1 ½
5382 - 3	41	9	8	4
5383 - 2	41	4	3	1½
5383 - 3	37	9	8	4

REFERENCE DRAWINGS:
FABRIC DETAILS & FLAT PATTERN
416-214-5362

REV NO		
2.1	208	UPDATED TO SHOW CURTAIN CONNECTED BY SANDWICH JOINTS
2-8-94	AS BUILT CHANGES ADDED	Greg O'Haver

ALWAYS THINK SAFETY

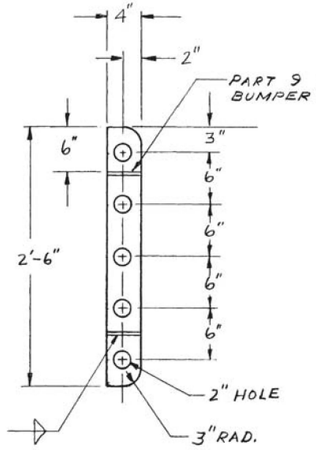
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

WHISKEYTOWN LAKE
TEMPERATURE CONTROL CURTAIN
OAK BOTTOM PARK & SPRING CK. INTAKE
CURTAIN FABRIC DETAILS

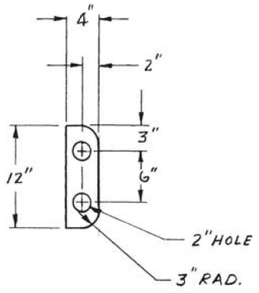
DESIGNED Greg O'Haver FIELD APPROVAL David W. Bore
DRAWN Greg O'Haver TECHNICAL APPROVAL
CHECKED David W. Bore APPROVED A. Burk - Lawrence

REDDING, CA. 1-20-93 | 416-214-5384

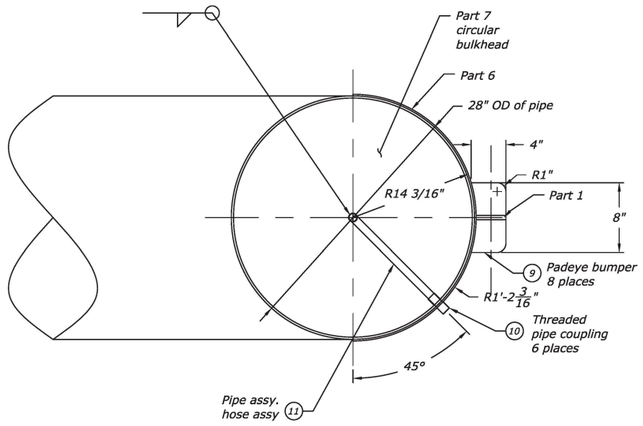
SPEC. NO. 20-C0409



DETAIL PART 1
NTS

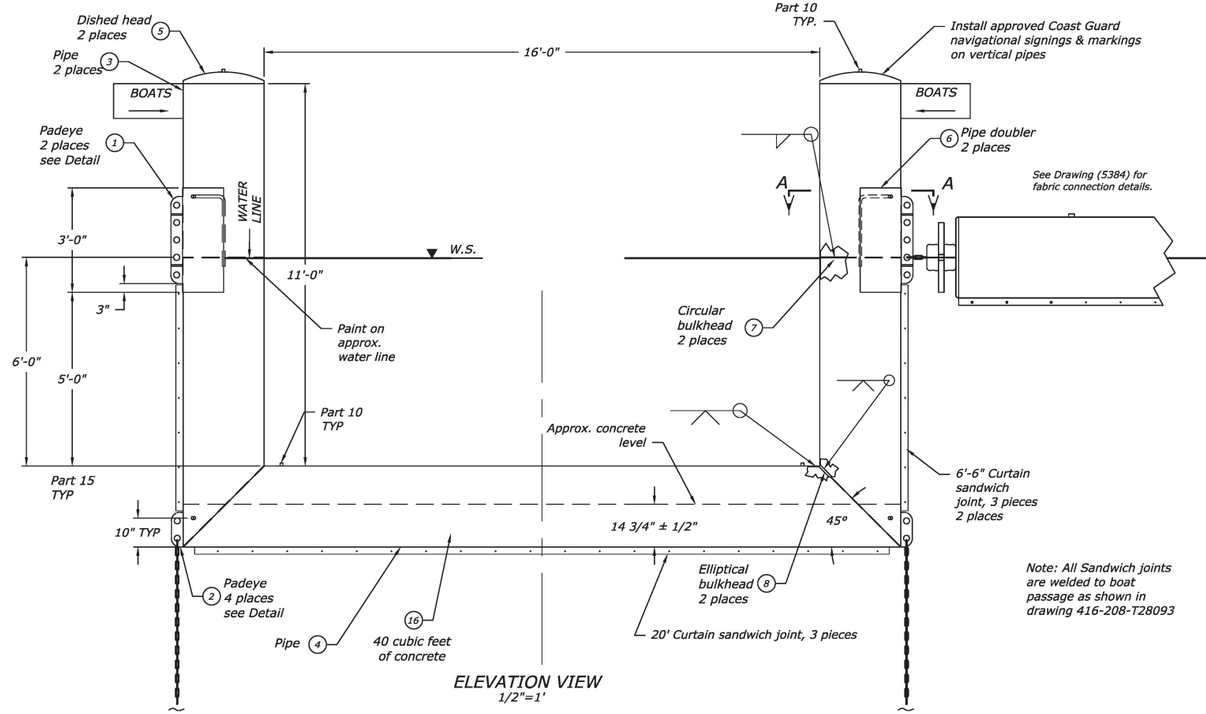


DETAIL PART 2
NTS



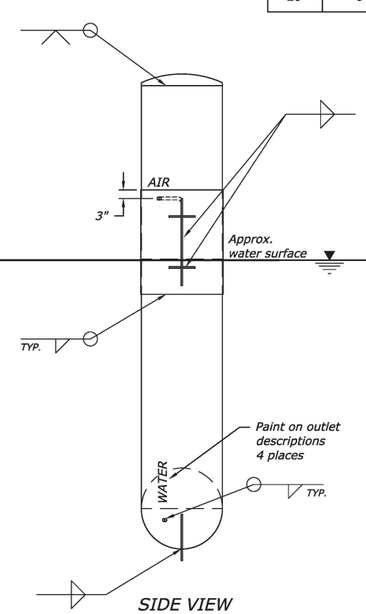
SECTION A-A
1-1/2"=1'

LIST OF MATERIALS			
PART No.	QTY. REQD.	DESCRIPTION	MATERIAL SPEC.
1	2	PADEYE 1/2" THICK, 4"x30" SHAPED AS SHOWN	ASTM A36 CARBON STEEL, ZRC COATED
2	2	PADEYE 1/2" THICK, 4"x12" SHAPED AS SHOWN	ASTM A36 CARBON STEEL, ZRC COATED
3	2	PIPE, VERTICAL, 28"O.D., 10GA. WALL 13'-4" LONG	ASTM A135 E.R.W. STEEL PIPE OR EQUAL, ZRC COATED
4	1	PIPE, HORIZ., 28"O.D., 10GA. WALL 20'-8" LONG	ASTM A135 E.R.W. STEEL PIPE OR EQUAL, ZRC COATED
5	2	DISHED HEAD, SEE SPECS. 10GA MIN 28" O.D. PIPE	ASME 60 PSI WORKING PRESS. , ASTM A570 STEEL
6	2	PIPE DOUBLER 3/16" THICK, 28" I.D. 3'-0" LONG	ASTM A36 CARBON STEEL
7	2	CIRCULAR BULKHEAD 1/4" THICK, 27 5/8" DIA.	ASTM A36 CARBON STEEL, ZRC COATED
8	2	ELLIPTICAL BULKHEAD 1/4" THICH 27 5/8"x39"	ASTM A36 CARBON STEEL, ZRC COATED
9	8	PADEYE BUMPER 1/2" THICK, 4" x 3 3/4"	ASTM A36 CARBON STEEL, ZRC COATED
10	6	1" THREADED PIPE COUPLING, NPT.	SCH. 40 STEEL, STD. FITTING, GALV. OR ZRC COATED
11	2	PIPE ASSEMBLY 1" W/ NIPPLES & ELBOWS TO FIT	SCH. 40 STEEL, GALV. OR ZRC COATED
12	2	3/8" CHAIN PER SPEC. 8' LONG	LONG LINK GALV. STEEL, SEE SPEC.
13	2	3/8" CHAIN PER SPEC. 6 ½' LONG APPROX.	LONG LINK GALV. STEEL, SEE SPEC.
14	1	3/8" CHAIN PER SPEC. 18' 9" LONG APPROX.	LONG LINK GALV. STEEL, SEE SPEC.
15	10	7/8" SHACKLE ANCHOR TYPE WITH BOLT PIN	GALV. STEEL, SEE SPEC.
16	2	HOSE ASSEMBLY 1", 10 FT LONG, SEE SPECS	STEEL BRAIDED, REINF. RUBBER, MALE 1" NPT SWIVEL FITTINGS BRASS
17	2	PIPE CAP 1" WITH RING FOR CHAIN ATTACHMENT	SCH. 40 GALV. STEEL
18	40 FT^3	CONCRETE BALLAST	STANDARD MIX SEE SPECS.
19	3	CURTAIN SANDWICH JOINT, 20' LONG	
20	6	CURTAIN SANDWICH JOING, 6'-6" LONG	



ELEVATION VIEW
1/2"=1'

Note: All Sandwich joints are welded to boat passage as shown in drawing 416-208-T28093



SIDE VIEW

NOTES

1. See notes 1, 2 & 3, drawing 416-214-5363

REFERENCE DRAWINGS

OAK BOTTOM PARK CURTAIN SECTION_____416-214-5358

REV NO		
2.1	208	MODIFIED TO SANDWQICH JOINT, UPDATE WITH BUOY AND BUMPER DESIGN
2-8-94	AS BUILT CHANGES ADDED	Gry O'Haver

ALWAYS THINK SAFETY

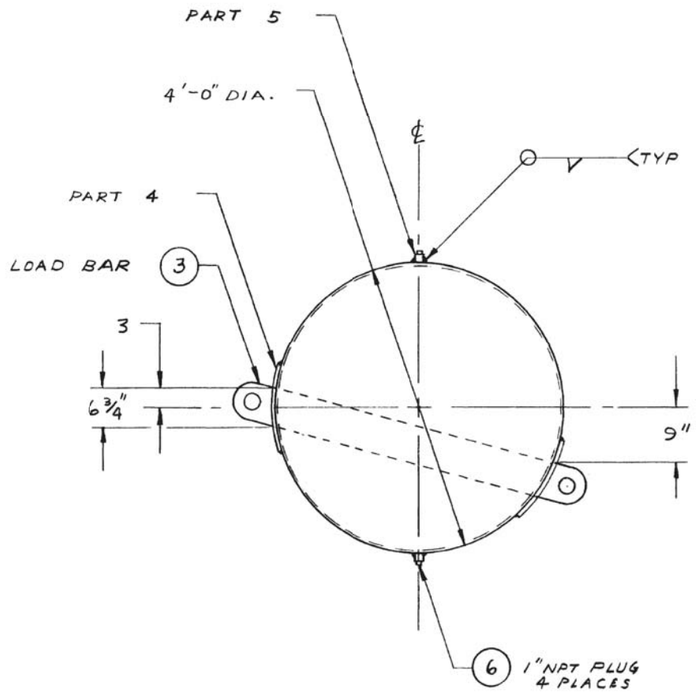
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
WHISKEYTOWN LAKE
TEMPERATURE CONTROL CURTAIN
OAK BOTTOM PARK
BOAT PASSAGE DETAILS

DESIGNED Gry O'Haver FIELD APPROVAL David W. Bass
DRAWN Gry O'Haver TECHNICAL APPROVAL
CHECKED David W. Bass APPROVED

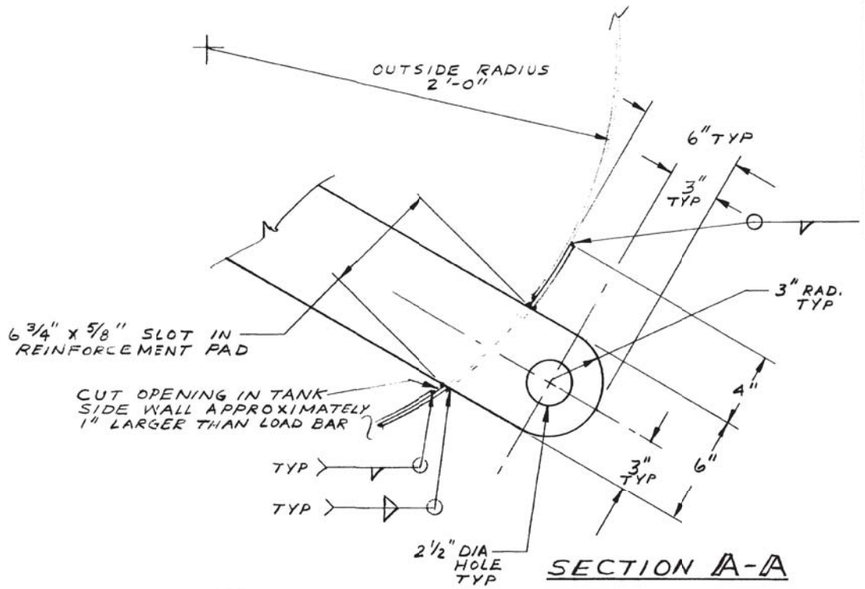
REDDING, CA 1-8-93 | 416-214-5369

Draft

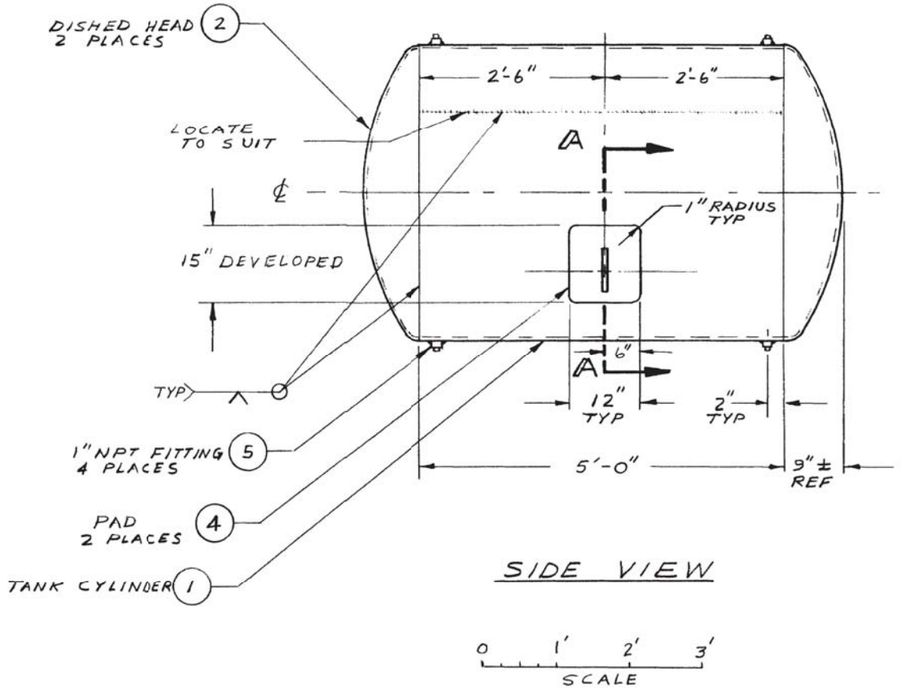
LIST OF MATERIALS (ONE TANK)			
PART NO.	QTY. REQ'D	DESCRIPTION	MATERIAL SPEC.
1	1	48" O.D. TANK CYLINDER	ASTM A-570 STEEL SHEET 10 GAUGE WALL, ZRC COATED
2	2	48" O.D. DISHED HEAD SEE SPECS	ASME 60 PSI WORKING PRESSURE - ASTM A-570, ZRC COATED, 3/16" MIN.
3	1	LOAD BAR	1/2" THICK x 6" x 60" ASTM A-36 STEEL PLATE,
4	2	REINFORCEMENT PAD	ASTM A-570 STEEL SHEET 1/4" THICK
5	4	THREADED PIPE COUPLING 1" NPT WITH PLUG	SCH. 40 STEEL STANDARD FITTING
6	4	PIPE PLUG	1" NPT GALVANIZED



END VIEW
SCALE: 1" = 1'-0"



SECTION A-A



SIDE VIEW

0 1' 2' 3'
SCALE

NOTES

1. QUANTITY REQUIRED FOR OAK BOTTOM PARK CURTAIN = 4.
2. ALL WELDING SHALL CONFORM WITH AWS STANDARDS AND ASME REQUIREMENTS FOR PRESSURE VESSELS WITH STANDING 25 PSIG INTERNAL PRESSURES.
3. TANK INTERIOR & EXTERIOR SHALL BE COATED WITH ZINC RICH COATING, 2 COATS AS SUPPLIED BY ZRC PRODUCTS CO. 21 NEWPORT AVE., QUINCY, MA, 02171; TELE: 617-328-6700 OR EQUAL. ALL WELDS AND DAMAGED ZINC COATING SHALL BE TOUCHED UP WITH ZRC, 2 COATS EXCEPT INTERIOR WELDS WHICH CANNOT BE REACHED.
4. TEST COMPLETED TANKS PER SPECS. USING AIR & SOAP BUBBLE COMPOUND OVER ENTIRE TANK EXTERIOR, OR BY HYDROSTATIC METHODS. ALL LEAKS SHALL BE REPAIRED & TESTED AGAIN.

REFERENCE DRAWINGS:

CURTAIN LAKE ANCHOR SYSTEM DETAILS	416-214-5376
OAK BOTTOM PARK, GENERAL PLAN	416-214-5353

REV NO	REVISED NOTES	
208		
2-8-94	AS BUILT CHANGES ADDED	Greg O'Haver

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
WHISKEYTOWN LAKE

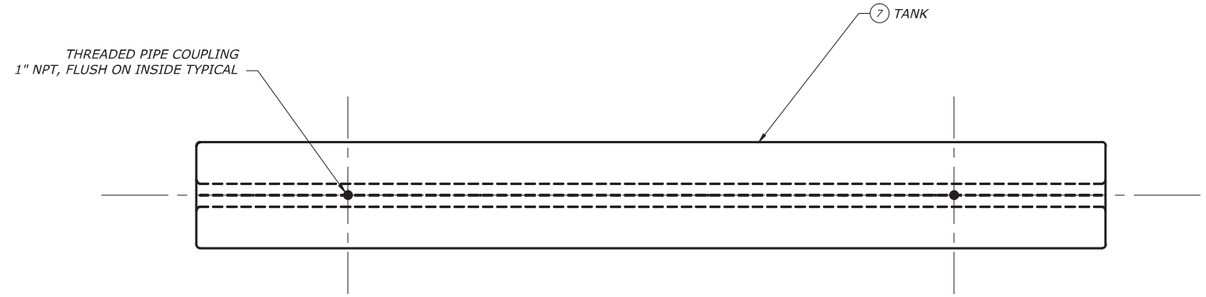
TEMPERATURE CONTROL CURTAIN
OAK BOTTOM PARK
SURFACE STABILIZING TANK
DETAILS & ASSEMBLY

DESIGNED Greg O'Haver FIELD APPROVAL Bob Gutshaw
DRAWN Greg O'Haver TECHNICAL APPROVAL David W. Poore
CHECKED APPROVED Paul Lepori

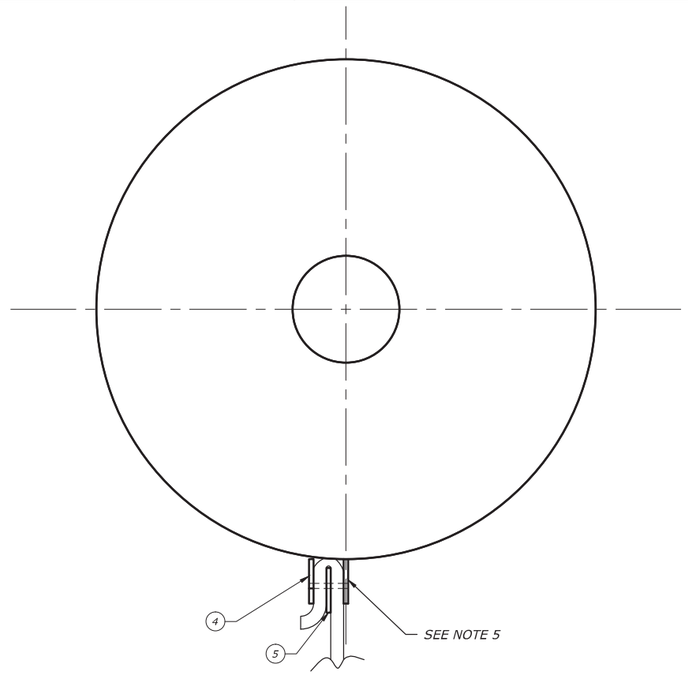
REDDING, CA 12-21-92 | 416-214-5374

Spec. No. 20-C0409

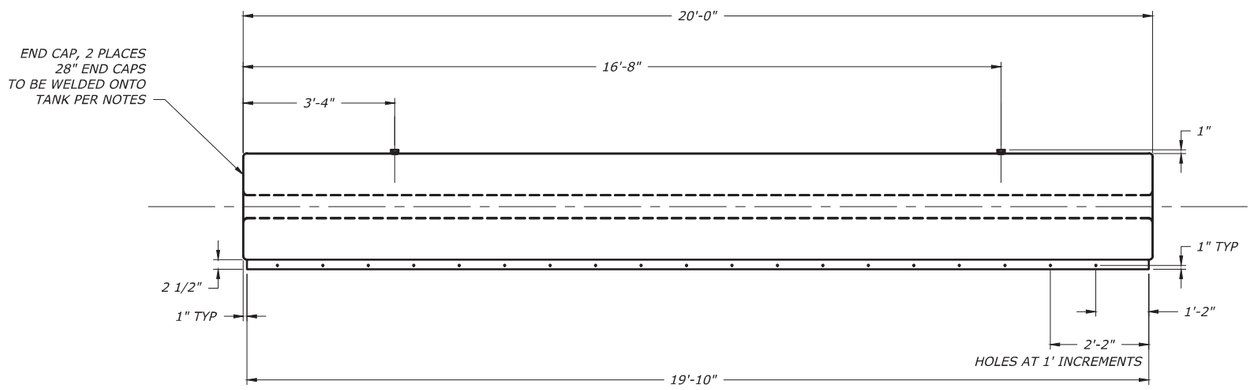
Draft



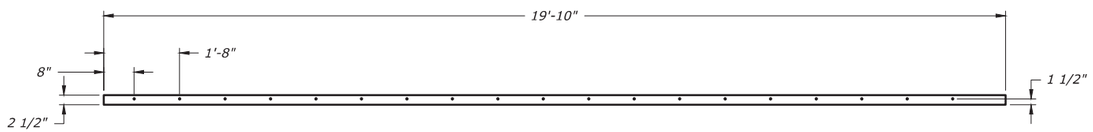
TOP VIEW



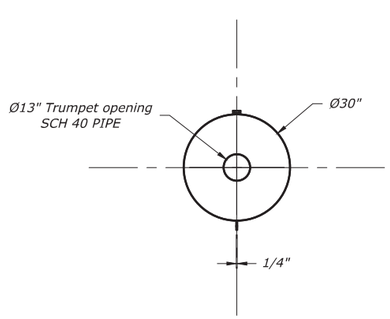
SANDWICH BAR ASSEMBLY
NOT TO SCALE



SIDE VIEW



4 CURTAIN SANDWICH BAR



END VIEW
NOT TO SCALE

NOTES

ALL WELDING SHALL CONFORM WITH A.W.S. STANDARDS AND ASME REQUIREMENTS FOR PRESSURE VESSELS WITHSTANDING 60 PSI INTERNAL PRESSURES.

1. TANK INTERIOR & EXTERIOR SHALL BE COATED WITH ZINC RICH COATING, 2 COATS AS SUPPLIED BY ZRC PRODUCTS Co. 21 NEWPORT AVE. QUINCY, MASS. 02171 ; TELE: 617-328-6700 OR EQUAL. ALL WELDS AND DAMAGED ZINC COATING SHALL BE TOUCHED UP WITH ZRC, 2 COATS EXCEPT INTERIOR WELDS WHICH CAN NOT BE REACHED.
2. TEST COMPLETED TANKS PER SPECS. USING AIR & SOAP BUBBLE COMPOUND OVER ENTIRE TANK EXTERIOR; OR BY HYDROSTATIC METHODS. ALL LEAKS SHALL BE REPAIRED & TESTED AGAIN.
3. QUANTITIES REQ'D. : 26 BUOYS
4. TANK TO BE FILLED WITH FOAM PER SPECS.
5. HOLES THROUGH CURTAIN AND HDPE STRIP TO BE MATCHED TO HOLES ON SANDWICH BAR DURING ASSEMBLY OF SANDWICH JOINTS.
6. ALL WELDS OR AREAS WHERE GALVANIZED TREATMENT HAS BEEN DAMAGED, TOUCH UP AS PER ASTM IS3/780 AS APPLICABLE.
7. OUTER WALL AND INNER WALL OF PART CAN BE MANUFACTURED FROM NO MORE THAN 4 PIECES EACH, WELDED.

LIST OF MATERIALS FOR 1 BUOY

PART NO.	QTY. REQ'D	DESCRIPTION	MATERIAL SPEC.
1	20	BOLT, 1/2" x 1'- 1/4", HOT DIPPED GALVANIZED	A307, GRADE A
2	20	NUT, HEX, 1/2", HOT DIP GALVANIZED	
3	20	WASHER	
4	1	CURTAIN SANDWICH BAR	GALVANIZED STEEL
5	1	STRIP, 1/4" x 2'- 1/2" x 19'-10"	HDPE
6	2	PLUGS, 1" NPT	SCH 40 STANDARD STEEL
7	1	TANK (OUTER WALL, INNER WALL, 2 END CAPS)	STEEL , OR EQUAL
8	2	30" DIA. STEEL DISHED HEAD	85% CROWN RADIUS, 6% KNUCKLE RADIUS OR AS APPROVED

RECLAMATION
Managing Water in the West

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
TRINITY RIVER DIVISION

WHISKEYTOWN LAKE

OAK BOTTOM PARK

Kylee Moore
DESIGNED
James Litts
DRAWN
Ankur Bhattacharya
CHECKED
TECH. APPR.
APPROVED
ADMIN APPROVAL -
SACRAMENTO, CA

TEMPERATURE CONTROL CURTAIN

CURTAIN BUOY DETAILS

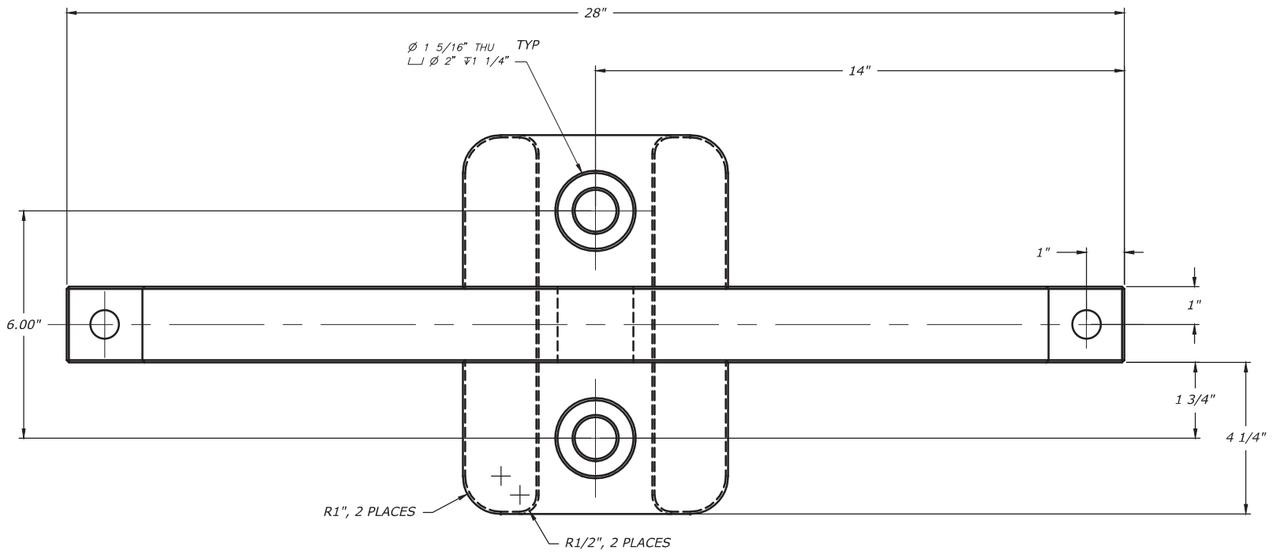
416-208-60005

SHEET 1

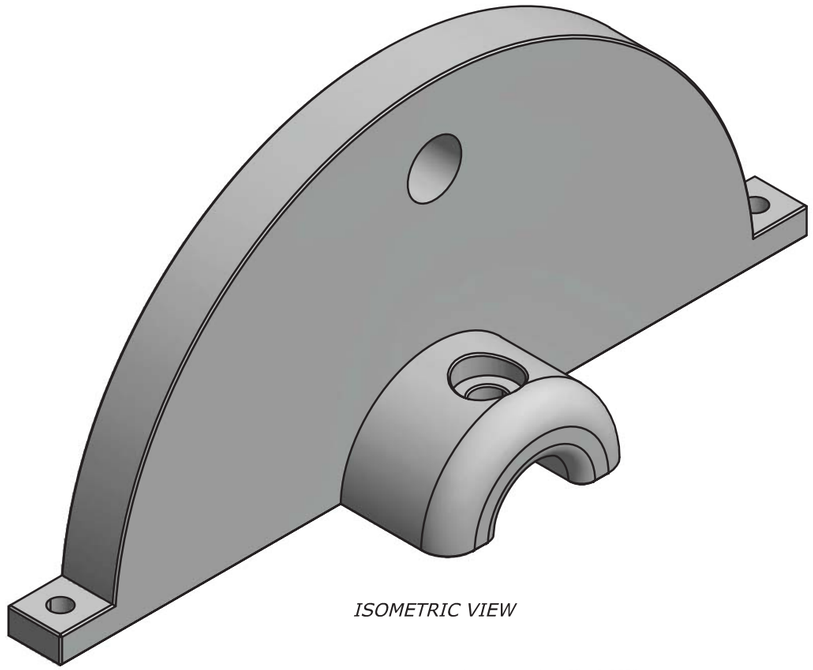
DATE AND TIME PLOTTED
Not Plotted
PLOTTED BY
Not Plotted

CAD SYSTEM
AUTOCAD
CAD FILENAME
UNKNOWN

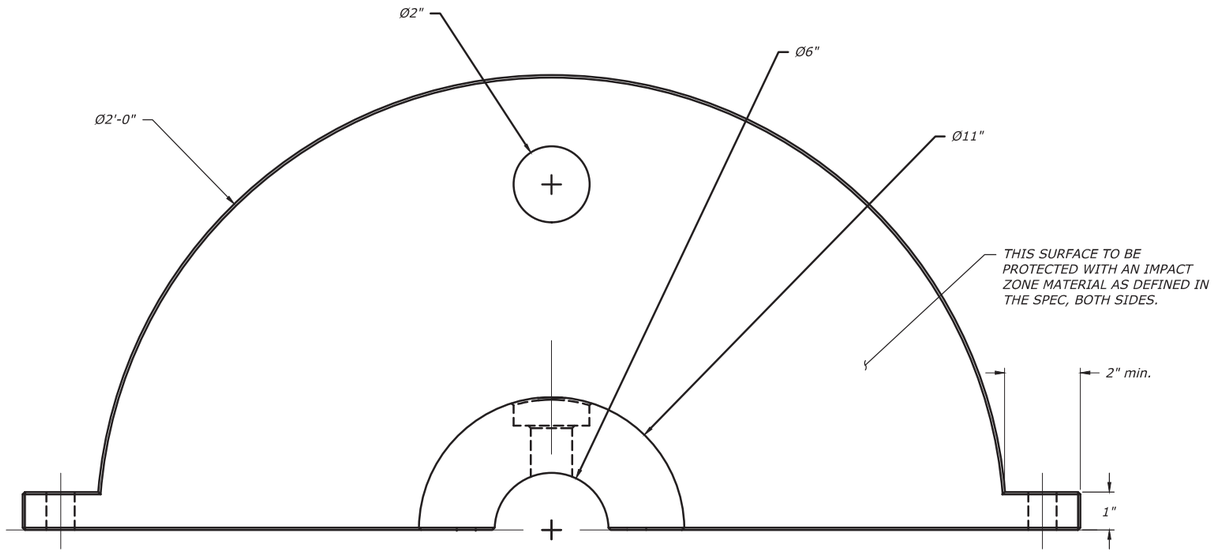
Draft



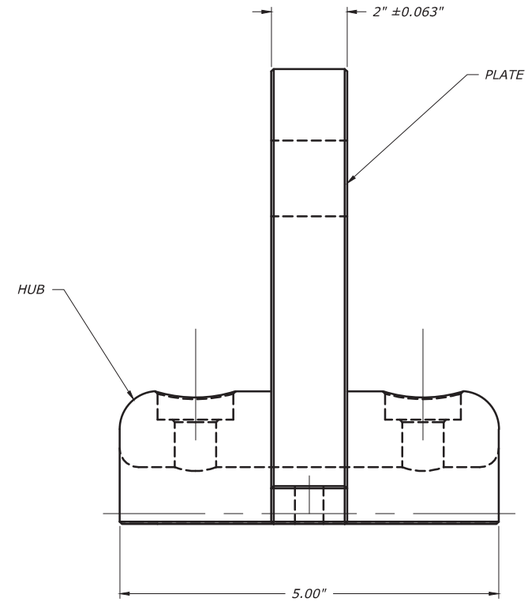
TOP VIEW



ISOMETRIC VIEW



FRONT VIEW



SIDE VIEW

NOTES

1. MATERIAL: ALUMINUM
2. CAN BE MANUFACTURED FROM TWO PIECES. HUB AND PLATE CAN BE WELDED TOGETHER PER LATEST REVISION OF AWS D1.2
3. TWO BUMPERS PER ASSEMBLY

DATE AND TIME PLOTTED
Not Plotted
PLOTTED BY
Not Plotted

CAD SYSTEM
AUTOCAD
CAD FILENAME
UNKNOWN

RECLAMATION
Managing Water in the West

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
TRINITY RIVER DIVISION

WHISKEYTOWN LAKE

OAK BOTTOM PARK

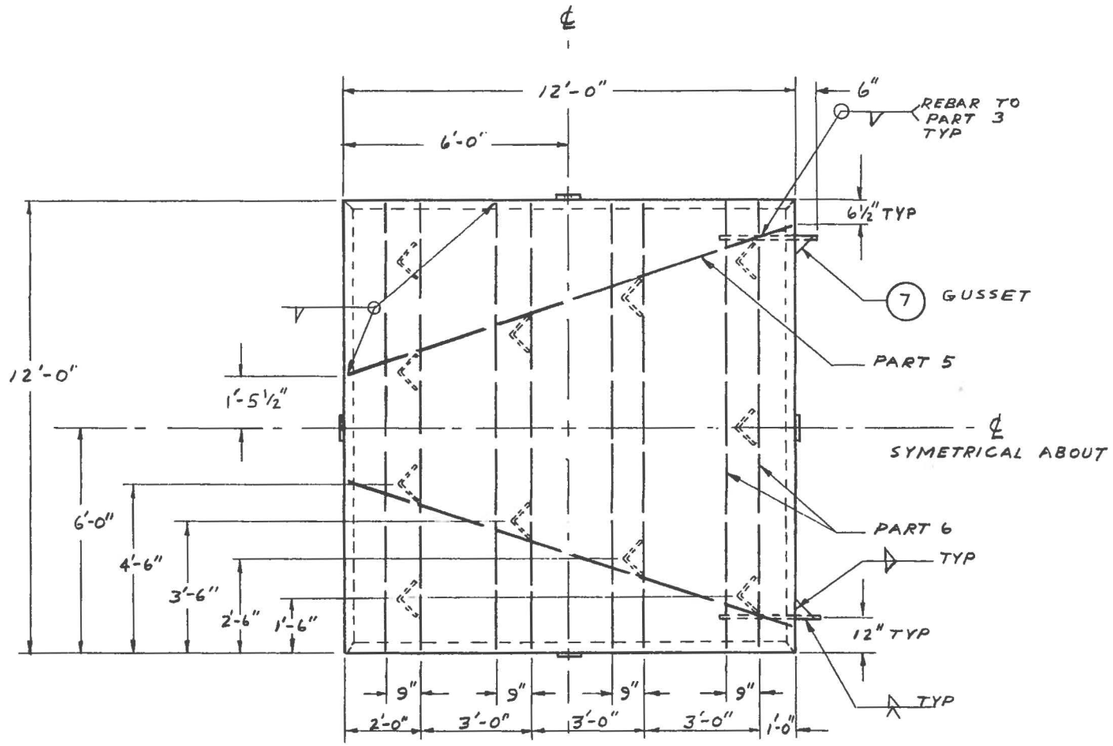
Kylee Moore
DESIGNED
James Litts
DRAWN
Ankur Bhattacharya
CHECKED
TECH. APPR.
APPROVED
ADMIN. APPROVAL -
SACRAMENTO, CA

TEMPERATURE CONTROL CURTAIN

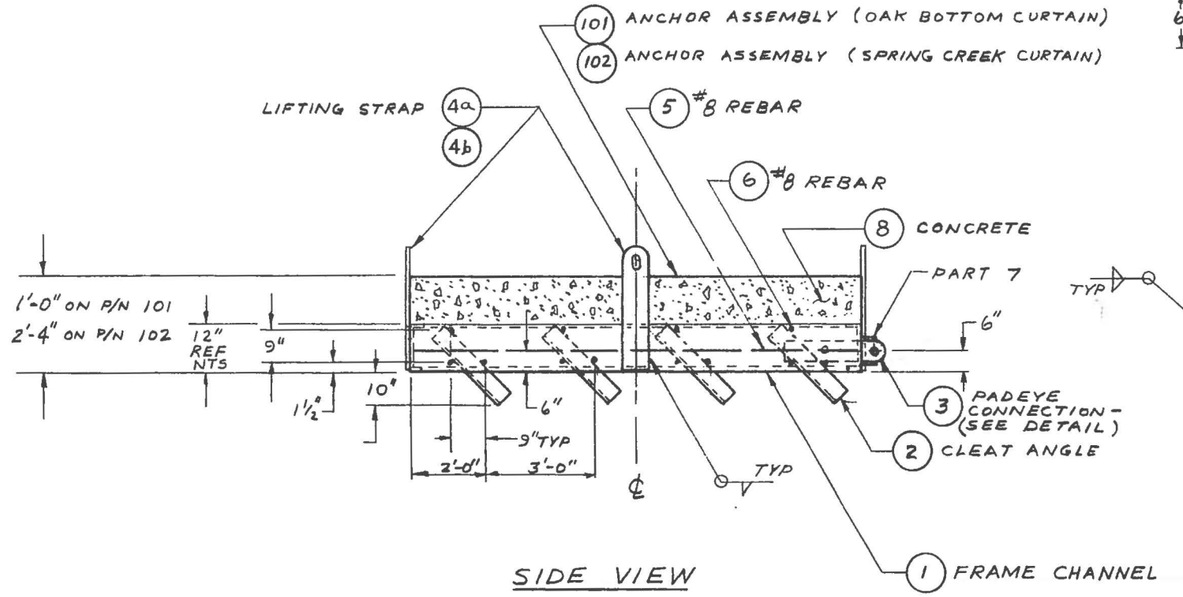
BUMPER DETAILS

416-208-60006

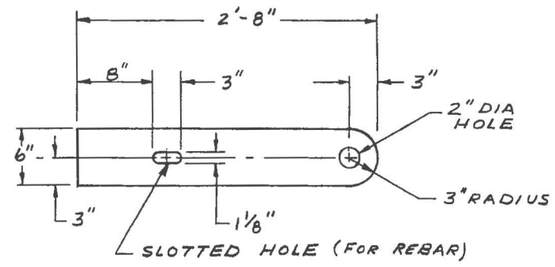
SHEET 1



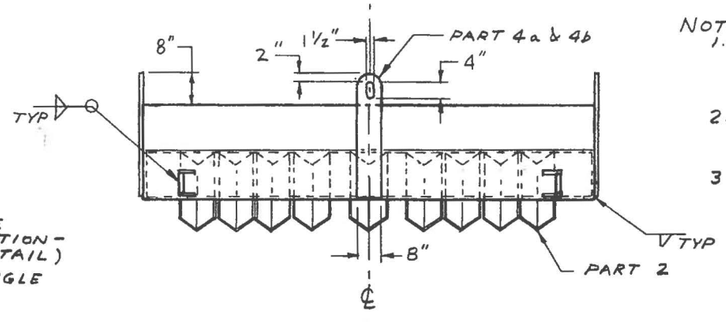
TOP VIEW



SIDE VIEW



DETAIL PART 3 NTS



FRONT VIEW

0 1 2 3 4 5
SCALE FT.

LIST OF MATERIALS EACH ANCHOR

PART NO.	QTY. REQ'D ON 101	QTY. REQ'D ON 102	DESCRIPTION	MATERIAL SPEC.
101			ANCHOR ASSEMBLY (OAK BOTTOM)	
102			ANCHOR ASSEMBLY (SPRING CREEK INTAKE)	
1	4	4	FRAME CHANNEL 12" 12 FT. LONG, STEEL	ASTM A-36 CHANNEL 12" x 3" 20.7 Lb/FT ZRC COATED
2	11	11	CLEAT ANGLE 8" 25½" LONG, STEEL	ASTM A-36 ANGLE 8" x 8" x ½", 26.4 Lb/FT ZRC COATED
3	2	2	PADEYE CONNECTION 1" STEEL x 6" x 2'-8" LONG	ASTM A-36 BAR 1" x 6", 20.4 Lb/FT. ZRC COATED
4a	4		LIFTING STRAP ½" STEEL x 8" x 19¾" LONG	ASTM A-36 BAR ½" x 8", 13.6 Lb/FT. ZRC COATED
4b		4	LIFTING STRAP ½" STEEL x 8" x 35¾" LONG	ASTM A-36 BAR ½" x 8", 13.6 Lb/FT. ZRC COATED
5	2	2	#8 REBAR 12'-7¾" LONG	ASTM A-615 GRADE 60 STEEL
6	12	12	#8 REBAR 11'-1⅜" LONG	ASTM A-615 GRADE 60 STEEL
7	4	4	GUSSET ½" x 3½" x 3½" STEEL	ASTM A-36 BAR ½" x 3½", 5.95 Lb/FT. ZRC COATED
8a	144 FT³		CONCRETE BALLAST	STANDARD NON-STRUCT. MIX (5 SACK APPROX.) SEE SPECS.
8b		336 FT³	CONCRETE BALLAST	STANDARD NON-STRUCT. MIX (5 SACK APPROX.) SEE SPECS.

NOTES:
1. MAXIMUM WEIGHT OF 101 ANCHOR SHALL NOT EXCEED 24,000 Lb., MINIMUM WT. = 23,000 Lb MAXIMUM WEIGHT OF 102 ANCHOR SHALL NOT EXCEED 50,500 Lb., MINIMUM WT. = 50,000 Lb
2. QUANTITIES REQ'D.:
   PART NO. 101 = 4 SEE DWG. 5353
   PART NO. 102 = 22 SEE DWGS. 5354 TO 5356
3. CONSTRUCTION NOTE - BUILD ANCHOR UPSIDE-DOWN & WELD ON PARTS 4 LAST AFTER TURNING ASSEMBLY UPRIGHT.

2-8-94	AS BUILT CHANGES ADDED	Guy O'Haver

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
WHISKEYTOWN LAKE

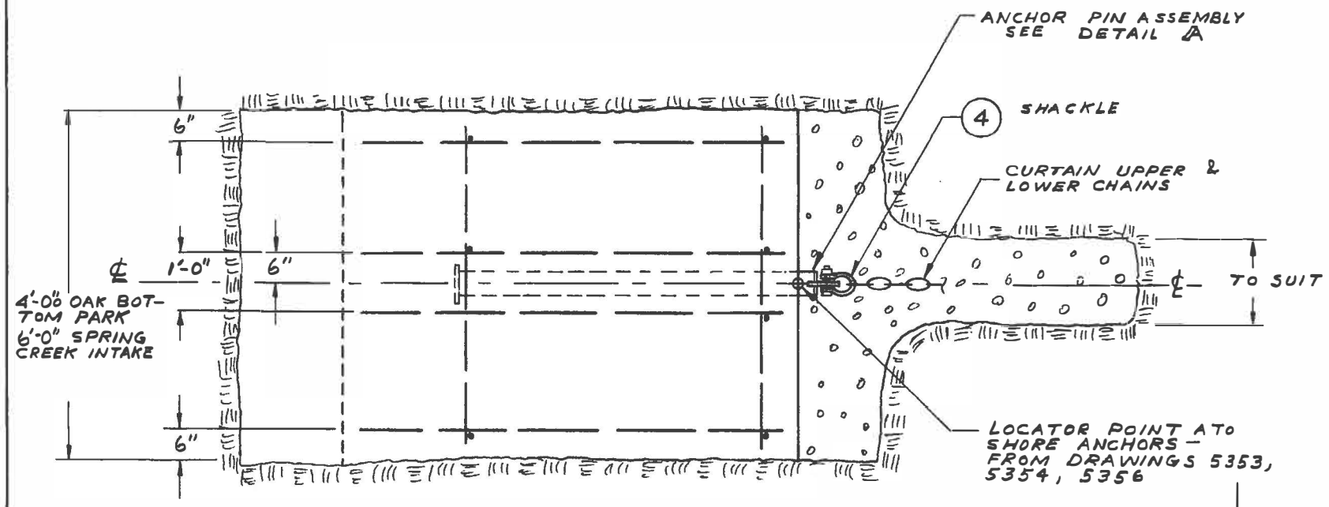
TEMPERATURE CONTROL CURTAINS, SPRING CREEK INTAKE, & OAK BOTTOM PARK, LAKE ANCHOR DETAILS

DESIGNED Guy O'Haver FIELD APPROVAL David W. Poore
DRAWN Guy O'Haver TECHNICAL APPROVAL
CHECKED David W. Poore APPROVED

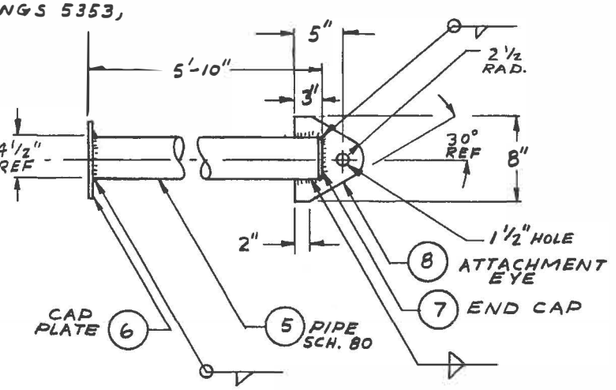
REDDING, CA. 12-21-92 | 416-214-5357
Spec. No. 20-C0409

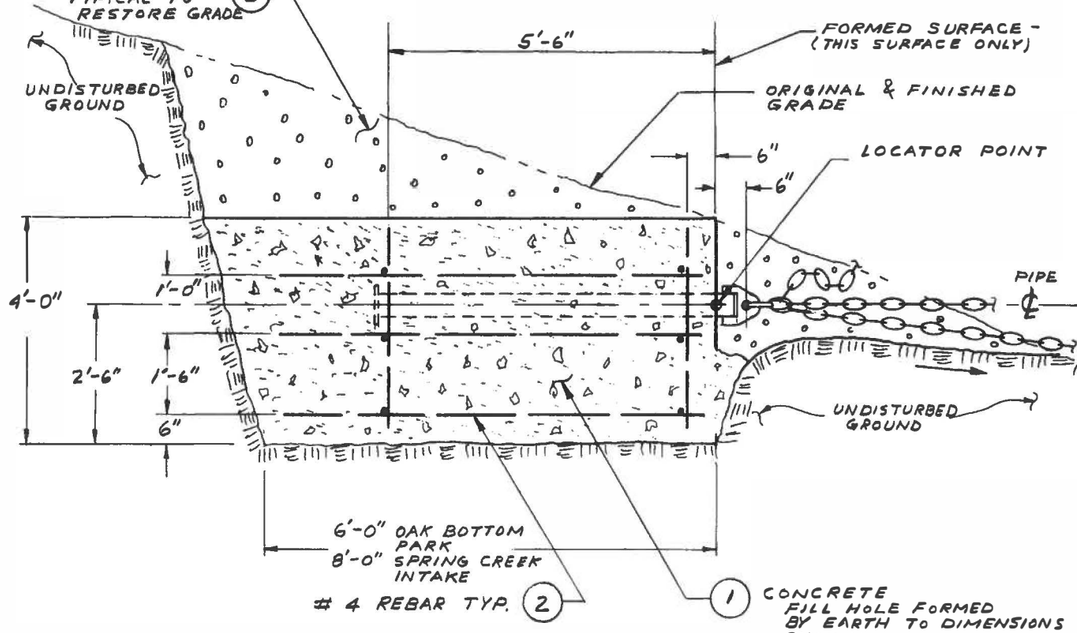
FOR INFORMATION ONLY

FOR OFFICIAL USE ONLY



TOP VIEW





SIDE VIEW

0 1 2 3 4 5

SCALE: FT.

LIST OF MATERIALS

PART NO.	QTY. REQ'D. OAK BOTTOM	QTY. REQ'D. SPRING CREEK	DESCRIPTION	MATERIAL SPEC
1	3.6 CU. YDS.	7.2 CU. YDS.	CONCRETE	STANDARD MIX SEE SPECS.
2	90 FT	120 FT	#4 REBAR	ASTM A615 GRADE 60 STEEL
3	AS REQ'D.	AS REQ'D.	LEACH FIELD ROCK	3/4" TO 1 1/2" SMOOTH ROUND ROCK
4a	1		3/4" SHACKLE, BOLT PIN WITH LOCKNUT	GALV. STEEL SEE SPECS.
4b		1	7/8" SHACKLE, BOLT PIN WITH LOCKNUT	GALV. STEEL SEE SPECS.
5	1	1	PIPE 4" SCH. 80	GALV. STEEL
6	1	1	CAP PLATE 8"x8" 1/2" THICK	ASTM A36 STEEL
2 7	1	1	END CAP 4 1/2" DIA. 1/2" THICK	ASTM A242 STEEL
2 8	1	1	ATTACHMENT EYE 1" THICK & AS SHOWN	ASTM A242 STEEL OR EQUAL 50,000 PSI Y.

NOTES:

1. FOLLOWING FABRICATION OF ANCHOR PIN ASSEMBLY, COAT PIN WITH 3 COATS OF ZRC PER SPECS.
2. ATTACHMENT EYE & END CAP SHALL BE HIGH STRENGTH-LOW ALLOY GRADE, 50,000 PSI MINIMUM YEILD STRENGTH, & 4 TIMES THE CORROSION RESISTANCE OF STRUCTURAL STEEL
3. AXIS OF PIN & ℄ OF ANCHOR SHALL BE ORIENTED TO ALIGN WITH DIRECTION OF CURTAIN CHAINS WHEN CURTAIN IS LOADED BY FLOW AS SHOWN ON REFERENCE DRAWINGS 5354 & 5356 SPRING CREEK INTAKE. AT OAK BOTTOM PARK, PIN & ℄ SHALL POINT TO THE OPPOSITE SHORE ANCHOR.

REFERENCE DRAWINGS:

OAK BOTTOM PARK GENERAL PLAN	416-214-	5353
SPRING CREEK INTAKE " "		5354
SPRING CREEK INTAKE " "		5356

FOR INFORMATION ONLY

FOR OFFICIAL USE ONLY

2-8-94	AS BUILT CHANGES ADDED	Greg O'Haver

ALWAYS THINK SAFETY

UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION

WHISKEYTOWN LAKE
TEMPERATURE CONTROL CURTAIN
OAK BOTTOM PARK & SPRING CREEK INTAKE
SHORE ANCHOR DETAILS

DESIGNED Greg O'Haver FIELD APPROVAL David Poore
DRAWN Greg O'Haver TECHNICAL APPROVAL
CHECKED David Poore APPROVED J. Paul Tauzer

REDDING, CA. 1-21-93 | 416-214-5377

Spec. No. RO-C0409

PROJECT: CAP 1135 Clarence Cannon	**Calculated by: Aleris Castaner-Rodriguez**
Subject: Gated Selective Withdrawal System	**Checked by: Ryan Holland**

Known Info

2 turbines

2 penstocks per turbine, 18' x 50' each, then 16' diameter and combine to a 26' diameter between both at the entrance of the turbines

Flaming Gorge units are ~ 30'x30'x200'; upper gates have 3 leaves each ~ 24' x 30', lower gate is 1 leaf ~24' x 30'

CC elevations range to managed

Materials	Quantity	Remarks	Unit price	Amount	Assumptions
Upper shutter gates	3	ASTM A36 Steel.	$13,320,000	$26,640,000	1 SWS per turbine, 1 SWS for 2 penstocks, 36' x 133' /unit
Lower shutter gates	1	ASTM A36 Steel.	$4,350,000	$8,700,000	3 Flaming Gorge units = 72' of gates width -> 2 CC penstocks ~ 36' x 2 units = 72' Assumed 3 units of FG ~ 2 units for CC 3 - 30' tall gates = 90' of managed water levels from 520-610
Structural frame					133 ft from penstock inverts to top of PH @ bridge floor elevation
panel siding					
W sections					Not calculated since gates furnishing and intallation was already over the price limit for the project as a whole.
L shapes					
stop angles					
guide angles					
				$35,340,000	$26M if lower shutter gate from FG not considered. This is for furnishing and installation.

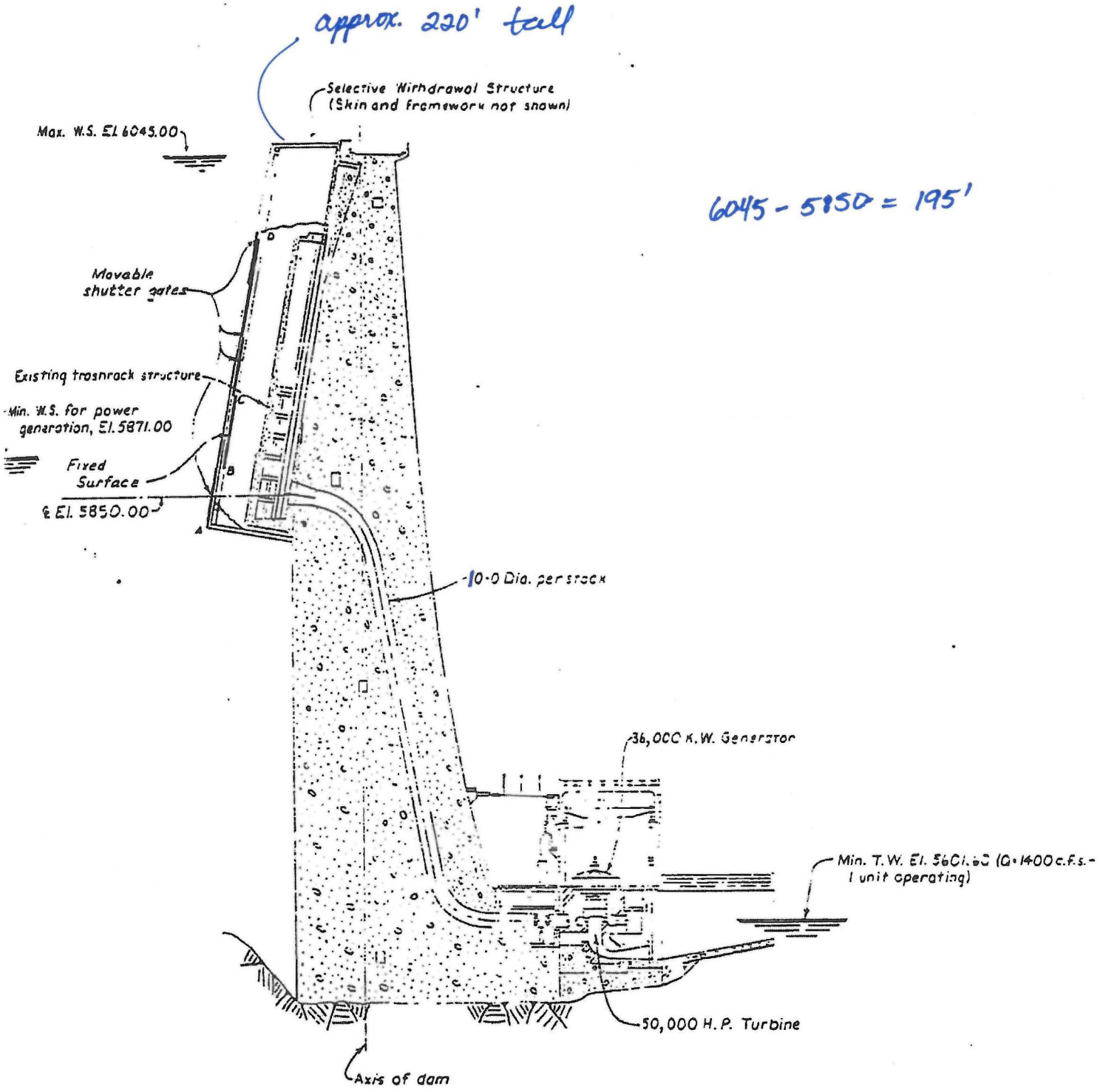
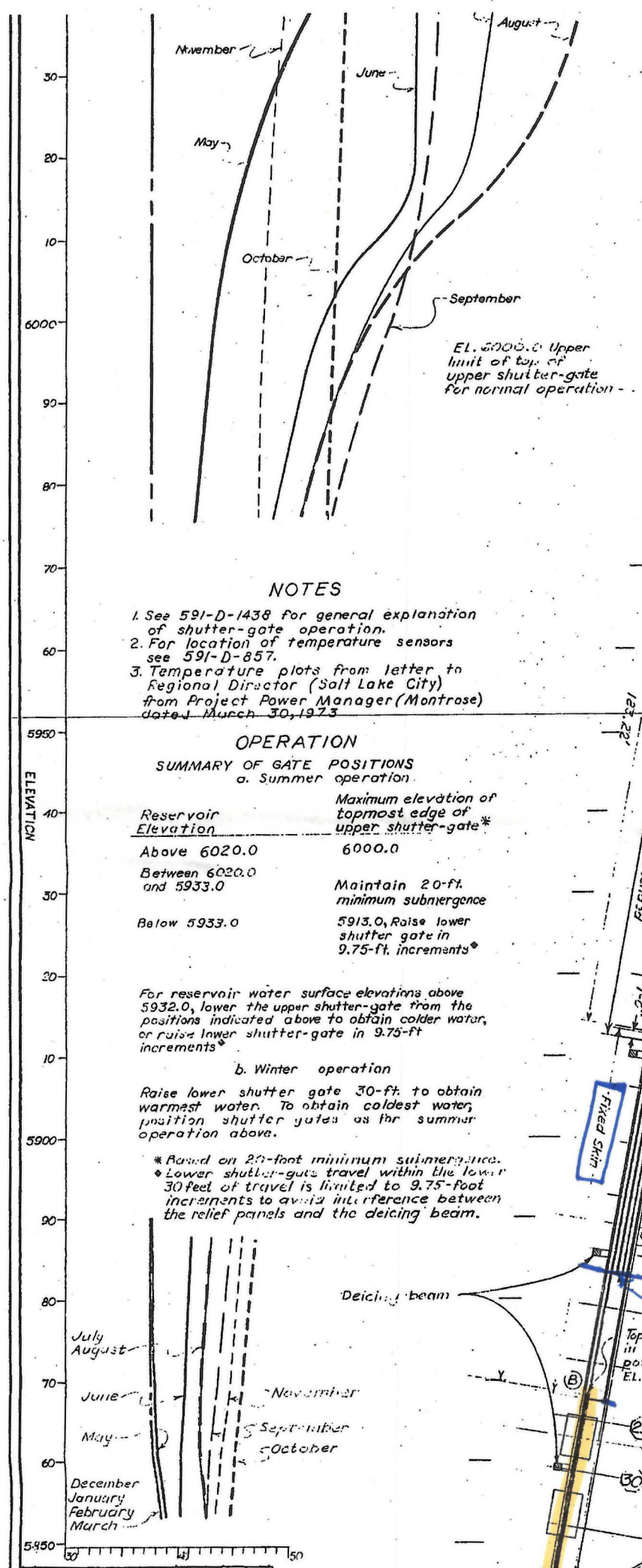


Fig. 2

Schematic drawing of the selective withdrawal structure on the face of the dam



NOTES

1. See 591-D-1438 for general explanation of shutter-gate operation.
2. For location of temperature sensors see 591-D-857.
3. Temperature plots from letter to Regional Director (Salt Lake City) from Project Power Manager (Montrose) dated March 30, 1973

OPERATION

SUMMARY OF GATE POSITIONS

a. Summer operation

Reservoir Elevation	Maximum elevation of topmost edge of upper shutter-gate*
Above 6020.0	6000.0
Between 6020.0 and 5933.0	Maintain 20-ft. minimum submergence
Below 5933.0	5913.0, Raise lower shutter gate in 9.75-ft. increments◆

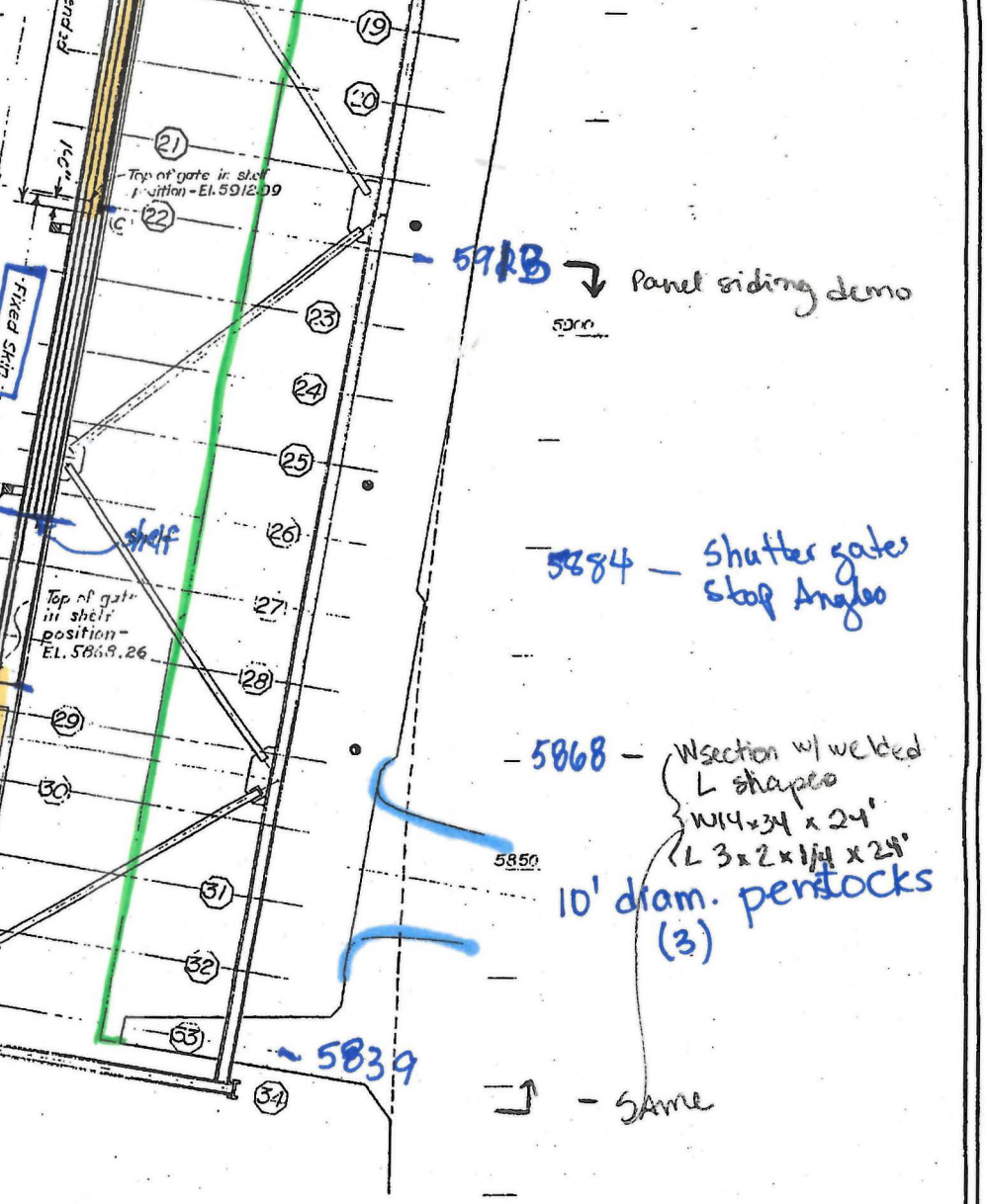
For reservoir water surface elevations above 5932.0, lower the upper shutter-gate from the positions indicated above to obtain colder water, or raise lower shutter-gate in 9.75-ft increments◆

b. Winter operation

Raise lower shutter gate 30-ft. to obtain warmest water. To obtain coldest water, position shutter gates as for summer operation above.

* Based on 20-foot minimum submergence.

◆ Lower shutter-gate travel within the lower 30 feet of travel is limited to 9.75-foot increments to avoid interference between the relief panels and the deicing beam.



5-16-78 D. RSS	CHANGED LEADERS AND ARROWS AT ⑤, ADDED ELEVATION AT ⑧

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER STORAGE PROJECT
GREEN RIVER DIVISION-FLAMING GORGE PROJECT UTAH

FLAMING GORGE DAM
SELECTIVE WITHDRAWAL STRUCTURE
SHUTTER GATE OPERATION

DESIGNED R.H. SUBMITTED
DRAWN CRC RECOMMENDED A.G. Wiederhorn
CHECKED APPROVED
CHIEF, MECHANICAL BRANCH
DENVER, COLORADO

591-D-1501

F (H-7)

F

21-0

TS 14 x 14 x .313

TS 6 x 6 x 0.25

H (1433)

TS 8 x 8 x 0.25

3 Spaces @ 10-0 = 30-0

7-0

11-6

11-6

7 Spaces @ 10-0 = (70-0

5-0

10-0

9-6

10-6

3 Spaces @ 10-0 = 30-0

5-0

2'-9"

Gusset PL ½ x 6 x 12, both sides

3/8

TS 10x14x0.5

SECTION W-W

NOTE
Water entrance areas indicated by crossed phantom lines

A (1433)

A

TS 6 x 6 x .25

TS 6 x 12 x .25

D (1419)

D

TS 14 x 14 x .313

D (1419)

D

J (1428)

J

5-10

5-7

5-7

5-7

5-7

3-10

30-0

TS 6 x 6 x .25

Shutters, corrugated skin, and shutter track not shown

H

~6000

Shutter track See Dwgs. 591-D-1413 and 1433 for details

Upper Shutter Gate Assembly (1424)

~5950

~5900

~5850

TS 6 x 6 x .25

Corrugated metal

Lower Shutter Gate Assembly (1476) with two way Relief Panels

El. 5832.75

TS 6 x 6 x .25

TS 6 x 6 x .25

Top of shutter gate @ El. 5999.96' with max. water surface elevation

29'-10

29'-10

30'-0

6'-2"

C-08

D-08

VIEW G-G (1418)

1-24-77 NSS	CHANGED SHUTTER GATE POSITION DIMENSIONS-ADDED SECTION W-W	
12-15-76 D-WMM	CHANGE SHUTTER TRACK CROSS TIE.	
11-12-76 D-	MINOR REVISIONS TO VIEW G-G	

ALWAYS THINK SAFETY

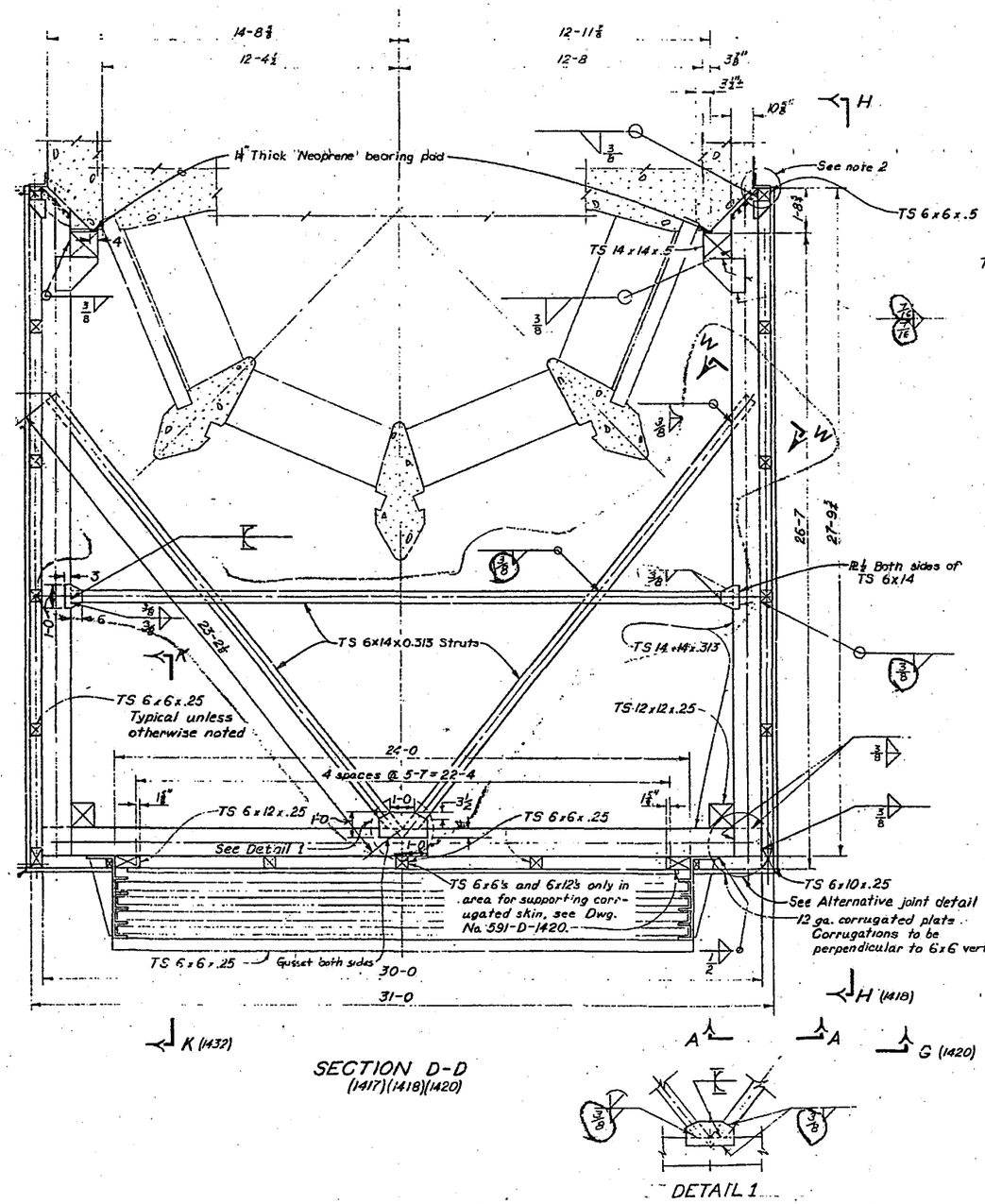
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER STORAGE PROJECT
GLEN CANYON DIVISION-PLANNING GORGE UNIT-UTAH-WYOMING

FLAMING GORGE DAM
SELECTIVE WITHDRAWAL STRUCTURE
NORTH ELEVATION

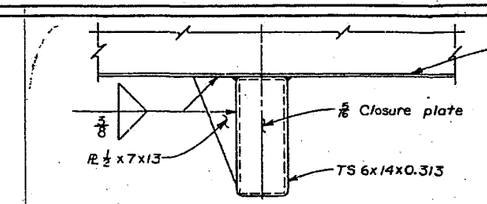
DESIGNED ... SUBMITTED ...
DRAWN ... RECOMMENDED ...
CHECKED ... APPROVED ...
DENVER, COLORADO ... CHIEF, MECHANICAL BRANCH

5-51-D-1220

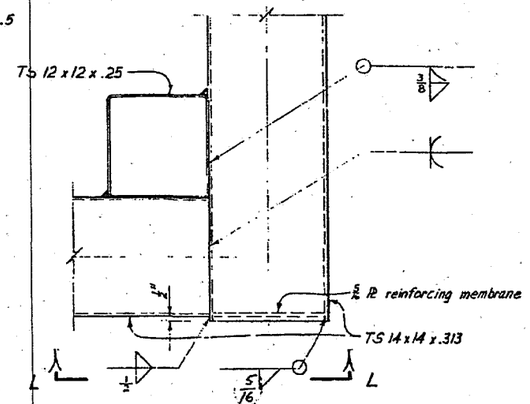
33



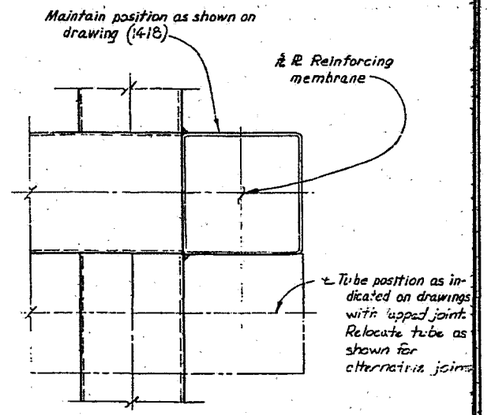
SECTION D-D
(1417)(1418)(1420)



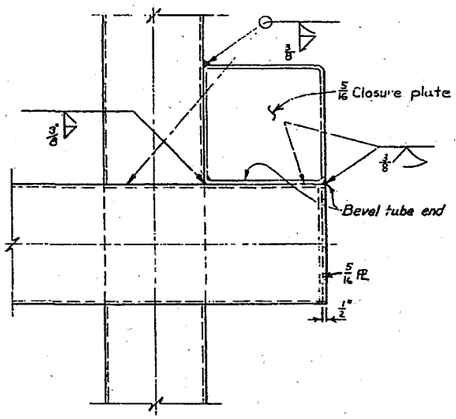
VIEW W-W



ALTERNATIVE JOINT DETAIL



VIEW L-L



VIEW A-A
JOINT DETAIL

DETAIL 1

NOTES

1. All gussets ½ PL. Unless otherwise noted.
2. TS 14 x 14 and 6x14 members are typical. Connection to concrete varies with elevation, see Dwg. No's 591-D-1429 and -1417.
3. If Contractor selects Alternative Joint, the Contractor shall be responsible for modifying design shown on drawings to obtain proper fit of shutter track, TS 6x14x0.313 struts, and shutter gate relief panels with structure.
4. All tube intersections to be welded all around, the weld to be not less than the minimum wall thickness. All ends to be beveled where necessary.
5. An end-closure channel shall be provided at all the corners.

12-16-76	D. RSS	ADDED DETAIL 1
11-15-76	D REC	RELOCATED STRUTS, ADDED VIEW W-W AND NOTE 5, AND MINOR REVISIONS

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER STORAGE PROJECT
GREEN DIV.-- FLAMING GORGE UNIT--UTAH-WYOMING

FLAMING GORGE DAM

SELECTIVE WITHDRAWAL STRUCTURE
TYPICAL STRUCTURAL SECTION BELOW EL. 5872.50

DESIGNED Terrell Sipes SUBMITTED S.R. Hudson
DRAWN Sam Mendez RECOMMENDED C.A.B.
CHECKED Terrell Sipes APPROVED [illegible]
CHIEF, MECHANICAL BRANCH

DENVER, COLORADO JULY 15, 1974

591-D-1419

1-24-77	D. RSS	CHANGE WELD SIZES-- END PL IN BEVEL CUT TUBES SHOWED

653

78' + 55' = 133'

630 -

620 -

610 —

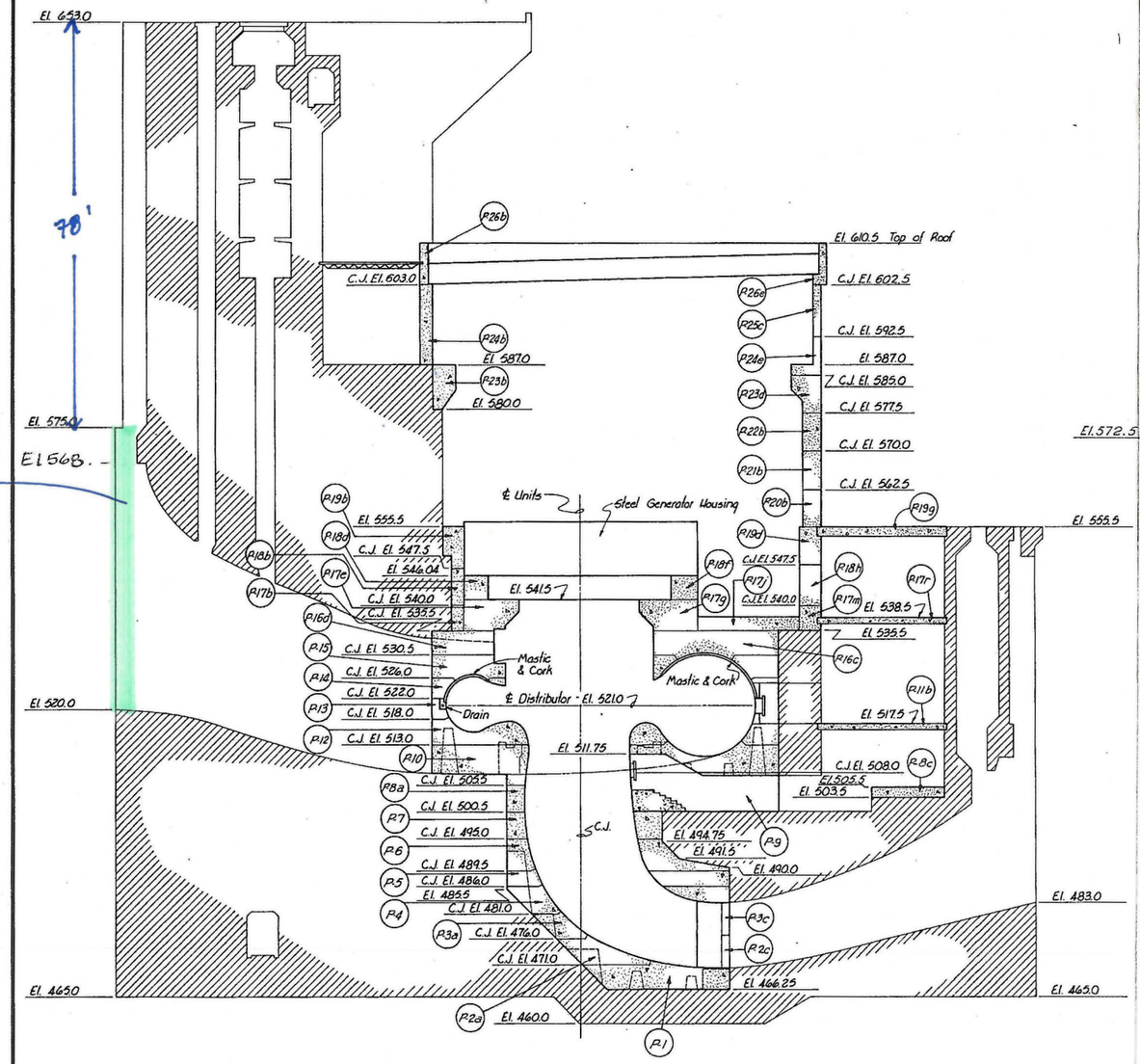
600 —

TCW 580

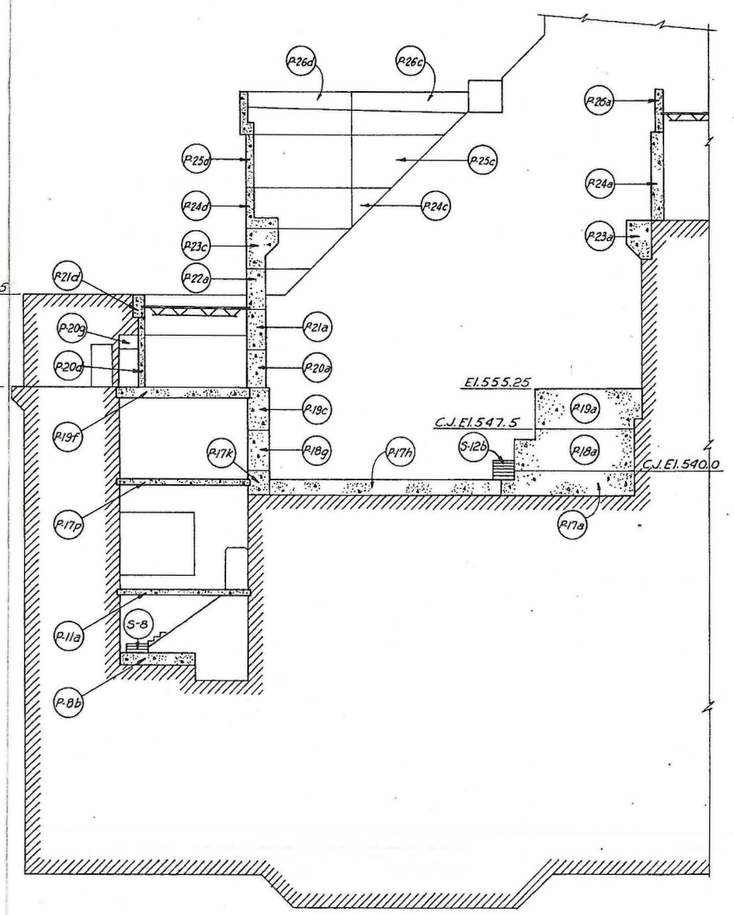
520 —

total 90'

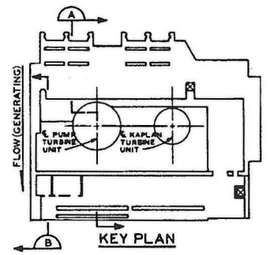
* Flaming Gorges Upper shutter gates Ht. when all closed.



SECTIONAL ELEVATION A
PUMP TURBINE UNIT
SCALE: 1/8 INCH = 1 FOOT



SECTIONAL ELEVATION B
PUMP TURBINE UNIT
SCALE: 1/8 INCH = 1 FOOT



SYMBOL	DESCRIPTION	DATE	APPROVED
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

DESIGNED BY: J. F. P.
DRAWN BY: R. C. R.
CHECKED BY: J. V. N.
DATE: 3 JAN. 1977

SUBMITTED:
CHIEF, ENGINEERING DIVISION, OMAHA DISTRICT

APPROVED:
CHIEF, DESIGN BRANCH, ST. LOUIS DISTRICT

APPROVED FOR DISTRICT ENGINEER:
CHIEF, ENGINEERING DIVISION, ST. LOUIS DISTRICT

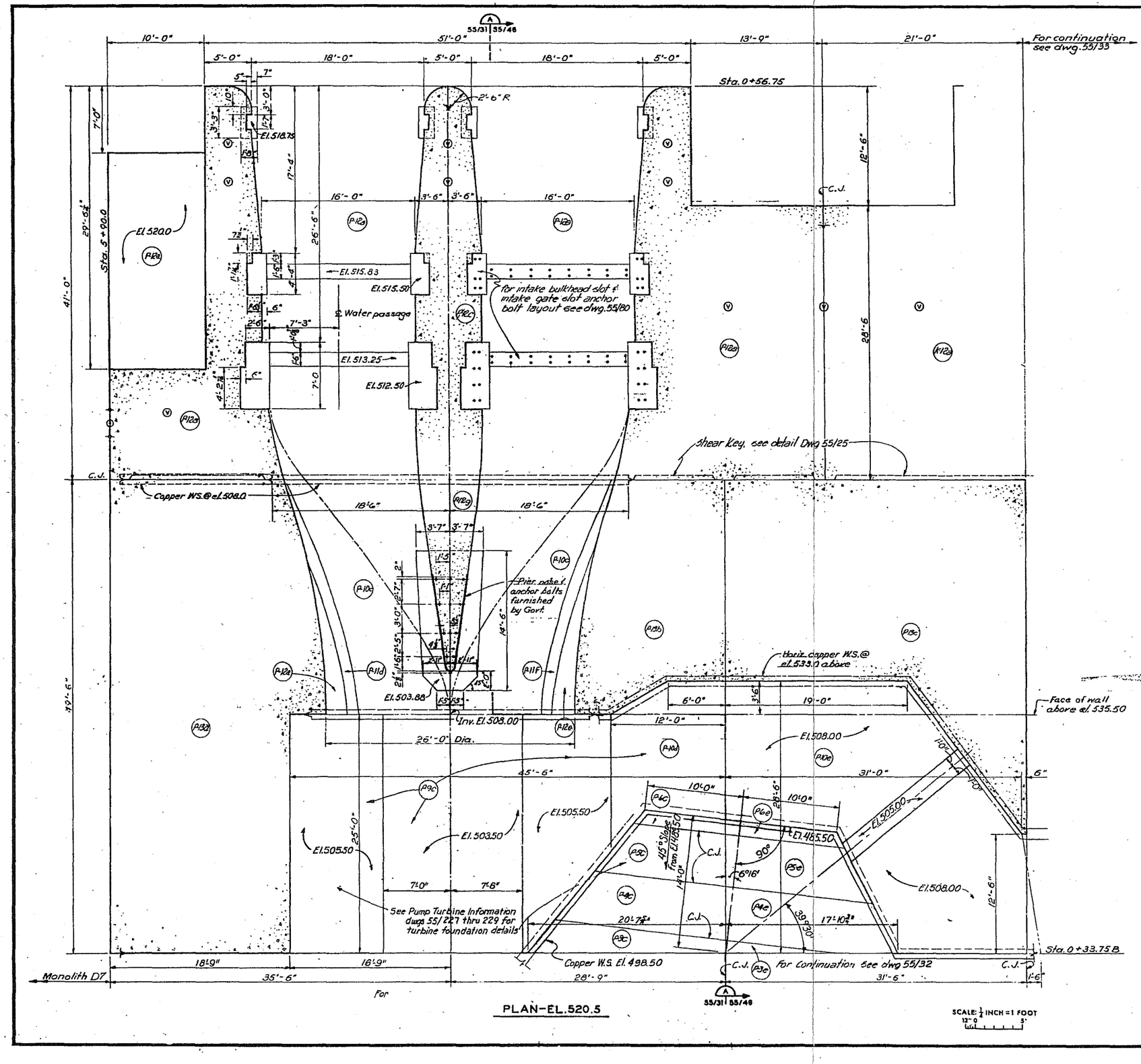
U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

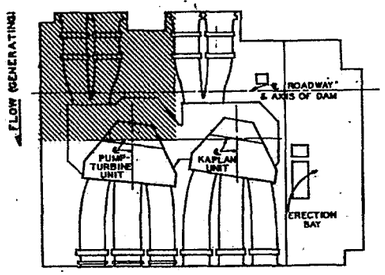
UPPER MISSISSIPPI RIVER BASIN - SALT RIVER, MISSOURI

CLARENCE CANNON RESERVOIR
POWER PLANT-SUPERSTRUCTURE
CONCRETE
PLACEMENT LAYOUT - SHEET 3

SIZE	CODE IDENT. NO.	DRAWING NO.
F	DACW 43	S-CC 53/103

SCALE: AS SHOWN | WW. NO. DACW 43-7 6-8-0008 | SHEET 4 OF 50





KEY PLAN
POWERHOUSE SUBSTRUCTURE WATER PASSAGES

REFERENCE DRAWINGS

Powerhouse Structural Excavation	17/19
Pour Layout	55/15, 19 & 20
Standard Details and General Notes	55/25
Concrete	55/26, 27, 28, 32, 33, 36, 46, 48 & 54
Reinforcement	55/415 & 417
Miscellaneous Metals	55/301
Electrical	55/307
Piping and Ductwork	55/209
Intake Gate and Bulkhead Slot Anchor Bolt Layout	55/80
Pump Turbine Foundation Inlet Pier Nose Information Drawings	55/222 & 223
Post-Tensioning Layout	55/54

INFORMATION DRAWINGS

THIS DRAWING WAS REPRODUCED FROM CLARENCE CANNON RESERVOIR, POWER PLANT - SUBSTRUCTURE AND INTAKE, CONTRACT DRAWING NO. S-CC 55/31 WITH CERTAIN ADDITIONS AND CORRECTIONS TO PROVIDE APPROXIMATE EXISTING CONDITIONS OF THE STRUCTURE.

SYMBOL	DESCRIPTION	DATE	APPROVED
	REVISIONS		

U.S. ARMY ENGINEER DISTRICT, OMAHA CORPS OF ENGINEERS OMAHA, NEBRASKA

DESIGNED BY:
DRAWN BY:
CHECKED BY:
DATE: 3 JAN. 1977
SUBMITTED:
CHIEF, ENGINEERING DIVISION, OMAHA DISTRICT
APPROVED:
CHIEF, DESIGN BRANCH, ST. LOUIS DISTRICT
APPROVED FOR DISTRICT ENGINEER:
CHIEF, ENGINEERING DIVISION, ST. LOUIS DISTRICT

U. S. ARMY ENGINEER DISTRICT, ST. LOUIS CORPS OF ENGINEERS ST. LOUIS, MISSOURI

UPPER MISSISSIPPI RIVER BASIN - SALT RIVER, MISSOURI

CLARENCE CANNON RESERVOIR

POWER PLANT-SUPERSTRUCTURE

CONCRETE

INFORMATION DRAWING SUBSTRUCTURE AND INTAKE - CONSTRUCTION

SIZE	CODE IDENT. NO.	DRAWING NO.
F	DACW 43	S-CC 53/133

SCALE: AS SHOWN | SPEC. NO. DACW 43-76-B-0008 | SHEET 34 OF 80

BUREAU OF RECLAMATION **ESTIMATE WORKSHEET** SHEET 1 OF 14

FEATURE: Flaming Gorge SWS Feasibility Design	**PROJECT:** Colorado River Storage Project, Utah-Wyoming
	WOID: FGSFS **ESTIMATE LEVEL:** FEASIBILITY
	REGION: UC **UNIT PRICE LEVEL:** Jan-25
Group: 86-68120	**FILE:** \\Bor\DO\TSC\Jobs\UC\Flaming Gorge Dam\2020-PDC-Repair and Upgrade Selective Withdrawal\FEAS\EST\8170\FinalEst\[Flaming Gorge SWS Feasibility.xlsx]8120-1

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		General Notes					
		Levels, and associated elevations refer to the					
		framing plan levels which are at a 9.76 degree					
		angle above horizontal. Elevations are given to					
		convey the approximate depth below					
		Normal Water Surface Elevation					
		A. Pertinent Elevations					
		6057 ft - Top of Hoist Desk					
		6049 ft - Top of SWS deck - Level 1					
		6047 ft - Top of Dam					
		6040 ft - Max reservoir elevation					
		6030 ft - Assumed Water Surface Elevation					
		5913ft (approx.) - level 22					
		5884 ft (approx.) - level 26					
		5868 ft (approx.) - Level 28.7					
		5839 ft - (approx.)- Level 33					
		lowest level of damage					
		B. Procedure					
		Removal of damaged members of the trash rack, and the gate and shutter panel will be complicated.					
		The gantry crane for the dam does not reach the location of the gates or any part of the SWS.					
		Assumed the contractor use a barge mounted crane or hoists to remove and reinstall the gates.					
		Assumed the contractor also use a dive team to perform demolition, repair, and replacement					
		of damaged sections of the SWS.					
		SUBTOTAL THIS SHEET					

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
L. Orgren	C. Gemperline	Matthew Shaw	Christopher Florence
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
12/09/24	M. Shepherd, P.E. 3/5/2025	04/10/25	Brendan Ahern, P.E.

FEATURE: Flaming Gorge SWS Feasibility Design	**PROJECT:** Colorado River Storage Project, Utah-Wyoming
	WOID: FGSFS — **ESTIMATE LEVEL:** FEASIBILITY
	REGION: UC — **UNIT PRICE LEVEL:** Jan-25
Group: 86-68120	**FILE:** \\Bor\DO\TSC\Jobs\UC\Flaming Gorge Dam\2020-PDC-Repair and Upgrade Selective Withdrawal\FEAS\EST\8170\FinalEst\[Flaming Gorge SWS Feasibility.xlsx]8120-2Demo

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
8120-2Demo-001		**Underwater Demolition**	86-68120	1	LS	$4,600,000.00	$4,600,000.00
		Panel Siding (Mk-176A, Mk-176B, Mk-212A,					
		Mk-212B, Mk-212C, Mk-212D)					
		From Level 22 - approx. El. 5913 to Level 33					
		approx. El. 5839. (117 to 191 ft below El. 6030)					
		Bethlehem 12ga, 2-1/2 x 6-1/2 bridge floor deck					
		Total area = 730 ft2					
		Wt. = 4900lb					
		L2x2x3/16 ASTM A36					
		Wt. = 135lb					
		W Sections with welded L Shapes					
		Level 28.7 - approx. El. 5868					
		(162 ft below El. 6030)					
		W14x34 x 24'-0" ASTM A572					
		Wt = 820 lb					
		L3x2x1/4 x 24'-0" ASTM A36					
		Wt = 100 lb					
		Level 33 - approx. El. 5839					
		(191 ft below El. 6030)					
		W14x34 x 24'-0" ASTM A572					
		Wt = 820 lb					
		L3x2x1/4 x 24'-0" ASTM A36					
		Wt = 100 lb					
		Shutter Gate Stop Angles					
		Below Level 26 - approx. El. 5884					
		(146 ft below El. 6030)					
		2x L8x4x1 x 1'-10" ASTM A36					
		Wt = 140 lb					
		SUBTOTAL THIS SHEET					**$4,600,000.00**

QUANTITIES		**PRICES**	
BY	**CHECKED**	**BY**	**CHECKED**
L. Orgren	C. Gemperline	Matthew Shaw	Christopher Florence
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
12/09/24	M. Shepherd, P.E. 3/5/2025	04/10/25	Brendan Ahern, P.E.

FEATURE: Flaming Gorge SWS Feasibility Design	**PROJECT:** Colorado River Storage Project, Utah-Wyoming
	WOID: FGSFS — **ESTIMATE LEVEL:** FEASIBILITY
	REGION: UC — **UNIT PRICE LEVEL:** Jan-25
Group: 86-68120	**FILE:** \\Bor\DO\TSC\Jobs\UC\Flaming Gorge Dam\2020-PDC-Repair and Upgrade Selective Withdrawal\FEAS\EST\8170\FinalEst\[Flaming Gorge SWS Feasibility.xlsx]8120-3Demo

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Underwater Demolition (Cont.)	86-68120	[Note: see previous sheet]			
		Shutter Gate Guide Angle - segments					
		El. 5983 to 6002					
		(47 to 28 ft below El. 6030)					
		2x L8x6x3/4 x 19'-9" ASTM A36					
		Wt = 1350 lb					
		2x L8x6x3/4 x 18'-9" ASTM A36					
		Wt = 1300 lb					
		2x L8x6x3/4 x 17'-9" ASTM A36					
		Wt = 1200 lb					
		2x L8x6x3/4 x 14'-9" ASTM A36					
		Wt = 1000 lb					
		Upper Shutter - 100A					
		Wedged at approx. El. 6002 to 6032					
		(0 to 28 ft below El. 6030)					
		Approximate wt = 60,000 lb					
		Overall dimensions: 23'-6" x 30'-0"					
		Lower Shutter Gate - 69A					
		Wedged at approx. El. 6002 to 6032					
		(0 to 28 ft below El. 6030)					
		Approximate wt = 30,000 lb					
		Overall dimensions: 23'-6" x 30'-0"					
8120-3Demo-001		**Demolition Above Water Level**	86-68120	1	LS	$135,000.00	$135,000.00
		Hoist Frame					
		Consists of W Sections, plates, other steel sections					
		Approximate wt = 10,500 lb					
		SUBTOTAL THIS SHEET					**$135,000.00**

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
L. Orgren	C. Gemperline	Matthew Shaw	Christopher Florence
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
12/09/24	M. Shepherd, P.E. 3/5/2025	04/10/25	Brendan Ahern, P.E.

FEATURE: Flaming Gorge SWS Feasibility Design

PROJECT: Colorado River Storage Project, Utah-Wyoming

WOID:	FGSFS	**ESTIMATE LEVEL:**	FEASIBILITY
REGION:	UC	**UNIT PRICE LEVEL:**	Jan-25

FILE: \\Bor\DO\TSC\Jobs\UC\Flaming Gorge Dam\2020-PDC-Repair and Upgrade Selective Withdrawal\FEAS\EST\8170\FinalEst\[Flaming Gorge SWS Feasibility.xlsx]8120-4New

Group: 86-68120

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
8120-4	New-001	**Structural Steel - Underwater Installation**	86-68120	1	LS	$83,000.00	$83,000.00
		Assumed to shop fabricated, and installed					
		underwater with divers					
		Panel Siding (Mk-176A, Mk-176B, Mk-212A,					
		Mk-212B, Mk-212C, Mk-212D)					
		87' From Level 22 - approx. El. 5926 to Level 33					
		approx. El. 5839. (104 to 191 ft below El. 6030)					
		Type N 3" Floor Deck 12 ga Galvanized					
		24" panels, 3" deep, 2.375" ribs at 8" centers					
		Yield strength = 33ksi, 7.40 psf					
		Includes 10% for closure plates					
		Approximate weight = 6,000 lbs					
		Total area = 730 ft2					
		https://www.jamesriversteel.com/n-deck					
		W Sections with welded L Shapes					
		Level 28.7 - approx. El. 5868					
		(162 ft below El. 6030)					
		W14x34 x 24'-0" ASTM A572					
		Wt = 820 lb					
		L3x2x1/4 x 24'-0" ASTM A36					
		Wt = 100 lb					
		Level 33 - approx. El. 5839					
		(191 ft below El. 6030)					
		W14x34 x 24'-0" ASTM A572					
		Wt = 820 lb					
		L3x2x1/4 x 24'-0" ASTM A36					
		Wt = 100 lb					
		Shutter Gate Stop Angles (upper gates)					
		Below Level 26 - approx. El. 5884					
		2x L8x4x1 x 1'-10" ASTM A36					
		Wt = 140 lb					
		SUBTOTAL THIS SHEET					**$83,000.00**

QUANTITIES		**PRICES**	
BY	**CHECKED**	**BY**	**CHECKED**
L. Orgren	C. Gemperline	Matthew Shaw	Christopher Florence
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
12/09/24	M. Shepherd, P.E. 3/5/2025	04/10/25	Brendan Ahern, P.E.

FEATURE: Flaming Gorge SWS Feasibility Design	**PROJECT:** Colorado River Storage Project, Utah-Wyoming
	WOID: FGSFS **ESTIMATE LEVEL:** FEASIBILITY
	REGION: UC **UNIT PRICE LEVEL:** Jan-25
Group: 86-68120	**FILE:** \\Bor\DO\TSC\Jobs\UC\Flaming Gorge Dam\2020-PDC-Repair and Upgrade Selective Withdrawal\FEAS\EST\8170\FinalEst\[Flaming Gorge SWS Feasibility.xlsx]8120-5New

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Structural Steel - Underwater Installation	86-68120	[Note: see previous sheet]			
		(Cont'd)					
		Shutter Gate Guide Angle - segments					
		El. 5983 to 6002 x 19'					
		(47 to 28 ft below El. 6030)					
		2x L8x6x3/4 x 19'-9" ASTM A36					
		Wt = 1350 lb					
		2x L8x6x3/4 x 18'-9" ASTM A36					
		Wt = 1300 lb					
		2x L8x6x3/4 x 17'-9" ASTM A36					
		Wt = 1200 lb					
		2x L8x6x3/4 x 14'-9" ASTM A36					
		Wt = 1000 lb					
		This is installation only					
8120-5New-002		**Structural Steel**	86-68120	1	LS	$520,000.00	$520,000.00
		Assumed Shop fabricated, and able to be		[Note: Duplicate Quantities on 8420 sheets.]			
		lowered into position underwater with SWS hoist					
		Upper Shutter Gate (100A, 100B, 100C)(3 total) (replace in kind)					
		see Dwgs. (591M-D-79-81 through 591M-D-79-85)					
		Overall dimensions (ea.): 23'-6" x 30'-0"					
		ASTM A36 steel					
		Approximate wt (ea.) = 60,000 lb					
		Lower Shutter Gate (69A) (replace in kind)					
		see Dwgs. (591M-D-79-66 through 591M-D-79-80)					
		Overall dimensions: 23'-6" x 30'-0"					
		ASTM A36 Steel					
		Approximate wt = 15,500 lb					
		ASTM A572 Steel					
		Approximate wt = 14,000 lb					
		ASTM A304 Stainless Steel					
		Approximate wt = 500 lb					
		SUBTOTAL THIS SHEET					**$520,000.00**

QUANTITIES		**PRICES**	
BY	**CHECKED**	**BY**	**CHECKED**
L. Orgren	C. Gemperline	Matthew Shaw	Christopher Florence
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
12/09/24	M. Shepherd, P.E. 3/5/2025	04/10/25	Brendan Ahern, P.E.

FEATURE: Flaming Gorge SWS Feasibility Design

PROJECT: Colorado River Storage Project, Utah-Wyoming

WOID:	FGSFS	**ESTIMATE LEVEL:**	FEASIBILITY
REGION:	UC	**UNIT PRICE LEVEL:**	Jan-25

FILE: \\Bor\DO\TSC\Jobs\UC\Flaming Gorge Dam\2020-PDC-Repair and Upgrade Selective Withdrawal\FEAS\EST\8170\FinalEst\[Flaming Gorge SWS Feasibility.xlsx]8120-6New

Group: 86-68120

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Structural Steel (Cont'd)	86-68120	[Note: see previous sheet]			
		SWS Hoist Frame (replace in kind)					
		see Dwgs. (591M-D-79-1 through 591-D-79-30)					
		ASTM A36 Steel					
		Approximate wt = 10,500 lb					
		SUBTOTAL THIS SHEET					

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
L. Orgren	C. Gemperline	Matthew Shaw	Christopher Florence
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
12/09/24	M. Shepherd, P.E. 3/5/2025	04/10/25	Brendan Ahern, P.E.

FEATURE: Flaming Gorge SWS Feasibility Design
SWS Gates

Group No: 86-68420 Mechanical Structures

PROJECT: Colorado River Storage Project, Utah-Wyoming

WOID:	**FGSFS**	**ESTIMATE LEVEL:**	**FEASIBILITY**
REGION:	**UC**	**UNIT PRICE LEVEL:**	**Jan-25**

FILE: \\Bor\DO\TSC\Jobs\UC\Flaming Gorge Dam\2020-PDC-Repair and Upgrade Selective Withdrawal\FEAS\EST\8170\FinalEst\[Flaming Gorge SWS Feasibility.xlsx]8420-1

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Remove and Dispose					
8420-1-001		Lower shutter gate approx 20' x 30'	86-68420	29,000	LB		
		approximately 29,000 lb, Qty: 1		[Note: Duplicate Quantities on 8410 sheets.]			
8420-1-002		Upper Shutter Gate, approx 20' x 30'	86-68420	59,200	LB		
		approximately 29,600 lb ea, Qty: 2		[Note: Duplicate Quantities on 8410 sheets.]			
		Assumptions:					
		1. Gate disposal quanities is subject to change					
		due to existing Gate conditions.					
		2. Assume that gates are all one piece. And require					
		no additional leaf assembly on site besides installation.					
		3. No hazmat coatings on existing gates.					
		4. Upper shutter gate is made of three gate leafs.					
		5. One gate leaf has fallen below the SWS structure					
		and cannot be recoved for disposal.					
		Furnish and Install					
8420-1-003		SWS Lower Shutter Gate	86-68420	29,000	LB	$150.00	$4,350,000.00
		ASTM A36 structural steel, fabricated, welded					
		coated; Qty 1, 23'x30', 29,000 lb ea; includes					
		fasteners and lifting points					
8420-1-004		SWS Upper Shutter Gate	86-68420	88,800	LB	$150.00	$13,320,000.00
		ASTM A36 structural steel, fabricated, welded					
		coated; Qty 3, 23'-5" x30', 29,600 lb ea; includes					
		fasteners and lifting points					
		SUBTOTAL THIS SHEET					**$17,670,000.00**

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
Maggie Faustin	Zac Cepak, P.E.	Matthew Shaw	Christopher Florence
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
02/03/25	Ryan Stephen, P.E.	04/10/25	Brendan Ahern, P.E.

FEATURE: Flaming Gorge SWS Feasibility Design
Hoist Machinery

Group: 86-68420

PROJECT: Colorado River Storage Project, Utah-Wyoming

WOID:	**FGSFS**	**ESTIMATE LEVEL:**	**FEASIBILITY**
REGION:	**UC**	**UNIT PRICE LEVEL:**	**Jan-25**

FILE: \\Bor\DO\TSC\Jobs\UC\Flaming Gorge Dam\2020-PDC-Repair and Upgrade Selective Withdrawal\FEAS\EST\8170\FinalEst\[Flaming Gorge SWS Feasibility.xlsx]8420-2

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Remove and Dispose					
8420-2-001		Shutter Gate Hoist	86-68420	1	LS	$135,000.00	$135,000.00
		Hoist Actuator					
		Electric Motor					
		Dresser Model 7A-85013 OH					
		Helical Gear Reducer					
		Dresser Model 723A-G213D					
		Brake					
		Dings Dynamics Model MR72025-4					
		Approx. Weight: 220 lbs.					
		Worm Gear Reducer					
		Cone Drive Model HU-80000-AM					
		Approx. Weight: 3360 lbs.					
		Gear Reducer					
		See dwg. 591M-D-79-3 (Part Nos. 1-27, 32-34, & 60-76)					
		Approx. Weight: 3975 lbs.					
		Qty. 2					
		Wire Rope Drum					
		Pitch diameter: 37.5 inches					
		Material: A36 Structural Steel					
		Approx. Weight: 5800 lbs.					
		Qty. 2					
		Wire Rope					
		Diameter: 1.25 inches					
		Construction: 6x19 Stainless steel					
		Length: 162.5 feet					
		Approx. Weight: 925 lbs.					
		Qty. 2					
		Ancillary gears, bearings, shafts, guards, shims, links, switches, encoders, nuts, bolts, washers, etc.					
		Total Hoist Equipment Weight: approx. 26000 lbs					
		Assume coatings contain heavy metals					
		Assume electrical wiring contains asbestos					
		SUBTOTAL THIS SHEET					**$135,000.00**

QUANTITIES		**PRICES**	
BY	**CHECKED**	**BY**	**CHECKED**
M. Becker	Z. Cepak	Matthew Shaw	Christopher Florence
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
01/16/25	R. Stephen	04/10/25	Brendan Ahern, P.E.

FEATURE: Flaming Gorge SWS Feasibility Design
Hoist Machinery

Group: 86-68420

PROJECT: Colorado River Storage Project, Utah-Wyoming

WOID:	**FGSFS**	**ESTIMATE LEVEL:**	**FEASIBILITY**
REGION:	**UC**	**UNIT PRICE LEVEL:**	**Jan-25**
FILE:	\\Bor\DO\TSC\Jobs\UC\Flaming Gorge Dam\2020-PDC-Repair and Upgrade Selective Withdrawal\FEAS\EST\8170\FinalEst\[Flaming Gorge SWS Feasibility.xlsx]8420-3		

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Remove and Dispose					
8420-3-001		Lower Gate Hoist	86-68420	1	LS	$135,000.00	$135,000.00
		Hoist Actuator					
		Electric Motor					
		Dresser Model 7A-85012 OH					
		Helical Gear Reducer					
		Dresser Model 3T-49300					
		Brake					
		Dings Dynamics Model M4-63015-30					
		Approx. Weight: 264 lbs.					
		Worm Gear Reducer					
		Cone Drive Model HU-80000-AM					
		Approx. Weight: 3360 lbs.					
		Gear Reducer					
		See dwg. 591M-D-79-5 (Part Nos. 1-17, 20-23, 25-47, & 50-51)					
		Approx. Weight: 915 lbs.					
		Qty. 2					
		Wire Rope Drum					
		Pitch diameter: 30.625 inches					
		Material: A36 Structural Steel					
		Approx. Weight: 3500 lbs.					
		Qty. 2					
		Wire Rope					
		Diameter: 0.875 inches					
		Construction: 6x19 Stainless steel					
		Length: 210 feet					
		Approx. Weight: 550 lbs.					
		Qty. 2					
		Ancillary gears, bearings, shafts, guards, shims, links, switches, encoders, etc.					
		Total Hoist Equipment Weight: approx. 14400 lbs					
		Assume coatings contain heavy metals					
		Assume electrical wiring contains asbestos					
		SUBTOTAL THIS SHEET					**$135,000.00**

QUANTITIES		**PRICES**	
BY	**CHECKED**	**BY**	**CHECKED**
M. Becker	Z. Cepak	Matthew Shaw	Christopher Florence
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
01/16/25	R. Stephen	04/10/25	Brendan Ahern, P.E.

FEATURE: Flaming Gorge SWS Feasibility Design
Hoist Machinery

Group: 86-68420

PROJECT: Colorado River Storage Project, Utah-Wyoming

WOID:	**FGSFS**	**ESTIMATE LEVEL:**	**FEASIBILITY**
REGION:	**UC**	**UNIT PRICE LEVEL:**	**Jan-25**

FILE: \\Bor\DO\TSC\Jobs\UC\Flaming Gorge Dam\2020-PDC-Repair and Upgrade Selective Withdrawal\FEAS\EST\8170\FinalEst\[Flaming Gorge SWS Feasibility.xlsx]8420-4

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Remove and Dispose					
8420-4-001		Controller	86-68420	1	LS	$2,500,000.00	$2,500,000.00
		Control enclosure					
		Control panel with digital display					
		Disconnect switches					
		Associated electric wiring, fuses, breakers, terminals, etc.					
		Assume coatings contain heavy metals					
		Conduit from controller to hoist					
		SUBTOTAL THIS SHEET					**$2,500,000.00**

QUANTITIES		**PRICES**	
BY	**CHECKED**	**BY**	**CHECKED**
M. Becker	Z. Cepak	Matthew Shaw	Christopher Florence
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
01/16/25	R. Stephen	04/10/25	Brendan Ahern, P.E.

FEATURE: Flaming Gorge SWS Feasibility Design
Hoist Machinery

Group: 86-68420

PROJECT: Colorado River Storage Project, Utah-Wyoming

WOID:	FGSFS	**ESTIMATE LEVEL:**	FEASIBILITY
REGION:	UC	**UNIT PRICE LEVEL:**	Jan-25

FILE: \\Bor\DO\TSC\Jobs\UC\Flaming Gorge Dam\2020-PDC-Repair and Upgrade Selective Withdrawal\FEAS\EST\8170\FinalEst\[Flaming Gorge SWS Feasibility.xlsx]8420-5

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Furnish and Install					
	8420-5-001	Shutter Gate Hoist (Upper gates)	86-68420	1	LS	$260,000.00	$260,000.00
		Furnish, install and test hoist for the					
		shutter gate system					
		Hoist capacity: approx. 95,000 lbs					
		Gate travel speed approx. 1 - 2 fpm					
		Weight of hoist equip. = approx 26,000 lbs					
		Electrically-operated, wire rope-type , center-drive,					
		(2) Gear Drum Assembly					
		Total Reduction: 19.11:1					
		Wire rope drums - approx 37.5" diam, 51-inch grooved length					
		see dwg. 591M-D-79-3					
		(4) Wire ropes: 1.25" diam, 6x19, IWRC, Stainless steel					
		(approx 163 ft per rope with stainless steel speltered socket)					
		(2) Equalizing connection assembly					
		Electric Gear Motor					
		7.5 Hp, 1750 rpm, 480V, 3 Phase, 60 Hz, TENV					
		Continuous Duty					
		Reduction: 17:1					
		Motor Brake					
		Rated Torque: 25 ft*lbs					
		Worm gear reducer:					
		Reduction: 50:1					
		Output torque: 119,369 in-lbs.					
		Speed: 100 rpm					
		Provide steel supports for gearboxes and bearings					
		(4) Spherical roller-type pillow block bearings					
		(5) Double-engagement geared coupling					
		(2) Steel drive shafts: 2.9375" diam, 29" length					
		Instrumentation:					
		Rotary limit switch					
		Over-torque protection					
		SUBTOTAL THIS SHEET					**$260,000.00**

QUANTITIES		**PRICES**	
BY	**CHECKED**	**BY**	**CHECKED**
M. Becker	Z. Cepak	Matthew Shaw	Christopher Florence
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
01/16/25	R. Stephen	04/10/25	Brendan Ahern, P.E.

FEATURE: Flaming Gorge SWS Feasibility Design
Hoist Machinery

Group: 86-68420

PROJECT: Colorado River Storage Project, Utah-Wyoming

WOID:	**FGSFS**	**ESTIMATE LEVEL:**	**FEASIBILITY**
REGION:	**UC**	**UNIT PRICE LEVEL:**	**Jan-25**

FILE: \\Bor\DO\TSC\Jobs\UC\Flaming Gorge Dam\2020-PDC-Repair and Upgrade Selective Withdrawal\FEAS\EST\8170\FinalEst\[Flaming Gorge SWS Feasibility.xlsx]8420-6

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Furnish and Install					
8420-6-001		Lower Gate Hoist	86-68420	1	LS	$260,000.00	$260,000.00
		Furnish, install and test hoist for the					
		shutter gate system					
		Hoist capacity: approx. 41,000 lbs					
		Gate travel speed approx. 1 - 2 fpm					
		Weight of hoist equip. = approx 14,400 lbs					
		Electrically-operated, wire rope-type , center-drive,					
		(2) Gear Drum Assembly					
		Total Reduction:					
		Wire rope drum - approx 30.625" diam, 58.5-inch grooved length					
		see dwg. 591M-D-79-5					
		(4) Wire ropes: 0.875" diam, 6x19, IWRC, Stainless steel					
		(approx 210 ft per rope with stainless steel speltered socket)					
		(2) Equalizing connection assembly					
		Electric Gear Motor					
		5 Hp, 1725 rpm, 480V, 3 Phase, 60 Hz, TENV					
		Continuous Duty					
		Reduction: 47:1					
		Motor Brake					
		Rated Torque: 15 ft*lbs					
		Worm gear reducer:					
		Reduction: 50:1					
		Output torque: 119,369 in-lbs.					
		Speed: 100 rpm					
		Provide steel supports for gearboxes and bearings					
		(4) Spherical roller-type pillow block bearings					
		(5) Double-engagement geared coupling					
		Instrumentation:					
		Rotary limit switch					
		Over-torque protection					
		SUBTOTAL THIS SHEET					**$260,000.00**

QUANTITIES		**PRICES**	
BY	**CHECKED**	**BY**	**CHECKED**
M. Becker	Z. Cepak	Matthew Shaw	Christopher Florence
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
01/16/25	R. Stephen	04/10/25	Brendan Ahern, P.E.

FEATURE: Flaming Gorge SWS Feasibility Design
Hoist Machinery

PROJECT: Colorado River Storage Project, Utah-Wyoming

WOID:	FGSFS	**ESTIMATE LEVEL:**	FEASIBILITY
REGION:	UC	**UNIT PRICE LEVEL:**	Jan-25

FILE: \\Bor\DO\TSC\Jobs\UC\Flaming Gorge Dam\2020-PDC-Repair and Upgrade Selective Withdrawal\FEAS\EST\8170\FinalEst\[Flaming Gorge SWS Feasibility.xlsx]8420-7

Group: 86-68420

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Furnish and Install					
8420-7-001		Controller	86-68420	1	LS	$2,800,000.00	$2,800,000.00
		NEMA 250 Type 4X Enclosure					
		Programmable Automation Controller					
		Selector switch for individual hoist control					
		Momentary contact pushbuttons: UP/DOWN/STOP					
		Digital position indication display (ft. elevation)					
		Capable of remote operation					
		4-preset gate position automatic operation pushbuttons					
		(4) Power disconnect switches					
		Upper Gate					
		Lower Gate					
		Control Power					
		120 VAC Supply					
		Light switch for platform lighting.					
		Associated conduit and wiring from controller to each hoist					
		SUBTOTAL THIS SHEET					**$2,800,000.00**

QUANTITIES		**PRICES**	
BY	**CHECKED**	**BY**	**CHECKED**
M. Becker	Z. Cepak	Matthew Shaw	Christopher Florence
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
01/16/25	R. Stephen	04/10/25	Brendan Ahern, P.E.

FEATURE:	PROJECT:			
Flaming Gorge SWS Feasibility Design	Colorado River Storage Project, Utah-Wyoming			
	WOID:	FGSFS	ESTIMATE LEVEL:	FEASIBILITY
	REGION:	UC	UNIT PRICE LEVEL:	Jan-25
Summary Sheet	FILE:	\\Bor\DO\TSC\Jobs\UC\Flaming Gorge Dam\2020-PDC-Repair and Upgrade Selective Withdrawal\FEAS\EST\8170\FinalEst\[Flaming Gorge SWS Feasibility.xlsx]Summary		

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Subtotal (from 8120 Plant Structures previous sheets)					$5,338,000.00
		Subtotal (from 8420 Mechanical Structures previous sheets)					$23,760,000.00
		Subtotal					**$29,098,000.00**
		Mobilization	5%	+/-			$1,450,000.00
		Subtotal with Mobilization					**$30,548,000.00**
		Contract Cost Allowances (Sum of):	20%	+/-			$6,452,000.00
		Design Contingencies, 15 % (+/-)					
		APS, 5 % (+/-). Type of procurement: Request for Proposal					
		CONTRACT COST					**$37,000,000.00**
		Construction Contingencies	20%	+/-			$7,000,000.00
		FIELD COST (Unit Price Level Jan 2025)					**$44,000,000.00**
		Escalation to Notice to Proceed (NTP), from Unit Price Level (Jan 2025) to NTP (Jan 2029)					$8,000,000.00
		at	4.5%	per year for	4.00	years	
		FIELD COST (with Escalation to NTP, Price Level Jan 2029)					**$52,000,000.00**
		Non-Contract Costs	**To be determined by the appropriate responsible office (see Note below)**				
		FEATURE CONSTRUCTION COST	**To be determined by the appropriate responsible office (see Note below)**				
		Note: The Certified Cost Estimate Executive Summary (CCEES) Form is to be completed by the appropriate Reclamation o					
		if determined to be required. Reference Deputy Commissioner's 1/18/23 email regarding the CCEES requirement.					
		Ref.: For appropriate use and terminology, see Reclamation Manual, Directives and Standards FAC; 09-01, 09-02 and 09-03.					

QUANTITIES		PRICES	
BY	CHECKED	BY Matthew Shaw P.E. Digitally signed by MATTHEW SHAW Date: 2025.04.16 14:45:27 -06'00'	CHECKED CHRISTOPHER FLORENCE Digitally signed by CHRISTOPHER FLORENCE Date: 2025.04.16 14:38:49 -06'00'
Refer to previous sheets	Refer to previous sheets	Matthew Shaw	Christopher Florence
DATE PREPARED	PEER REVIEW / DATE	DATE PREPARED	PEER REVIEW / DATE
Refer to previous sheets	Refer to previous sheets	04/10/25	Brendan Ahern, P.E. BRENDAN AHERN Digitally signed by BRENDAN AHERN Date: 2025.04.17 10:14:27 -06'00'

US Army Corps of Engineers
St. Louis District®

Environmental Quality Section
1222 Spruce Street
St Louis Missouri 63103

PHASE I ENVIRONMENTAL SITE ASSESSMENT REPORT
CLARENCE CANNON DAM CAP 1135

PREPARED FOR:

The U.S. Army Corps of Engineers
St. Louis District
1222 Spruce Steet
St. Louis, Missouri 63103

January 28, 2026

Page Left Intentionally Blank

Table of Contents

1.0 ABBREVIATIONS 4
2.0 ACKNOWLEDGEMENTS AND QUALIFICATIONS 5
3.0 EXECUTIVE SUMMARY 6
4.0 INTRODUCTION 7
4.1 Background 7
4.2 Scope of Work 7
5.0 GENERAL PROJECT AND SITE INFORMATION 7
5.1 Project Description 8
5.2 Physical Site Description 11
5.3 Historical and Current Land Use 12
5.4 Adjoining Property Use 12
6.0 PHASE I ENVIRONMENTAL SITE ASSESSMENT DUE DILIGENCE 12
6.1 Interview(s) with Past and Present Owners, Operators, and Occupants 12
6.2 Interview(s) with State and/or Local Government Officials 13
6.3 Site Reconnaissance 13
6.4 Records Review 13
7.0 NON-SCOPE SERVICES 14
7.1 NONE 14
8.0 SUMMARY OF FINDINGS 14
9.0 OPINION OF THE ENVIRONMENTAL PROFESSIONAL 15
10.0 CONCLUSIONS 15
11.0 DEVIATIONS 16
12.0 LIMITATIONS AND EXCEPTIONS 16
13.0 REFERENCES 18
14.0 TABLE OF REFERENCED FIGURES 19
15.0 PHOTOGRAPHS 20
SUPPLEMENTARY MATERIALS A: INTERVIEW QUESTIONNAIRE 43
SUPPLEMENTARY MATERIALS B: RECORDS REVIEW 52
SUPPLEMENTARY MATERIALS C: CORRESPONDENCE 53

1.0 ABBREVIATIONS

ABV	Description
AAI	All Appropriate Inquiry
ATSM	American Society for Testing and Materials
CAP	Continuing Authorities Program
CEMVS	Corps of Engineers St. Louis District Environmental Quality Section U.S. Army Corps of Engineers, Environmental Quality and HTRW Section,
EC-EQ	Environmental and Munitions Branch
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CCD	Clarence Cannon Dam
DOD	Department of Defense
EMF	Electromotive force
ES	Enforcement Standard
EPA	Environmental Protection Agency
ER	Engineering Regulation
ERIS	Environmental Risk Information Services
ERNS	Emergency Response Notification System
ESA	Environmental Site Assessment
HTRW	Hazardous Toxic Radioactive Waste
IEPA	Illinois Environmental Protection Agency
LUST	Leaking Underground Storage Tank
MDC	Missouri Department of Conservation
MoDNR	Missouri Department of Natural Resources
MVS	St. Louis District
NFRAP	No Further Remedial Action Planned
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
PCB	Polychlorinated Biphenyl
PDT	Project Delivery Team
RCEM	Randolph County Emergency Management Agency
RCRA	Resource Conservation and Recovery Act
REC	Recognized Environmental Condition
TSD	Treatment, Storage, and Disposal Facilities
TSP	Tentatively Selected Plan
USACE	United States Army Corps of Engineers
UST	Underground Storage Tank

2.0 ACKNOWLEDGEMENTS AND QUALIFICATIONS

Project Name: Clarence Cannon Dam CAP 1135

Site Information: Located at Mark Twain Lake, MO

County: Ralls County, Missouri

Latitude, Longitude: 39.523778° N, -91.645144° W

Site Assessor:

GREELING.BENJAMIN.ANTHONY.1384561124
Digitally signed by GREELING.BENJAMIN.ANTHONY.1384561124
Date: 2026.01.28 09:41:18 -06'00'

Benjamin A Greeling
Environmental Specialist

Environmental Professional Qualification:

I declare that, to the best of my professional knowledge and belief, I meet the definition of Environmental Professional as defined in 40 CFR 312.10.

I have the specific qualifications based on education, training, and experience to assess a property of the nature, history, and setting of the subject property. I have developed and performed the all appropriate inquiries in conformance with the standards and practices set forth in 40 CFR Part 312.

HENRY.MICHAEL.L.1058591684
Digitally signed by HENRY.MICHAEL.L.1058591684
Date: 2026.01.28 10:45:32 -06'00'

Michael L Henry
Senior Reviewer
Industrial Hygienist

3.0 EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers regulations (ER-1165-2-132, ER 200-2-3) and Division policy requires procedures be established to facilitate early identification and appropriate consideration of potential HTRW in reconnaissance, feasibility, preconstruction engineering and design, land acquisition, construction, operations and maintenance, repairs, replacement, and rehabilitation phases of water resources studies or projects by conducting a Phase I Environmental Site Assessment (ESA). USACE specifies that these assessments follow the process/standard practices for conducting a Phase I ESA published by the American Society for Testing and Materials (ASTM).

The purpose of a Phase I ESA is to identify, to the extent feasible in the absence of sampling and analysis, the range of contaminants (i.e. Recognized Environmental Conditions, RECs) within the scope of the U.S. Environmental Protection Agency's (EPA) Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and petroleum products. Current policy is to avoid known HTRW to the extent practicable or until hazard risks and potential liability are mitigated.

A Phase I ESA has been conducted for the Clarence Cannon Dam (CCD) Continuing Authorities Program (CAP) 1135 project using methods outlined by ASTM E1527-21. This included a records review, physical site visit, and communications with persons knowledgeable of the project footprint and adjoining properties. This assessment has revealed no RECs in connection with the subject property. The subject property contains no major sites of interest that would impact the project's design, cost, or schedule. The environmental impact for the migration of off-site contaminants onto the Project Area is negligible, a Phase II ESA is currently not recommended. It is however recommended that a Site Health and Safety Plan, and a Quality Control Plan are submitted by the awarded contractor, discussed internally by USACE personnel, and implemented to prevent environmental hazards from being developed during construction. The U.S. Army Corps of Engineers, Environmental Quality and HTRW Section, Environmental and Munitions Branch (CEMVS EC-EQ) should be contacted immediately if future development of the property discovers hazardous or toxic materials.

4.0 INTRODUCTION

4.1 Background

The purpose of this Environmental Site Assessment (ESA) was to evaluate the current and historical conditions of the subject property in an effort to identify Recognized Environmental Conditions (RECs) in connection with the subject property and surrounding operations. RECs are defined as the presence or likely presence of any hazardous substances or petroleum products in, on, or at a property: (1) due to release to the environment; (2) under conditions indicative of a release to the environment; or (3) under conditions that pose a material threat of a future release to the environment. *De minimis* conditions are not recognized environmental conditions.

4.2 Scope of Work

A Phase I ESA was conducted at the subject property in accordance with ASTM Standards Practice E 1527-21, and further defined below:

- USACE has engaged with individuals having institutional knowledge of the subject properties to discuss environmental conditions. Documented conversations and questionnaires are available in Supplementary Materials A and C.

- USACE has physically inspected the subject property via walking survey, looking for signs of recognized environmental conditions such as stressed vegetation, soil staining, dumping, and evidence of aboveground and underground storage tanks. Photo documentation for the site visit is available in Section 15.

- USACE has gathered and reviewed available Federal, State, and tribal environmental records. Standard environmental records reviewed included Federal National Priority List NPL; Federal and State Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS); Federal and State institutional controls/engineering controls registries; Federal Emergency Response Notification System (ERNS) list; State and tribal landfill and/or disposal site lists; State and tribal leaking storage tank lists; State and tribal registered storage tank lists; State and tribal voluntary cleanup sites; and State Brownfield sites. Details from the standard environmental records review are available in Supplementary Materials B.

- USACE has physically observed adjoining properties, paying particular attention to evidence of aboveground and underground storage tanks, questionable housekeeping practices, or unusual business practices.

5.0 GENERAL PROJECT AND SITE INFORMATION

5.1 Project Description

Mark Twain Lake is located in northeastern Missouri on the Salt River in the Salt River Basin. Mark Twain Lake spans both Ralls and Monroe Counties, is located approximately 20 miles southwest of Hannibal, MO and 140 miles north of St. Louis, MO. CCD and its associated re-regulation dam are located in Ralls County, MO, upstream from the confluence with the Mississippi River at river miles (RM) 63.0 and 53.5, respectively. Figure 1 shows the site in relation to St Louis.

CCD and Mark Twain Lake are owned by the federal government and operated by the District's Hydrology and Hydraulics Branch. It is one of Missouri's largest lakes, consisting of 18,600 surface acres of water at normal pool and over 36,000 acres of land, totaling approximately 54,700 acres. There are 500 campsites, 17 boat ramps, two marinas, over 40 miles of trails, the M.W. Boudreaux Memorial Visitor Center, and Mark Twain State Park. Mark Twain Lake is known for its fishing resources and is frequented by sport fisherman and tourists who visit the area for fishing tournaments, camping, festivals, etc.

The Temperature Control Weir (TCW) (Figures 2 & 3), approximately 780 feet long and consisting of rolled earth embankment, gabion baskets, and concrete capstones is located approximately 400 feet upstream of the main dam with a crest elevation of 580 feet. The invert elevation of the intake structure is 520 feet. The TCW acts as a skimming weir, which allows warmer oxygenated water to be released through the turbines during periods of lake stratification; however, when the lake's water level is high, cooler, poorly oxygenated water passes through the turbines and into the re-regulation pool during power generation. During periods of non-generation at this elevation, low oxygenated water fills the forebay between the TCW and main dam. This water leaks through the wicket gates into the re-regulation pool. Upon initiation of hydropower generation, this poor-quality water is flushed downstream below the dam and into the regulation pool.

A feasibility study was conducted by USACE under the CAP, Section 1135 Authority. Section 1135 of the Water Resources Development Act of 1986, as amended, provides the United States Army Corps of Engineers (USACE) authority to modify existing USACE projects to restore the environment and construct new projects to restore areas degraded by USACE projects. A project is accepted for construction after a detailed investigation shows it is technically feasible, environmentally acceptable, and economically efficient. The study was conducted on the CCD at Mark Twain Lake, located in Ralls and Monroe Counties, Missouri, in partnership with the Missouri Department of Conservation (MDC) as the non-Federal sponsor (NFS). If constructed, total project costs would be shared 75% federal and 25% non-federal. MDC, as the NFS, provided a letter confirming its support of the project.

The CAP project purpose is to reduce regular occurrences of dissolved oxygen (DO) measuring below 5 mg/L to reduce stress on fish species and decrease the frequency and size of fish mortality events within the study area. A project is needed here because

without federal action, poorly oxygenated water will continue to move through the hydropower turbines into the re-regulation pool, leading to low DO levels, fish mortality events, and ecosystem disruption downstream of the dam. This project is focused on ecosystem restoration through the improvement of DO levels. An additional benefit of improving DO conditions is that more water may become available for peaking hydropower because dam operators would no longer need to spill water as often to mitigate low DO. The USACE Project Delivery Team's (PDT) Tentatively Selected Plan (TSP) includes raising the weir by placing rock to an elevation of 585 feet.

Low DO at the study site is partially driven by three-layered temperature stratification from late spring and early fall that occurs behind the TCW located upstream of the main CCD. The upper layer is highly biologically productive with DO levels sufficient to sustain aquatic life. The middle layer contains a horizontal plane with the greatest water temperature change. The lowest layer consists of cold, dense water with DO levels as low as 0 mg/L. DO levels steadily drop over the course of the summer as stratification becomes stronger. When power generation is initiated, low DO water travels through the turbines and enters the re-regulation pool.

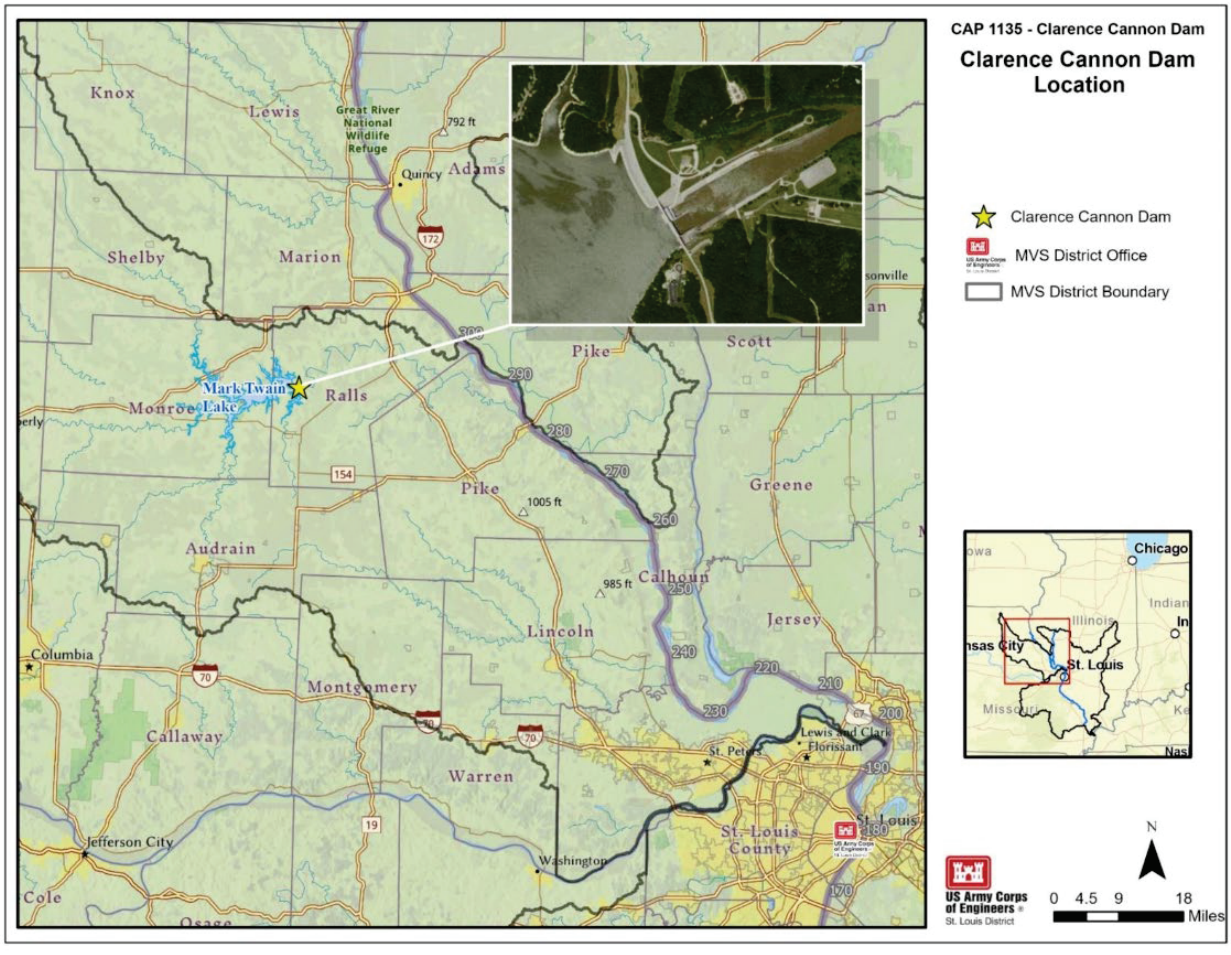


Figure 1. Project Study Area.

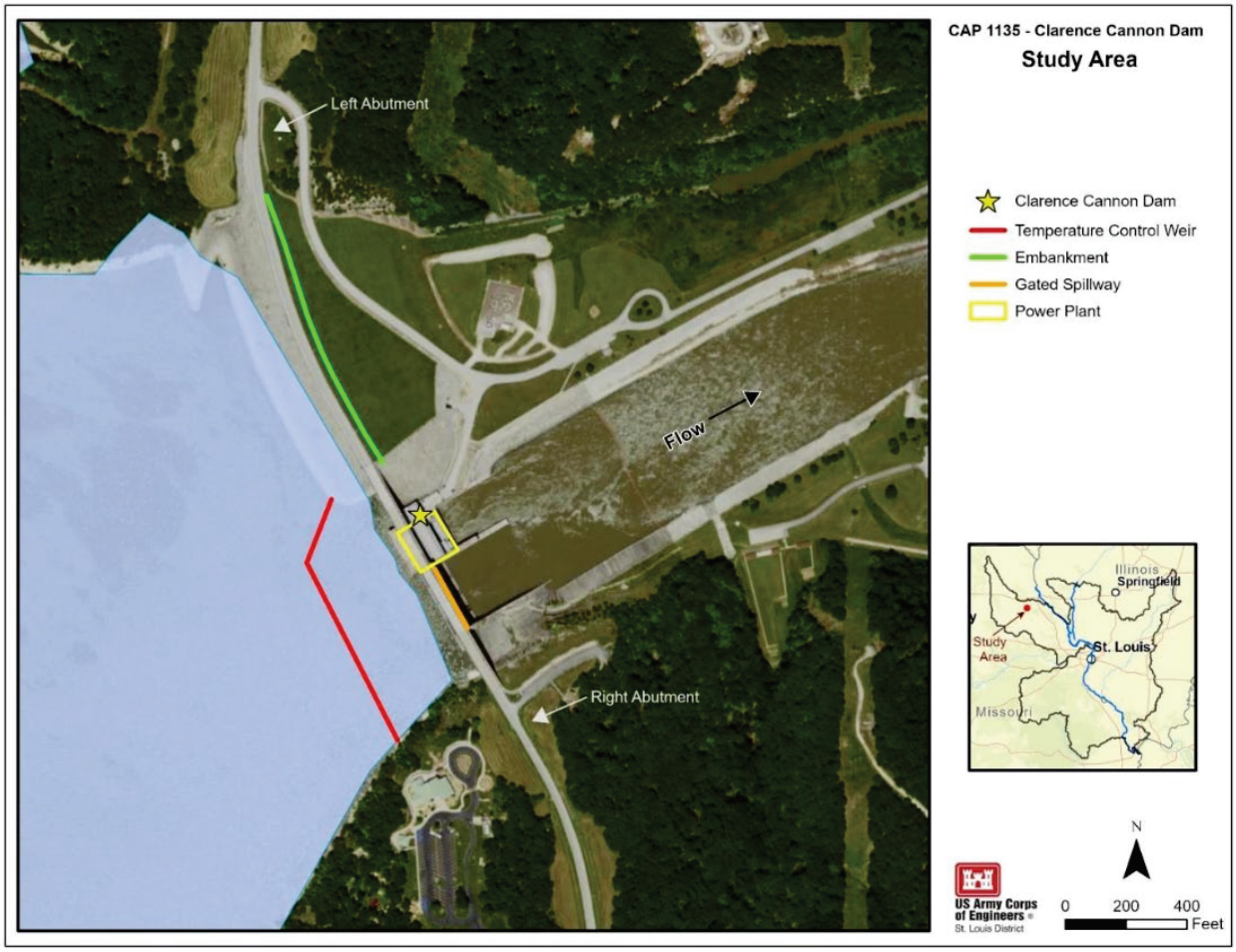


Figure 2. CAP Study Area with Temperature Control Weir.

Figure 3. Photograph during CCD and weir construction.

5.2 Physical Site Description

The physical components of the project include CCD and its associated features: the hydroelectric power plant, water temperature control weir (TCW), and re-regulation dam. Figures 2 and 3 show the features of the main CCD. State Highway J crosses over the top of the dam. The dam is 1,940 feet long with its centerline running in a near north-south direction. The concrete portion of the dam is 846 feet long and borders the valley's southern rim. The earthen portion is 1,094 feet long and borders the northern side of the basin. The dam has two hydropower units capable of producing 58,000 kilowatts of electricity collectively. A second dam, the re-regulation dam, is located about 9.5 miles downstream of the main dam and impounds water for storage and to control downstream release volumes and intensities.

Mark Twain Lake exists on the upstream (southwest) side of CCD while the Salt River re-regulation pool is located on the downstream (northeast) side of the dam. Immediately downstream of the dam on the left descending bank (LDB) is an access road, power transfer station, dam instrumentation, comfort station (pit-vault toilet),

parking lots, and recreational area used for fishing. Similarly, the following are located immediately downstream of the dam on the right descending bank (RDB): access road, parking lots, viewing area, gun range, comfort station, boat ramp, fairgrounds area, and pavilions.

5.3 Historical and Current Land Use

The Flood Control Act of 28 June 1938 authorized a dam and reservoir on the Salt River as part of a general comprehensive plan for flood control in the Upper Mississippi River Basin. A restudy of the project indicated the feasibility of a multi-purpose development that included hydroelectric power. The project was authorized by Section 203 of the Flood Control Act of 23 October 1962 (Public Law (PL) 87-874), as recommended by the Chief of Engineers in House Document No. 507, 87th Congress, 2nd Session. The construction of Mark Twain Lake and CCD began in 1970 and was completed in 1983. Construction was completed in three phases. Phase 1, from 1970 to 1973, consisted of preparation of the foundation. Phase II, from 1973 to 1978, consisted of the construction of the concrete section, earthen embankment, spillway, power plant substructure, and downstream works. Phase III, from 1978 to 1983, consisted of the construction of the power plant superstructure and installation of turbines, generators, and related equipment.

The reservoir, originally named the Joanna Reservoir, was officially renamed CCD and Reservoir by Public Law 89-298, 89th Congress, 3rd Session on 27 October 1965. CCD and Reservoir was officially renamed CCD and Mark Twain Lake by PL 97-128, 97th Congress, 29 December 1981. The authorized purposes of Mark Twain Lake are flood risk management in the Salt River Basin, hydroelectric power generation, water supply, fish and wildlife conservation, recreation, and incidental navigation.

5.4 Adjoining Property Use

USACE owns CCD and Mark Twain Lake which includes a significant portion of land adjacent to the water's edge. The USACE property encompasses the immediate vicinity around CCD. There is a mix of residential and agricultural properties downstream of CCD and along the re-regulation pool.

6.0 PHASE I ENVIRONMENTAL SITE ASSESSMENT DUE DILIGENCE

6.1 Interview(s) with Past and Present Owners, Operators, and Occupants

A questionnaire was sent to Mr. Allen Mehrer, the current USACE operations manager of Mark Twain Lake on December 31, 2025. A questionnaire was sent to Mr. Michael Henry, the USACE Industrial Hygienist Regional Technical Expert (IH RTE) and HTRW point of contact on December 31, 2025. The content of the questions asked followed the format of ASTM 1527-21. Relevant information discovered during the interview is summarized in Supplementary Materials A. Email correspondence is located in Supplementary Materials C.

6.2 Interview(s) with State and/or Local Government Officials

The Ralls County Emergency Management Agency was contacted via email on December 31, 2025. No response has been received as of the completion of this report.

6.3 Site Reconnaissance

On January 14, 2026, Environmental Specialist Mr. Ben Greeling of USACE Environmental Quality performed a site visit for the CCD project area. During the site visit no RECs were observed. Mr. Greeling met with project staff Mr. Deric Bishop and Ms. Gretta Simon at the Mark Twain Lake project office. Gretta escorted Ben through the service road entrance to the area immediately north of the earthen part of the dam (known as Frank Russell Staging Area) where the site was visually assessed. Photographs were taken periodically throughout this area and include the road intersection, open area adjacent to Highway J, rock pile, buoys, forest, and potential boat ramp on the western edge. The remainder of the site visit was conducted by Ben Greeling without escort and occurred as follows.

1. Downstream side of the earthen dam including the powerhouse, transfer station, and recreation area.
2. Downstream side of the concrete portion of the dam at the overlook parking lot on the RDB.
3. Upstream side of the dam at the MW Boudreaux Memorial Visitor Center overlook.
4. Ray Behrens recreation area upper boat trailer parking lot (including comfort station), access road, and boat ramp.

6.4 Records Review

Table 1 provides a list of records reviewed by the Environmental Professional for this assessment, as summarized in the radius map report. These records assist in meeting the requirements of EPA's Standards and Practices for All Appropriate Inquiry (AAI; 40 CFR Part 312), and the ASTM Standard Practice for Environmental Site Assessments (ASTM E1527-21). In addition, the physical setting was assessed for the project area by reviewing topographic maps to identify conditions in which hazardous substances or petroleum products could migrate. Additional details can be reviewed in Supplemental Materials B. The records review revealed no RECs.

Table 1: Government Records Reviewed

Standard Environmental Record Resources Provided by ERIS	Search Distance miles (kilometers)
Federal NPL (Superfund) sites	1.0 (1.6)
Federal Delisted NPL sites	1.0 (1.6)
Federal sites subject to CERCLA removals and CERCLA orders	0.5 (0.8)

Federal CERCLA sites with NFRAP	0.5 (0.8)
Federal RCRA facilities undergoing Corrective Action	1.0 (1.6)
Federal RCRA TSD facilities	0.5 (0.8)
Federal RCRA generators	Target property and adjoining properties
Federal institutional control/engineering control registries	0.5 (0.8)
Federal ERNS list	Target Property Only
State and tribal “Superfund” equivalent sites	1.0 (1.6)
State and tribal hazardous waste facilities	0.5 (0.8)
State and tribal landfills and solid waste disposal facilities	0.5 (0.8)
State and tribal leaking storage tanks	0.5 (0.8)
State and tribal registered storage tanks	Target property and adjoining properties
State and tribal institutional control/engineering control registries	0.5 (0.8)
State and tribal voluntary cleanup sites	0.5 (0.8)
State and tribal brownfield sites	0.5(0.8)

7.0 NON-SCOPE SERVICES

7.1 NONE

Non-scope services are issues or conditions to be addressed that are outside of the ASTM 1527-21 standard requirements. Much of the information provided in the interview with the IH, Mr. Henry, are non-scope and include IH, lead-based paint, asbestos-containing building materials, and health and safety items. These non-scope items have no impacts to the project.

8.0 SUMMARY OF FINDINGS

A records review, site reconnaissance, and interviews with knowledgeable persons identified no RECs near or within the subject property. Findings of this effort are summarized below.

The records review, in addition to the sources listed in Table 1, included available aerial photographs, environmental liens, historical topographic maps, city directory, Sanborn maps, and tax maps. The radius map report identified two sites, both of which belong to the USACE Mark Twain Lake Project Office; 1) E Manifest, 2) RCRA VSQG (Conditionally Exempt Small Quantity Generator). All records were reviewed and no RECs were identified. Though not considered significant, a data gap exists in the aerial photographs due to the absence of any photography available during the construction of CCD.

The site reconnaissance consisted of a visual inspection and photography of available areas at and around CCD. No RECs were identified. The interior of the dam and powerhouse was not accessed during this site visit. This is not considered a significant data gap as any potential environmental concern is captured in interviews with knowledgeable persons and records review.

Interviews conducted with knowledgeable persons followed the format of ASTM 1527-21 and can be viewed Supplementary Materials A. No RECs were identified. The interview with the USACE operations manager of Mark Twain Lake, Mr. Allen Mehrer, revealed typical pesticide use of recreational areas, non-PCB transformers, and two pipelines downstream of CCD. The National Pipeline Mapping System (NPMS) was accessed on January 27, 2026 to review the documented pipelines. That review revealed one hazardous liquid pipeline which crosses under the re-regulation pool approximately 1.2 miles downstream of CCD, three additional pipeline crossings downstream of the re-regulation dam, and pipeline crossings upstream of the lake in all major tributaries.

The USACE IH RTE and HTRW point of contact, Mr. Michael Henry, was interviewed. Mr. Henry works in the Environmental Quality Section of the St. Louis USACE and provided the following additional information. Mr. Henry provided a list of potential environmental concerns and non-scope items generated by the operations and maintenance of CCD according to internal environmental records. His general response is summarized thusly. “In my professional opinion - all historic and present potential RECs have been/are being managed in such a manner that they have either been mitigated, or are being managed in such a way that they are considered a de-minimus risk not impacting the proposed CAP.”

9.0 OPINION OF THE ENVIRONMENTAL PROFESSIONAL

No RECs were identified for this effort. All historical potential RECs and non-scope items referred to by Mr. Henry have been managed or are being managed in such a way that there is no environmental concern. Information provided by Mr. Allen and all other sources has revealed no environmental concerns. Based on the data and resources available for this assessment, it is the Environmental Professional’s opinion that the subject property contains no major sites of interest that would impact the project’s design, cost, or schedule. The environmental impact for the migration of off-site contaminants onto the Project Area is negligible, a Phase II ESA is currently not recommended.

10.0 CONCLUSIONS

A Phase I ESA has been performed in conformance with the scope and limitations of ASTM E1527-21 on CCD, the subject property. Any exceptions to, or deletions from, this practice are described in Section 11 of this report. This assessment has revealed no RECs or significant data gaps in connection with the subject property. The subject property contains no major sites of interest that would impact the project’s design, cost, or schedule. The environmental impact for the migration of off-site

contaminants onto the Project Area is negligible, a Phase II ESA is currently not recommended.

The CEMVS-EC-EQ should be contacted with any known or suspected variations from the conditions described herein. If future development of the properties indicates the presence of hazardous or toxic materials, CEMVS-EC-EQ should be notified.

11.0 DEVIATIONS

There are no deviations from the ASTM method used for this Phase I.

12.0 LIMITATIONS AND EXCEPTIONS

The observations, measurements, and research reported herein are considered sufficient in detail and scope to form a reasonable basis for a limited Phase I ESA of the subject property (ASTM E1527-21). The assessment, conclusions, and recommendations presented herein are based upon the subjective evaluation of limited data. The data may not represent all conditions at the subject site, as they reflect the information gathered from specific locations. The limitations of this assessment should be recognized as the client formulates conclusions on the environmental risks associated with these properties.

CEMVS-EC-EQ should be contacted with any known or suspected variations from the conditions described herein. If future development of the property indicates the presence of hazardous or toxic materials, USACE should be notified to perform a re-evaluation of the environmental conditions.

The scope of this assessment did not include any additional environmental investigation, not outlined herein, or analyses for the presence or absence of hazardous or toxic materials in the soil, ground water, surface water, or air, in, on, under, or above the subject tract.

This site assessment was performed in accordance with generally accepted practices of consultants undertaking similar studies at the same time and in the same geographical area, and USACE observed that degree of care and skill generally exercised by consultants under similar circumstances and conditions. The findings and conclusions stated herein must be considered not as scientific certainties, but rather as professional opinions concerning the significance of the limited data gathered during the course of the environmental site assessment. No other warranty, expressed or implied, is made.

Specifically, USACE does not and cannot represent that the site contains no hazardous waste or material, oil (including petroleum products), or other latent condition beyond that observed by USACE during its site assessment.

The observations described in this report were made under the conditions stated herein. The conclusions presented in the report were based solely upon the services described therein, and not on scientific tasks or procedure beyond the scope of described services or the time and budgetary constraints imposed by the client. Furthermore, such

conclusions are based solely on site conditions and rules and regulations, which were in effect at the time of the study.

In preparing this report, USACE relied on certain information provided by State and local officials and other parties referenced herein, and on information contained in the files of State and/or local agencies available to USACE at the time of the site assessment. Although there may have been some degree of overlap in the information provided by these various sources, an attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this site assessment was not made.

Observations were made of the site and of structures on the site as indicated within the report. Where access to portions of the site or to structures on the site was unavailable or limited, USACE renders no opinion as to the presence of indirect evidence relating to hazardous waste, material, oil, or other petroleum products in that portion of the site or structure. In addition, USACE renders no opinion as to the presence of hazardous waste or material, oil, or other petroleum products or to the presence of indirect evidence relating to hazardous material, oil, or petroleum products where direct observation of the interior walls, floor, roof, or ceiling of a structure on a site was obstructed by objects or coverings on or over these surfaces.

Unless otherwise specified in the report, USACE did not perform testing or analyses to determine the presence or concentration of asbestos, radon, formaldehyde, lead-based paint, lead in drinking water, electromagnetic fields (EMFs), or polychlorinated biphenyls (PCBs) at the site or in the environment at the site. These items fall under non-scope services as described in Section 7.1.

The purpose of this report is to assess the physical characteristics of the subject site with respect to the presence of hazardous waste, material, oil, or petroleum products in the environment. Except as otherwise described in this report, no specific attempt was made to check on the compliance of present or past owners or operators of the site with Federal, State, or local laws and regulations, environmental or otherwise.

Personnel from CEMVS-EC-EQ have specific qualifications based on education, training, and experience to assess a property of the nature, history, and setting of the subject property and declare that, to the best of their professional knowledge and belief, meet the definitions of Environmental Professionals as defined under 40 CFR 312.

13.0 REFERENCES

ASTM, 2021. 1527-21 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process.

ASTM, 2023. E2247-23 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process for Forestland or Rural Property.

USACE, 1992. ER 1165-2-132 Hazardous Toxic and Radioactive Waste Guidance for Civil Works Projects, Washington DC: Department of the Army.

USACE, 2010. ER 200-2-3 *Environmental Compliance Policies,* Washington D. C.: Department of the Army.

USEPA, 2005. 40 CFR 312: Innocent Landowners, Standards for Conducting All Appropriate Inquiries. *Code of Federal Regulations.*

14.0 TABLE OF REFERENCED FIGURES

Figure 1: Project Study Area……..8

Figure 2: CAP Study Area…….……..…….9

Figure 3: Construction photo of CCD and weir…….……10

Figures 4-13: Frank Russell Staging Area……..……...22-31

Figures 14-17: North Spillway……..……..……..…….32-35

Figures 18-19: South Spillway……...…….……..….36-37

Figure 20: Overlook M.W. Boudreaux Memorial Visitor Center……..……...38

Figures 21-23: Ray Behrens Parking Lot…….……....39-41

Figure 23: Access to Ray Behrens Boat Ramp…….……41

Figures 24-25: Ray Behrens Boat Ramp…….…….42-43

15.0 PHOTOGRAPHS

All photographs in this section were taken during the site visit on January 14, 2026.

Figure 4: Intersection of Highway J and entrance to Frank Russell Staging Area.

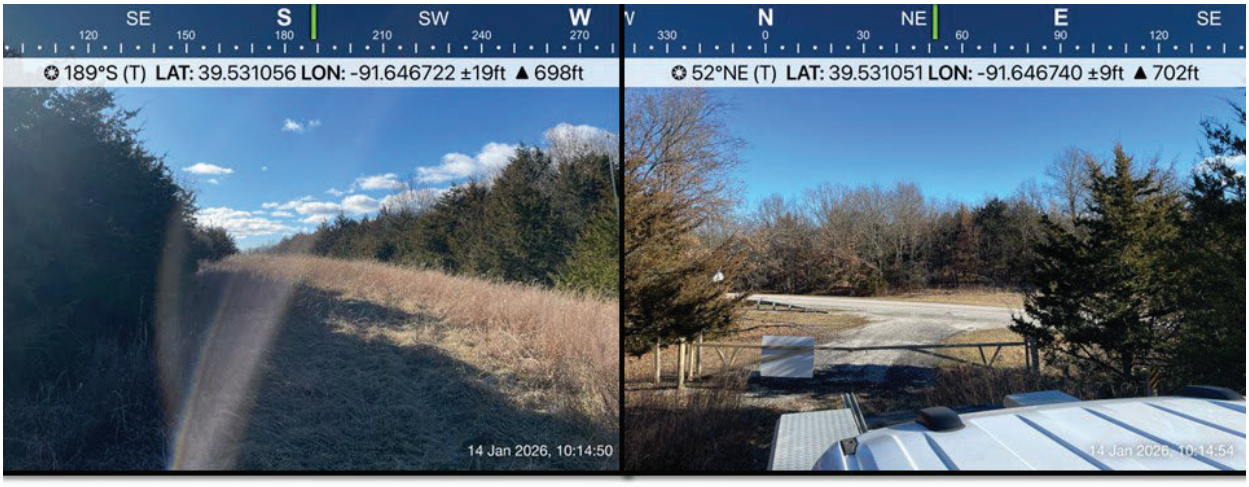


Figure 5: Staging area access road, approximately 30 yards SW of Highway J intersection.

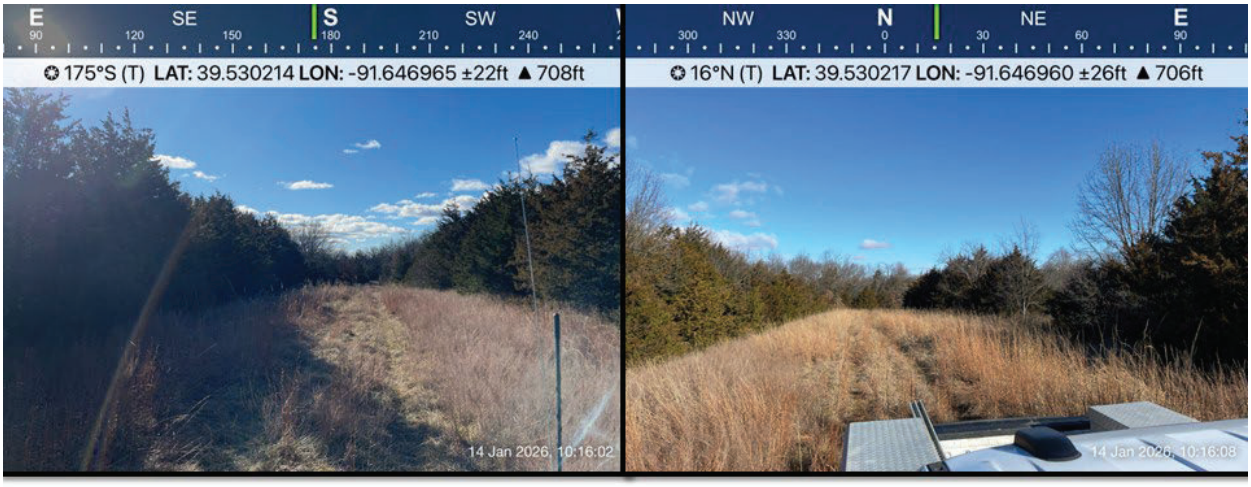


Figure 6: Staging area access road, approximately 140 yards from Highway J intersection.

Figure 7: Staging area access road, near old staging area and soils lab building.

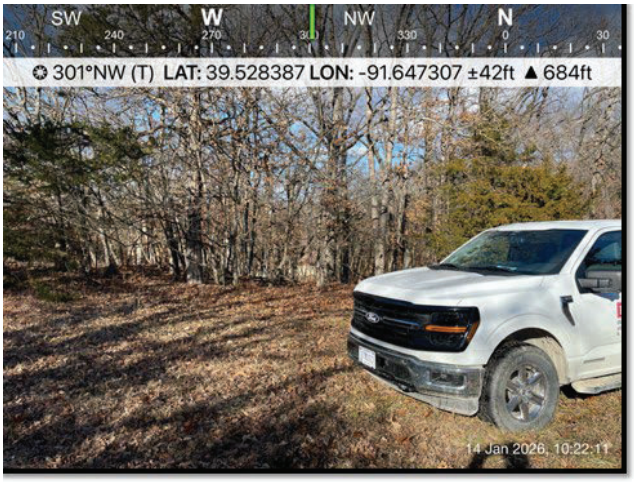


Figure 8: Staging area access road, near old staging area and soils lab building - continued.

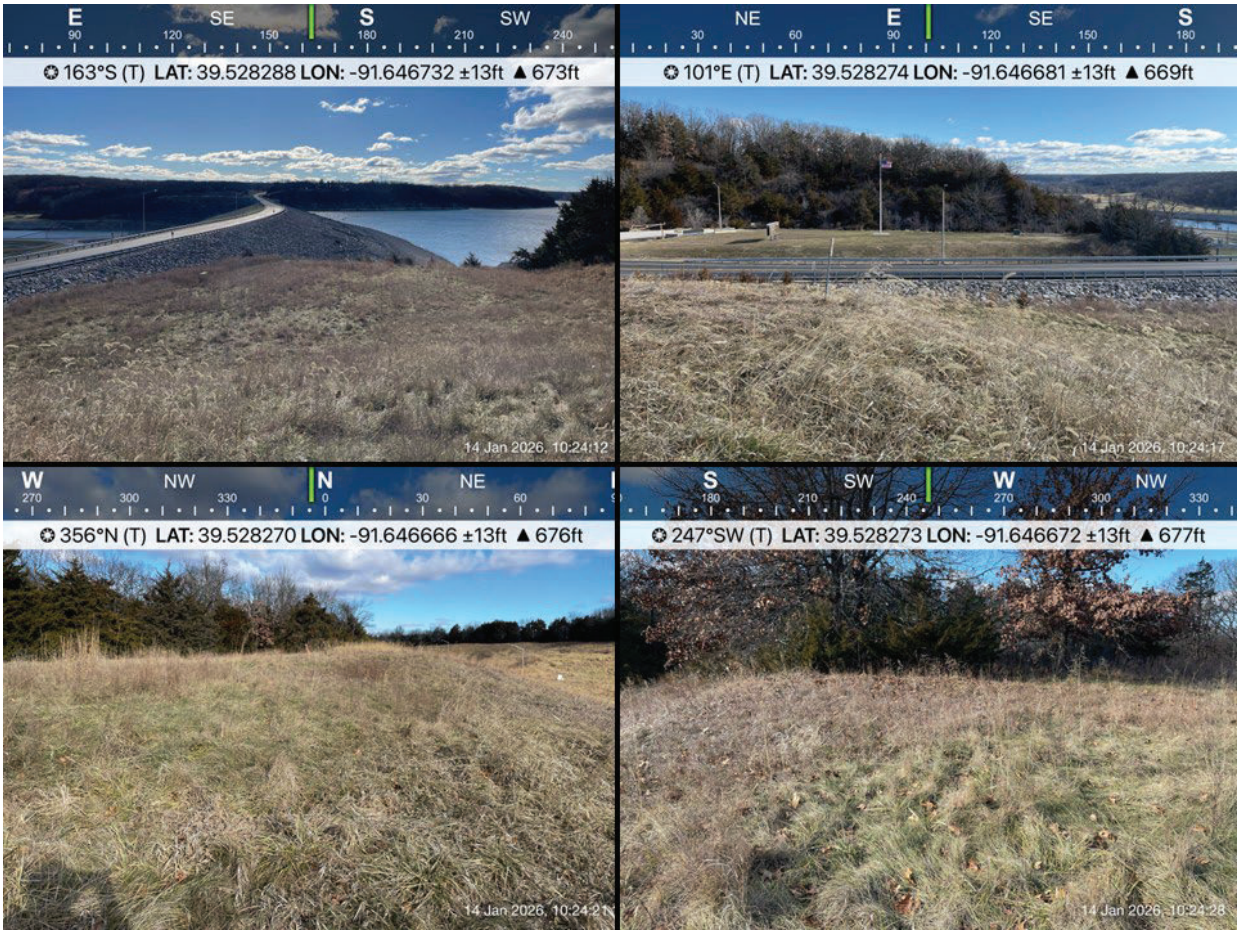


Figure 9: Eastern edge of old staging area.

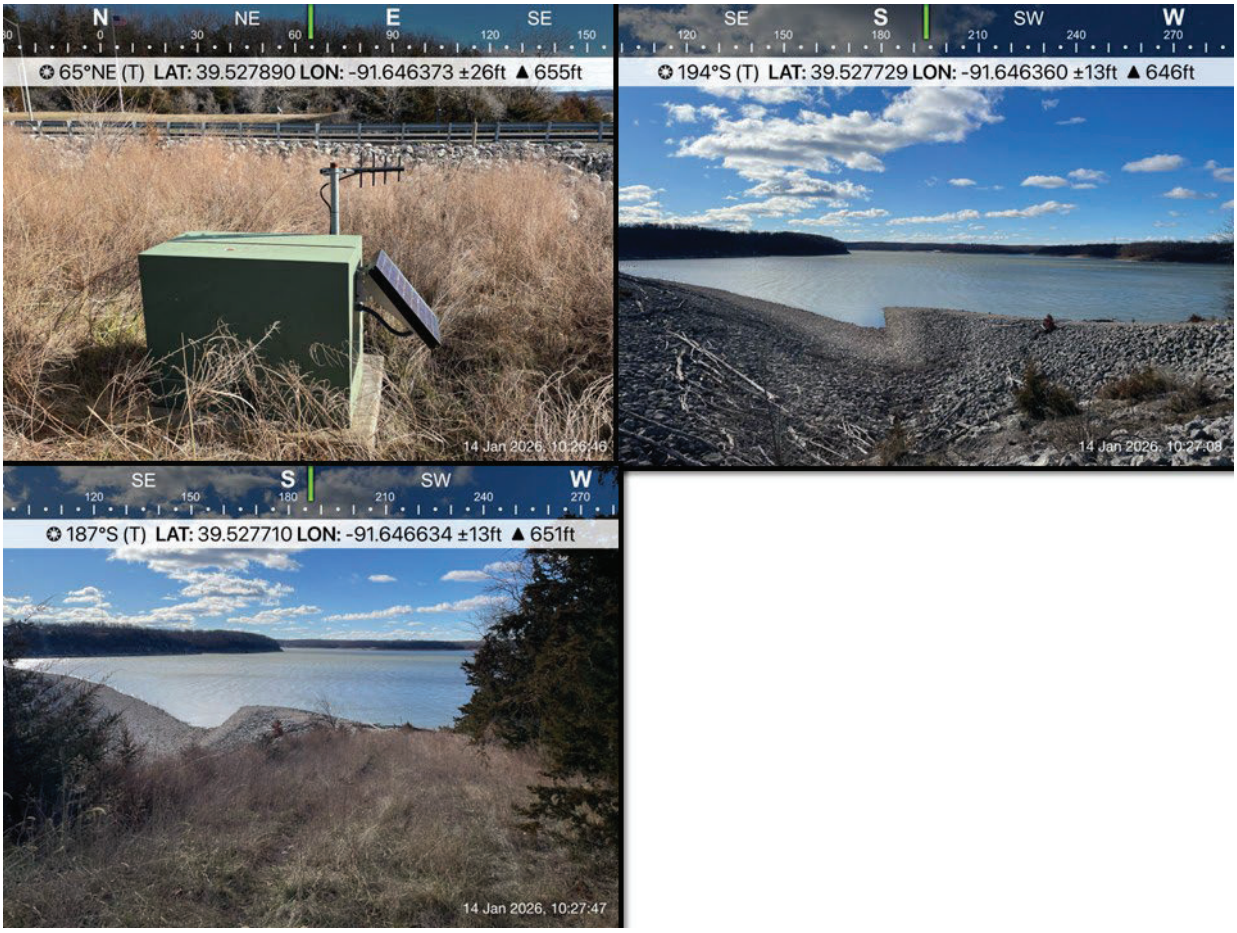


Figure 10: Adjacent to western side of Highway J and northern edge of the earthen dam. Top left: dam instrumentation.

Figure 11: Staging area access road approximately 165 yards west of old staging area. Top left: buoys in background.

Figure 12: Staging area access road near the old access ramp.

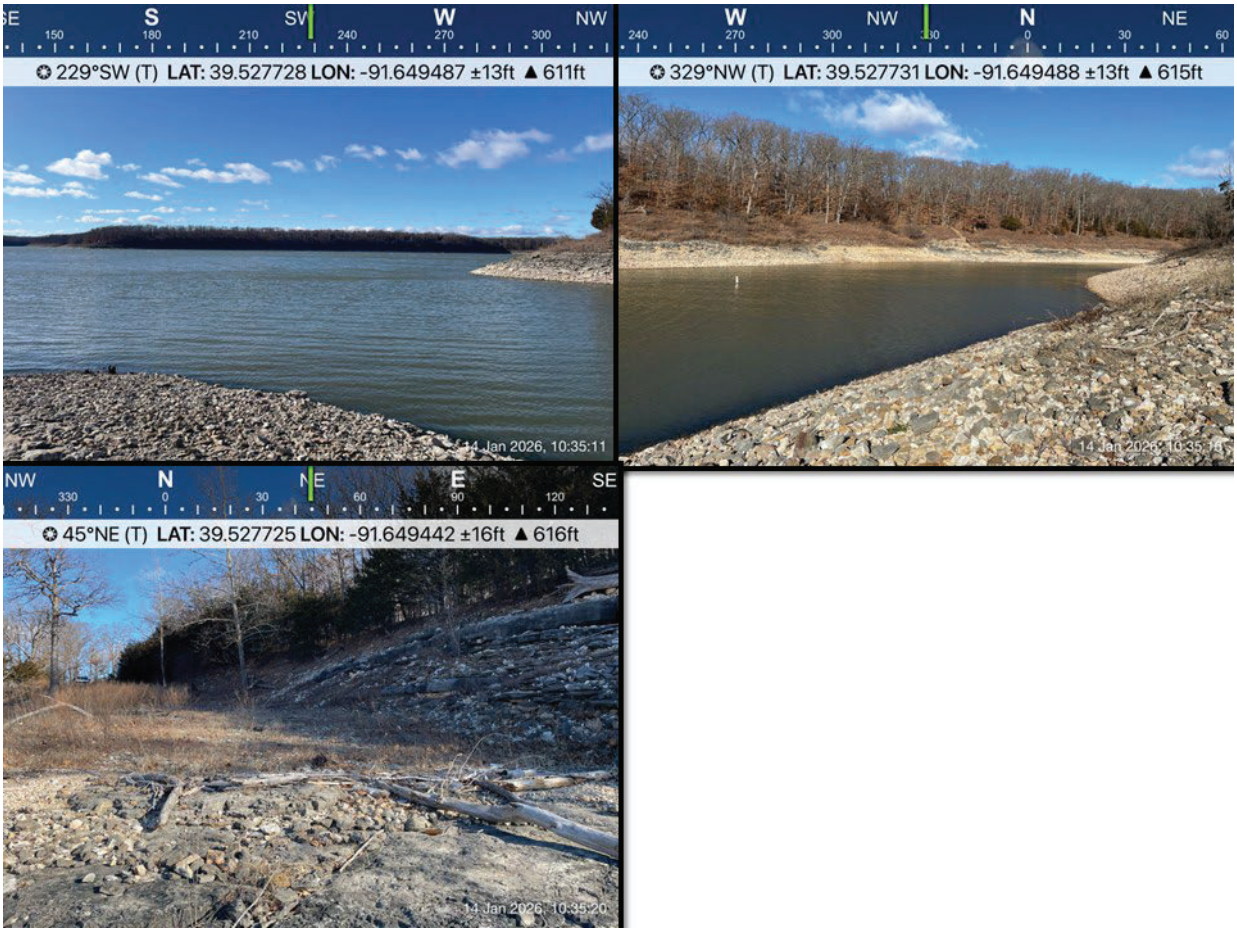


Figure 13: Staging area access road near the old access ramp - continued.

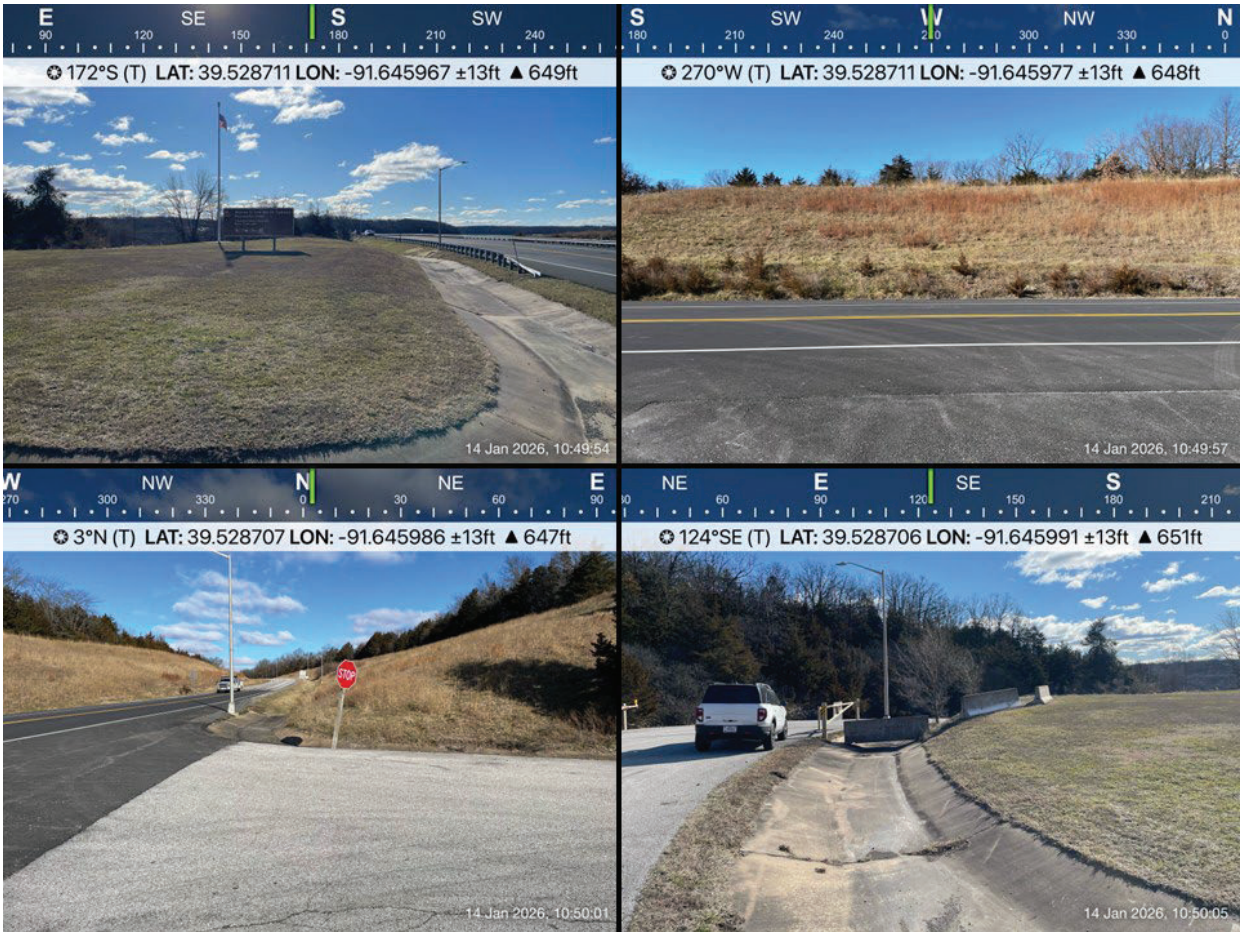


Figure 14: Intersection of Highway J and Warren G. See North Spillway Recreation Area Access road.

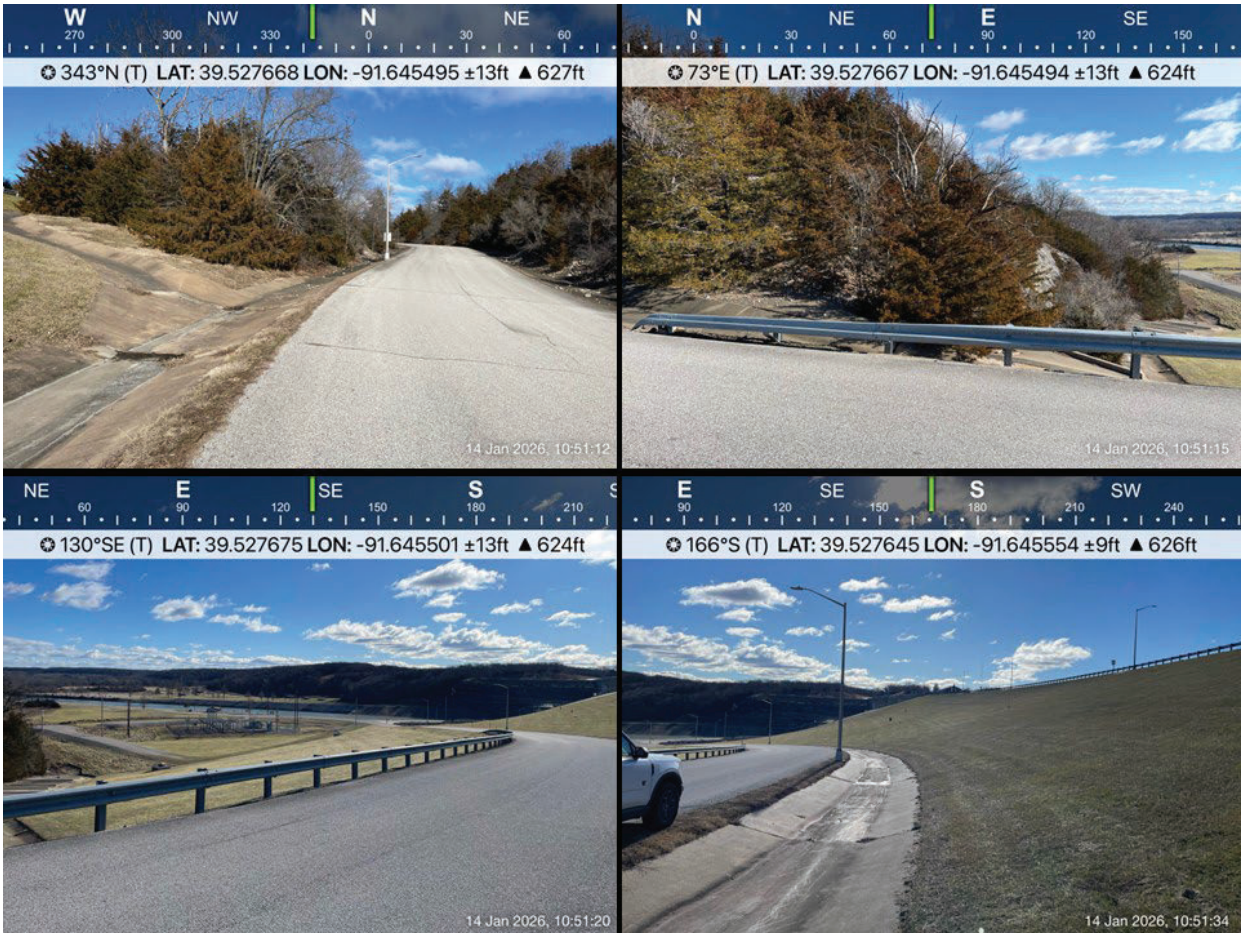


Figure 15: North Spillway access road approximately 140 yards SE of Highway J intersection.

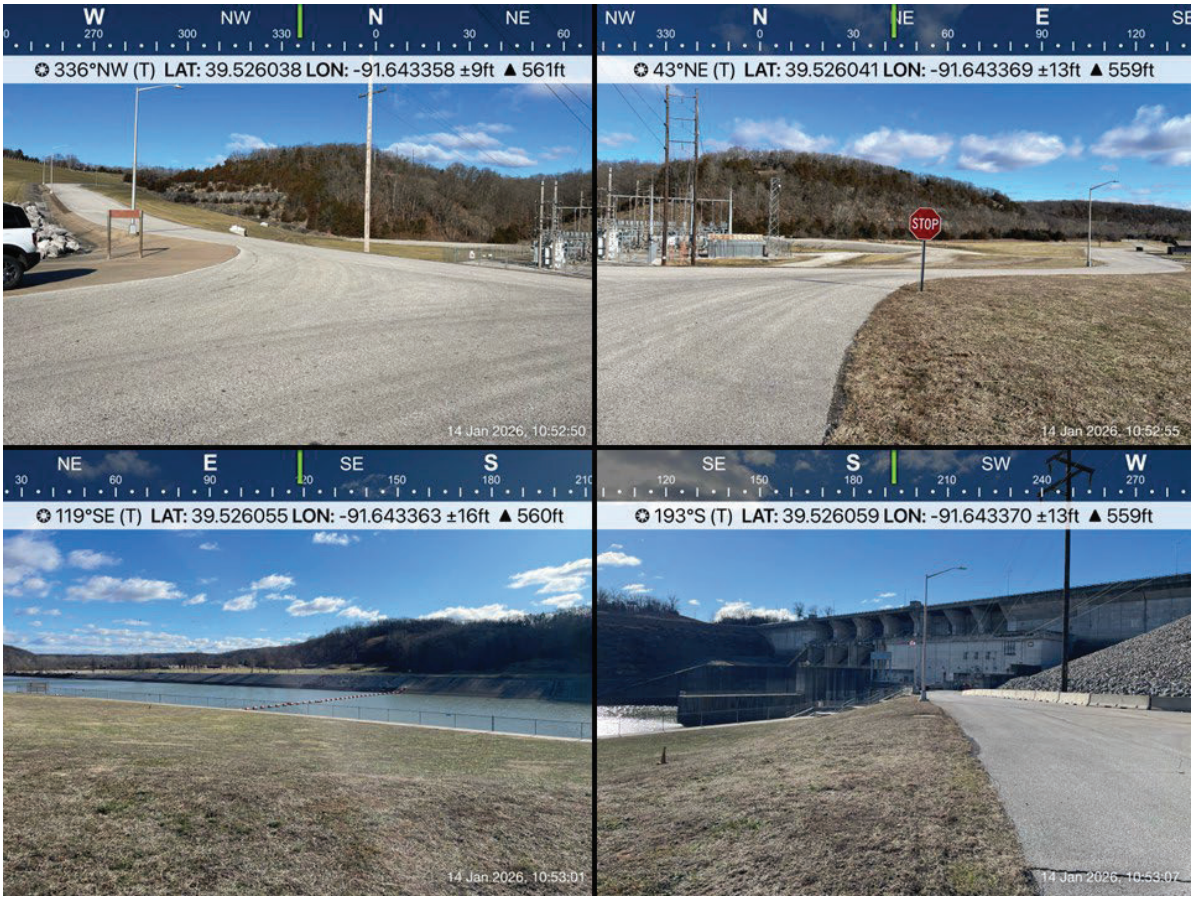


Figure 16: Intersection of CCD access road and North Spillway access road. Top: power transfer station. Bottom right: CCD.

Figure 17: Intersection of CCD access road and North Spillway access road – continued.

Figure 18: Overlook at Warren G. See South Spillway Recreation Area. Top left: CCD. Bottom left: re-reg. pool.

Figure 19: Overlook at Warren G. See South Spillway Recreation Area - continued.

Figure 20: Overlook at M.W. Boudreaux Memorial Visitor Center. View of Mark Twain Lake and CCD.

Figure 21: SW corner of Ray Behrens parking lot.

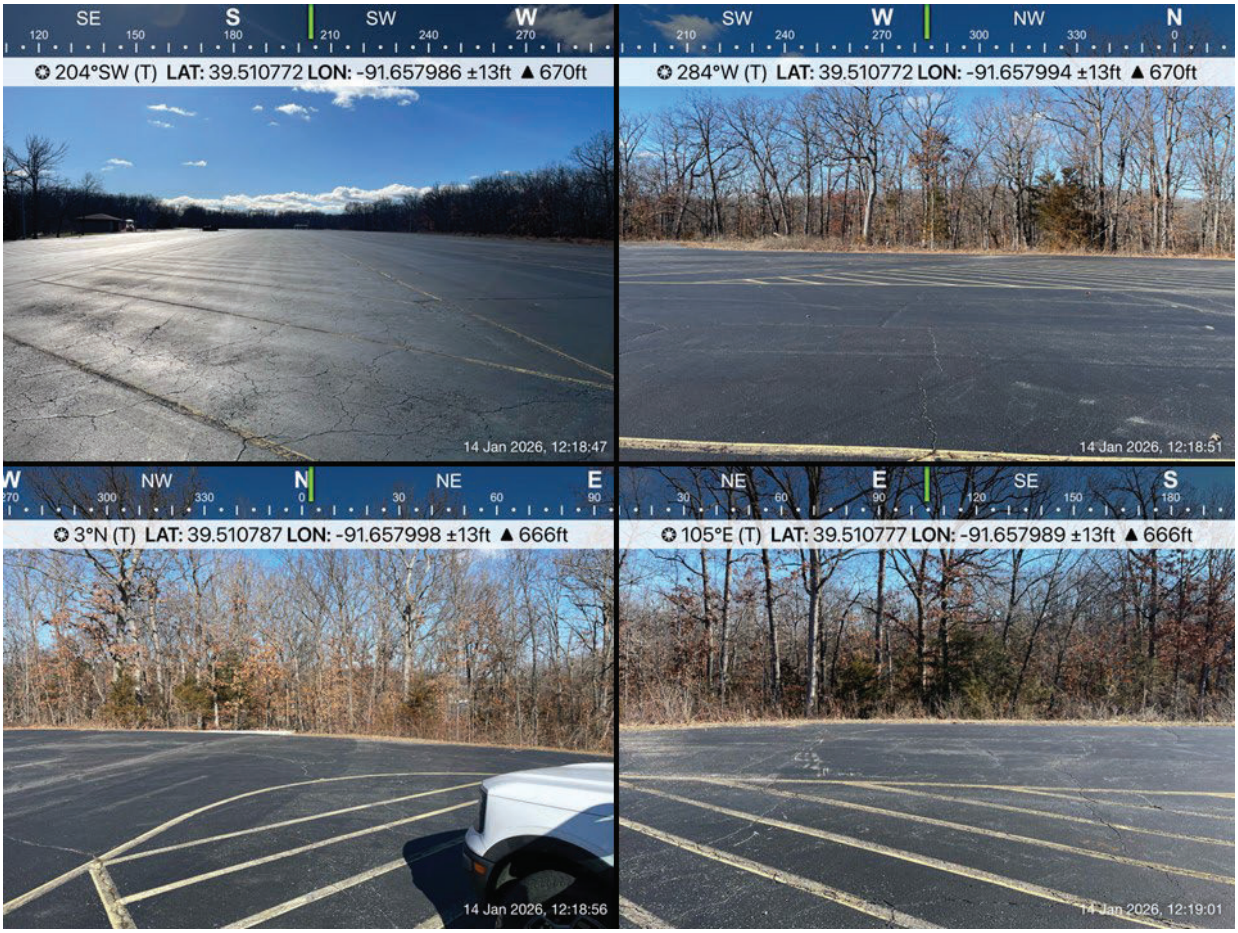


Figure 22: NE corner of Ray Behrens parking lot.

Figure 23: Top left: Comfort station at Ray Behrens lot. Bottom: access road to Ray Behrens boat ramp.

Figure 24: Ray Behrens boat ramp.

Figure 25: Ray Behrens boat ramp - continued.

SUPPLEMENTARY MATERIALS A: INTERVIEW QUESTIONNAIRE

HTRW Questionnaire

Date: January 5, 2026

Name of person answering this questionnaire: **Allen Mehrer**

Are they the current owner? **No. Owned in fee title by USACE.**

If not, what is their association with the property and/or the current owner? **Operation Manager**

1. How long has the current owner owned this property?

Property purchased in fee title in 1969 by USACE.

2. Has there ever been any herbicide or pesticide application to the property?

TCW – Operational in 1984 upon impoundment of lake. No pesticides have been applied since then. Between 1969 and 1984, site was a construction zone. Pesticide application is unknown. Prior to 1969, Pesticide application is unknown.

Frank Russell Staging Area – Area directly north of Clarence Cannon Dam was mostly wooded, but did house a small soils laboratory on the crest of the hill top. Site construction is unknown. Pesticide application is unknown. Access road leading down bluff accessing the bottomland site directly upstream of the Cannon Dam. Pesticide application is unknown prior to 1984.

Ray Behrens Recreation Area – Pesticide application in the area adjacent to the boat ramp and parking area has occurred on an irregular basis since 1984. Generally limited to broad spectrum herbicide (glyphosate) to control vegetation in rip-rap areas.

If so, what chemicals were applied?
How many years were they applied?

3. Has there ever been any type of spill (oil products, chemicals, etc.) on the property?
If so, what was spilled an approximately how many gallons?
Did spill reach surface waters?

TCW – Since 1984, no spills documented.

Frank Russell Staging Area – Since 1984, no oil spills documented. Prior to 1984, unknown.

Ray Behrens – No significant spills noted. Insignificant quantities generated by recreational use of visitors.

4. Were the properties ever used for an industrial use? **No.**
If so, what type?

5. Were the properties ever used as a dump site (metal, tires, glass, chemical containers, old drums, etc.), either household or industrial? **Unknown.**

6. Were there or are there any storage tanks either underground or aboveground?
If so, how many gallons, what did they store, gasoline, fuel oil, etc.?

No known fixed material storage tanks

Did they leak and were they removed?

7. Are there any wells (drinking or other) on this property? **No known wells.**

8. Were there or are there any waste water treatment facilities (septic systems, lagoons, etc.) on these property? **No waste water treatment facilities.**

9. Was there or are there any transformers, capacitors or hydraulic equipment which could have contained PCB's?

All three sites during construction phase of Project had heavy equipment operating on all surfaces. Most of the equipment had some form of hydraulic operating systems.

Cannon Dam transformers downstream of sites have transformers, but no PCBs

Ray Behrens has active transformers as part of its electric infrastructure, but no known PCBs.

No other transformers, capacitors, or hydraulics noted.

10 Any storage of hazardous materials?
If so, how much, when, for how many years?
Where on property?

No known hazardous storage.

11. Any burn pits on this property?

No permanent burn pits established. It is surmised that during construction, cleared vegetation was burned on site, especially in the area of the TCW.

12. Any buildings on this property?
Where they built before 1980?

Frank Russell Staging Area – Small building of unknown construction was located on site and served as a soils lab. Structure removed at termination of construction.

No other structures known.

13. Has an asbestos and lead based paint survey been completed for the buildings?
If so, was any asbestos and/or lead based paint found?
Was it removed?

Unknown

14. Is the property served by a public or private drinking water supply?
Is this supply conveyed through asbestos cement mains, lead containing lines or piping that uses copper and/or lead solder?

Ray Behrens Recreation Area – Area served by a public water system. Based on its age, no lead or asbestos is anticipated.

15. Are there pipelines on or near this property? If so, where are they located? What are they transporting?

Two pipelines exist approximately ¼ mile downstream of Clarence Cannon Dam. They convey natural gas and petroleum products.

16. Does the property require a National Pollutant Discharge Elimination System? If so, what is the NPDES number? Have there been any violations?

No

Contact:

Ben Greeling
Benjamin.greeling@usace.army.mil
Environmental Specialist
St. Louis District
U.S. Army Corps of Engineers
100 Arsenal St
St. Louis, MO, 63118
314-331-8768
636-399-5105

HTRW Questionnaire

Date: 05 JAN 20226

Name of person answering this questionnaire: **Michael Henry, IH EC-EQ**

Are they the current owner?

If not, what is their association with the property and/or the current owner? (**See attached email dated 05 JAN 2026)**

1. How long has the current owner owned this property?

NA

2. Has there ever been any herbicide or pesticide application to the property?

   If so, what chemicals were applied?
   How many years were they applied?

NA

3. Has there ever been any type of spill (oil products, chemicals, etc.) on the property?
   If so, what was spilled an approximately how many gallons?
   Did spill reach surface waters?

Yes- See attached

4. Were the properties ever used for an industrial use?
   If so, what type?

Not that I am aware of.

5. Were the properties ever used as a dump site (metal, tires, glass, chemical containers, old drums, etc.), either household or industrial?

Yes- See attached

6. Were there or are there any storage tanks either underground or aboveground?
   If so, how many gallons, what did they store, gasoline, fuel oil, etc.?

Did they leak and were they removed?

Historic USTs were removed and replaced with ASTs

7. Are there any wells (drinking or other) on this property?

Not that I am aware of.

8. Were there or are there any waste water treatment facilities (septic systems, lagoons, etc.) on these property?

Not that I am aware of.

9. Was there or are there any transformers, capacitors or hydraulic equipment which could have contained PCB's?

Y**es—See attached – non-PCB (mineral oil) transformers**

10 Any storage of hazardous materials?
If so, how much, when, for how many years?
Where on property?

Yes – See Attached (limited quantities stored in flammable cabinets with spill control.

11. Any burn pits on this property?

Not that I am aware of.12. Any buildings on this property?

Where they built before 1980?

Yes

13. Has an asbestos and lead based paint survey been completed for the buildings?
If so, was any asbestos and/or lead based paint found?
Was it removed?
See attached

14. Is the property served by a public or private drinking water supply?
Is this supply conveyed through asbestos cement mains, lead containing lines or piping that uses copper and/or lead solder?

Public. ACM or LBP conveyances - Not that I am aware of

15. Are there pipelines on or near this property? If so, where are they located? What are they transporting?**)**

Not that I am aware of.

16. Does the property require a National Pollutant Discharge Elimination System? If so, what is the NPDES number? Have there been any violations?

Not that I am aware of.

Contact:

Ben Greeling
Benjamin.greeling@usace.army.mil
Environmental Specialist
St. Louis District
U.S. Army Corps of Engineers
100 Arsenal St
St. Louis, MO, 63118
314-331-8768
636-399-5105

Emergency Response Questionnaire

Name: Eric Murfin

Organization: Coordinator Ralls County Emergency Management

No Response

1. Are you aware of any spills or releases of hazardous substances or petroleum products at or near the subject property?

2. Are you aware of the subject property ever being used as a dump site (excessive metals, tires, glass, chemical containers, old drums, etc.) either household or industrial?

3. Are you aware of any type of illegal activities at or near the subject property involving hazardous substances (drug manufacturing or other)?

4. Are you aware of the property being the subject of any environmental sampling or studies?

5. Are you aware of any additional environmental conditions that are not listed that you feel are relevant at the subject property?

SUPPLEMENTARY MATERIALS B: RECORDS REVIEW

Clarence Cannon Dam

43691 Power Plant

Perry, MO 63462

Inquiry Number: 8202033.11

December 17, 2025

The EDR Aerial Photo Decade Package

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

EDR Aerial Photo Decade Package

12/17/25

Site Name:

Clarence Cannon Dam
43691 Power Plant
Perry, MO 63462
EDR Inquiry # 8202033.11

Client Name:

U.S. Army Corps of Engineers
Svc. Base,
St. Louis, MO 63118
Contact: Ben Greeling

Environmental Data Resources, Inc. (EDR) Aerial Photo Decade Package is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's professional researchers provide digitally reproduced historical aerial photographs, and when available, provide one photo per decade.

Search Results:

Year	*Scale*	*Details*	*Source*
2022	1"=500'	Flight Year: 2022	USDA/NAIP
2018	1"=500'	Flight Year: 2018	USDA/NAIP
2014	1"=500'	Flight Year: 2014	USDA/NAIP
2010	1"=500'	Flight Year: 2010	USDA/NAIP
2007	1"=500'	Flight Year: 2007	USDA/NAIP
1995	1"=500'	Acquisition Date: April 03, 1995	USGS/DOQQ
1984	1"=500'	Flight Date: April 06, 1984	USGS
1956	1"=500'	Flight Date: April 20, 1956	USGS
1948	1"=500'	Flight Date: September 01, 1948	USGS

When delivered electronically by EDR, the aerial photo images included with this report are for ONE TIME USE ONLY. Further reproduction of these aerial photo images is prohibited without permission from EDR. For more information contact your EDR Account Executive.

Disclaimer - Copyright and Trademark Notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, LLC. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. This Report is provided on an "AS IS", "AS AVAILABLE" basis. NO WARRANTY EXPRESS OR IMPLIED IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT. ENVIRONMENTAL DATA RESOURCES, LLC AND ITS SUBSIDIARIES, AFFILIATES AND THIRD PARTY SUPPLIERS DISCLAIM ALL WARRANTIES, OF ANY KIND OR NATURE, EXPRESS OR IMPLIED, ARISING OUT OF OR RELATED TO THIS REPORT OR ANY OF THE DATA AND INFORMATION PROVIDED IN THIS REPORT, INCLUDING WITHOUT LIMITATION, ANY WARRANTIES REGARDING ACCURACY, QUALITY, CORRECTNESS, COMPLETENESS, COMPREHENSIVENESS, SUITABILITY, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, NON-INFRINGEMENT, MISAPPROPRIATION, OR OTHERWISE. ALL RISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, LLC OR ITS SUBSIDIARIES, AFFILIATES OR THIRD PARTY SUPPLIERS BE LIABLE TO ANYONE FOR ANY DIRECT, INCIDENTAL, INDIRECT, SPECIAL, CONSEQUENTIAL OR OTHER DAMAGES OF ANY TYPE OR KIND (INCLUDING BUT NOT LIMITED TO LOSS OF PROFITS, LOSS OF USE, OR LOSS OF DATA), ARISING OUT OF OR IN ANY WAY CONNECTED WITH THIS REPORT OR ANY OF THE DATA AND INFORMATION PROVIDED IN THIS REPORT.

Any analyses, estimates, ratings, environmental risk levels, or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providing any facts regarding, or prediction or forecast of, any environmental risk for any property. Only an assessment performed by a qualified environmental professional can provide findings, opinions or conclusions regarding the environmental risk or conditions in, on or at any property.

Copyright 2025 by Environmental Data Resources, Inc. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, Inc., or its affiliates, is prohibited without prior written permission.

EDR and its logos (including Sanborn and Sanborn Map) are trademarks of Environmental Data Resources, LLC or its affiliates. All other trademarks used herein are the property of their respective owners.

INQUIRY #: 8202033.11

YEAR: 2022

= 500'

N

EDR

INQUIRY #: 8202033.11

YEAR: 2018

= 500'

N

EDR

INQUIRY #: 8202033.11

YEAR: 2014

= 500'

N

EDR

INQUIRY #: 8202033.11

YEAR: 2010

= 500'

N

EDR

INQUIRY #: 8202033.11

YEAR: 2007

= 500'

N

EDR

INQUIRY #: 8202033.11

YEAR: 1995

= 500'

N

EDR

INQUIRY #: 8202033.11

YEAR: 1984

= 500'

N

EDR

INQUIRY #: 8202033.11

YEAR: 1956

= 500'

N

EDR

INQUIRY #: 8202033.11

YEAR: 1948

= 500'

N

EDR

Clarence Cannon Dam
43691 Power Plant
Perry, MO 63462

Inquiry Number: 8202033.8
December 17, 2025

EDR Building Permit Report

Target Property and Adjoining Properties

Environmental Data Resources Inc

6 Armstrong Road
Shelton, CT 06484
800.352.0050
www.edrnet.com

EDR Building Permit Report: Search Documentation

12/17/25

Site Name:
Clarence Cannon
43691 Power Plant
Perry, MO 63462

Client Name:
U.S. Army Corps of Engineers
Svc. Base,
St. Louis, MO 63118

EDR Inquiry # 8202033.8

Contact: Ben Greeling

Search Documentation

DATA GAP

The complete collection of Building Permit data available to EDR has been searched, and as of 12/17/25, EDR does not have access to building permits in the city where your target property is located (Perry, MO).

Disclaimer - Copyright and Trademark Notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, Inc. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. NO WARRANTY EXPRESSED ORIMPLIED, IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT. ENVIRONMENTAL DATA RESOURCES, INC. SPECIFICALLY DISCLAIMS THEMAKING OF ANY SUCH WARRANTIES, INCLUDING WITHOUT LIMITATION, MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE. ALLRISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, INC. BE LIABLE TO ANYONE, WHETHER ARISING OUT OFERRORS OR OMISSIONS, NEGLIGENCE, ACCIDENT OR ANY OTHER CAUSE, FOR ANY LOSS OF DAMAGE, INCLUDING, WITHOUT LIMITATION, SPECIAL,INCIDENTAL CONSEQUENTIAL, OR EXEMPLARY DAMAGES. ANY LIABILITY ON THE PART OF ENVIRONMENTAL DATA RESOURCES, INC. IS STRICTLYLIMITED TO A REFUND OF THE AMOUNT PAID FOR THIS REPORT. Purchaser accepts this Report "AS IS". Any analyses, estimates, ratings, environmental risklevels or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providingany facts regarding, or prediction or forecast of, any environmental risk for any property. Only a Phase I Environmental Site Assessment performed by anenvironmental professional can provide information regarding the environmental risk for any property. Additionally, the information provided in this Report is not to beconstrued as legal advice.

Copyright 2017 by Environmental Data Resources, Inc. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, Inc., or its affiliates, is prohibited without prior written permission.

EDR and its logos including Sanborn and Sanborn Map are trademarks of Environmental Data Resources, Inc. or its affiliates. All other trademarks used herein are the property of their respective owners.

EDR BUILDING PERMIT REPORT

About This Report

The EDR Building Permit Report provides a practical and efficient method to search building department records for indications of environmental conditions. Generated via a search of municipal building permit records gathered from more than 1,600 cities nationwide, this report will assist you in meeting the search requirements of EPA's Standards and Practices for All Appropriate Inquiries 40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments E1527 - 21), or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

Building permit data can be used to identify current and/or former operations and structures/features of environmental concern. The data can provide information on a target property and adjoining properties such as the presence of underground storage tanks, pump islands, sumps, drywells, etc., as well as information regarding water, sewer, natural gas, electrical connection dates, and current/former septic tanks.

Methodology

EDR has developed the EDR Building Permit Report through our partnership with BuildFax, the nation's largest repository of building department records. BuildFax collects, updates, and manages building department records from local municipal governments. The database now includes 30 million permits, on more than 10 million properties across 1,600 cities in the United States.

The EDR Building Permit Report comprises local municipal building permit records, gathered directly from local jurisdictions, including both target property and adjoining properties. Years of coverage vary by municipality. Data reported includes where available): date of permit, permit type, permit number, status, valuation, contractor company, contractor name, and description.

Incoming permit data is checked at seven stages in a regimented quality control process, from initial data source interview, to data preparation, through final auditing. To ensure the building department is accurate, each of the seven quality control stages contains, on average, 15 additional quality checks, resulting in a process of approximately 105 quality control "touch points."

For more information about the EDR Building Permit Report, please contact your EDR Account Executive at 800) 352-0050.

EDR® Environmental Data Resources Inc

BUILD FAX PROPERTY HISTORY

Clarence Cannon Dam
43691 Power Plant
Perry, MO 63462

Inquiry Number: 8202033.5
December 17, 2025

The EDR-City Directory Image Report

Environmental Data Resources Inc

6 Armstrong Road
Shelton, CT 06484
800.352.0050
www.edrnet.com

TABLE OF CONTENTS

SECTION

Executive Summary

Findings

City Directory Images

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

Disclaimer - Copyright and Trademark Notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, LLC. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. This Report is provided on an "AS IS", "AS AVAILABLE" basis. **NO WARRANTY EXPRESS OR IMPLIED IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT. ENVIRONMENTAL DATA RESOURCES, LLC AND ITS SUBSIDIARIES, AFFILIATES AND THIRD PARTY SUPPLIERS DISCLAIM ALL WARRANTIES, OF ANY KIND OR NATURE, EXPRESS OR IMPLIED, ARISING OUT OF OR RELATED TO THIS REPORT OR ANY OF THE DATA AND INFORMATION PROVIDED IN THIS REPORT, INCLUDING WITHOUT LIMITATION, ANY WARRANTIES REGARDING ACCURACY, QUALITY, CORRECTNESS, COMPLETENESS, COMPREHENSIVENESS, SUITABILITY, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, NON-INFRINGEMENT, MISAPPROPRIATION, OR OTHERWISE. ALL RISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, LLC OR ITS SUBSIDIARIES, AFFILIATES OR THIRD PARTY SUPPLIERS BE LIABLE TO ANYONE FOR ANY DIRECT, INCIDENTAL, INDIRECT, SPECIAL, CONSEQUENTIAL OR OTHER DAMAGES OF ANY TYPE OR KIND (INCLUDING BUT NOT LIMITED TO LOSS OF PROFITS, LOSS OF USE, OR LOSS OF DATA), ARISING OUT OF OR IN ANY WAY CONNECTED WITH THIS REPORT OR ANY OF THE DATA AND INFORMATION PROVIDED IN THIS REPORT.** Any analyses, estimates, ratings, environmental risk levels, or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providing any facts regarding, or prediction or forecast of, any environmental risk for any property. Only an assessment performed by a qualified environmental professional can provide findings, opinions or conclusions regarding the environmental risk or conditions in, on or at any property.

Copyright 2023 by Environmental Data Resources, LLC. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, LLC, or its affiliates, is prohibited without prior written permission.

EDR and its logos including Sanborn and Sanborn Map are trademarks of Environmental Data Resources, LLC or its affiliates. All other trademarks used herein are the property of their respective owners.

EXECUTIVE SUMMARY

DESCRIPTION

Environmental Data Resources, Inc.'s EDR City Directory Report is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's City Directory Report includes a search of available business directory data at approximately five year intervals.

RECORD SOURCES

The EDR City Directory Report accesses a variety of business directory sources, including Haines, InfoUSA, Polk, Cole, Bresser, and Stewart. Listings marked as EDR Digital Archive access Cole and InfoUSA records. The various directory sources enhance and complement each other to provide a more thorough and accurate report.

EDR is licensed to reproduce certain City Directory works by the copyright holders of those works. The purchaser of this EDR City Directory Report may include it in reports delivered to a customer.

RESEARCH SUMMARY

The following research sources were consulted in the preparation of this report. A check mark indicates where information was identified in the source and provided in this report.

Year	*Target Street*	*Cross Street*	*Source*
2022	☑	☐	EDR Digital Archive
2017	☑	☐	Cole Information
2014	☑	☐	Cole Information
2010	☑	☐	Cole Information
2005	☑	☐	Cole Information
2000	☑	☐	Cole Information
1995	☐	☐	Cole Information
1992	☐	☐	Cole Information

FINDINGS

TARGET PROPERTY STREET

43691 Power Plant
Perry, MO 63462

Year	*CD Image*	*Source*	
HIGHWAY J			
2022	pg A2	EDR Digital Archive	
2017	pg A4	Cole Information	
2014	pg A5	Cole Information	
2010	pg A6	Cole Information	
2005	pg A7	Cole Information	
2000	pg A8	Cole Information	
1995	-	Cole Information	Target and Adjoining not listed in Source
1992	-	Cole Information	Target and Adjoining not listed in Source

FINDINGS

CROSS STREETS

No Cross Streets Identified

City Directory Images

Target Street	Cross Street	Source
✓	-	EDR Digital Archive

HIGHWAY J 2022

22448	MELISSA HAMILTON
	THE RUSTIC OAK CABIN RESTAURANT & CAMPGROUNDS
22715	BRITTNEY MEYER
	KOLTEN MEYER
	KRAIG MEYER
	MTLE LLC
	SHAINA MEYER
22807	AIMEE FERRY
	ALYSSA FERRY
	AMBER FERRY
	MICHELLE FERRY
	NICOLAS FERRY
22859	KIRK NOXON
22875	WILLIAM STREET
23768	JASON YANCEY
	KRISTY YANCEY
24067	DAVE YANCEY
	FRANCES YANCEY
	JERRY YANCEY
	JUSTIN HULTGREN
	YANCEY AUTO PARTS
	YANCEY AUTO PARTS INC
	YANCEY AUTO SALVAGE
	YANCEYS AUTO PARTS INC
24144	CLIFFORD BIAS
	DEBRA BIAS
	ELIZABETH BIAS
	HANNAH BIAS
24290	ANDY COUCH
	SCOTT COUCH
	SHARI COUCH
24294	FOREST ZUMWALT
	RHONDA ZUMWALT
	SHERI ZUMWALT
24473	FRANCES YANCEY
24555	BRADLEY HARRISON
	DEAN HARRISON
	GREGORY HARRISON
	HARRISON FAMILY FARM
	MARTHA HARRISON
25007	DAVID LEWELLEN
	JILL LEWELLEN
	WYATT LEWELLEN
25863	NANCY COOMES
	THOMAS COOMES
25879	STEPHEN COOMES
26458	CAROL HAYS
	GARY HAYS
26655	BELINDA KRCHELICH
	MARY KRCHELICH

Target Street	Cross Street	Source
✓	-	EDR Digital Archive

HIGHWAY J 2022 (Cont'd)

26657	BLAIR JOINER
	DANIEL JOINER
	ERIC JOINER
	JUSTIN JOINER
26684	ALICIA CREECH
	JEFFERY CREECH
	JORDAN CREECH
26777	RECHELLE CARROLL
	ROBIN CARROLL
26790	AMY BRANHAM
	BRADLEY BRANHAM
	DONNY BRANHAM
	HALEY BRANHAM
26827	AMANDA RAGLAND
	KATHY RAGLAND
	RAGLAND FAMILY FARM
	RANDY RAGLAND
26883	AMANDA PICTON
	TAYLOR PICTON
27124	DAVID BERRY
	PERRY MACHINE & DIE

Target Street	Cross Street	Source
✓	-	Cole Information

HIGHWAY J 2017

22226	HITCHING POST DAVE LUETKEMEYER DBA
	THE HITCHING POST
22448	RUSTIC OAK CABIN
	RUSTIC OAK CABIN RESTAURANT & CAMPGR
22715	MEYER, KRAIG E
22807	FERRY, NICK I
22859	NOXON, KIRK S
23768	YANCEY, JASON C
24067	YANCEY AUTO PARTS
24144	BIAS, HANNAH
24290	COUCH, SCOTT C
24294	ZUMWALT, FOREST W
24473	YANCEY, FRANCES J
24555	HARRISON, GREGORY L
25007	LEWELLEN, DAVID W
25863	COOMES, THOMAS H
25879	COOMES, STEVEN R
26655	KRCHELICH, BELINDA K
26657	JOINER, ERIC S
26684	CREECH, JEFF C
26777	CARROLL, ROBIN L
26790	BRANHAM, DON W
26827	RAGLAND, RANDY C
26883	PICTON, AMANDA J
27124	PERRY MACHINE & DIE

Target Street	Cross Street	Source
✓	-	Cole Information

HIGHWAY J 2014

22444	SCHEINER, DORIS A
22448	RUSTIC OAK CABIN RESTAURANT & CAMPGR
22587	OCCUPANT UNKNOWN,
22715	MEYER, KRAIG E
22807	FERRY, NICK I
22859	NOXON, KIRK S
22875	OCCUPANT UNKNOWN,
23717	YANCEY, KRIS K
23768	YANCEY, JASON C
24138	HAYES, GARY D
24144	MAYS, BETH
24290	COUCH, SCOTT C
24294	ZUMWALT, FOREST W
24467	YANCEY, KRISTY
24473	YANCEY, FRANCES J
24537	HARRISON, MARTHA
24555	HARRISON, DEAN L
25007	LEWELLEN, DAVID W
25863	COOMES, THOMAS H
25879	COOMES, STEVEN R
26655	KRCHELICH, BELINDA K
26657	JOINER, ERIC S
26684	CREECH, JORDAN M
26777	CARROLL, ROBIN L
26790	OCCUPANT UNKNOWN,
26827	RAGLAND, RANDY C
26883	PICTON, AMANDA J
27124	PERRY MACHINE & DIE

Target Street	Cross Street	Source
✓	-	Cole Information

HIGHWAY J 2010

22358 SHIELS, VICTORIA L
22444 SCHEINER, DORIS A
22448 RUSTIC OAK CABIN RESTAURANT
22587 OCCUPANT UNKNOWN,
22715 MEYER, KRAIG E
22807 FERRY, NICK I
22859 NOXON, KIRK S
22875 OCCUPANT UNKNOWN,
23768 YANCEY, KRISTY K
24067 YANCEY AUTO SALVAGE
24138 CLARKSON, ANDREW
HAYES, GARY D
24144 EVERSMEYER, ALBERT L
24290 COUCH, SCOTT C
24294 OCCUPANT UNKNOWN,
ZUMWALT CONSTRUCTION
24473 YANCEY, FRANCES J
24555 HARRISON, DEAN L
25007 LEWELLEN, DAVID W
25863 COOMES, THOMAS H
26655 KRCHELICH, BELINDA K
26657 RAGLAND, LEWIS C
26684 CREECH, JEFF C
26777 CARROLL, DAMON L
26790 WOODHURST, BRIAN A
26827 JACKSON, DAWN
RAGLAND, RANDY C

Target Street	Cross Street	Source
✓	-	Cole Information

HIGHWAY J 2005

22358 BILL KUHLMANN RACING
SHIELS, VICTORIA L
22448 REEVES, KATHERINE I
SCHEINER CONSTRUCTION
22587 LEAKE, HASKELL
22715 MEYER, KRAIG E
22807 FERRY, NICK I
22859 NOXON, KIRK S
23768 YANCEY, KRISTY
24067 YANCEY AUTO SALES PARTS INC
24144 CREEL, JAMES
24290 RICHARDS, SHARI
24294 ZUMWALT, FOREST W
24473 YANCEY, WILLIAM R
24555 HARRISON, DEAN L
25879 OCCUPANT UNKNOWN,
26458 COOMES, THOMAS H
26655 KRCHELICH, MARK A
26657 RAGLAND, LEWIS C
26684 OCCUPANT UNKNOWN,
26777 CARROLL, DAMON L
26790 KIEKEL, CECIL
26827 RAGLAND, RANDY C

Target Street	Cross Street	Source
✓	-	Cole Information

HIGHWAY J 2000

22587	LEAKE, HASKELL
22807	FERRY, NICK
23717	YANCEY, KRIS
23768	YANCEY, KRISTY
24144	TAYLOR, PATRICK
24290	RICHARDS, ANDY
24473	YANCEY, WILLIAM R
24555	HARRISON, DEAN L
25863	COOMES, THOMAS H
26458	COOMES, THOMAS H
26655	KRCHELICH, MARK
26777	CARROLL, DAMON
26790	KIEKEL, CECIL

CLARENCE CANNON DAM
43691 POWER PLANT
PERRY, MO 63462

Inquiry Number: 8202033.7S
DECEMBER 21, 2025

EDR Environmental Lien and AUL Search

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

EDR Environmental Lien and AUL Search

The EDR Environmental Lien Search Report provides results from a search of available current land title records for environmental cleanup liens and other activity and use limitations, such as engineering controls and institutional controls.

A network of professional, trained researchers, following established procedures, uses client supplied address and/or parcel information to:

- search for parcel information and/or legal description
- search for ownership information
- research official land title documents recorded at jurisdictional agencies such as recorders' offices, registries of deeds, county clerks' offices, etc
- search for publicly available environmental encumbering instrument(s) filed on or after the recording of the current deed; between the recording of the current deed and present
- provide a copy of any environmental encumbrance s)
- provide a copy of the current deed when available

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

Disclaimer – Copyright and Trademark Notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, LLC and AFX Research, LLC. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. This Report is provided on an "AS IS", "AS AVAILABLE" basis. NO WARRANTY EXPRESS OR IMPLIED IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT. ENVIRONMENTAL DATA RESOURCES, LLC AND ITS SUBSIDIARIES, AFFILIATES AND THIRD PARTY SUPPLIERS DISCLAIM ALL WARRANTIES, OF ANY KIND OR NATURE, EXPRESS OR IMPLIED, ARISING OUT OF OR RELATED TO THIS REPORT OR ANY OF THE DATA AND INFORMATION PROVIDED IN THIS REPORT, INCLUDING WITHOUT LIMITATION, ANY WARRANTIES REGARDING ACCURACY, QUALITY, CORRECTNESS, COMPLETENESS, COMPREHENSIVENESS, SUITABILITY, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, NON-INFRINGEMENT, MISAPPROPRIATION, OR OTHERWISE. ALL RISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, LLC OR ITS SUBSIDIARIES, AFFILIATES OR THIRD PARTY SUPPLIERS BE LIABLE TO ANYONE FOR ANY DIRECT, INCIDENTAL, INDIRECT, SPECIAL, CONSEQUENTIAL OR OTHER DAMAGES OF ANY TYPE OR KIND INCLUDING BUT NOT LIMITED TO LOSS OF PROFITS, LOSS OF USE, OR LOSS OF DATA , ARISING OUT OF OR IN ANY WAY CONNECTED WITH THIS REPORT OR ANY OF THE DATA AND INFORMATION PROVIDED IN THIS REPORT. Any analyses, estimates, ratings, environmental risk levels, or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providing any facts regarding, or prediction or forecast of, any environmental risk for any property. Only an assessment performed by a qualified environmental professional can provide findings, opinions or conclusions regarding the environmental risk or conditions in, on or at any property.

Copyright 2025 by Environmental Data Resources, LLC. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, LLC, or its affiliates, is prohibited without prior written permission.

EDR and its logos (including Sanborn and Sanborn Map) are trademarks of Environmental Data Resources, LLC or its affiliates. All other trademarks used herein are the property of their respective owners.

EDR Environmental Lien and AUL Search

TARGET PROPERTY INFORMATION

ADDRESS

CLARENCE CANNON DAM
43691 POWER PLANT
PERRY, MO 63462

RESEARCH SOURCE

Source 1: RALLS COUNTY RECORDER S OFFICE

Source 2: MISSOURI DEPARTMENT OF NATURAL RESOURCES

Source 3: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Source 4: JUDICIAL RECORDS

PROPERTY INFORMATION

Legal Description: 480 AC IN SEC 23-55-7 SEC 23 R003 VAC 1.710
Current Owner: UNITED STATES OF AMERICA
Property Identifiers: 06-0.6-23-000-00-03.00000
Comments: NO DEED FOUND 1980 - PRESENT.

EDR Environmental Lien and AUL Search

ENVIRONMENTAL LIEN

Environmental Lien: Found ☐ Not Found ☒

Comments: NONE IDENTIFIED.

OTHER ACTIVITY AND USE LIMITATIONS (AULS)

Other AUL's: Found ☐ Not Found ☒

Comments: NONE IDENTIFIED.

EDR Environmental Lien and AUL Search

MISCELLANEOUS

Comments: NONE IDENTIFIED.

CLARENCE CANNON DAM
43691 POWER PLANT
PERRY, MO 63462

Inquiry Number: 8202033.7S
DECEMBER 21, 2025

EDR Environmental Lien and AUL Search

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

EDR Environmental Lien and AUL Search

The EDR Environmental Lien Search Report provides results from a search of available current land title records for environmental cleanup liens and other activity and use limitations, such as engineering controls and institutional controls.

A network of professional, trained researchers, following established procedures, uses client supplied address and/or parcel information to:

- search for parcel information and/or legal description
- search for ownership information
- research official land title documents recorded at jurisdictional agencies such as recorders' offices, registries of deeds, county clerks' offices, etc
- search for publicly available environmental encumbering instrument(s) filed on or after the recording of the current deed; between the recording of the current deed and present
- provide a copy of any environmental encumbrance s)
- provide a copy of the current deed when available

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

Disclaimer – Copyright and Trademark Notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, LLC and AFX Research, LLC. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. This Report is provided on an "AS IS", "AS AVAILABLE" basis. NO WARRANTY EXPRESS OR IMPLIED IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT. ENVIRONMENTAL DATA RESOURCES, LLC AND ITS SUBSIDIARIES, AFFILIATES AND THIRD PARTY SUPPLIERS DISCLAIM ALL WARRANTIES, OF ANY KIND OR NATURE, EXPRESS OR IMPLIED, ARISING OUT OF OR RELATED TO THIS REPORT OR ANY OF THE DATA AND INFORMATION PROVIDED IN THIS REPORT, INCLUDING WITHOUT LIMITATION, ANY WARRANTIES REGARDING ACCURACY, QUALITY, CORRECTNESS, COMPLETENESS, COMPREHENSIVENESS, SUITABILITY, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, NON-INFRINGEMENT, MISAPPROPRIATION, OR OTHERWISE. ALL RISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, LLC OR ITS SUBSIDIARIES, AFFILIATES OR THIRD PARTY SUPPLIERS BE LIABLE TO ANYONE FOR ANY DIRECT, INCIDENTAL, INDIRECT, SPECIAL, CONSEQUENTIAL OR OTHER DAMAGES OF ANY TYPE OR KIND INCLUDING BUT NOT LIMITED TO LOSS OF PROFITS, LOSS OF USE, OR LOSS OF DATA , ARISING OUT OF OR IN ANY WAY CONNECTED WITH THIS REPORT OR ANY OF THE DATA AND INFORMATION PROVIDED IN THIS REPORT. Any analyses, estimates, ratings, environmental risk levels, or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providing any facts regarding, or prediction or forecast of, any environmental risk for any property. Only an assessment performed by a qualified environmental professional can provide findings, opinions or conclusions regarding the environmental risk or conditions in, on or at any property.

Copyright 2025 by Environmental Data Resources, LLC. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, LLC, or its affiliates, is prohibited without prior written permission.

EDR and its logos (including Sanborn and Sanborn Map) are trademarks of Environmental Data Resources, LLC or its affiliates. All other trademarks used herein are the property of their respective owners.

EDR Environmental Lien and AUL Search

TARGET PROPERTY INFORMATION

ADDRESS

CLARENCE CANNON DAM
43691 POWER PLANT
PERRY, MO 63462

RESEARCH SOURCE

Source 1: RALLS COUNTY RECORDER S OFFICE

Source 2: MISSOURI DEPARTMENT OF NATURAL RESOURCES

Source 3: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Source 4: JUDICIAL RECORDS

PROPERTY INFORMATION

Legal Description: ALL THAT PT SEC. 26-55-7 LYING N OF MAIN CHANNEL OF SALT RIVER SEC 26

Current Owner: UNITED STATES OF AMERICA

Property Identifiers: 06-0.7-26-000-00-01.00000

Comments: NO DEED FOUND 1980 - PRESENT.

EDR Environmental Lien and AUL Search

ENVIRONMENTAL LIEN

Environmental Lien: Found ☐ Not Found ☒

Comments: NONE IDENTIFIED.

OTHER ACTIVITY AND USE LIMITATIONS (AULS)

Other AUL's: Found ☐ Not Found ☒

Comments: NONE IDENTIFIED.

EDR Environmental Lien and AUL Search

MISCELLANEOUS

Comments: NONE IDENTIFIED.

CLARENCE CANNON DAM
43691 POWER PLANT
PERRY, MO 63462

Inquiry Number: 8202033.7S
DECEMBER 21, 2025

EDR Environmental Lien and AUL Search

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

EDR Environmental Lien and AUL Search

The EDR Environmental Lien Search Report provides results from a search of available current land title records for environmental cleanup liens and other activity and use limitations, such as engineering controls and institutional controls.

A network of professional, trained researchers, following established procedures, uses client supplied address and/or parcel information to:

- search for parcel information and/or legal description
- search for ownership information
- research official land title documents recorded at jurisdictional agencies such as recorders' offices, registries of deeds, county clerks' offices, etc
- search for publicly available environmental encumbering instrument(s) filed on or after the recording of the current deed; between the recording of the current deed and present
- provide a copy of any environmental encumbrance s)
- provide a copy of the current deed when available

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

Disclaimer – Copyright and Trademark Notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, LLC and AFX Research, LLC. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. This Report is provided on an "AS IS", "AS AVAILABLE" basis. NO WARRANTY EXPRESS OR IMPLIED IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT. ENVIRONMENTAL DATA RESOURCES, LLC AND ITS SUBSIDIARIES, AFFILIATES AND THIRD PARTY SUPPLIERS DISCLAIM ALL WARRANTIES, OF ANY KIND OR NATURE, EXPRESS OR IMPLIED, ARISING OUT OF OR RELATED TO THIS REPORT OR ANY OF THE DATA AND INFORMATION PROVIDED IN THIS REPORT, INCLUDING WITHOUT LIMITATION, ANY WARRANTIES REGARDING ACCURACY, QUALITY, CORRECTNESS, COMPLETENESS, COMPREHENSIVENESS, SUITABILITY, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, NON-INFRINGEMENT, MISAPPROPRIATION, OR OTHERWISE. ALL RISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, LLC OR ITS SUBSIDIARIES, AFFILIATES OR THIRD PARTY SUPPLIERS BE LIABLE TO ANYONE FOR ANY DIRECT, INCIDENTAL, INDIRECT, SPECIAL, CONSEQUENTIAL OR OTHER DAMAGES OF ANY TYPE OR KIND INCLUDING BUT NOT LIMITED TO LOSS OF PROFITS, LOSS OF USE, OR LOSS OF DATA , ARISING OUT OF OR IN ANY WAY CONNECTED WITH THIS REPORT OR ANY OF THE DATA AND INFORMATION PROVIDED IN THIS REPORT. Any analyses, estimates, ratings, environmental risk levels, or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providing any facts regarding, or prediction or forecast of, any environmental risk for any property. Only an assessment performed by a qualified environmental professional can provide findings, opinions or conclusions regarding the environmental risk or conditions in, on or at any property.

Copyright 2025 by Environmental Data Resources, LLC. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, LLC, or its affiliates, is prohibited without prior written permission.

EDR and its logos (including Sanborn and Sanborn Map) are trademarks of Environmental Data Resources, LLC or its affiliates. All other trademarks used herein are the property of their respective owners.

EDR Environmental Lien and AUL Search

TARGET PROPERTY INFORMATION

ADDRESS

CLARENCE CANNON DAM
43691 POWER PLANT
PERRY, MO 63462

RESEARCH SOURCE

Source 1: RALLS COUNTY RECORDER S OFFICE

Source 2: MISSOURI DEPARTMENT OF NATURAL RESOURCES

Source 3: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Source 4: JUDICIAL RECORDS

PROPERTY INFORMATION

Legal Description: ALL THAT PT OF SEC. 26-55-7 LYING S OF MAIN CHANNEL OF SALT RIVER SEC 26
Current Owner: UNITED STATES OF AMERICA
Property Identifiers: 06-0.7-26-000-00-02.00000
Comments: NO DEED FOUND 1980 - PRESENT.

EDR Environmental Lien and AUL Search

ENVIRONMENTAL LIEN

Environmental Lien: Found ☐ Not Found ☒

Comments: NONE IDENTIFIED.

OTHER ACTIVITY AND USE LIMITATIONS (AULS)

Other AUL's: Found ☐ Not Found ☒

Comments: NONE IDENTIFIED.

EDR Environmental Lien and AUL Search

MISCELLANEOUS

Comments: NONE IDENTIFIED.

Clarence Cannon Dam
43691 Power Plant
Perry, MO 63462

Inquiry Number: 8202033.4
December 17, 2025

EDR Historical Topo Map Report

with QuadMatch™

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

EDR Historical Topo Map Report

12/17/25

Site Name:

Clarence Cannon Dam
43691 Power Plant
Perry, MO 63462
EDR Inquiry # 8202033.4

Client Name:

U.S. Army Corps of Engineers
Svc. Base,
St. Louis, MO 63118
Contact: Ben Greeling

EDR Topographic Map Library has been searched by EDR and maps covering the target property location as provided by U.S. Army Corps of Engineers were identified for the years listed below. EDR's Historical Topo Map Report is designed to assist professionals in evaluating potential liability on a target property resulting from past activities. EDRs Historical Topo Map Report includes a search of a collection of public and private color historical topographic maps, dating back to the late 1800s.

Search Results:

P.O.# NA
Project: Clarence Cannon Dam

Coordinates:

Latitude:	39.523778 39° 31' 26" North
Longitude:	-91.645144 -91° 38' 43" West
UTM Zone:	Zone 15 North
UTM X Meters:	616451.57
UTM Y Meters:	4375779.72
Elevation:	606.00' above sea level

Maps Provided:

2021
2017
2015, 2014
1995
1959
1903

Disclaimer - Copyright and Trademark Notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, LLC. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. This Report is provided on an "AS IS", "AS AVAILABLE" basis. NO WARRANTY EXPRESS OR IMPLIED IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT. ENVIRONMENTAL DATA RESOURCES, LLC AND ITS SUBSIDIARIES, AFFILIATES AND THIRD PARTY SUPPLIERS DISCLAIM ALL WARRANTIES, OF ANY KIND OR NATURE, EXPRESS OR IMPLIED, ARISING OUT OF OR RELATED TO THIS REPORT OR ANY OF THE DATA AND INFORMATION PROVIDED IN THIS REPORT, INCLUDING WITHOUT LIMITATION, ANY WARRANTIES REGARDING ACCURACY, QUALITY, CORRECTNESS, COMPLETENESS, COMPREHENSIVENESS, SUITABILITY, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, NON-INFRINGEMENT, MISAPPROPRIATION, OR OTHERWISE. ALL RISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, LLC OR ITS SUBSIDIARIES, AFFILIATES OR THIRD PARTY SUPPLIERS BE LIABLE TO ANYONE FOR ANY DIRECT, INCIDENTAL, INDIRECT, SPECIAL, CONSEQUENTIAL OR OTHER DAMAGES OF ANY TYPE OR KIND (INCLUDING BUT NOT LIMITED TO LOSS OF PROFITS, LOSS OF USE, OR LOSS OF DATA), ARISING OUT OF OR IN ANY WAY CONNECTED WITH THIS REPORT OR ANY OF THE DATA AND INFORMATION PROVIDED IN THIS REPORT. Any analyses, estimates, ratings, environmental risk levels, or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providing any facts regarding, or prediction or forecast of, any environmental risk for any property. Only an assessment performed by a qualified environmental professional can provide findings, opinions or conclusions regarding the environmental risk or conditions in, on or at any property.

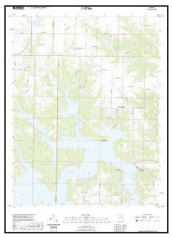
Copyright 2025 by Environmental Data Resources, Inc. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, Inc., or its affiliates, is prohibited without prior written permission.

EDR and its logos (including Sanborn and Sanborn Map) are trademarks of Environmental Data Resources, LLC or its affiliates. All other trademarks used herein are the property of their respective owners.

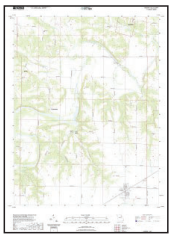
Topo Sheet Key

This EDR Topo Map Report is based upon the following USGS topographic map sheets.

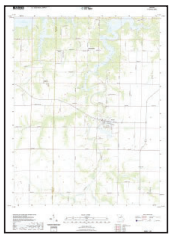
2021 Source Sheets



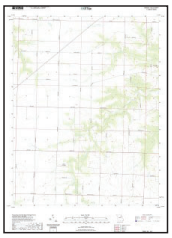
Clarence Cannon Dam
2021
7.5-minute, 24000



Center
2021
7.5-minute, 24000

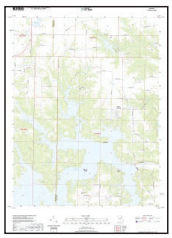


Perry
2021
7.5-minute, 24000

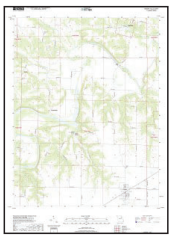


Perry NE
2021
7.5-minute, 24000

2017 Source Sheets

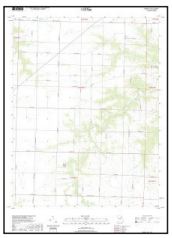


Clarence Cannon Dam
2017
7.5-minute, 24000



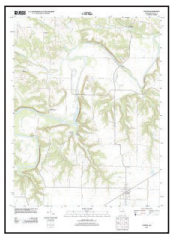
Center
2017
7.5-minute, 24000

Perry
2017
7.5-minute, 24000



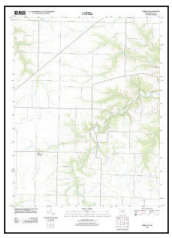
Perry NE
2017
7.5-minute, 24000

2015, 2014 Source Sheets



Center
2015
7.5-minute, 24000

Perry
2015
7.5-minute, 24000



Perry NE
2015
7.5-minute, 24000

Clarence Cannon Dam
2014
7.5-minute, 24000

1995 Source Sheets

Clarence Cannon Dam
1995
7.5-minute, 24000
Aerial Photo Revised 1957

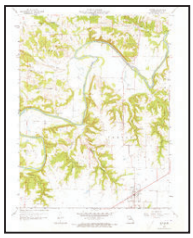
Center
1995
7.5-minute, 24000

Topo Sheet Key

This EDR Topo Map Report is based upon the following USGS topographic map sheets.

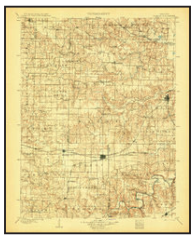
1959 Source Sheets

Joanna
1959
7.5-minute, 24000
Aerial Photo Revised 1957



Center
1959
7.5-minute, 24000
Aerial Photo Revised 1957

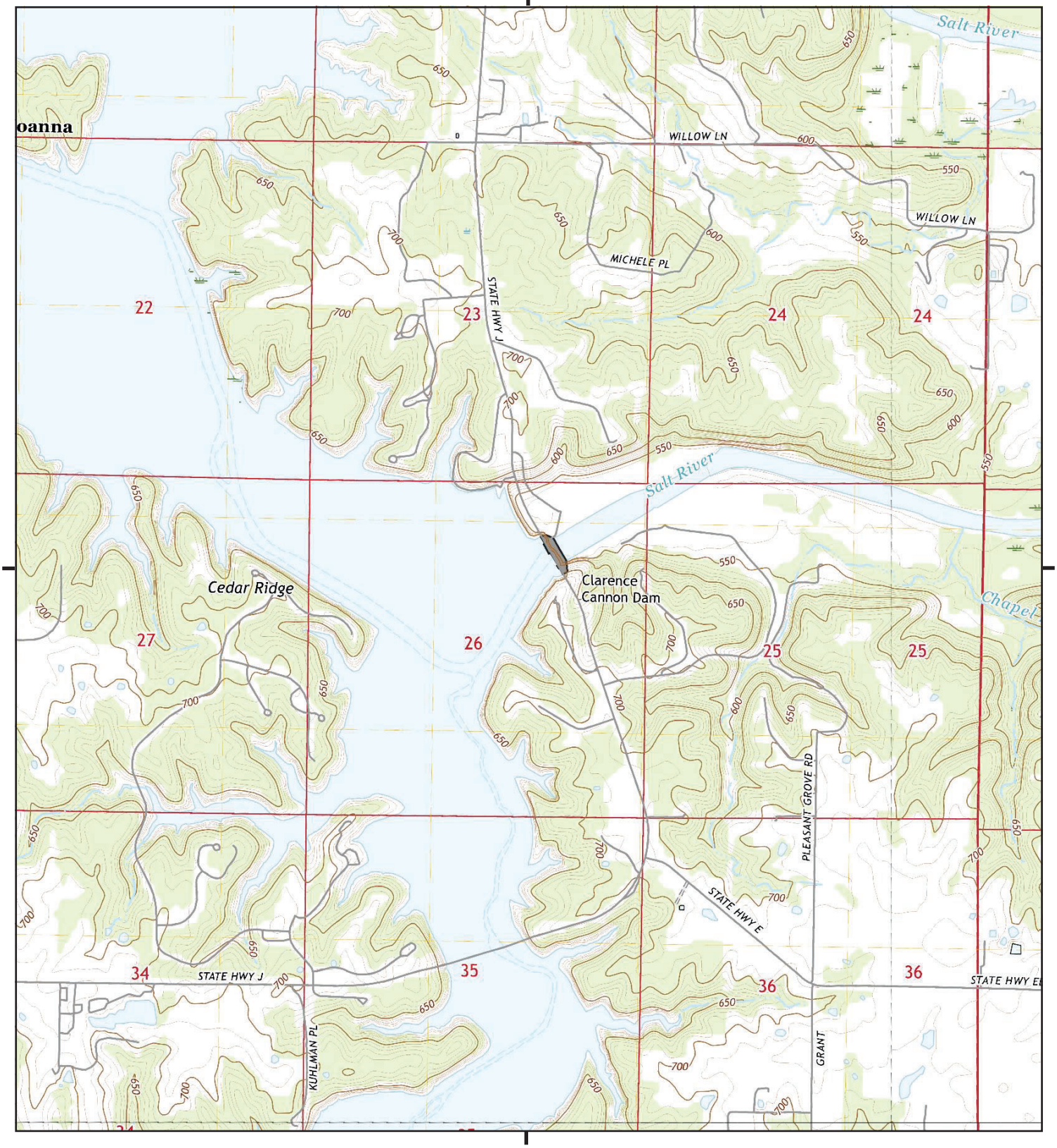
1903 Source Sheets



Palmyra
1903
30-minute, 125000

Historical Topo Map

2021



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

TP, Clarence Cannon Dam, 2021, 7.5-minute
NE, Center, 2021, 7.5-minute
SE, Perry NE, 2021, 7.5-minute
S, Perry, 2021, 7.5-minute

SITE NAME: Clarence Cannon Dam
ADDRESS: 43691 Power Plant
Perry, MO 63462
CLIENT: U.S. Army Corps of Engineers

N

Historical Topo Map

2017

This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

TP, Clarence Cannon Dam, 2017, 7.5-minute
NE, Center, 2017, 7.5-minute
SE, Perry NE, 2017, 7.5-minute
S, Perry, 2017, 7.5-minute

SITE NAME: Clarence Cannon Dam
ADDRESS: 43691 Power Plant
Perry, MO 63462
CLIENT: U.S. Army Corps of Engineers

N

Historical Topo Map

2015, 2014

This report includes information from the following map sheet(s).

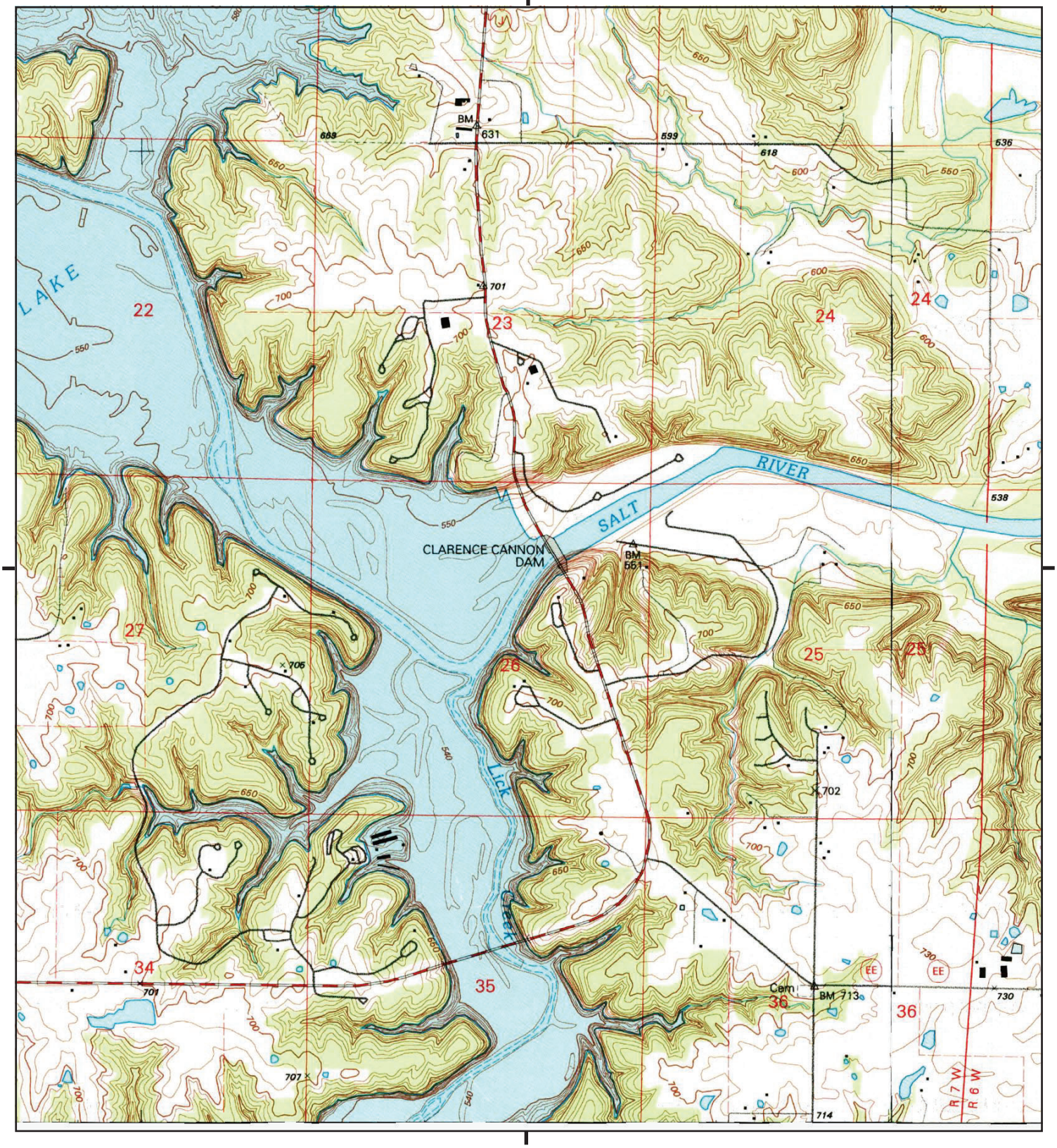
0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

TP, Clarence Cannon Dam, 2014, 7.5-minute
NE, Center, 2015, 7.5-minute
SE, Perry NE, 2015, 7.5-minute
S, Perry, 2015, 7.5-minute

SITE NAME: Clarence Cannon Dam
ADDRESS: 43691 Power Plant
Perry, MO 63462
CLIENT: U.S. Army Corps of Engineers

N



This report includes information from the following map sheet(s).

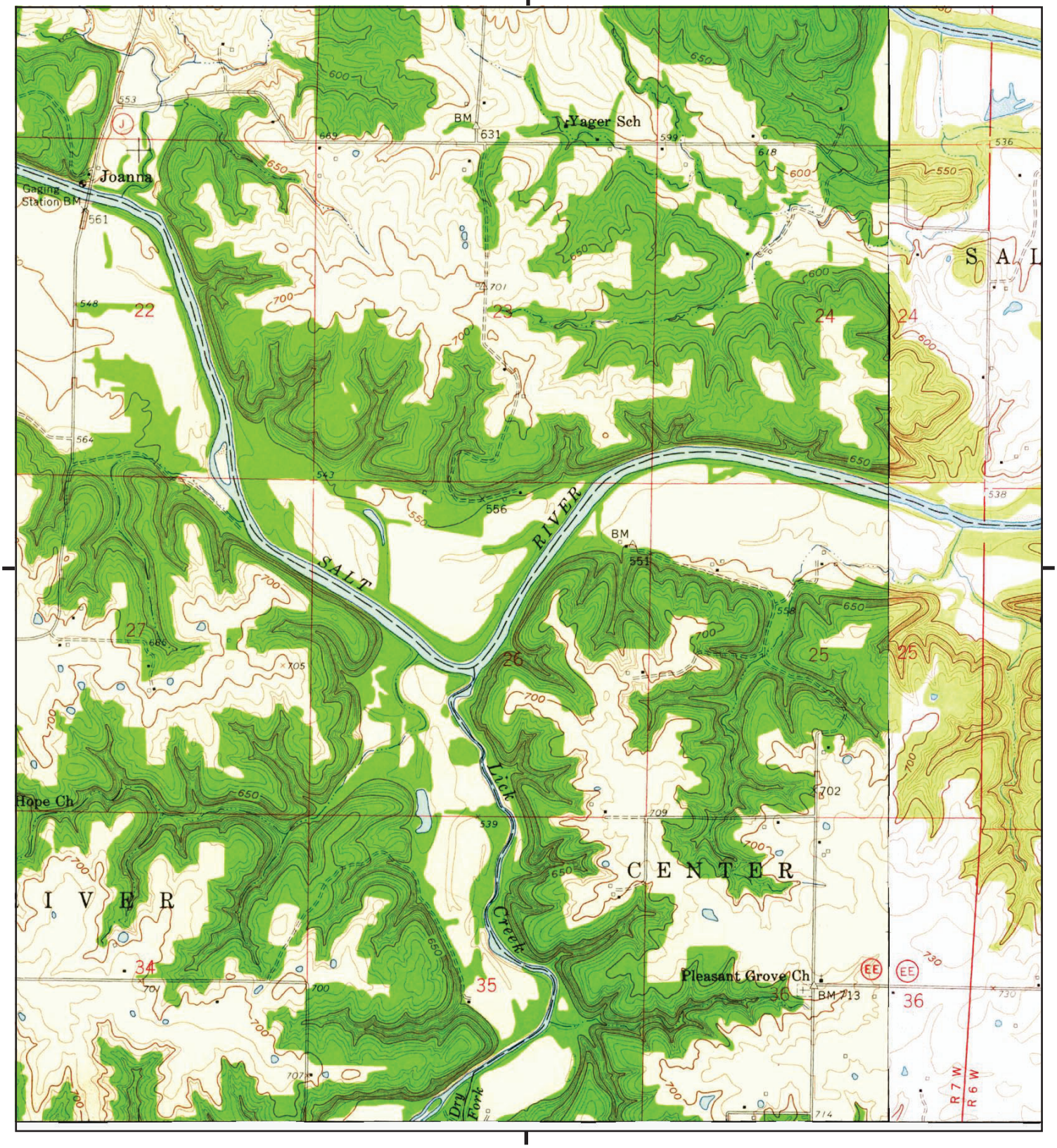
0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

TP, Clarence Cannon Dam, 1995, 7.5-minute
NE, Center, 1995, 7.5-minute

SITE NAME: Clarence Cannon Dam
ADDRESS: 43691 Power Plant
Perry, MO 63462
CLIENT: U.S. Army Corps of Engineers

N



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

TP, Joanna, 1959, 7.5-minute
NE, Center, 1959, 7.5-minute

SITE NAME: Clarence Cannon Dam
ADDRESS: 43691 Power Plant
Perry, MO 63462
CLIENT: U.S. Army Corps of Engineers

N

This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

TP, Palmyra, 1903, 30-minute

SITE NAME: Clarence Cannon Dam
ADDRESS: 43691 Power Plant
Perry, MO 63462
CLIENT: U.S. Army Corps of Engineers

N

Clarence Cannon Dam
43691 Power Plant
Perry, MO 63462

Inquiry Number: 8202033.2s
December 17, 2025

The EDR Radius Map™ Report with GeoCheck®

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

TABLE OF CONTENTS

LIGHTBOX LIVE

Open LightBox Live to access data, tools, and advanced analytics in one online platform.

http://www.web.edrnet.com/ordering/switchboard/login.aspx?s=goto_lightbox&pguid=51F6F510-3574-495B-818A-654987F85DDA

SECTION	PAGE
Executive Summary	ES1
Overview Map	2
Detail Map	3
Map Findings Summary	4
Map Findings	8
Orphan Summary	41
Government Records Searched/Data Currency Tracking	GR-1

GEOCHECK ADDENDUM

Physical Setting Source Addendum	A-1
Physical Setting Source Summary	A-2
Physical Setting SSURGO Soil Map	A-5
Physical Setting Source Map	A-9
Physical Setting Source Map Findings	A-11
Physical Setting Source Records Searched	PSGR-1

Disclaimer - Copyright and Trademark Notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, LLC. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. This Report is provided on an "AS IS", "AS AVAILABLE" basis. **NO WARRANTY EXPRESS OR IMPLIED IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT. ENVIRONMENTAL DATA RESOURCES, LLC AND ITS SUBSIDIARIES, AFFILIATES AND THIRD PARTY SUPPLIERS DISCLAIM ALL WARRANTIES, OF ANY KIND OR NATURE, EXPRESS OR IMPLIED, ARISING OUT OF OR RELATED TO THIS REPORT OR ANY OF THE DATA AND INFORMATION PROVIDED IN THIS REPORT, INCLUDING WITHOUT LIMITATION, ANY WARRANTIES REGARDING ACCURACY, QUALITY, CORRECTNESS, COMPLETENESS, COMPREHENSIVENESS, SUITABILITY, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, NON-INFRINGEMENT, MISAPPROPRIATION, OR OTHERWISE. ALL RISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, LLC OR ITS SUBSIDIARIES, AFFILIATES OR THIRD PARTY SUPPLIERS BE LIABLE TO ANYONE FOR ANY DIRECT, INCIDENTAL, INDIRECT, SPECIAL, CONSEQUENTIAL OR OTHER DAMAGES OF ANY TYPE OR KIND (INCLUDING BUT NOT LIMITED TO LOSS OF PROFITS, LOSS OF USE, OR LOSS OF DATA) INFORMATION PROVIDED IN THIS REPORT.** Any analyses, estimates, ratings, environmental risk levels, or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providing any facts regarding, or prediction or forecast of, any environmental risk for any property. Only an assessment performed by a qualified environmental professional can provide findings, opinions or conclusions regarding the environmental risk or conditions in, on or at any property.

Copyright 2025 by Environmental Data Resources, LLC. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, LLC, or its affiliates, is prohibited without prior written permission.

EDR and its logos (including Sanborn and Sanborn Map) are trademarks of Environmental Data Resources, LLC or its affiliates. All other trademarks used herein are the property of their respective owners.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E1527 - 21), the ASTM Standard Practice for Environmental Site Assessments for Forestland or Rural Property (E2247 - 23), the ASTM Standard Practice for Limited Environmental Due Diligence: Transaction Screen Process (E1528 - 22) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

43691 POWER PLANT
PERRY, MO 63462

COORDINATES

Latitude (North):	39.5237780 - 39˚ 31' 25.60''
Longitude (West):	91.6451440 - 91˚ 38' 42.51''
Universal Tranverse Mercator:	Zone 15
UTM X (Meters):	616454.6
UTM Y (Meters):	4375570.5
Elevation:	606 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	24325594 CLARENCE CANNON DAM, MO
Version Date:	2021

AERIAL PHOTOGRAPHY IN THIS REPORT

Portions of Photo from:	20220616
Source:	USDA

MAPPED SITES SUMMARY

Target Property Address:
43691 POWER PLANT
PERRY, MO 63462

Click on Map ID to see full detail.

MAP ID	SITE NAME	ADDRESS	DATABASE ACRONYMS	RELATIVE ELEVATION	DIST (ft. & mi.) DIRECTION
A1	US CORP OF ENGINEERS	20642 HIGHWAY J	E MANIFEST	Lower	776, 0.147, North
A2	USACE CLARENCE CANNO	20642 HWY J	RCRA-VSQG	Lower	776, 0.147, North

EXECUTIVE SUMMARY

TARGET PROPERTY SEARCH RESULTS

The target property was not listed in any of the databases searched by EDR.

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

STANDARD ENVIRONMENTAL RECORDS

Lists of Federal NPL (Superfund) sites

NPL ---------- National Priority List
Proposed NPL ---------- Proposed National Priority List Sites
NPL LIENS ---------- Federal Superfund Liens

Lists of Federal Delisted NPL sites

Delisted NPL ---------- National Priority List Deletions

Lists of Federal sites subject to CERCLA removals and CERCLA orders

FEDERAL FACILITY ---------- Federal Facility Site Information listing
SEMS ---------- Superfund Enterprise Management System

Lists of Federal CERCLA sites with NFRAP

SEMS-ARCHIVE ---------- Superfund Enterprise Management System Archive

Lists of Federal RCRA facilities undergoing Corrective Action

CORRACTS ---------- Corrective Action Report

Lists of Federal RCRA TSD facilities

RCRA-TSDF ---------- RCRA - Treatment, Storage and Disposal

Lists of Federal RCRA generators

RCRA-LQG ---------- RCRA - Large Quantity Generators
RCRA-SQG ---------- RCRA - Small Quantity Generators

Federal institutional controls / engineering controls registries

LUCIS ---------- Land Use Control Information System
US ENG CONTROLS ---------- Engineering Controls Sites List
US INST CONTROLS ---------- Institutional Controls Sites List

EXECUTIVE SUMMARY

Federal ERNS list

ERNS ---------- Emergency Response Notification System

Lists of state- and tribal hazardous waste facilities

SHWS ---------- Registry of Confirmed Abandoned or Uncontrolled Hazardous Waste Disposal Sites

Lists of state and tribal landfills and solid waste disposal facilities

SWF/LF ---------- Permitted Facility List

Lists of state and tribal leaking storage tanks

LUST ---------- Leaking Underground Storage Tanks
LAST ---------- Leaking Aboveground Storage Tanks
INDIAN LUST ---------- Leaking Underground Storage Tanks on Indian Land

Lists of state and tribal registered storage tanks

FEMA UST ---------- Underground Storage Tank Listing
UST ---------- Petroleum Storage Tanks
AST ---------- Aboveground Petroleum Storage Tanks
INDIAN UST ---------- Underground Storage Tanks on Indian Land
TANKS ---------- Underground Storage Tank Database

State and tribal institutional control / engineering control registries

AUL ---------- Sites with Controls

Lists of state and tribal voluntary cleanup sites

VCP ---------- Voluntary Cleanup Program Site Listing
INDIAN VCP ---------- Voluntary Cleanup Priority Listing

Lists of state and tribal brownfield sites

BROWNFIELDS ---------- Brownfields Site List

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS ---------- A Listing of Brownfields Sites

Local Lists of Landfill / Solid Waste Disposal Sites

SWRCY ---------- Solid Waste Recycling Facilities
HIST LF ---------- Solid Waste Facility Database List
INDIAN ODI ---------- Report on the Status of Open Dumps on Indian Lands
ODI ---------- Open Dump Inventory
DEBRIS REGION 9 ---------- Torres Martinez Reservation Illegal Dump Site Locations
IHS OPEN DUMPS ---------- Open Dumps on Indian Land

EXECUTIVE SUMMARY

Local Lists of Hazardous waste / Contaminated Sites

US HIST CDL	Delisted National Clandestine Laboratory Register
CDL	Environmental Emergency Response System
DEL SHWS	Registry Sites Withdrawn or Deleted
US CDL	National Clandestine Laboratory Register

Local Land Records

LIENS 2	CERCLA Lien Information

Records of Emergency Release Reports

HMIRS	Hazardous Materials Information Reporting System
SPILLS	Environmental Response Tracking Database
SPILLS 90	SPILLS 90 data from FirstSearch

Other Ascertainable Records

RCRA NonGen / NLR	RCRA - Non Generators / No Longer Regulated
FUDS	Formerly Used Defense Sites
DOD	Department of Defense Sites
SCRD DRYCLEANERS	State Coalition for Remediation of Drycleaners Listing
US FIN ASSUR	Financial Assurance Information
EPA WATCH LIST	EPA WATCH LIST
2020 COR ACTION	2020 Corrective Action Program List
TSCA	Toxic Substances Control Act
TRIS	Toxic Chemical Release Inventory System
SSTS	Section 7 Tracking Systems
ROD	Records Of Decision
RMP	Risk Management Plans
RAATS	RCRA Administrative Action Tracking System
PRP	Potentially Responsible Parties
PADS	PCB Activity Database System
ICIS	Integrated Compliance Information System
FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
MLTS	Material Licensing Tracking System
COAL ASH DOE	Steam-Electric Plant Operation Data
COAL ASH EPA	Coal Combustion Residues Surface Impoundments List
PCB TRANSFORMER	PCB Transformer Registration Database
RADINFO	Radiation Information Database
HIST FTTS	FIFRA/TSCA Tracking System Administrative Case Listing
DOT OPS	Incident and Accident Data
CONSENT	Superfund (CERCLA) Consent Decrees
INDIAN RESERV	Indian Reservations
FUSRAP	Formerly Utilized Sites Remedial Action Program
UMTRA	Uranium Mill Tailings Sites
LEAD SMELTERS	Lead Smelter Sites
US AIRS	Aerometric Information Retrieval System Facility Subsystem
US MINES	Mines Master Index File
MINES MRDS	Mineral Resources Data System
ABANDONED MINES	Abandoned Mines
FINDS	Facility Index System/Facility Registry System

ECHO - Enforcement & Compliance History Information
UXO - Unexploded Ordnance Sites
DOCKET HWC - Hazardous Waste Compliance Docket Listing
FUELS PROGRAM - EPA Fuels Program Registered Listing
PFAS NPL - Superfund Sites with PFAS Detections Information
PFAS FEDERAL SITES - Federal Sites PFAS Information
PFAS TRIS - List of PFAS Added to the TRI
PFAS TSCA - PFAS Manufacture and Imports Information
PFAS RCRA MANIFEST - PFAS Transfers Identified In the RCRA Database Listing
PFAS ATSDR - PFAS Contamination Site Location Listing
PFAS WQP - Ambient Environmental Sampling for PFAS
PFAS PROJECT - NORTHEASTERN UNIVERSITY PFAS PROJECT
PFAS NPDES - Clean Water Act Discharge Monitoring Information
PFAS ECHO - Facilities in Industries that May Be Handling PFAS Listing
PFAS ECHO FIRE TRAIN - Facilities in Industries that May Be Handling PFAS Listing
PFAS PT 139 AIRPORT - All Certified Part 139 Airports PFAS Information Listing
AQUEOUS FOAM NRC - Aqueous Foam Related Incidents Listing
BIOSOLIDS - ICIS-NPDES Biosolids Facility Data
UST FINDER RELEASE - UST Finder Releases Database
UST FINDER - UST Finder Database
PFAS - PFAS Detections
AIRS - Permit Facility Listing
ASBESTOS - Asbestos Notification Listing
COAL ASH - Coal Ash Disposal Sites
DRYCLEANERS - Drycleaners in Missouri Listing
Financial Assurance - Financial Assurance Information Listing
MINES - Industrial Mineral Mines Database
NPDES - Permitted Facility Listing
MO RRC - Certified Hazardous Waste Resource Recovery Facilities
SMARS - Site Management and Reporting System
UIC - Underground Injection Wells Database

EDR HIGH RISK HISTORICAL RECORDS

EDR Exclusive Records

EDR MGP - EDR Proprietary Manufactured Gas Plants
EDR Hist Auto - EDR Exclusive Historical Auto Stations
EDR Hist Cleaner - EDR Exclusive Historical Cleaners

EDR RECOVERED GOVERNMENT ARCHIVES

Exclusive Recovered Govt. Archives

RGA HWS - Recovered Government Archive State Hazardous Waste Facilities List
RGA LF - Recovered Government Archive Solid Waste Facilities List
RGA LUST - Recovered Government Archive Leaking Underground Storage Tank

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were identified in the following databases.

EXECUTIVE SUMMARY

Elevations have been determined from the USGS Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified. Sites with an elevation equal to or higher than the target property have been differentiated below from sites with an elevation lower than the target property.
Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

Unmappable (orphan) sites are not considered in the foregoing analysis.

STANDARD ENVIRONMENTAL RECORDS

Lists of Federal RCRA generators

RCRA-VSQG: RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Very small quantity generators (VSQGs) generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month.

A review of the RCRA-VSQG list, as provided by EDR, and dated 11/30/2025 has revealed that there is 1 RCRA-VSQG site within approximately 0.25 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
USACE CLARENCE CANNO EPA ID:: MO9210890076	20642 HWY J	N 1/8 - 1/4 (0.147 mi.)	A2	16

ADDITIONAL ENVIRONMENTAL RECORDS

Other Ascertainable Records

E MANIFEST: EPA established a national system for tracking hazardous waste shipments electronically. This system, known as ?e-Manifest,? will modernize the nation?s cradle-to-grave hazardous waste tracking process while saving valuable time, resources, and dollars for industry and states.

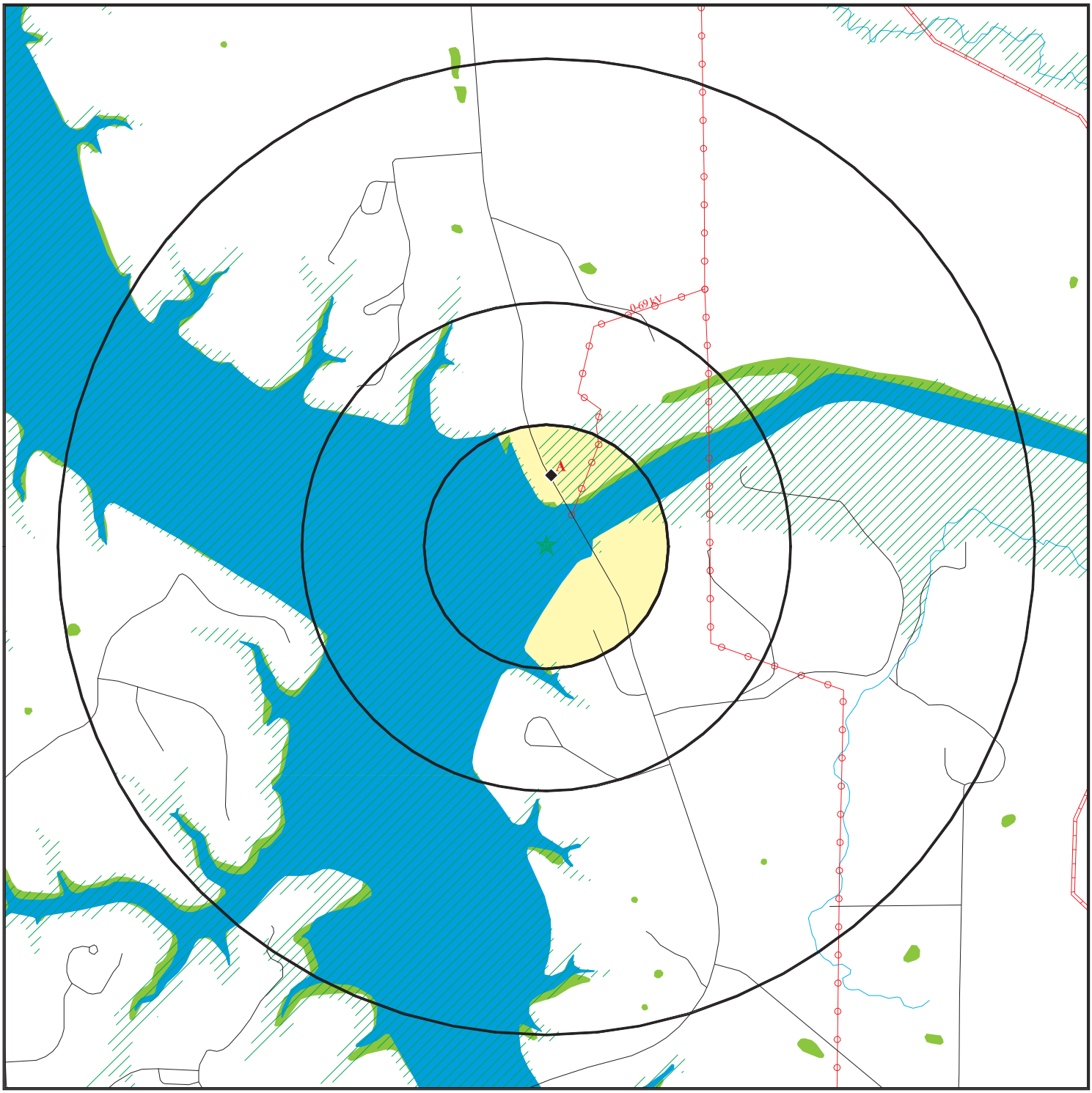
A review of the E MANIFEST list, as provided by EDR, and dated 06/02/2025 has revealed that there is 1 E MANIFEST site within approximately 0.25 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
US CORP OF ENGINEERS	20642 HIGHWAY J	N 1/8 - 1/4 (0.147 mi.)	A1	8

EXECUTIVE SUMMARY

There were no unmapped sites in this report.

OVERVIEW MAP - 8202033.2S



0 1/4 1/2 1 Miles

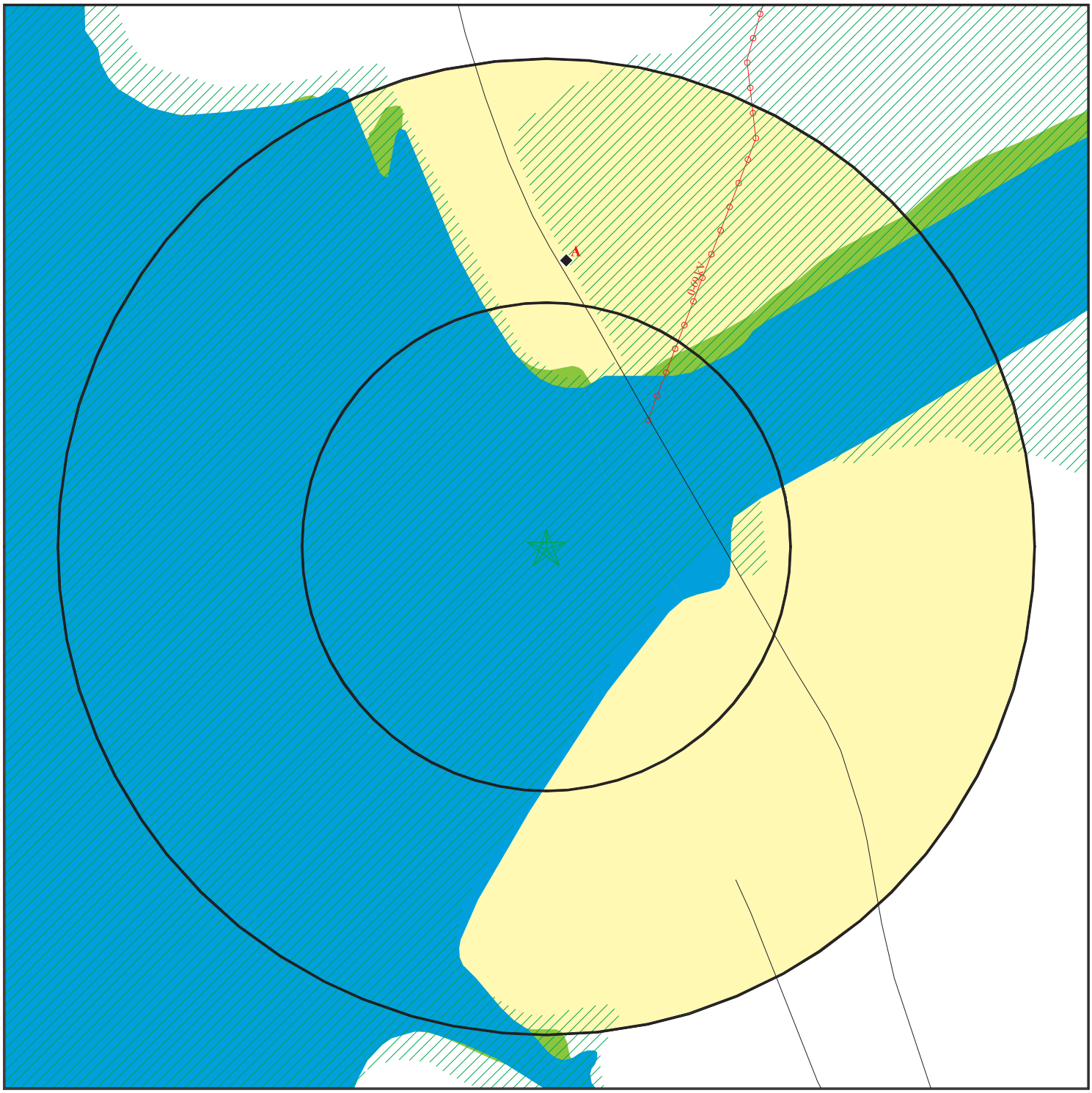
- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Power transmission lines
- Pipelines
- Special Flood Hazard Area (1%)
- 0.2% Annual Chance Flood Hazard
- National Wetland Inventory
- State Wetlands

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME:	Clarence Cannon Dam	CLIENT:	U.S. Army Corps of Engineers
ADDRESS:	43691 Power Plant Perry MO 63462	CONTACT:	Ben Greeling
		INQUIRY #:	8202033.2s
LAT/LONG:	39.523778 / 91.645144	DATE:	December 17, 2025 10:27 am

Copyright © 2025 EDR, Inc. © 2015 TomTom Rel. 2015.

DETAIL MAP - 8202033.2S



- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- Sensitive Receptors
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Power transmission lines
- Special Flood Hazard Area (1%)
- 0.2% Annual Chance Flood Hazard
- National Wetland Inventory
- State Wetlands

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME:	Clarence Cannon Dam	CLIENT:	U.S. Army Corps of Engineers
ADDRESS:	43691 Power Plant Perry MO 63462	CONTACT:	Ben Greeling
		INQUIRY #:	8202033.2s
LAT/LONG:	39.523778 / 91.645144	DATE:	December 17, 2025 10:29 am

Copyright © 2025 EDR, Inc. © 2015 TomTom Rel. 2015.

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
STANDARD ENVIRONMENTAL RECORDS								
Lists of Federal NPL (Superfund) sites								
NPL	1.000		0	0	0	0	NR	0
Proposed NPL	1.000		0	0	0	0	NR	0
NPL LIENS	1.000		0	0	0	0	NR	0
Lists of Federal Delisted NPL sites								
Delisted NPL	1.000		0	0	0	0	NR	0
Lists of Federal sites subject to CERCLA removals and CERCLA orders								
FEDERAL FACILITY	0.500		0	0	0	NR	NR	0
SEMS	0.500		0	0	0	NR	NR	0
Lists of Federal CERCLA sites with NFRAP								
SEMS-ARCHIVE	0.500		0	0	0	NR	NR	0
Lists of Federal RCRA facilities undergoing Corrective Action								
CORRACTS	1.000		0	0	0	0	NR	0
Lists of Federal RCRA TSD facilities								
RCRA-TSDF	0.500		0	0	0	NR	NR	0
Lists of Federal RCRA generators								
RCRA-LQG	0.250		0	0	NR	NR	NR	0
RCRA-SQG	0.250		0	0	NR	NR	NR	0
RCRA-VSQG	0.250		0	1	NR	NR	NR	1
Federal institutional controls / engineering controls registries								
LUCIS	0.500		0	0	0	NR	NR	0
US ENG CONTROLS	0.500		0	0	0	NR	NR	0
US INST CONTROLS	0.500		0	0	0	NR	NR	0
Federal ERNS list								
ERNS	TP		NR	NR	NR	NR	NR	0
Lists of state- and tribal hazardous waste facilities								
SHWS	1.000		0	0	0	0	NR	0
Lists of state and tribal landfills and solid waste disposal facilities								
SWF/LF	0.500		0	0	0	NR	NR	0
Lists of state and tribal leaking storage tanks								
LUST	0.500		0	0	0	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
LAST	0.500		0	0	0	NR	NR	0
INDIAN LUST	0.500		0	0	0	NR	NR	0
Lists of state and tribal registered storage tanks								
FEMA UST	0.250		0	0	NR	NR	NR	0
UST	0.250		0	0	NR	NR	NR	0
AST	0.250		0	0	NR	NR	NR	0
INDIAN UST	0.250		0	0	NR	NR	NR	0
TANKS	0.250		0	0	NR	NR	NR	0
State and tribal institutional control / engineering control registries								
AUL	0.500		0	0	0	NR	NR	0
Lists of state and tribal voluntary cleanup sites								
VCP	0.500		0	0	0	NR	NR	0
INDIAN VCP	0.500		0	0	0	NR	NR	0
Lists of state and tribal brownfield sites								
BROWNFIELDS	0.500		0	0	0	NR	NR	0
ADDITIONAL ENVIRONMENTAL RECORDS								
Local Brownfield lists								
US BROWNFIELDS	0.500		0	0	0	NR	NR	0
Local Lists of Landfill / Solid Waste Disposal Sites								
SWRCY	0.500		0	0	0	NR	NR	0
HIST LF	0.500		0	0	0	NR	NR	0
INDIAN ODI	0.500		0	0	0	NR	NR	0
ODI	0.500		0	0	0	NR	NR	0
DEBRIS REGION 9	0.500		0	0	0	NR	NR	0
IHS OPEN DUMPS	0.500		0	0	0	NR	NR	0
Local Lists of Hazardous waste / Contaminated Sites								
US HIST CDL	TP		NR	NR	NR	NR	NR	0
CDL	TP		NR	NR	NR	NR	NR	0
DEL SHWS	1.000		0	0	0	0	NR	0
US CDL	TP		NR	NR	NR	NR	NR	0
Local Land Records								
LIENS 2	TP		NR	NR	NR	NR	NR	0
Records of Emergency Release Reports								
HMIRS	TP		NR	NR	NR	NR	NR	0
SPILLS	TP		NR	NR	NR	NR	NR	0
SPILLS 90	TP		NR	NR	NR	NR	NR	0
Other Ascertainable Records								
RCRA NonGen / NLR	0.250		0	0	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
FUDS	1.000		0	0	0	0	NR	0
DOD	1.000		0	0	0	0	NR	0
SCRD DRYCLEANERS	0.500		0	0	0	NR	NR	0
US FIN ASSUR	TP		NR	NR	NR	NR	NR	0
EPA WATCH LIST	TP		NR	NR	NR	NR	NR	0
2020 COR ACTION	0.250		0	0	NR	NR	NR	0
TSCA	TP		NR	NR	NR	NR	NR	0
TRIS	TP		NR	NR	NR	NR	NR	0
SSTS	TP		NR	NR	NR	NR	NR	0
ROD	1.000		0	0	0	0	NR	0
RMP	TP		NR	NR	NR	NR	NR	0
RAATS	TP		NR	NR	NR	NR	NR	0
PRP	TP		NR	NR	NR	NR	NR	0
PADS	TP		NR	NR	NR	NR	NR	0
ICIS	TP		NR	NR	NR	NR	NR	0
FTTS	TP		NR	NR	NR	NR	NR	0
MLTS	TP		NR	NR	NR	NR	NR	0
COAL ASH DOE	TP		NR	NR	NR	NR	NR	0
COAL ASH EPA	0.500		0	0	0	NR	NR	0
PCB TRANSFORMER	TP		NR	NR	NR	NR	NR	0
RADINFO	TP		NR	NR	NR	NR	NR	0
HIST FTTS	TP		NR	NR	NR	NR	NR	0
DOT OPS	TP		NR	NR	NR	NR	NR	0
CONSENT	1.000		0	0	0	0	NR	0
INDIAN RESERV	1.000		0	0	0	0	NR	0
FUSRAP	1.000		0	0	0	0	NR	0
UMTRA	0.500		0	0	0	NR	NR	0
LEAD SMELTERS	TP		NR	NR	NR	NR	NR	0
US AIRS	TP		NR	NR	NR	NR	NR	0
US MINES	0.250		0	0	NR	NR	NR	0
MINES MRDS	0.250		0	0	NR	NR	NR	0
ABANDONED MINES	0.250		0	0	NR	NR	NR	0
FINDS	TP		NR	NR	NR	NR	NR	0
ECHO	TP		NR	NR	NR	NR	NR	0
UXO	1.000		0	0	0	0	NR	0
DOCKET HWC	TP		NR	NR	NR	NR	NR	0
FUELS PROGRAM	0.250		0	0	NR	NR	NR	0
PFAS NPL	0.250		0	0	NR	NR	NR	0
PFAS FEDERAL SITES	0.250		0	0	NR	NR	NR	0
PFAS TRIS	0.250		0	0	NR	NR	NR	0
PFAS TSCA	0.250		0	0	NR	NR	NR	0
PFAS RCRA MANIFEST	0.250		0	0	NR	NR	NR	0
PFAS ATSDR	0.250		0	0	NR	NR	NR	0
PFAS WQP	0.250		0	0	NR	NR	NR	0
PFAS PROJECT	0.250		0	0	NR	NR	NR	0
PFAS NPDES	0.250		0	0	NR	NR	NR	0
PFAS ECHO	0.250		0	0	NR	NR	NR	0
PFAS ECHO FIRE TRAIN	0.250		0	0	NR	NR	NR	0
PFAS PT 139 AIRPORT	0.250		0	0	NR	NR	NR	0
AQUEOUS FOAM NRC	0.250		0	0	NR	NR	NR	0
BIOSOLIDS	TP		NR	NR	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
UST FINDER RELEASE	0.500		0	0	0	NR	NR	0
UST FINDER	0.250		0	0	NR	NR	NR	0
E MANIFEST	0.250		0	1	NR	NR	NR	1
PFAS	0.250		0	0	NR	NR	NR	0
AIRS	TP		NR	NR	NR	NR	NR	0
ASBESTOS	TP		NR	NR	NR	NR	NR	0
COAL ASH	0.500		0	0	0	NR	NR	0
DRYCLEANERS	0.250		0	0	NR	NR	NR	0
Financial Assurance	TP		NR	NR	NR	NR	NR	0
MINES	0.250		0	0	NR	NR	NR	0
NPDES	TP		NR	NR	NR	NR	NR	0
MO RRC	TP		NR	NR	NR	NR	NR	0
SMARS	0.500		0	0	0	NR	NR	0
UIC	TP		NR	NR	NR	NR	NR	0
EDR HIGH RISK HISTORICAL RECORDS								
EDR Exclusive Records								
EDR MGP	1.000		0	0	0	0	NR	0
EDR Hist Auto	0.125		0	NR	NR	NR	NR	0
EDR Hist Cleaner	0.125		0	NR	NR	NR	NR	0
EDR RECOVERED GOVERNMENT ARCHIVES								
Exclusive Recovered Govt. Archives								
RGA HWS	TP		NR	NR	NR	NR	NR	0
RGA LF	TP		NR	NR	NR	NR	NR	0
RGA LUST	TP		NR	NR	NR	NR	NR	0
- Totals --		0	0	2	0	0	0	2

NOTES:

TP = Target Property

NR = Not Requested at this Search Distance

Sites may be listed in more than one database

A1
North
1/8-1/4
0.147 mi.
776 ft.

US CORP OF ENGINEERS
20642 HIGHWAY J
MONROE CITY, MO 63456

Site 1 of 2 in cluster A

E MANIFEST **1032362333**
N/A

Relative:
Lower

Actual:
540 ft.

E MANIFEST:

Manifest Tracking Number:	006543820SKS
Last Updated Date:	20180920
Shipped Date:	20180712
Received Date:	20180712
Manifest Status:	Signed
Submission Type:	DataImage5Copy
Origin Type:	Service
Generator EPA ID:	MO9210890076
Generator Name:	Us Corp Of Engineers
Generator Location Street Number:	Not reported
Generator Location Street 1:	20642 HIGHWAY J
Generator Location Street 2:	Not reported
Generator Location City:	MONROE CITY
Generator Location State:	MO
Generator Location Zip:	63456
Generator Mail Street Number:	Not reported
Generator Mail Street 1:	20642 Highway J
Generator Mail Street 2:	Not reported
Generator Mail City:	Monroe City
Generator Mail Zip:	63456
Generator Mail State:	MO
Generator Contact Company Name:	Not reported
Designated Facility EPA ID:	MOD980971626
Designated Facility Name:	Not reported
Designated Facility Mail Street Number:	Not reported
Designated Facility Mail Street 1:	Not reported
Designated Facility Mail Street 2:	2400 Big Bear Boulevard
Designated Facility Mail City:	Columbia
Designated Facility Mail Zip:	65202
Designated Facility Mail State:	MO
Designated Facility Location Street Number:	Not reported
Designated Facility Location Street 1:	2400 Big Bear Boulevard
Designated Facility Location Street 2:	Not reported
Designated Facility Location City:	Columbia
Designated Facility Location Zip:	65202
Designated Facility Location State:	MO
Designated Facility Contact Company Name:	Safety-Kleen Systems, Inc.
Manifest Residue Indicator:	N
Rejection Indicator:	N

Manifest Tracking Number:	007668151SKS
Last Updated Date:	20200616
Shipped Date:	20200527
Received Date:	20200527
Manifest Status:	Signed
Submission Type:	DataImage5Copy
Origin Type:	Service
Generator EPA ID:	MO9210890076
Generator Name:	Us Corp Of Engineers
Generator Location Street Number:	Not reported
Generator Location Street 1:	20642 HIGHWAY J
Generator Location Street 2:	Not reported

US CORP OF ENGINEERS (Continued) **1032362333**

Generator Location City:	MONROE CITY
Generator Location State:	MO
Generator Location Zip:	63456
Generator Mail Street Number:	Not reported
Generator Mail Street 1:	20642 Highway J
Generator Mail Street 2:	Not reported
Generator Mail City:	Monroe City
Generator Mail Zip:	63456
Generator Mail State:	MO
Generator Contact Company Name:	Us Corp Of Engineers
Designated Facility EPA ID:	MOD980971626
Designated Facility Name:	Safety-Kleen Systems, Inc.
Designated Facility Mail Street Number:	Not reported
Designated Facility Mail Street 1:	Not reported
Designated Facility Mail Street 2:	2400 Big Bear Court
Designated Facility Mail City:	Columbia
Designated Facility Mail Zip:	65202
Designated Facility Mail State:	MO
Designated Facility Location Street Number:	Not reported
Designated Facility Location Street 1:	2400 Big Bear Court
Designated Facility Location Street 2:	Not reported
Designated Facility Location City:	Columbia
Designated Facility Location Zip:	65202
Designated Facility Location State:	MO
Designated Facility Contact Company Name:	Not reported
Manifest Residue Indicator:	N
Rejection Indicator:	N

Manifest Tracking Number:	007714229SKS
Last Updated Date:	20210104
Shipped Date:	20201210
Received Date:	20201210
Manifest Status:	Signed
Submission Type:	DataImage5Copy
Origin Type:	Service
Generator EPA ID:	MO9210890076
Generator Name:	Us Corp Of Engineers
Generator Location Street Number:	Not reported
Generator Location Street 1:	20642 HIGHWAY J
Generator Location Street 2:	Not reported
Generator Location City:	MONROE CITY
Generator Location State:	MO
Generator Location Zip:	63456
Generator Mail Street Number:	Not reported
Generator Mail Street 1:	20642 Highway J
Generator Mail Street 2:	Not reported
Generator Mail City:	Monroe City
Generator Mail Zip:	63456
Generator Mail State:	MO
Generator Contact Company Name:	Us Corp Of Engineers
Designated Facility EPA ID:	MOD980971626
Designated Facility Name:	Safety-Kleen Systems, Inc.
Designated Facility Mail Street Number:	Not reported
Designated Facility Mail Street 1:	Not reported
Designated Facility Mail Street 2:	2400 Big Bear Court
Designated Facility Mail City:	Columbia
Designated Facility Mail Zip:	65202

US CORP OF ENGINEERS (Continued) **1032362333**

Designated Facility Mail State:	MO
Designated Facility Location Street Number:	Not reported
Designated Facility Location Street 1:	2400 Big Bear Court
Designated Facility Location Street 2:	Not reported
Designated Facility Location City:	Columbia
Designated Facility Location Zip:	65202
Designated Facility Location State:	MO
Designated Facility Contact Company Name:	Not reported
Manifest Residue Indicator:	N
Rejection Indicator:	N

Manifest Tracking Number:	009411302SKS
Last Updated Date:	20250203
Shipped Date:	20250113
Received Date:	20250113
Manifest Status:	Signed
Submission Type:	DataImage5Copy
Origin Type:	Service
Generator EPA ID:	MO9210890076
Generator Name:	Us Corp Of Engineers
Generator Location Street Number:	Not reported
Generator Location Street 1:	20642 HIGHWAY J
Generator Location Street 2:	Not reported
Generator Location City:	MONROE CITY
Generator Location State:	MO
Generator Location Zip:	63456
Generator Mail Street Number:	Not reported
Generator Mail Street 1:	20642 HIGHWAY J
Generator Mail Street 2:	Not reported
Generator Mail City:	MONROE CITY
Generator Mail Zip:	63456
Generator Mail State:	MO
Generator Contact Company Name:	US CORP OF ENGINEERS
Designated Facility EPA ID:	MOD980971626
Designated Facility Name:	Safety-Kleen Systems, Inc.
Designated Facility Mail Street Number:	Not reported
Designated Facility Mail Street 1:	Not reported
Designated Facility Mail Street 2:	2400 BIG BEAR COURT
Designated Facility Mail City:	COLUMBIA
Designated Facility Mail Zip:	65202
Designated Facility Mail State:	MO
Designated Facility Location Street Number:	Not reported
Designated Facility Location Street 1:	2400 BIG BEAR COURT
Designated Facility Location Street 2:	Not reported
Designated Facility Location City:	COLUMBIA
Designated Facility Location Zip:	65202
Designated Facility Location State:	MO
Designated Facility Contact Company Name:	Not reported
Manifest Residue Indicator:	N
Rejection Indicator:	N

Manifest Tracking Number:	006711187SKS
Last Updated Date:	20190227
Shipped Date:	20190110
Received Date:	20190110
Manifest Status:	Signed
Submission Type:	DataImage5Copy

US CORP OF ENGINEERS (Continued) **1032362333**

Origin Type:	Service
Generator EPA ID:	MO9210890076
Generator Name:	Us Corp Of Engineers
Generator Location Street Number:	Not reported
Generator Location Street 1:	20642 HIGHWAY J
Generator Location Street 2:	Not reported
Generator Location City:	MONROE CITY
Generator Location State:	MO
Generator Location Zip:	63456
Generator Mail Street Number:	Not reported
Generator Mail Street 1:	20642 Highway J
Generator Mail Street 2:	Not reported
Generator Mail City:	Monroe City
Generator Mail Zip:	63456
Generator Mail State:	MO
Generator Contact Company Name:	Not reported
Designated Facility EPA ID:	MOD980971626
Designated Facility Name:	Not reported
Designated Facility Mail Street Number:	Not reported
Designated Facility Mail Street 1:	Not reported
Designated Facility Mail Street 2:	2400 Big Bear Boulevard
Designated Facility Mail City:	Columbia
Designated Facility Mail Zip:	65202
Designated Facility Mail State:	MO
Designated Facility Location Street Number:	Not reported
Designated Facility Location Street 1:	2400 Big Bear Boulevard
Designated Facility Location Street 2:	Not reported
Designated Facility Location City:	Columbia
Designated Facility Location Zip:	65202
Designated Facility Location State:	MO
Designated Facility Contact Company Name:	Safety-Kleen Systems, Inc.
Manifest Residue Indicator:	N
Rejection Indicator:	N
Manifest Tracking Number:	007107033SKS
Last Updated Date:	20191001
Shipped Date:	20190905
Received Date:	20190905
Manifest Status:	Signed
Submission Type:	DataImage5Copy
Origin Type:	Service
Generator EPA ID:	MO9210890076
Generator Name:	Us Corp Of Engineers
Generator Location Street Number:	Not reported
Generator Location Street 1:	20642 HIGHWAY J
Generator Location Street 2:	Not reported
Generator Location City:	MONROE CITY
Generator Location State:	MO
Generator Location Zip:	63456
Generator Mail Street Number:	Not reported
Generator Mail Street 1:	20642 Highway J
Generator Mail Street 2:	Not reported
Generator Mail City:	Monroe City
Generator Mail Zip:	63456
Generator Mail State:	MO
Generator Contact Company Name:	Not reported
Designated Facility EPA ID:	MOD980971626

US CORP OF ENGINEERS (Continued) **1032362333**

Designated Facility Name:	Safety-Kleen Systems, Inc.
Designated Facility Mail Street Number:	Not reported
Designated Facility Mail Street 1:	Not reported
Designated Facility Mail Street 2:	2400 Big Bear Boulevard
Designated Facility Mail City:	Columbia
Designated Facility Mail Zip:	65202
Designated Facility Mail State:	MO
Designated Facility Location Street Number:	Not reported
Designated Facility Location Street 1:	2400 Big Bear Boulevard
Designated Facility Location Street 2:	Not reported
Designated Facility Location City:	Columbia
Designated Facility Location Zip:	65202
Designated Facility Location State:	MO
Designated Facility Contact Company Name:	Not reported
Manifest Residue Indicator:	N
Rejection Indicator:	N

Manifest Tracking Number:	008458104SKS
Last Updated Date:	20221024
Shipped Date:	20220928
Received Date:	20220928
Manifest Status:	Signed
Submission Type:	DataImage5Copy
Origin Type:	Service
Generator EPA ID:	MO9210890076
Generator Name:	Us Corp Of Engineers
Generator Location Street Number:	Not reported
Generator Location Street 1:	20642 HIGHWAY J
Generator Location Street 2:	Not reported
Generator Location City:	MONROE CITY
Generator Location State:	MO
Generator Location Zip:	63456
Generator Mail Street Number:	Not reported
Generator Mail Street 1:	20642 Highway J
Generator Mail Street 2:	Not reported
Generator Mail City:	Monroe City
Generator Mail Zip:	63456
Generator Mail State:	MO
Generator Contact Company Name:	Us Corp Of Engineers
Designated Facility EPA ID:	MOD980971626
Designated Facility Name:	Safety-Kleen Systems, Inc.
Designated Facility Mail Street Number:	Not reported
Designated Facility Mail Street 1:	Not reported
Designated Facility Mail Street 2:	2400 Big Bear Court
Designated Facility Mail City:	Columbia
Designated Facility Mail Zip:	65202
Designated Facility Mail State:	MO
Designated Facility Location Street Number:	Not reported
Designated Facility Location Street 1:	2400 Big Bear Court
Designated Facility Location Street 2:	Not reported
Designated Facility Location City:	Columbia
Designated Facility Location Zip:	65202
Designated Facility Location State:	MO
Designated Facility Contact Company Name:	Not reported
Manifest Residue Indicator:	N
Rejection Indicator:	N

US CORP OF ENGINEERS (Continued) **1032362333**

Manifest Tracking Number:	007071318SKS
Last Updated Date:	20190712
Shipped Date:	20190611
Received Date:	20190612
Manifest Status:	Signed
Submission Type:	DataImage5Copy
Origin Type:	Service
Generator EPA ID:	MO9210890076
Generator Name:	Us Corp Of Engineers
Generator Location Street Number:	Not reported
Generator Location Street 1:	20642 HIGHWAY J
Generator Location Street 2:	Not reported
Generator Location City:	MONROE CITY
Generator Location State:	MO
Generator Location Zip:	63456
Generator Mail Street Number:	Not reported
Generator Mail Street 1:	20642 Highway J
Generator Mail Street 2:	Not reported
Generator Mail City:	Monroe City
Generator Mail Zip:	63456
Generator Mail State:	MO
Generator Contact Company Name:	Not reported
Designated Facility EPA ID:	MOD980971626
Designated Facility Name:	Safety-Kleen Systems, Inc.
Designated Facility Mail Street Number:	Not reported
Designated Facility Mail Street 1:	Not reported
Designated Facility Mail Street 2:	2400 Big Bear Boulevard
Designated Facility Mail City:	Columbia
Designated Facility Mail Zip:	65202
Designated Facility Mail State:	MO
Designated Facility Location Street Number:	Not reported
Designated Facility Location Street 1:	2400 Big Bear Boulevard
Designated Facility Location Street 2:	Not reported
Designated Facility Location City:	Columbia
Designated Facility Location Zip:	65202
Designated Facility Location State:	MO
Designated Facility Contact Company Name:	Not reported
Manifest Residue Indicator:	N
Rejection Indicator:	N

Manifest Tracking Number:	008429866SKS
Last Updated Date:	20240516
Shipped Date:	20240424
Received Date:	20240424
Manifest Status:	Signed
Submission Type:	DataImage5Copy
Origin Type:	Service
Generator EPA ID:	MO9210890076
Generator Name:	Us Corp Of Engineers
Generator Location Street Number:	Not reported
Generator Location Street 1:	20642 HIGHWAY J
Generator Location Street 2:	Not reported
Generator Location City:	MONROE CITY
Generator Location State:	MO
Generator Location Zip:	63456
Generator Mail Street Number:	Not reported
Generator Mail Street 1:	20642 HIGHWAY J

US CORP OF ENGINEERS (Continued) **1032362333**

Generator Mail Street 2:	Not reported
Generator Mail City:	MONROE CITY
Generator Mail Zip:	63456
Generator Mail State:	MO
Generator Contact Company Name:	US CORP OF ENGINEERS
Designated Facility EPA ID:	MOD980971626
Designated Facility Name:	Safety-Kleen Systems, Inc.
Designated Facility Mail Street Number:	Not reported
Designated Facility Mail Street 1:	Not reported
Designated Facility Mail Street 2:	2400 BIG BEAR COURT
Designated Facility Mail City:	COLUMBIA
Designated Facility Mail Zip:	65202
Designated Facility Mail State:	MO
Designated Facility Location Street Number:	Not reported
Designated Facility Location Street 1:	2400 BIG BEAR COURT
Designated Facility Location Street 2:	Not reported
Designated Facility Location City:	COLUMBIA
Designated Facility Location Zip:	65202
Designated Facility Location State:	MO
Designated Facility Contact Company Name:	Not reported
Manifest Residue Indicator:	N
Rejection Indicator:	N

Manifest Tracking Number:	006786818SKS
Last Updated Date:	20181101
Shipped Date:	20181004
Received Date:	20181004
Manifest Status:	Signed
Submission Type:	DataImage5Copy
Origin Type:	Service
Generator EPA ID:	MO9210890076
Generator Name:	Us Corp Of Engineers
Generator Location Street Number:	Not reported
Generator Location Street 1:	20642 HIGHWAY J
Generator Location Street 2:	Not reported
Generator Location City:	MONROE CITY
Generator Location State:	MO
Generator Location Zip:	63456
Generator Mail Street Number:	Not reported
Generator Mail Street 1:	20642 Highway J
Generator Mail Street 2:	Not reported
Generator Mail City:	Monroe City
Generator Mail Zip:	63456
Generator Mail State:	MO
Generator Contact Company Name:	Not reported
Designated Facility EPA ID:	MOD980971626
Designated Facility Name:	Safety-Kleen Systems, Inc.
Designated Facility Mail Street Number:	Not reported
Designated Facility Mail Street 1:	Not reported
Designated Facility Mail Street 2:	2400 Big Bear Boulevard
Designated Facility Mail City:	Columbia
Designated Facility Mail Zip:	65202
Designated Facility Mail State:	MO
Designated Facility Location Street Number:	Not reported
Designated Facility Location Street 1:	2400 Big Bear Boulevard
Designated Facility Location Street 2:	Not reported
Designated Facility Location City:	Columbia

US CORP OF ENGINEERS (Continued) **1032362333**

Designated Facility Location Zip:	65202
Designated Facility Location State:	MO
Designated Facility Contact Company Name:	Not reported
Manifest Residue Indicator:	N
Rejection Indicator:	N

Manifest Tracking Number:	006849087SKS
Last Updated Date:	20190429
Shipped Date:	20190321
Received Date:	20190321
Manifest Status:	Signed
Submission Type:	DataImage5Copy
Origin Type:	Service
Generator EPA ID:	MO9210890076
Generator Name:	Us Corp Of Engineers
Generator Location Street Number:	Not reported
Generator Location Street 1:	20642 HIGHWAY J
Generator Location Street 2:	Not reported
Generator Location City:	MONROE CITY
Generator Location State:	MO
Generator Location Zip:	63456
Generator Mail Street Number:	Not reported
Generator Mail Street 1:	20642 Highway J
Generator Mail Street 2:	Not reported
Generator Mail City:	Monroe City
Generator Mail Zip:	63456
Generator Mail State:	MO
Generator Contact Company Name:	Not reported
Designated Facility EPA ID:	MOD980971626
Designated Facility Name:	Safety-Kleen Systems, Inc.
Designated Facility Mail Street Number:	Not reported
Designated Facility Mail Street 1:	Not reported
Designated Facility Mail Street 2:	2400 Big Bear Boulevard
Designated Facility Mail City:	Columbia
Designated Facility Mail Zip:	65202
Designated Facility Mail State:	MO
Designated Facility Location Street Number:	Not reported
Designated Facility Location Street 1:	2400 Big Bear Boulevard
Designated Facility Location Street 2:	Not reported
Designated Facility Location City:	Columbia
Designated Facility Location Zip:	65202
Designated Facility Location State:	MO
Designated Facility Contact Company Name:	Not reported
Manifest Residue Indicator:	N
Rejection Indicator:	N

Transporter:

Manifest Tracking Number:	007380791SKS
Transporter Line Number:	1
Transporter EPA ID:	TXR000081205
Transporter Name:	Safety-Kleen Systems, Inc.

Waste Line:

Manifest Tracking Number:	007380791SKS
Waste Line Number:	1
U.S. DOT Hazardous Indicator:	Y

US CORP OF ENGINEERS (Continued) **1032362333**

U.S. DOT ID Number:	NA1993
U.S. DOT Description:	Na1993, Waste Na1993 Waste Combustible Liquid, N.O.S. (Petroleum Naphtha) Pgiii Dot-Sp11606 (D039)(Erg#128), Combustible Liquid, Pg Iii
Non-Hazardous Waste Description:	Not reported
Number of Containers:	2
Container Type Code:	DM
Container Type Description:	Metal drums, barrels, kegs
Waste Quantity:	40
Quantity Unit of Measure Code:	G
Quantity Unit of Measure Description:	Gallons
Waste Quantity, in Tons:	0.16680567
Acute Waste Quantity, in Tons:	0
Non-Acute Waste Quantity, in Tons:	0.16680567
Waste Quantity, in Kilograms:	151.29774
Acute Waste Quantity, in Kilograms:	0
Non-Acute Waste Quantity, in Kilorgrams:	151.29774
Management Method Code:	H141
Management Method Description:	STORAGE, BULKING AND/OR TRANSFER OFF SITE
Waste Residue Indicator:	N
Quantity Discrepancy Indicator:	N
Waste Type Discrepancy Indicator:	N
Waste Density:	Not reported
Waste Density Unit of Measure Code:	Not reported
Waste Density Unit of Measure Description:	Not reported
Form Code:	Not reported
Form Code Description:	Not reported
Source Code:	Not reported
Source Code Description:	Not reported
Waste Minimization Code:	Not reported
Waste Minimization Code Description:	Not reported
Consent Number:	Not reported
EPA Waste Indicator:	Y
Federal Waste Codes:	D039
Quantity Haz Kg:	151.29774
Quantity Haz Tons:	0.16680567
Quantity Non Haz Kg:	0
Quantity Non Haz Tons:	0
State Waste Codes:	Not reported

Click this hyperlink while viewing on your computer to access
7 additional US EManifest: record(s) in the EDR Site Report.

A2 **USACE CLARENCE CANNON DAM** **RCRA-VSQG** **1007104101**
North **20642 HWY J** **MO9210890076**
1/8-1/4 **MONROE CITY, MO 63456**
0.147 mi.
776 ft. **Site 2 of 2 in cluster A**

Relative: **Lower**

Actual: **540 ft.**

RCRA Listings:

Date Form Received by Agency:	20250220
Handler Name:	Usace Clarence Cannon Dam
Handler Address:	20642 Hwy J
Handler City,State,Zip:	MONROE CITY, MO 63456-2949
EPA ID:	MO9210890076
Contact Name:	TIMOTHY EASH
Contact Address:	20642 HWY J
Contact City,State,Zip:	MONROE CITY, MO 63456-2949
Contact Telephone:	573-735-4097

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Contact Fax:	Not reported
Contact Email:	Not reported
Contact Title:	PROJECT OPERATIONS MANAGER
EPA Region:	07
Land Type:	Federal
Federal Waste Generator Description:	Conditionally Exempt Small Quantity Generator
Non-Notifier:	Not reported
Biennial Report Cycle:	Not reported
Accessibility:	Not reported
Active Site Indicator:	Handler Activities
State District Owner:	Not reported
State District:	Not reported
Mailing Address:	20642 HWY J
Mailing City,State,Zip:	MONROE CITY, MO 63456-2949
Owner Name:	Usace Mississippi Valley Division
Owner Type:	Federal
Operator Name:	Usace Mississippi Valley Division
Operator Type:	Federal
Short-Term Generator Activity:	No
Importer Activity:	No
Mixed Waste Generator:	No
Transporter Activity:	No
Transfer Facility Activity:	No
Recycler Activity with Storage:	No
Small Quantity On-Site Burner Exemption:	No
Smelting Melting and Refining Furnace Exemption:	No
Underground Injection Control:	No
Off-Site Waste Receipt:	No
Universal Waste Indicator:	No
Universal Waste Destination Facility:	No
Federal Universal Waste:	No
Active Site State-Reg Handler:	---
Federal Facility Indicator:	The land is federally-owned, The site is federally-owned, The site is federally-operated
Hazardous Secondary Material Indicator:	N
Sub-Part K Indicator:	Not reported
2018 GPRA Permit Baseline:	Not on the Baseline
2018 GPRA Renewals Baseline:	Not on the Baseline
202 GPRA Corrective Action Baseline:	No
Subject to Corrective Action Universe:	No
Non-TSDFs Where RCRA CA has Been Imposed Universe:	No
Corrective Action Priority Ranking:	No NCAPS ranking
Environmental Control Indicator:	No
Institutional Control Indicator:	No
Human Exposure Controls Indicator:	N/A
Groundwater Controls Indicator:	N/A
Significant Non-Complier Universe:	No
Unaddressed Significant Non-Complier Universe:	No
Addressed Significant Non-Complier Universe:	No
Significant Non-Complier With a Compliance Schedule Universe:	No
Financial Assurance Required:	Not reported
Handler Date of Last Change:	20250402
Recognized Trader-Importer:	No
Recognized Trader-Exporter:	No
Importer of Spent Lead Acid Batteries:	No
Exporter of Spent Lead Acid Batteries:	No
Recycler Activity Without Storage:	No

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Manifest Broker: No
Sub-Part P Indicator: No

Hazardous Waste Summary:
Waste Code: D001
Waste Description: Ignitable Waste

Waste Code: D008
Waste Description: Lead

Waste Code: D009
Waste Description: Mercury

Waste Code: D018
Waste Description: Benzene

Waste Code: D026
Waste Description: Cresol

Waste Code: D039
Waste Description: Tetrachloroethylene

Waste Code: D040
Waste Description: Trichloroethylene

Waste Code: F001
Waste Description: The Following Spent Halogenated Solvents Used In Degreasing: Tetrachloroethylene, Trichlorethylene, Methylene Chloride, 1,1,1-Trichloroethane, Carbon Tetrachloride And Chlorinated Fluorocarbons; All Spent Solvent Mixtures/Blends Used In Degreasing Containing, Before Use, A Total Of Ten Percent Or More (By Volume) Of One Or More Of The Above Halogenated Solvents Or Those Solvents Listed In F002, F004, And F005; And Still Bottoms From The Recovery Of These Spent Solvents And Spent Solvent Mixtures.

Handler - Owner Operator:
Owner/Operator Indicator: Owner
Owner/Operator Name: USACE MISSISSIPPI VALLEY DIVISION
Legal Status: Federal
Date Became Current: 20030813
Date Ended Current: Not reported
Owner/Operator Address: 1222 SPRUCE ST
Owner/Operator City,State,Zip: ST LOUIS, MO 63103-2833
Owner/Operator Telephone: 314-865-6335
Owner/Operator Telephone Ext: Not reported
Owner/Operator Fax: Not reported
Owner/Operator Email: Not reported

Owner/Operator Indicator: Owner
Owner/Operator Name: CORPS OF ENGINEERS
Legal Status: Federal
Date Became Current: Not reported
Date Ended Current: Not reported
Owner/Operator Address: Not reported
Owner/Operator City,State,Zip: Not reported

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Owner/Operator Telephone: Not reported
Owner/Operator Telephone Ext: Not reported
Owner/Operator Fax: Not reported
Owner/Operator Email: Not reported

Owner/Operator Indicator: Owner
Owner/Operator Name: USACE MISSISSIPPI VALLEY DIVISION
Legal Status: Federal
Date Became Current: 20030813
Date Ended Current: Not reported
Owner/Operator Address: 1222 SPRUCE ST
Owner/Operator City,State,Zip: ST LOUIS, MO 63103-2833
Owner/Operator Telephone: 314-865-6335
Owner/Operator Telephone Ext: Not reported
Owner/Operator Fax: Not reported
Owner/Operator Email: Not reported

Owner/Operator Indicator: Operator
Owner/Operator Name: USACE MISSISSIPPI VALLEY DIVISION
Legal Status: Federal
Date Became Current: 20030813
Date Ended Current: Not reported
Owner/Operator Address: 1222 SPRUCE ST
Owner/Operator City,State,Zip: ST LOUIS, MO 63103-2833
Owner/Operator Telephone: 314-865-6335
Owner/Operator Telephone Ext: Not reported
Owner/Operator Fax: Not reported
Owner/Operator Email: Not reported

Owner/Operator Indicator: Operator
Owner/Operator Name: USACE MISSISSIPPI VALLEY DIVISION
Legal Status: Federal
Date Became Current: 20030813
Date Ended Current: Not reported
Owner/Operator Address: 1222 SPRUCE ST
Owner/Operator City,State,Zip: ST LOUIS, MO 63103-2833
Owner/Operator Telephone: 314-865-6335
Owner/Operator Telephone Ext: Not reported
Owner/Operator Fax: Not reported
Owner/Operator Email: Not reported

Owner/Operator Indicator: Owner
Owner/Operator Name: ST LOUIS DIST CORPS OF ENGRS
Legal Status: Federal
Date Became Current: 20030813
Date Ended Current: Not reported
Owner/Operator Address: 122 SPRUCE ST
Owner/Operator City,State,Zip: ST LOUIS, MO 63103
Owner/Operator Telephone: 314-332-8010
Owner/Operator Telephone Ext: Not reported
Owner/Operator Fax: Not reported
Owner/Operator Email: Not reported

Owner/Operator Indicator: Owner
Owner/Operator Name: ST LOUIS DIST CORP OF ENGINEERS
Legal Status: Federal
Date Became Current: Not reported

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Date Ended Current: Not reported
Owner/Operator Address: 122 SPRUCE ST
Owner/Operator City,State,Zip: ST LOUIS, MO 63103
Owner/Operator Telephone: 314-331-8010
Owner/Operator Telephone Ext: Not reported
Owner/Operator Fax: Not reported
Owner/Operator Email: Not reported

Owner/Operator Indicator: Owner
Owner/Operator Name: ST LOUIS DIST CORPS OF ENGRS
Legal Status: Federal
Date Became Current: 20030813
Date Ended Current: Not reported
Owner/Operator Address: 122 SPRUCE ST
Owner/Operator City,State,Zip: ST LOUIS, MO 63103
Owner/Operator Telephone: 314-332-8010
Owner/Operator Telephone Ext: Not reported
Owner/Operator Fax: Not reported
Owner/Operator Email: Not reported

Owner/Operator Indicator: Operator
Owner/Operator Name: ST LOUIS DIST CORPS OF ENGRS
Legal Status: Federal
Date Became Current: 20030813
Date Ended Current: Not reported
Owner/Operator Address: 122 SPRUCE ST
Owner/Operator City,State,Zip: ST LOUIS, MO 63103
Owner/Operator Telephone: 314-332-8010
Owner/Operator Telephone Ext: Not reported
Owner/Operator Fax: Not reported
Owner/Operator Email: Not reported

Owner/Operator Indicator: Owner
Owner/Operator Name: ST LOUIS DIST CORPS OF ENGRS
Legal Status: Federal
Date Became Current: 20030813
Date Ended Current: Not reported
Owner/Operator Address: 122 SPRUCE ST
Owner/Operator City,State,Zip: ST LOUIS, MO 63103
Owner/Operator Telephone: 314-332-8010
Owner/Operator Telephone Ext: Not reported
Owner/Operator Fax: Not reported
Owner/Operator Email: Not reported

Owner/Operator Indicator: Owner
Owner/Operator Name: ST LOUIS DIST CORPS OF ENGRS
Legal Status: Federal
Date Became Current: 20030813
Date Ended Current: Not reported
Owner/Operator Address: 122 SPRUCE ST
Owner/Operator City,State,Zip: ST LOUIS, MO 63103
Owner/Operator Telephone: 314-332-8010
Owner/Operator Telephone Ext: Not reported
Owner/Operator Fax: Not reported
Owner/Operator Email: Not reported

Owner/Operator Indicator: Operator

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Owner/Operator Name: ST LOUIS DIST CORPS OF ENGRS
Legal Status: Federal
Date Became Current: 20030813
Date Ended Current: Not reported
Owner/Operator Address: 122 SPRUCE ST
Owner/Operator City,State,Zip: ST LOUIS, MO 63103
Owner/Operator Telephone: 314-332-8010
Owner/Operator Telephone Ext: Not reported
Owner/Operator Fax: Not reported
Owner/Operator Email: Not reported

Owner/Operator Indicator: Operator
Owner/Operator Name: ST LOUIS DIST CORPS OF ENGRS
Legal Status: Federal
Date Became Current: 20030813
Date Ended Current: Not reported
Owner/Operator Address: 122 SPRUCE ST
Owner/Operator City,State,Zip: ST LOUIS, MO 63103
Owner/Operator Telephone: 314-332-8010
Owner/Operator Telephone Ext: Not reported
Owner/Operator Fax: Not reported
Owner/Operator Email: Not reported

Owner/Operator Indicator: Operator
Owner/Operator Name: ST LOUIS DIST CORPS OF ENGRS
Legal Status: Federal
Date Became Current: 20030813
Date Ended Current: Not reported
Owner/Operator Address: 122 SPRUCE ST
Owner/Operator City,State,Zip: ST LOUIS, MO 63103
Owner/Operator Telephone: 314-332-8010
Owner/Operator Telephone Ext: Not reported
Owner/Operator Fax: Not reported
Owner/Operator Email: Not reported

Owner/Operator Indicator: Operator
Owner/Operator Name: NAME UNKNOWN
Legal Status: Federal
Date Became Current: Not reported
Date Ended Current: Not reported
Owner/Operator Address: Not reported
Owner/Operator City,State,Zip: Not reported
Owner/Operator Telephone: Not reported
Owner/Operator Telephone Ext: Not reported
Owner/Operator Fax: Not reported
Owner/Operator Email: Not reported

Owner/Operator Indicator: Operator
Owner/Operator Name: ST LOUIS DIST CORP OF ENGINEERS
Legal Status: Federal
Date Became Current: Not reported
Date Ended Current: Not reported
Owner/Operator Address: 122 SPRUCE ST
Owner/Operator City,State,Zip: ST LOUIS, MO 63103
Owner/Operator Telephone: 314-331-8010
Owner/Operator Telephone Ext: Not reported
Owner/Operator Fax: Not reported

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Owner/Operator Email: Not reported

Historic Generators:

Receive Date: 20160708
Handler Name: USACE CLARENCE CANNON DAM
Federal Waste Generator Description: Small Quantity Generator
State District Owner: Not reported
Large Quantity Handler of Universal Waste: No
Recognized Trader Importer: No
Recognized Trader Exporter: No
Spent Lead Acid Battery Importer: No
Spent Lead Acid Battery Exporter: No
Current Record: No
Non Storage Recycler Activity: Not reported
Electronic Manifest Broker: Not reported

Receive Date: 20250220
Handler Name: USACE CLARENCE CANNON DAM
Federal Waste Generator Description: Very Small Quantity Generator (formerly Conditionally-Exempt Small Quantity Generator
State District Owner: Not reported
Large Quantity Handler of Universal Waste: No
Recognized Trader Importer: No
Recognized Trader Exporter: No
Spent Lead Acid Battery Importer: No
Spent Lead Acid Battery Exporter: No
Current Record: Yes
Non Storage Recycler Activity: No
Electronic Manifest Broker: No

Receive Date: 19950518
Handler Name: CANNON POWER PLANT
Federal Waste Generator Description: Small Quantity Generator
State District Owner: Not reported
Large Quantity Handler of Universal Waste: No
Recognized Trader Importer: No
Recognized Trader Exporter: No
Spent Lead Acid Battery Importer: No
Spent Lead Acid Battery Exporter: No
Current Record: No
Non Storage Recycler Activity: Not reported
Electronic Manifest Broker: Not reported

Receive Date: 20030813
Handler Name: CORP OF ENGINEERS CLARENCE CANNON DAM
Federal Waste Generator Description: Small Quantity Generator
State District Owner: Not reported
Large Quantity Handler of Universal Waste: No
Recognized Trader Importer: No
Recognized Trader Exporter: No
Spent Lead Acid Battery Importer: No
Spent Lead Acid Battery Exporter: No
Current Record: No
Non Storage Recycler Activity: Not reported
Electronic Manifest Broker: Not reported

Receive Date: 20190830

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Handler Name: USACE CLARENCE CANNON DAM
Federal Waste Generator Description: Small Quantity Generator
State District Owner: Not reported
Large Quantity Handler of Universal Waste: No
Recognized Trader Importer: No
Recognized Trader Exporter: No
Spent Lead Acid Battery Importer: No
Spent Lead Acid Battery Exporter: No
Current Record: No
Non Storage Recycler Activity: Not reported
Electronic Manifest Broker: Not reported

Receive Date: 20231108
Handler Name: USACE CLARENCE CANNON DAM
Federal Waste Generator Description: Small Quantity Generator
State District Owner: Not reported
Large Quantity Handler of Universal Waste: No
Recognized Trader Importer: No
Recognized Trader Exporter: No
Spent Lead Acid Battery Importer: No
Spent Lead Acid Battery Exporter: No
Current Record: No
Non Storage Recycler Activity: No
Electronic Manifest Broker: No

Receive Date: 20240904
Handler Name: USACE CLARENCE CANNON DAM
Federal Waste Generator Description: Small Quantity Generator
State District Owner: Not reported
Large Quantity Handler of Universal Waste: No
Recognized Trader Importer: No
Recognized Trader Exporter: No
Spent Lead Acid Battery Importer: No
Spent Lead Acid Battery Exporter: No
Current Record: No
Non Storage Recycler Activity: No
Electronic Manifest Broker: No

Receive Date: 20250205
Handler Name: USACE CLARENCE CANNON DAM
Federal Waste Generator Description: Very Small Quantity Generator (formerly Conditionally-Exempt Small Quantity Generator
State District Owner: Not reported
Large Quantity Handler of Universal Waste: No
Recognized Trader Importer: No
Recognized Trader Exporter: No
Spent Lead Acid Battery Importer: No
Spent Lead Acid Battery Exporter: No
Current Record: No
Non Storage Recycler Activity: No
Electronic Manifest Broker: No

List of NAICS Codes and Descriptions:
NAICS Code: 221111
NAICS Description: Hydroelectric Power Generation

NAICS Code: 54133

USACE CLARENCE CANNON DAM (Continued) **1007104101**

NAICS Description: Engineering Services

Has the Facility Received Notices of Violations:

Found Violation:	No
Agency Which Determined Violation:	Not reported
Violation Short Description:	Not reported
Date Violation was Determined:	Not reported
Actual Return to Compliance Date:	Not reported
Return to Compliance Qualifier:	Not reported
Violation Responsible Agency:	Not reported
Scheduled Compliance Date:	Not reported
Enforcement Identifier:	Not reported
Date of Enforcement Action:	Not reported
Enforcement Responsible Agency:	Not reported
Enforcement Docket Number:	Not reported
Enforcement Attorney:	Not reported
Corrective Action Component:	Not reported
Appeal Initiated Date:	Not reported
Appeal Resolution Date:	Not reported
Disposition Status Date:	Not reported
Disposition Status:	Not reported
Disposition Status Description:	Not reported
Consent/Final Order Sequence Number:	Not reported
Consent/Final Order Respondent Name:	Not reported
Consent/Final Order Lead Agency:	Not reported
Enforcement Type:	Not reported
Enforcement Responsible Person:	Not reported
Enforcement Responsible Sub-Organization:	Not reported
SEP Sequence Number:	Not reported
SEP Expenditure Amount:	Not reported
SEP Scheduled Completion Date:	Not reported
SEP Actual Date:	Not reported
SEP Defaulted Date:	Not reported
SEP Type:	Not reported
SEP Type Description:	Not reported
Proposed Amount:	Not reported
Final Monetary Amount:	Not reported
Paid Amount:	Not reported
Final Count:	Not reported
Final Amount:	Not reported

Found Violation:	No
Agency Which Determined Violation:	Not reported
Violation Short Description:	Not reported
Date Violation was Determined:	Not reported
Actual Return to Compliance Date:	Not reported
Return to Compliance Qualifier:	Not reported
Violation Responsible Agency:	Not reported
Scheduled Compliance Date:	Not reported
Enforcement Identifier:	Not reported
Date of Enforcement Action:	Not reported
Enforcement Responsible Agency:	Not reported
Enforcement Docket Number:	Not reported
Enforcement Attorney:	Not reported
Corrective Action Component:	Not reported
Appeal Initiated Date:	Not reported
Appeal Resolution Date:	Not reported

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Disposition Status Date:	Not reported
Disposition Status:	Not reported
Disposition Status Description:	Not reported
Consent/Final Order Sequence Number:	Not reported
Consent/Final Order Respondent Name:	Not reported
Consent/Final Order Lead Agency:	Not reported
Enforcement Type:	Not reported
Enforcement Responsible Person:	Not reported
Enforcement Responsible Sub-Organization:	Not reported
SEP Sequence Number:	Not reported
SEP Expenditure Amount:	Not reported
SEP Scheduled Completion Date:	Not reported
SEP Actual Date:	Not reported
SEP Defaulted Date:	Not reported
SEP Type:	Not reported
SEP Type Description:	Not reported
Proposed Amount:	Not reported
Final Monetary Amount:	Not reported
Paid Amount:	Not reported
Final Count:	Not reported
Final Amount:	Not reported

Found Violation:	Yes
Agency Which Determined Violation:	State
Violation Short Description:	Generators - General
Date Violation was Determined:	19931215
Actual Return to Compliance Date:	19940304
Return to Compliance Qualifier:	Observed
Violation Responsible Agency:	State
Scheduled Compliance Date:	Not reported
Enforcement Identifier:	000
Date of Enforcement Action:	19940110
Enforcement Responsible Agency:	State
Enforcement Docket Number:	Not reported
Enforcement Attorney:	MO
Corrective Action Component:	No
Appeal Initiated Date:	Not reported
Appeal Resolution Date:	Not reported
Disposition Status Date:	Not reported
Disposition Status:	Not reported
Disposition Status Description:	Not reported
Consent/Final Order Sequence Number:	Not reported
Consent/Final Order Respondent Name:	Not reported
Consent/Final Order Lead Agency:	Not reported
Enforcement Type:	WRITTEN INFORMAL
Enforcement Responsible Person:	MOSW
Enforcement Responsible Sub-Organization:	Not reported
SEP Sequence Number:	Not reported
SEP Expenditure Amount:	Not reported
SEP Scheduled Completion Date:	Not reported
SEP Actual Date:	Not reported
SEP Defaulted Date:	Not reported
SEP Type:	Not reported
SEP Type Description:	Not reported
Proposed Amount:	Not reported
Final Monetary Amount:	Not reported
Paid Amount:	Not reported

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Final Count:	Not reported
Final Amount:	Not reported
Found Violation:	Yes
Agency Which Determined Violation:	State
Violation Short Description:	Generators - General
Date Violation was Determined:	19931215
Actual Return to Compliance Date:	19931229
Return to Compliance Qualifier:	Observed
Violation Responsible Agency:	State
Scheduled Compliance Date:	19931230
Enforcement Identifier:	000
Date of Enforcement Action:	19931222
Enforcement Responsible Agency:	State
Enforcement Docket Number:	Not reported
Enforcement Attorney:	MO
Corrective Action Component:	No
Appeal Initiated Date:	Not reported
Appeal Resolution Date:	Not reported
Disposition Status Date:	Not reported
Disposition Status:	Not reported
Disposition Status Description:	Not reported
Consent/Final Order Sequence Number:	Not reported
Consent/Final Order Respondent Name:	Not reported
Consent/Final Order Lead Agency:	Not reported
Enforcement Type:	WRITTEN INFORMAL
Enforcement Responsible Person:	MOSW
Enforcement Responsible Sub-Organization:	Not reported
SEP Sequence Number:	Not reported
SEP Expenditure Amount:	Not reported
SEP Scheduled Completion Date:	Not reported
SEP Actual Date:	Not reported
SEP Defaulted Date:	Not reported
SEP Type:	Not reported
SEP Type Description:	Not reported
Proposed Amount:	Not reported
Final Monetary Amount:	Not reported
Paid Amount:	Not reported
Final Count:	Not reported
Final Amount:	Not reported
Found Violation:	Yes
Agency Which Determined Violation:	State
Violation Short Description:	Generators - General
Date Violation was Determined:	19931215
Actual Return to Compliance Date:	19940304
Return to Compliance Qualifier:	Observed
Violation Responsible Agency:	State
Scheduled Compliance Date:	Not reported
Enforcement Identifier:	000
Date of Enforcement Action:	19931222
Enforcement Responsible Agency:	State
Enforcement Docket Number:	Not reported
Enforcement Attorney:	MO
Corrective Action Component:	No
Appeal Initiated Date:	Not reported
Appeal Resolution Date:	Not reported

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Disposition Status Date:	Not reported
Disposition Status:	Not reported
Disposition Status Description:	Not reported
Consent/Final Order Sequence Number:	Not reported
Consent/Final Order Respondent Name:	Not reported
Consent/Final Order Lead Agency:	Not reported
Enforcement Type:	WRITTEN INFORMAL
Enforcement Responsible Person:	MOSW
Enforcement Responsible Sub-Organization:	Not reported
SEP Sequence Number:	Not reported
SEP Expenditure Amount:	Not reported
SEP Scheduled Completion Date:	Not reported
SEP Actual Date:	Not reported
SEP Defaulted Date:	Not reported
SEP Type:	Not reported
SEP Type Description:	Not reported
Proposed Amount:	Not reported
Final Monetary Amount:	Not reported
Paid Amount:	Not reported
Final Count:	Not reported
Final Amount:	Not reported

Found Violation:	Yes
Agency Which Determined Violation:	State
Violation Short Description:	LDR - General
Date Violation was Determined:	19931215
Actual Return to Compliance Date:	19931229
Return to Compliance Qualifier:	Observed
Violation Responsible Agency:	State
Scheduled Compliance Date:	19931230
Enforcement Identifier:	000
Date of Enforcement Action:	19931222
Enforcement Responsible Agency:	State
Enforcement Docket Number:	Not reported
Enforcement Attorney:	MO
Corrective Action Component:	No
Appeal Initiated Date:	Not reported
Appeal Resolution Date:	Not reported
Disposition Status Date:	Not reported
Disposition Status:	Not reported
Disposition Status Description:	Not reported
Consent/Final Order Sequence Number:	Not reported
Consent/Final Order Respondent Name:	Not reported
Consent/Final Order Lead Agency:	Not reported
Enforcement Type:	WRITTEN INFORMAL
Enforcement Responsible Person:	MOSW
Enforcement Responsible Sub-Organization:	Not reported
SEP Sequence Number:	Not reported
SEP Expenditure Amount:	Not reported
SEP Scheduled Completion Date:	Not reported
SEP Actual Date:	Not reported
SEP Defaulted Date:	Not reported
SEP Type:	Not reported
SEP Type Description:	Not reported
Proposed Amount:	Not reported
Final Monetary Amount:	Not reported
Paid Amount:	Not reported

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Final Count:	Not reported
Final Amount:	Not reported
Found Violation:	Yes
Agency Which Determined Violation:	State
Violation Short Description:	Generators - General
Date Violation was Determined:	19931215
Actual Return to Compliance Date:	19931229
Return to Compliance Qualifier:	Observed
Violation Responsible Agency:	State
Scheduled Compliance Date:	19931230
Enforcement Identifier:	000
Date of Enforcement Action:	19931222
Enforcement Responsible Agency:	State
Enforcement Docket Number:	Not reported
Enforcement Attorney:	MO
Corrective Action Component:	No
Appeal Initiated Date:	Not reported
Appeal Resolution Date:	Not reported
Disposition Status Date:	Not reported
Disposition Status:	Not reported
Disposition Status Description:	Not reported
Consent/Final Order Sequence Number:	Not reported
Consent/Final Order Respondent Name:	Not reported
Consent/Final Order Lead Agency:	Not reported
Enforcement Type:	WRITTEN INFORMAL
Enforcement Responsible Person:	MOSW
Enforcement Responsible Sub-Organization:	Not reported
SEP Sequence Number:	Not reported
SEP Expenditure Amount:	Not reported
SEP Scheduled Completion Date:	Not reported
SEP Actual Date:	Not reported
SEP Defaulted Date:	Not reported
SEP Type:	Not reported
SEP Type Description:	Not reported
Proposed Amount:	Not reported
Final Monetary Amount:	Not reported
Paid Amount:	Not reported
Final Count:	Not reported
Final Amount:	Not reported
Found Violation:	Yes
Agency Which Determined Violation:	State
Violation Short Description:	Generators - General
Date Violation was Determined:	19931215
Actual Return to Compliance Date:	19940304
Return to Compliance Qualifier:	Observed
Violation Responsible Agency:	State
Scheduled Compliance Date:	Not reported
Enforcement Identifier:	000
Date of Enforcement Action:	19940110
Enforcement Responsible Agency:	State
Enforcement Docket Number:	Not reported
Enforcement Attorney:	MO
Corrective Action Component:	No
Appeal Initiated Date:	Not reported
Appeal Resolution Date:	Not reported

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Disposition Status Date:	Not reported
Disposition Status:	Not reported
Disposition Status Description:	Not reported
Consent/Final Order Sequence Number:	Not reported
Consent/Final Order Respondent Name:	Not reported
Consent/Final Order Lead Agency:	Not reported
Enforcement Type:	WRITTEN INFORMAL
Enforcement Responsible Person:	MOSW
Enforcement Responsible Sub-Organization:	Not reported
SEP Sequence Number:	Not reported
SEP Expenditure Amount:	Not reported
SEP Scheduled Completion Date:	Not reported
SEP Actual Date:	Not reported
SEP Defaulted Date:	Not reported
SEP Type:	Not reported
SEP Type Description:	Not reported
Proposed Amount:	Not reported
Final Monetary Amount:	Not reported
Paid Amount:	Not reported
Final Count:	Not reported
Final Amount:	Not reported

Found Violation:	Yes
Agency Which Determined Violation:	State
Violation Short Description:	Generators - General
Date Violation was Determined:	19931215
Actual Return to Compliance Date:	19931229
Return to Compliance Qualifier:	Observed
Violation Responsible Agency:	State
Scheduled Compliance Date:	19931230
Enforcement Identifier:	000
Date of Enforcement Action:	19931222
Enforcement Responsible Agency:	State
Enforcement Docket Number:	Not reported
Enforcement Attorney:	MO
Corrective Action Component:	No
Appeal Initiated Date:	Not reported
Appeal Resolution Date:	Not reported
Disposition Status Date:	Not reported
Disposition Status:	Not reported
Disposition Status Description:	Not reported
Consent/Final Order Sequence Number:	Not reported
Consent/Final Order Respondent Name:	Not reported
Consent/Final Order Lead Agency:	Not reported
Enforcement Type:	WRITTEN INFORMAL
Enforcement Responsible Person:	MOSW
Enforcement Responsible Sub-Organization:	Not reported
SEP Sequence Number:	Not reported
SEP Expenditure Amount:	Not reported
SEP Scheduled Completion Date:	Not reported
SEP Actual Date:	Not reported
SEP Defaulted Date:	Not reported
SEP Type:	Not reported
SEP Type Description:	Not reported
Proposed Amount:	Not reported
Final Monetary Amount:	Not reported
Paid Amount:	Not reported

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Final Count:	Not reported
Final Amount:	Not reported
Found Violation:	Yes
Agency Which Determined Violation:	State
Violation Short Description:	Generators - Pre-transport
Date Violation was Determined:	19931215
Actual Return to Compliance Date:	19931229
Return to Compliance Qualifier:	Observed
Violation Responsible Agency:	State
Scheduled Compliance Date:	19931230
Enforcement Identifier:	000
Date of Enforcement Action:	19931222
Enforcement Responsible Agency:	State
Enforcement Docket Number:	Not reported
Enforcement Attorney:	MO
Corrective Action Component:	No
Appeal Initiated Date:	Not reported
Appeal Resolution Date:	Not reported
Disposition Status Date:	Not reported
Disposition Status:	Not reported
Disposition Status Description:	Not reported
Consent/Final Order Sequence Number:	Not reported
Consent/Final Order Respondent Name:	Not reported
Consent/Final Order Lead Agency:	Not reported
Enforcement Type:	WRITTEN INFORMAL
Enforcement Responsible Person:	MOSW
Enforcement Responsible Sub-Organization:	Not reported
SEP Sequence Number:	Not reported
SEP Expenditure Amount:	Not reported
SEP Scheduled Completion Date:	Not reported
SEP Actual Date:	Not reported
SEP Defaulted Date:	Not reported
SEP Type:	Not reported
SEP Type Description:	Not reported
Proposed Amount:	Not reported
Final Monetary Amount:	Not reported
Paid Amount:	Not reported
Final Count:	Not reported
Final Amount:	Not reported
Found Violation:	Yes
Agency Which Determined Violation:	State
Violation Short Description:	Generators - General
Date Violation was Determined:	19931215
Actual Return to Compliance Date:	19940304
Return to Compliance Qualifier:	Observed
Violation Responsible Agency:	State
Scheduled Compliance Date:	Not reported
Enforcement Identifier:	000
Date of Enforcement Action:	19940110
Enforcement Responsible Agency:	State
Enforcement Docket Number:	Not reported
Enforcement Attorney:	MO
Corrective Action Component:	No
Appeal Initiated Date:	Not reported
Appeal Resolution Date:	Not reported

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Disposition Status Date: Not reported
Disposition Status: Not reported
Disposition Status Description: Not reported
Consent/Final Order Sequence Number: Not reported
Consent/Final Order Respondent Name: Not reported
Consent/Final Order Lead Agency: Not reported
Enforcement Type: WRITTEN INFORMAL
Enforcement Responsible Person: MOSW
Enforcement Responsible Sub-Organization: Not reported
SEP Sequence Number: Not reported
SEP Expenditure Amount: Not reported
SEP Scheduled Completion Date: Not reported
SEP Actual Date: Not reported
SEP Defaulted Date: Not reported
SEP Type: Not reported
SEP Type Description: Not reported
Proposed Amount: Not reported
Final Monetary Amount: Not reported
Paid Amount: Not reported
Final Count: Not reported
Final Amount: Not reported

Found Violation: Yes
Agency Which Determined Violation: State
Violation Short Description: Generators - General
Date Violation was Determined: 19931215
Actual Return to Compliance Date: 19940304
Return to Compliance Qualifier: Observed
Violation Responsible Agency: State
Scheduled Compliance Date: Not reported
Enforcement Identifier: 000
Date of Enforcement Action: 19931222
Enforcement Responsible Agency: State
Enforcement Docket Number: Not reported
Enforcement Attorney: MO
Corrective Action Component: No
Appeal Initiated Date: Not reported
Appeal Resolution Date: Not reported
Disposition Status Date: Not reported
Disposition Status: Not reported
Disposition Status Description: Not reported
Consent/Final Order Sequence Number: Not reported
Consent/Final Order Respondent Name: Not reported
Consent/Final Order Lead Agency: Not reported
Enforcement Type: WRITTEN INFORMAL
Enforcement Responsible Person: MOSW
Enforcement Responsible Sub-Organization: Not reported
SEP Sequence Number: Not reported
SEP Expenditure Amount: Not reported
SEP Scheduled Completion Date: Not reported
SEP Actual Date: Not reported
SEP Defaulted Date: Not reported
SEP Type: Not reported
SEP Type Description: Not reported
Proposed Amount: Not reported
Final Monetary Amount: Not reported
Paid Amount: Not reported

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Final Count:	Not reported
Final Amount:	Not reported
Found Violation:	Yes
Agency Which Determined Violation:	State
Violation Short Description:	Generators - General
Date Violation was Determined:	19931215
Actual Return to Compliance Date:	19931229
Return to Compliance Qualifier:	Observed
Violation Responsible Agency:	State
Scheduled Compliance Date:	19931230
Enforcement Identifier:	000
Date of Enforcement Action:	19931222
Enforcement Responsible Agency:	State
Enforcement Docket Number:	Not reported
Enforcement Attorney:	MO
Corrective Action Component:	No
Appeal Initiated Date:	Not reported
Appeal Resolution Date:	Not reported
Disposition Status Date:	Not reported
Disposition Status:	Not reported
Disposition Status Description:	Not reported
Consent/Final Order Sequence Number:	Not reported
Consent/Final Order Respondent Name:	Not reported
Consent/Final Order Lead Agency:	Not reported
Enforcement Type:	WRITTEN INFORMAL
Enforcement Responsible Person:	MOSW
Enforcement Responsible Sub-Organization:	Not reported
SEP Sequence Number:	Not reported
SEP Expenditure Amount:	Not reported
SEP Scheduled Completion Date:	Not reported
SEP Actual Date:	Not reported
SEP Defaulted Date:	Not reported
SEP Type:	Not reported
SEP Type Description:	Not reported
Proposed Amount:	Not reported
Final Monetary Amount:	Not reported
Paid Amount:	Not reported
Final Count:	Not reported
Final Amount:	Not reported
Found Violation:	Yes
Agency Which Determined Violation:	State
Violation Short Description:	Generators - General
Date Violation was Determined:	19931215
Actual Return to Compliance Date:	19931229
Return to Compliance Qualifier:	Observed
Violation Responsible Agency:	State
Scheduled Compliance Date:	19931230
Enforcement Identifier:	000
Date of Enforcement Action:	19931222
Enforcement Responsible Agency:	State
Enforcement Docket Number:	Not reported
Enforcement Attorney:	MO
Corrective Action Component:	No
Appeal Initiated Date:	Not reported
Appeal Resolution Date:	Not reported

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Disposition Status Date: Not reported
Disposition Status: Not reported
Disposition Status Description: Not reported
Consent/Final Order Sequence Number: Not reported
Consent/Final Order Respondent Name: Not reported
Consent/Final Order Lead Agency: Not reported
Enforcement Type: WRITTEN INFORMAL
Enforcement Responsible Person: MOSW
Enforcement Responsible Sub-Organization: Not reported
SEP Sequence Number: Not reported
SEP Expenditure Amount: Not reported
SEP Scheduled Completion Date: Not reported
SEP Actual Date: Not reported
SEP Defaulted Date: Not reported
SEP Type: Not reported
SEP Type Description: Not reported
Proposed Amount: Not reported
Final Monetary Amount: Not reported
Paid Amount: Not reported
Final Count: Not reported
Final Amount: Not reported

Found Violation: Yes
Agency Which Determined Violation: State
Violation Short Description: Generators - Pre-transport
Date Violation was Determined: 19931215
Actual Return to Compliance Date: 19931229
Return to Compliance Qualifier: Observed
Violation Responsible Agency: State
Scheduled Compliance Date: 19931230
Enforcement Identifier: 000
Date of Enforcement Action: 19931222
Enforcement Responsible Agency: State
Enforcement Docket Number: Not reported
Enforcement Attorney: MO
Corrective Action Component: No
Appeal Initiated Date: Not reported
Appeal Resolution Date: Not reported
Disposition Status Date: Not reported
Disposition Status: Not reported
Disposition Status Description: Not reported
Consent/Final Order Sequence Number: Not reported
Consent/Final Order Respondent Name: Not reported
Consent/Final Order Lead Agency: Not reported
Enforcement Type: WRITTEN INFORMAL
Enforcement Responsible Person: MOSW
Enforcement Responsible Sub-Organization: Not reported
SEP Sequence Number: Not reported
SEP Expenditure Amount: Not reported
SEP Scheduled Completion Date: Not reported
SEP Actual Date: Not reported
SEP Defaulted Date: Not reported
SEP Type: Not reported
SEP Type Description: Not reported
Proposed Amount: Not reported
Final Monetary Amount: Not reported
Paid Amount: Not reported

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Final Count: Not reported
Final Amount: Not reported

Found Violation: Yes
Agency Which Determined Violation: State
Violation Short Description: Generators - General
Date Violation was Determined: 19931215
Actual Return to Compliance Date: 19931229
Return to Compliance Qualifier: Observed
Violation Responsible Agency: State
Scheduled Compliance Date: 19931230
Enforcement Identifier: 000
Date of Enforcement Action: 19931222
Enforcement Responsible Agency: State
Enforcement Docket Number: Not reported
Enforcement Attorney: MO
Corrective Action Component: No
Appeal Initiated Date: Not reported
Appeal Resolution Date: Not reported
Disposition Status Date: Not reported
Disposition Status: Not reported
Disposition Status Description: Not reported
Consent/Final Order Sequence Number: Not reported
Consent/Final Order Respondent Name: Not reported
Consent/Final Order Lead Agency: Not reported
Enforcement Type: WRITTEN INFORMAL
Enforcement Responsible Person: MOSW
Enforcement Responsible Sub-Organization: Not reported
SEP Sequence Number: Not reported
SEP Expenditure Amount: Not reported
SEP Scheduled Completion Date: Not reported
SEP Actual Date: Not reported
SEP Defaulted Date: Not reported
SEP Type: Not reported
SEP Type Description: Not reported
Proposed Amount: Not reported
Final Monetary Amount: Not reported
Paid Amount: Not reported
Final Count: Not reported
Final Amount: Not reported

Found Violation: Yes
Agency Which Determined Violation: State
Violation Short Description: Generators - General
Date Violation was Determined: 19931215
Actual Return to Compliance Date: 19931229
Return to Compliance Qualifier: Observed
Violation Responsible Agency: State
Scheduled Compliance Date: 19931230
Enforcement Identifier: 000
Date of Enforcement Action: 19931222
Enforcement Responsible Agency: State
Enforcement Docket Number: Not reported
Enforcement Attorney: MO
Corrective Action Component: No
Appeal Initiated Date: Not reported
Appeal Resolution Date: Not reported

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Disposition Status Date: Not reported
Disposition Status: Not reported
Disposition Status Description: Not reported
Consent/Final Order Sequence Number: Not reported
Consent/Final Order Respondent Name: Not reported
Consent/Final Order Lead Agency: Not reported
Enforcement Type: WRITTEN INFORMAL
Enforcement Responsible Person: MOSW
Enforcement Responsible Sub-Organization: Not reported
SEP Sequence Number: Not reported
SEP Expenditure Amount: Not reported
SEP Scheduled Completion Date: Not reported
SEP Actual Date: Not reported
SEP Defaulted Date: Not reported
SEP Type: Not reported
SEP Type Description: Not reported
Proposed Amount: Not reported
Final Monetary Amount: Not reported
Paid Amount: Not reported
Final Count: Not reported
Final Amount: Not reported

Found Violation: Yes
Agency Which Determined Violation: State
Violation Short Description: Generators - General
Date Violation was Determined: 19931215
Actual Return to Compliance Date: 19940304
Return to Compliance Qualifier: Observed
Violation Responsible Agency: State
Scheduled Compliance Date: Not reported
Enforcement Identifier: 000
Date of Enforcement Action: 19931222
Enforcement Responsible Agency: State
Enforcement Docket Number: Not reported
Enforcement Attorney: MO
Corrective Action Component: No
Appeal Initiated Date: Not reported
Appeal Resolution Date: Not reported
Disposition Status Date: Not reported
Disposition Status: Not reported
Disposition Status Description: Not reported
Consent/Final Order Sequence Number: Not reported
Consent/Final Order Respondent Name: Not reported
Consent/Final Order Lead Agency: Not reported
Enforcement Type: WRITTEN INFORMAL
Enforcement Responsible Person: MOSW
Enforcement Responsible Sub-Organization: Not reported
SEP Sequence Number: Not reported
SEP Expenditure Amount: Not reported
SEP Scheduled Completion Date: Not reported
SEP Actual Date: Not reported
SEP Defaulted Date: Not reported
SEP Type: Not reported
SEP Type Description: Not reported
Proposed Amount: Not reported
Final Monetary Amount: Not reported
Paid Amount: Not reported

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Final Count: Not reported
Final Amount: Not reported

Evaluation Action Summary:
Evaluation Date: 20150121
Evaluation Responsible Agency: State
Found Violation: No
Evaluation Type Description: COMPLIANCE EVALUATION INSPECTION
Evaluation Responsible Person Identifier: MOGR
Evaluation Responsible Sub-Organization: Not reported
Actual Return to Compliance Date: Not reported
Scheduled Compliance Date: Not reported
Date of Request: Not reported
Date Response Received: Not reported
Request Agency: Not reported
Former Citation: Not reported

Evaluation Date: 20080825
Evaluation Responsible Agency: State
Found Violation: No
Evaluation Type Description: COMPLIANCE EVALUATION INSPECTION
Evaluation Responsible Person Identifier: MOGR
Evaluation Responsible Sub-Organization: ENF
Actual Return to Compliance Date: Not reported
Scheduled Compliance Date: Not reported
Date of Request: Not reported
Date Response Received: Not reported
Request Agency: Not reported
Former Citation: Not reported

Evaluation Date: 19931215
Evaluation Responsible Agency: State
Found Violation: Yes
Evaluation Type Description: COMPLIANCE EVALUATION INSPECTION
Evaluation Responsible Person Identifier: MOSW
Evaluation Responsible Sub-Organization: Not reported
Actual Return to Compliance Date: 19940304
Scheduled Compliance Date: Not reported
Date of Request: Not reported
Date Response Received: Not reported
Request Agency: Not reported
Former Citation: Not reported

Evaluation Date: 19931215
Evaluation Responsible Agency: State
Found Violation: Yes
Evaluation Type Description: COMPLIANCE EVALUATION INSPECTION
Evaluation Responsible Person Identifier: MOSW
Evaluation Responsible Sub-Organization: Not reported
Actual Return to Compliance Date: 19931229
Scheduled Compliance Date: 19931230
Date of Request: Not reported
Date Response Received: Not reported
Request Agency: Not reported
Former Citation: Not reported

Evaluation Date: 19931215

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Evaluation Responsible Agency:	State
Found Violation:	Yes
Evaluation Type Description:	COMPLIANCE EVALUATION INSPECTION
Evaluation Responsible Person Identifier:	MOSW
Evaluation Responsible Sub-Organization:	Not reported
Actual Return to Compliance Date:	19940304
Scheduled Compliance Date:	Not reported
Date of Request:	Not reported
Date Response Received:	Not reported
Request Agency:	Not reported
Former Citation:	Not reported

Evaluation Date:	19931215
Evaluation Responsible Agency:	State
Found Violation:	Yes
Evaluation Type Description:	COMPLIANCE EVALUATION INSPECTION
Evaluation Responsible Person Identifier:	MOSW
Evaluation Responsible Sub-Organization:	Not reported
Actual Return to Compliance Date:	19931229
Scheduled Compliance Date:	19931230
Date of Request:	Not reported
Date Response Received:	Not reported
Request Agency:	Not reported
Former Citation:	Not reported

Evaluation Date:	19931215
Evaluation Responsible Agency:	State
Found Violation:	Yes
Evaluation Type Description:	COMPLIANCE EVALUATION INSPECTION
Evaluation Responsible Person Identifier:	MOSW
Evaluation Responsible Sub-Organization:	Not reported
Actual Return to Compliance Date:	19931229
Scheduled Compliance Date:	19931230
Date of Request:	Not reported
Date Response Received:	Not reported
Request Agency:	Not reported
Former Citation:	Not reported

Evaluation Date:	19931215
Evaluation Responsible Agency:	State
Found Violation:	Yes
Evaluation Type Description:	COMPLIANCE EVALUATION INSPECTION
Evaluation Responsible Person Identifier:	MOSW
Evaluation Responsible Sub-Organization:	Not reported
Actual Return to Compliance Date:	19940304
Scheduled Compliance Date:	Not reported
Date of Request:	Not reported
Date Response Received:	Not reported
Request Agency:	Not reported
Former Citation:	Not reported

Evaluation Date:	19931215
Evaluation Responsible Agency:	State
Found Violation:	Yes
Evaluation Type Description:	COMPLIANCE EVALUATION INSPECTION
Evaluation Responsible Person Identifier:	MOSW
Evaluation Responsible Sub-Organization:	Not reported

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Actual Return to Compliance Date:	19931229
Scheduled Compliance Date:	19931230
Date of Request:	Not reported
Date Response Received:	Not reported
Request Agency:	Not reported
Former Citation:	Not reported
Evaluation Date:	19931215
Evaluation Responsible Agency:	State
Found Violation:	Yes
Evaluation Type Description:	COMPLIANCE EVALUATION INSPECTION
Evaluation Responsible Person Identifier:	MOSW
Evaluation Responsible Sub-Organization:	Not reported
Actual Return to Compliance Date:	19931229
Scheduled Compliance Date:	19931230
Date of Request:	Not reported
Date Response Received:	Not reported
Request Agency:	Not reported
Former Citation:	Not reported
Evaluation Date:	19931215
Evaluation Responsible Agency:	State
Found Violation:	Yes
Evaluation Type Description:	COMPLIANCE EVALUATION INSPECTION
Evaluation Responsible Person Identifier:	MOSW
Evaluation Responsible Sub-Organization:	Not reported
Actual Return to Compliance Date:	19940304
Scheduled Compliance Date:	Not reported
Date of Request:	Not reported
Date Response Received:	Not reported
Request Agency:	Not reported
Former Citation:	Not reported
Evaluation Date:	19931215
Evaluation Responsible Agency:	State
Found Violation:	Yes
Evaluation Type Description:	COMPLIANCE EVALUATION INSPECTION
Evaluation Responsible Person Identifier:	MOSW
Evaluation Responsible Sub-Organization:	Not reported
Actual Return to Compliance Date:	19940304
Scheduled Compliance Date:	Not reported
Date of Request:	Not reported
Date Response Received:	Not reported
Request Agency:	Not reported
Former Citation:	Not reported
Evaluation Date:	19931215
Evaluation Responsible Agency:	State
Found Violation:	Yes
Evaluation Type Description:	COMPLIANCE EVALUATION INSPECTION
Evaluation Responsible Person Identifier:	MOSW
Evaluation Responsible Sub-Organization:	Not reported
Actual Return to Compliance Date:	19931229
Scheduled Compliance Date:	19931230
Date of Request:	Not reported
Date Response Received:	Not reported
Request Agency:	Not reported

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Former Citation:	Not reported
Evaluation Date:	19931215
Evaluation Responsible Agency:	State
Found Violation:	Yes
Evaluation Type Description:	COMPLIANCE EVALUATION INSPECTION
Evaluation Responsible Person Identifier:	MOSW
Evaluation Responsible Sub-Organization:	Not reported
Actual Return to Compliance Date:	19931229
Scheduled Compliance Date:	19931230
Date of Request:	Not reported
Date Response Received:	Not reported
Request Agency:	Not reported
Former Citation:	Not reported
Evaluation Date:	19931215
Evaluation Responsible Agency:	State
Found Violation:	Yes
Evaluation Type Description:	COMPLIANCE EVALUATION INSPECTION
Evaluation Responsible Person Identifier:	MOSW
Evaluation Responsible Sub-Organization:	Not reported
Actual Return to Compliance Date:	19931229
Scheduled Compliance Date:	19931230
Date of Request:	Not reported
Date Response Received:	Not reported
Request Agency:	Not reported
Former Citation:	Not reported
Evaluation Date:	19931215
Evaluation Responsible Agency:	State
Found Violation:	Yes
Evaluation Type Description:	COMPLIANCE EVALUATION INSPECTION
Evaluation Responsible Person Identifier:	MOSW
Evaluation Responsible Sub-Organization:	Not reported
Actual Return to Compliance Date:	19931229
Scheduled Compliance Date:	19931230
Date of Request:	Not reported
Date Response Received:	Not reported
Request Agency:	Not reported
Former Citation:	Not reported
Evaluation Date:	19931215
Evaluation Responsible Agency:	State
Found Violation:	Yes
Evaluation Type Description:	COMPLIANCE EVALUATION INSPECTION
Evaluation Responsible Person Identifier:	MOSW
Evaluation Responsible Sub-Organization:	Not reported
Actual Return to Compliance Date:	19931229
Scheduled Compliance Date:	19931230
Date of Request:	Not reported
Date Response Received:	Not reported
Request Agency:	Not reported
Former Citation:	Not reported
Evaluation Date:	19931215
Evaluation Responsible Agency:	State
Found Violation:	Yes

USACE CLARENCE CANNON DAM (Continued) **1007104101**

Evaluation Type Description:	COMPLIANCE EVALUATION INSPECTION
Evaluation Responsible Person Identifier:	MOSW
Evaluation Responsible Sub-Organization:	Not reported
Actual Return to Compliance Date:	19940304
Scheduled Compliance Date:	Not reported
Date of Request:	Not reported
Date Response Received:	Not reported
Request Agency:	Not reported
Former Citation:	Not reported

Count: 0 records.

ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)
		NO SITES FOUND			

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Number of Days to Update: Provides confirmation that EDR is reporting records that have been updated within 90 days from the date the government agency made the information available to the public.

STANDARD ENVIRONMENTAL RECORDS

Lists of Federal NPL (Superfund) sites

NPL: National Priority List

National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC) and regional EPA offices.

Date of Government Version: 09/29/2025
Date Data Arrived at EDR: 10/01/2025
Date Made Active in Reports: 10/28/2025
Number of Days to Update: 27

Source: EPA
Telephone: N/A
Last EDR Contact: 12/01/2025
Next Scheduled EDR Contact: 01/05/2026
Data Release Frequency: Quarterly

NPL Site Boundaries

Sources:

EPA's Environmental Photographic Interpretation Center (EPIC)
Telephone: 202-564-7333

EPA Region 1
Telephone 617-918-1143

EPA Region 3
Telephone 215-814-5418

EPA Region 4
Telephone 404-562-8033

EPA Region 5
Telephone 312-886-6686

EPA Region 6
Telephone: 214-655-6659

EPA Region 7
Telephone: 913-551-7247

EPA Region 8
Telephone: 303-312-6774

EPA Region 9
Telephone: 415-947-4246

EPA Region 10
Telephone 206-553-8665

Proposed NPL: Proposed National Priority List Sites

A site that has been proposed for listing on the National Priorities List through the issuance of a proposed rule in the Federal Register. EPA then accepts public comments on the site, responds to the comments, and places on the NPL those sites that continue to meet the requirements for listing.

Date of Government Version: 09/29/2025
Date Data Arrived at EDR: 10/01/2025
Date Made Active in Reports: 10/28/2025
Number of Days to Update: 27

Source: EPA
Telephone: N/A
Last EDR Contact: 12/01/2025
Next Scheduled EDR Contact: 01/05/2026
Data Release Frequency: Quarterly

NPL LIENS: Federal Superfund Liens

Federal Superfund Liens. Under the authority granted the USEPA by CERCLA of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner received notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/1991
Date Data Arrived at EDR: 02/02/1994
Date Made Active in Reports: 03/30/1994
Number of Days to Update: 56

Source: EPA
Telephone: 202-564-4267
Last EDR Contact: 08/15/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: No Update Planned

Lists of Federal Delisted NPL sites

Delisted NPL: National Priority List Deletions

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 09/29/2025
Date Data Arrived at EDR: 10/01/2025
Date Made Active in Reports: 10/28/2025
Number of Days to Update: 27

Source: EPA
Telephone: N/A
Last EDR Contact: 12/01/2025
Next Scheduled EDR Contact: 01/05/2026
Data Release Frequency: Quarterly

Lists of Federal sites subject to CERCLA removals and CERCLA orders

FEDERAL FACILITY: Federal Facility Site Information listing

A listing of National Priority List (NPL) and Base Realignment and Closure (BRAC) sites found in the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) Database where EPA Federal Facilities Restoration and Reuse Office is involved in cleanup activities.

Date of Government Version: 09/22/2025
Date Data Arrived at EDR: 09/23/2025
Date Made Active in Reports: 11/18/2025
Number of Days to Update: 56

Source: Environmental Protection Agency
Telephone: 703-603-8704
Last EDR Contact: 12/10/2025
Next Scheduled EDR Contact: 04/06/2026
Data Release Frequency: Varies

SEMS: Superfund Enterprise Management System

SEMS (Superfund Enterprise Management System) tracks hazardous waste sites, potentially hazardous waste sites, and remedial activities performed in support of EPA's Superfund Program across the United States. The list was formerly know as CERCLIS, renamed to SEMS by the EPA in 2015. The list contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This dataset also contains sites which are either proposed to or on the National Priorities List (NPL) and the sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 09/29/2025
Date Data Arrived at EDR: 10/01/2025
Date Made Active in Reports: 10/28/2025
Number of Days to Update: 27

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 12/01/2025
Next Scheduled EDR Contact: 01/19/2026
Data Release Frequency: Quarterly

Lists of Federal CERCLA sites with NFRAP

SEMS-ARCHIVE: Superfund Enterprise Management System Archive

SEMS-ARCHIVE (Superfund Enterprise Management System Archive) tracks sites that have no further interest under the Federal Superfund Program based on available information. The list was formerly known as the CERCLIS-NFRAP, renamed to SEMS ARCHIVE by the EPA in 2015. EPA may perform a minimal level of assessment work at a site while it is archived if site conditions change and/or new information becomes available. Archived sites have been removed and archived from the inventory of SEMS sites. Archived status indicates that, to the best of EPA's knowledge, assessment at a site has been completed and that EPA has determined no further steps will be taken to list the site on the National Priorities List (NPL), unless information indicates this decision was not appropriate or other considerations require a recommendation for listing at a later time. The decision does not necessarily mean that there is no hazard associated with a given site; it only means that. based upon available information, the location is not judged to be potential NPL site.

Date of Government Version: 09/29/2025
Date Data Arrived at EDR: 10/01/2025
Date Made Active in Reports: 10/28/2025
Number of Days to Update: 27

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 12/01/2025
Next Scheduled EDR Contact: 01/19/2026
Data Release Frequency: Quarterly

Lists of Federal RCRA facilities undergoing Corrective Action

CORRACTS: Corrective Action Report

CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 11/30/2025
Date Data Arrived at EDR: 12/03/2025
Date Made Active in Reports: 12/10/2025
Number of Days to Update: 7

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 12/03/2025
Next Scheduled EDR Contact: 03/30/2026
Data Release Frequency: Quarterly

Lists of Federal RCRA TSD facilities

RCRA-TSDF: RCRA - Treatment, Storage and Disposal

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Transporters are individuals or entities that move hazardous waste from the generator offsite to a facility that can recycle, treat, store, or dispose of the waste. TSDFs treat, store, or dispose of the waste.

Date of Government Version: 11/30/2025
Date Data Arrived at EDR: 12/03/2025
Date Made Active in Reports: 12/10/2025
Number of Days to Update: 7

Source: Environmental Protection Agency
Telephone: 913-551-7003
Last EDR Contact: 12/03/2025
Next Scheduled EDR Contact: 03/30/2026
Data Release Frequency: Quarterly

Lists of Federal RCRA generators

RCRA-LQG: RCRA - Large Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Large quantity generators (LQGs) generate over 1,000 kilograms (kg) of hazardous waste, or over 1 kg of acutely hazardous waste per month.

Date of Government Version: 11/30/2025
Date Data Arrived at EDR: 12/03/2025
Date Made Active in Reports: 12/10/2025
Number of Days to Update: 7

Source: Environmental Protection Agency
Telephone: 913-551-7003
Last EDR Contact: 12/03/2025
Next Scheduled EDR Contact: 03/30/2026
Data Release Frequency: Quarterly

RCRA-SQG: RCRA - Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Small quantity generators (SQGs) generate between 100 kg and 1,000 kg of hazardous waste per month.

Date of Government Version: 11/30/2025
Date Data Arrived at EDR: 12/03/2025
Date Made Active in Reports: 12/10/2025
Number of Days to Update: 7

Source: Environmental Protection Agency
Telephone: 913-551-7003
Last EDR Contact: 12/03/2025
Next Scheduled EDR Contact: 03/30/2026
Data Release Frequency: Quarterly

RCRA-VSQG: RCRA - Very Small Quantity Generators (Formerly Conditionally Exempt Small Quantity Generators)

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Very small quantity generators (VSQGs) generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month.

Date of Government Version: 11/30/2025
Date Data Arrived at EDR: 12/03/2025
Date Made Active in Reports: 12/10/2025
Number of Days to Update: 7

Source: Environmental Protection Agency
Telephone: 913-551-7003
Last EDR Contact: 12/03/2025
Next Scheduled EDR Contact: 03/30/2026
Data Release Frequency: Quarterly

Federal institutional controls / engineering controls registries

LUCIS: Land Use Control Information System

LUCIS contains records of land use control information pertaining to the former Navy Base Realignment and Closure properties.

Date of Government Version: 03/11/2025
Date Data Arrived at EDR: 04/02/2025
Date Made Active in Reports: 06/24/2025
Number of Days to Update: 83

Source: Department of the Navy
Telephone: 843-820-7326
Last EDR Contact: 10/28/2025
Next Scheduled EDR Contact: 02/16/2026
Data Release Frequency: Varies

US ENG CONTROLS: Engineering Controls Sites List

A listing of sites with engineering controls in place. Engineering controls include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health.

Date of Government Version: 10/30/2025
Date Data Arrived at EDR: 11/11/2025
Date Made Active in Reports: 11/12/2025
Number of Days to Update: 1

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 11/11/2025
Next Scheduled EDR Contact: 03/02/2026
Data Release Frequency: Varies

US INST CONTROLS: Institutional Controls Sites List

A listing of sites with institutional controls in place. Institutional controls include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls.

Date of Government Version: 10/30/2025
Date Data Arrived at EDR: 11/11/2025
Date Made Active in Reports: 11/12/2025
Number of Days to Update: 1

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 11/11/2025
Next Scheduled EDR Contact: 03/02/2026
Data Release Frequency: Varies

Federal ERNS list

ERNS: Emergency Response Notification System

Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 09/23/2025
Date Data Arrived at EDR: 10/01/2025
Date Made Active in Reports: 12/10/2025
Number of Days to Update: 70

Source: National Response Center, United States Coast Guard
Telephone: 202-267-2180
Last EDR Contact: 12/08/2025
Next Scheduled EDR Contact: 03/30/2026
Data Release Frequency: Quarterly

Lists of state- and tribal hazardous waste facilities

HWS DETAIL: Registry Annual Report

Each site is described in detail in this annual report and includeds the following information: a general description of the site; a summary of any significant environmental problems at and near the site; a summary of any serious health problems in the immediate vicinity of the site; the status of any testing, monitoring or remedial actions in progress or recommended by the department.

Date of Government Version: 06/30/2024
Date Data Arrived at EDR: 02/26/2025
Date Made Active in Reports: 05/14/2025
Number of Days to Update: 77

Source: Department of Natural Resources
Telephone: 573-751-3176
Last EDR Contact: 11/11/2025
Next Scheduled EDR Contact: 03/02/2026
Data Release Frequency: Annually

SHWS: Registry of Confirmed Abandoned or Uncontrolled Hazardous Waste Disposal Sites

State Hazardous Waste Sites. State hazardous waste site records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where cleanup will be paid for by potentially responsible parties. Available information varies by state.

Date of Government Version: 09/02/2025
Date Data Arrived at EDR: 09/04/2025
Date Made Active in Reports: 11/26/2025
Number of Days to Update: 83

Source: Department of Natural Resources
Telephone: 573-751-1990
Last EDR Contact: 11/24/2025
Next Scheduled EDR Contact: 03/16/2026
Data Release Frequency: Annually

Lists of state and tribal landfills and solid waste disposal facilities

SWF/LF: Solid Waste Facility List

Solid Waste Facilities/Landfill Sites. SWF/LF type records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 08/18/2025
Date Data Arrived at EDR: 08/18/2025
Date Made Active in Reports: 11/05/2025
Number of Days to Update: 79

Source: Department of Natural Resources
Telephone: 573-751-5401
Last EDR Contact: 11/12/2025
Next Scheduled EDR Contact: 03/02/2026
Data Release Frequency: Varies

Lists of state and tribal leaking storage tanks

LAST: Leaking Aboveground Storage Tanks

A listing of leaking aboveground storage tanks.

Date of Government Version: 11/17/2025
Date Data Arrived at EDR: 11/21/2025
Date Made Active in Reports: 11/25/2025
Number of Days to Update: 4

Source: Department of Natural Resources
Telephone: 573-751-6822
Last EDR Contact: 11/21/2025
Next Scheduled EDR Contact: 03/16/2026
Data Release Frequency: Quarterly

LUST: Leaking Underground Storage Tanks

Leaking Underground Storage Tank Incident Reports. LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state.

Date of Government Version: 11/17/2025
Date Data Arrived at EDR: 11/21/2025
Date Made Active in Reports: 11/25/2025
Number of Days to Update: 4

Source: Department of Natural Resources
Telephone: 573-751-0135
Last EDR Contact: 11/21/2025
Next Scheduled EDR Contact: 03/16/2026
Data Release Frequency: Quarterly

INDIAN LUST R1: Leaking Underground Storage Tanks on Indian Land

A listing of leaking underground storage tank locations on Indian Land.

Date of Government Version: 04/21/2025
Date Data Arrived at EDR: 07/10/2025
Date Made Active in Reports: 10/02/2025
Number of Days to Update: 84

Source: EPA Region 1
Telephone: 617-918-1313
Last EDR Contact: 12/11/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Varies

INDIAN LUST R4: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Florida, Mississippi and North Carolina.

Date of Government Version: 04/21/2025
Date Data Arrived at EDR: 07/10/2025
Date Made Active in Reports: 10/02/2025
Number of Days to Update: 84

Source: EPA Region 4
Telephone: 404-562-8677
Last EDR Contact: 12/11/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Varies

INDIAN LUST R7: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Iowa, Kansas, and Nebraska

Date of Government Version: 05/22/2025
Date Data Arrived at EDR: 07/10/2025
Date Made Active in Reports: 10/02/2025
Number of Days to Update: 84

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 12/11/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Varies

INDIAN LUST R8: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming.

Date of Government Version: 05/22/2025
Date Data Arrived at EDR: 07/10/2025
Date Made Active in Reports: 10/02/2025
Number of Days to Update: 84

Source: EPA Region 8
Telephone: 303-312-6271
Last EDR Contact: 12/11/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Varies

INDIAN LUST R10: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Alaska, Idaho, Oregon and Washington.

Date of Government Version: 05/27/2025
Date Data Arrived at EDR: 07/10/2025
Date Made Active in Reports: 10/02/2025
Number of Days to Update: 84

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 11/21/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Varies

INDIAN LUST R9: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Arizona, California, New Mexico and Nevada

Date of Government Version: 04/21/2025
Date Data Arrived at EDR: 07/10/2025
Date Made Active in Reports: 10/02/2025
Number of Days to Update: 84

Source: Environmental Protection Agency
Telephone: 415-972-3372
Last EDR Contact: 12/11/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Varies

INDIAN LUST R5: Leaking Underground Storage Tanks on Indian Land
Leaking underground storage tanks located on Indian Land in Michigan, Minnesota and Wisconsin.

Date of Government Version: 04/21/2025
Date Data Arrived at EDR: 07/10/2025
Date Made Active in Reports: 10/02/2025
Number of Days to Update: 84
Source: EPA, Region 5
Telephone: 312-886-7439
Last EDR Contact: 12/11/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Varies

INDIAN LUST R6: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in New Mexico and Oklahoma.

Date of Government Version: 04/21/2025
Date Data Arrived at EDR: 07/10/2025
Date Made Active in Reports: 10/02/2025
Number of Days to Update: 84
Source: EPA Region 6
Telephone: 214-665-6597
Last EDR Contact: 12/11/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Varies

Lists of state and tribal registered storage tanks

FEMA UST: Underground Storage Tank Listing
A listing of all FEMA owned underground storage tanks.

Date of Government Version: 06/06/2025
Date Data Arrived at EDR: 08/26/2025
Date Made Active in Reports: 11/12/2025
Number of Days to Update: 78
Source: FEMA
Telephone: 202-646-5797
Last EDR Contact: 11/06/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: Varies

UST: Petroleum Storage Tanks
Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

Date of Government Version: 11/17/2025
Date Data Arrived at EDR: 11/21/2025
Date Made Active in Reports: 11/25/2025
Number of Days to Update: 4
Source: Department of Natural Resources
Telephone: 573-751-0135
Last EDR Contact: 11/21/2025
Next Scheduled EDR Contact: 03/16/2026
Data Release Frequency: Quarterly

AST: Aboveground Petroleum Storage Tanks
Registered Aboveground Storage Tanks.

Date of Government Version: 08/21/2025
Date Data Arrived at EDR: 08/21/2025
Date Made Active in Reports: 11/14/2025
Number of Days to Update: 85
Source: Department of Agriculture
Telephone: 573-751-7062
Last EDR Contact: 11/18/2025
Next Scheduled EDR Contact: 03/09/2026
Data Release Frequency: Semi-Annually

INDIAN UST R5: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 5 (Michigan, Minnesota and Wisconsin and Tribal Nations).

Date of Government Version: 04/21/2025
Date Data Arrived at EDR: 07/10/2025
Date Made Active in Reports: 10/02/2025
Number of Days to Update: 84
Source: EPA Region 5
Telephone: 312-886-6136
Last EDR Contact: 12/11/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Varies

INDIAN UST R6: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 6 (Louisiana, Arkansas, Oklahoma, New Mexico, Texas and 65 Tribes).

Date of Government Version: 04/21/2025
Date Data Arrived at EDR: 07/10/2025
Date Made Active in Reports: 10/02/2025
Number of Days to Update: 84

Source: EPA Region 6
Telephone: 214-665-7591
Last EDR Contact: 12/11/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Varies

INDIAN UST R10: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 10 (Alaska, Idaho, Oregon, Washington, and Tribal Nations).

Date of Government Version: 05/27/2025
Date Data Arrived at EDR: 07/10/2025
Date Made Active in Reports: 10/02/2025
Number of Days to Update: 84

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 12/11/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Varies

INDIAN UST R4: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 4 (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee and Tribal Nations)

Date of Government Version: 04/21/2025
Date Data Arrived at EDR: 07/10/2025
Date Made Active in Reports: 10/02/2025
Number of Days to Update: 84

Source: EPA Region 4
Telephone: 404-562-9424
Last EDR Contact: 12/11/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Varies

INDIAN UST R9: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 9 (Arizona, California, Hawaii, Nevada, the Pacific Islands, and Tribal Nations).

Date of Government Version: 04/21/2025
Date Data Arrived at EDR: 07/10/2025
Date Made Active in Reports: 10/02/2025
Number of Days to Update: 84

Source: EPA Region 9
Telephone: 415-972-3368
Last EDR Contact: 12/11/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Varies

INDIAN UST R8: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 8 (Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming and 27 Tribal Nations).

Date of Government Version: 05/22/2025
Date Data Arrived at EDR: 07/10/2025
Date Made Active in Reports: 10/02/2025
Number of Days to Update: 84

Source: EPA Region 8
Telephone: 303-312-6137
Last EDR Contact: 12/11/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Varies

INDIAN UST R7: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 7 (Iowa, Kansas, Missouri, Nebraska, and 9 Tribal Nations).

Date of Government Version: 05/22/2025
Date Data Arrived at EDR: 07/10/2025
Date Made Active in Reports: 10/02/2025
Number of Days to Update: 84

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 12/11/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Varies

INDIAN UST R1: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 1 (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont and ten Tribal Nations).

Date of Government Version: 04/21/2025
Date Data Arrived at EDR: 07/10/2025
Date Made Active in Reports: 10/02/2025
Number of Days to Update: 84
Source: EPA, Region 1
Telephone: 617-918-1313
Last EDR Contact: 12/11/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Varies

TANKS: Underground Storage Tank Database
Storage tank sites

Date of Government Version: 11/17/2025
Date Data Arrived at EDR: 11/21/2025
Date Made Active in Reports: 11/25/2025
Number of Days to Update: 4
Source: Department of Natural Resources
Telephone: 573-526-2058
Last EDR Contact: 11/21/2025
Next Scheduled EDR Contact: 03/16/2026
Data Release Frequency: Varies

State and tribal institutional control / engineering control registries

AUL: Sites with Controls
Activity and use limitations include both engineering controls and institutional controls.

Date of Government Version: 10/02/2025
Date Data Arrived at EDR: 11/12/2025
Date Made Active in Reports: 11/19/2025
Number of Days to Update: 7
Source: Department of Natural Resources
Telephone: 573-751-3176
Last EDR Contact: 11/12/2025
Next Scheduled EDR Contact: 02/16/2026
Data Release Frequency: Quarterly

Lists of state and tribal voluntary cleanup sites

VCP: Sites Participating in the Voluntary Cleanup Program
Sites participating in the Voluntary Cleanup Program.

Date of Government Version: 10/02/2025
Date Data Arrived at EDR: 11/12/2025
Date Made Active in Reports: 11/19/2025
Number of Days to Update: 7
Source: Department of Natural Resources
Telephone: 573-526-8913
Last EDR Contact: 11/12/2025
Next Scheduled EDR Contact: 02/16/2026
Data Release Frequency: Quarterly

INDIAN VCP R7: Voluntary Cleanup Priority Lisitng
A listing of voluntary cleanup priority sites located on Indian Land located in Region 7.

Date of Government Version: 03/20/2008
Date Data Arrived at EDR: 04/22/2008
Date Made Active in Reports: 05/19/2008
Number of Days to Update: 27
Source: EPA, Region 7
Telephone: 913-551-7365
Last EDR Contact: 07/08/2021
Next Scheduled EDR Contact: 07/20/2009
Data Release Frequency: Varies

INDIAN VCP R1: Voluntary Cleanup Priority Listing
A listing of voluntary cleanup priority sites located on Indian Land located in Region 1.

Date of Government Version: 07/27/2015
Date Data Arrived at EDR: 09/29/2015
Date Made Active in Reports: 02/18/2016
Number of Days to Update: 142
Source: EPA, Region 1
Telephone: 617-918-1102
Last EDR Contact: 12/03/2025
Next Scheduled EDR Contact: 03/30/2026
Data Release Frequency: Varies

Lists of state and tribal brownfield sites

BROWNFIELDS: Brownfields Site List

Brownfields are sites where redevelopment and reuse is hampered by known or suspected contamination with hazardous substances. While many brownfield sites are minimally contaminated, potential environmental liability can be a problem for owners, operators, prospective buyers and financial institutions. Because of the large number of these sites, their economic impact especially in heavily industrial areas is substantial.

Date of Government Version: 10/02/2025
Date Data Arrived at EDR: 11/12/2025
Date Made Active in Reports: 11/19/2025
Number of Days to Update: 7

Source: Department of Natural Resources
Telephone: 573-526-8913
Last EDR Contact: 11/12/2025
Next Scheduled EDR Contact: 02/16/2026
Data Release Frequency: Quarterly

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS: A Listing of Brownfields Sites

Brownfields are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up and reinvesting in these properties takes development pressures off of undeveloped, open land, and both improves and protects the environment. Assessment, Cleanup and Redevelopment Exchange System (ACRES) stores information reported by EPA Brownfields grant recipients on brownfields properties assessed or cleaned up with grant funding as well as information on Targeted Brownfields Assessments performed by EPA Regions. A listing of ACRES Brownfield sites is obtained from Cleanups in My Community. Cleanups in My Community provides information on Brownfields properties for which information is reported back to EPA, as well as areas served by Brownfields grant programs.

Date of Government Version: 09/19/2025
Date Data Arrived at EDR: 10/01/2025
Date Made Active in Reports: 11/24/2025
Number of Days to Update: 54

Source: Environmental Protection Agency
Telephone: 202-566-2777
Last EDR Contact: 12/03/2025
Next Scheduled EDR Contact: 03/23/2026
Data Release Frequency: Semi-Annually

Local Lists of Landfill / Solid Waste Disposal Sites

SWRCY: Solid Waste Recycling Facilities

A listing of recycling center locations.

Date of Government Version: 11/20/2024
Date Data Arrived at EDR: 11/22/2024
Date Made Active in Reports: 02/13/2025
Number of Days to Update: 83

Source: Department of Natural Resources
Telephone: 573-526-3944
Last EDR Contact: 11/11/2025
Next Scheduled EDR Contact: 03/02/2026
Data Release Frequency: Varies

HIST LF: Solid Waste Facility Database List

This database contains detailed information per site. It is no longer maintained by the Department of Natural Resources. For current information on solid waste facilities/landfills see the SWF/LF database.

Date of Government Version: 04/12/2005
Date Data Arrived at EDR: 07/19/2006
Date Made Active in Reports: 08/18/2006
Number of Days to Update: 30

Source: Department of Natural Resources
Telephone: 573-751-5401
Last EDR Contact: 01/12/2009
Next Scheduled EDR Contact: 04/13/2009
Data Release Frequency: No Update Planned

INDIAN ODI: Report on the Status of Open Dumps on Indian Lands

Location of open dumps on Indian land.

Date of Government Version: 12/31/1998
Date Data Arrived at EDR: 12/03/2007
Date Made Active in Reports: 01/24/2008
Number of Days to Update: 52

Source: Environmental Protection Agency
Telephone: 703-308-8245
Last EDR Contact: 10/15/2025
Next Scheduled EDR Contact: 02/02/2026
Data Release Frequency: Varies

ODI: Open Dump Inventory
An open dump is defined as a disposal facility that does not comply with one or more of the Part 257 or Part 258 Subtitle D Criteria.

Date of Government Version: 06/30/1985
Date Data Arrived at EDR: 08/09/2004
Date Made Active in Reports: 09/17/2004
Number of Days to Update: 39
Source: Environmental Protection Agency
Telephone: 800-424-9346
Last EDR Contact: 06/09/2004
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

DEBRIS REGION 9: Torres Martinez Reservation Illegal Dump Site Locations
A listing of illegal dump sites location on the Torres Martinez Indian Reservation located in eastern Riverside County and northern Imperial County, California.

Date of Government Version: 01/12/2009
Date Data Arrived at EDR: 05/07/2009
Date Made Active in Reports: 09/21/2009
Number of Days to Update: 137
Source: EPA, Region 9
Telephone: 415-947-4219
Last EDR Contact: 10/07/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: No Update Planned

IHS OPEN DUMPS: Open Dumps on Indian Land
A listing of all open dumps located on Indian Land in the United States.

Date of Government Version: 02/07/2024
Date Data Arrived at EDR: 11/13/2024
Date Made Active in Reports: 11/19/2024
Number of Days to Update: 6
Source: Department of Health & Human Serivces, Indian Health Service
Telephone: 301-443-1452
Last EDR Contact: 10/23/2025
Next Scheduled EDR Contact: 02/02/2026
Data Release Frequency: Varies

Local Lists of Hazardous waste / Contaminated Sites

US HIST CDL: National Clandestine Laboratory Register
A listing of clandestine drug lab locations that have been removed from the DEAs National Clandestine Laboratory Register.

Date of Government Version: 04/04/2025
Date Data Arrived at EDR: 06/02/2025
Date Made Active in Reports: 08/12/2025
Number of Days to Update: 71
Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 11/20/2025
Next Scheduled EDR Contact: 03/02/2026
Data Release Frequency: No Update Planned

CDL: Environmental Emergency Response System
Incidents reported to the Department of Natural Resources where drug lab materials were involved.

Date of Government Version: 06/03/2024
Date Data Arrived at EDR: 06/04/2024
Date Made Active in Reports: 06/07/2024
Number of Days to Update: 3
Source: Department of Natural Resources
Telephone: 573-751-3443
Last EDR Contact: 11/24/2025
Next Scheduled EDR Contact: 03/16/2026
Data Release Frequency: Quarterly

DEL SHWS: Registry Sites Withdrawn or Deleted
A list of sites that were removed from the Registry or for which Registry action was suspended due to cleanup.

Date of Government Version: 09/02/2025
Date Data Arrived at EDR: 09/04/2025
Date Made Active in Reports: 11/26/2025
Number of Days to Update: 83
Source: Department of Natural Resources
Telephone: 573-522-3710
Last EDR Contact: 11/24/2025
Next Scheduled EDR Contact: 03/16/2026
Data Release Frequency: Annually

US CDL: Clandestine Drug Labs

A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.

Date of Government Version: 04/04/2025
Date Data Arrived at EDR: 06/02/2025
Date Made Active in Reports: 08/12/2025
Number of Days to Update: 71

Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 11/20/2025
Next Scheduled EDR Contact: 03/02/2026
Data Release Frequency: Quarterly

Local Land Records

LIENS 2: CERCLA Lien Information

A Federal CERCLA ('Superfund') lien can exist by operation of law at any site or property at which EPA has spent Superfund monies. These monies are spent to investigate and address releases and threatened releases of contamination. CERCLIS provides information as to the identity of these sites and properties.

Date of Government Version: 09/29/2025
Date Data Arrived at EDR: 10/01/2025
Date Made Active in Reports: 10/28/2025
Number of Days to Update: 27

Source: Environmental Protection Agency
Telephone: 202-564-6023
Last EDR Contact: 12/01/2025
Next Scheduled EDR Contact: 01/05/2026
Data Release Frequency: Semi-Annually

Records of Emergency Release Reports

HMIRS: Hazardous Materials Information Reporting System

Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 09/29/2025
Date Data Arrived at EDR: 10/01/2025
Date Made Active in Reports: 12/10/2025
Number of Days to Update: 70

Source: U.S. Department of Transportation
Telephone: 202-366-4555
Last EDR Contact: 12/08/2025
Next Scheduled EDR Contact: 03/30/2026
Data Release Frequency: Quarterly

SPILLS: Environmental Response Tracking Database

Releases of hazardous substances reported to the department's Environmental Emergency Response (EER) section.

Date of Government Version: 06/03/2024
Date Data Arrived at EDR: 06/04/2024
Date Made Active in Reports: 06/07/2024
Number of Days to Update: 3

Source: Department of Natural Resources
Telephone: 573-526-3349
Last EDR Contact: 11/24/2025
Next Scheduled EDR Contact: 03/16/2026
Data Release Frequency: Quarterly

SPILLS 90: SPILLS90 data from FirstSearch

Spills 90 includes those spill and release records available exclusively from FirstSearch databases. Typically, they may include chemical, oil and/or hazardous substance spills recorded after 1990. Duplicate records that are already included in EDR incident and release records are not included in Spills 90.

Date of Government Version: 06/27/2012
Date Data Arrived at EDR: 01/03/2013
Date Made Active in Reports: 02/22/2013
Number of Days to Update: 50

Source: FirstSearch
Telephone: N/A
Last EDR Contact: 01/03/2013
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

Other Ascertainable Records

RCRA NonGen / NLR: RCRA - Non Generators / No Longer Regulated

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Non-Generators do not presently generate hazardous waste.

Date of Government Version: 11/30/2025
Date Data Arrived at EDR: 12/03/2025
Date Made Active in Reports: 12/10/2025
Number of Days to Update: 7

Source: Environmental Protection Agency
Telephone: 913-551-7003
Last EDR Contact: 12/03/2025
Next Scheduled EDR Contact: 03/30/2026
Data Release Frequency: Quarterly

FUDS: Formerly Used Defense Sites

The listing includes locations of Formerly Used Defense Sites properties where the US Army Corps of Engineers is actively working or will take necessary cleanup actions.

Date of Government Version: 07/23/2025
Date Data Arrived at EDR: 07/23/2025
Date Made Active in Reports: 07/29/2025
Number of Days to Update: 6

Source: U.S. Army Corps of Engineers
Telephone: 202-528-4285
Last EDR Contact: 11/06/2025
Next Scheduled EDR Contact: 02/23/2026
Data Release Frequency: Varies

DOD: Department of Defense Sites

This data set consists of federally owned or administered lands, administered by the Department of Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.

Date of Government Version: 06/07/2021
Date Data Arrived at EDR: 07/13/2021
Date Made Active in Reports: 03/09/2022
Number of Days to Update: 239

Source: USGS
Telephone: 888-275-8747
Last EDR Contact: 10/07/2025
Next Scheduled EDR Contact: 01/19/2026
Data Release Frequency: Varies

FEDLAND: Federal and Indian Lands

Federally and Indian administrated lands of the United States. Lands included are administrated by: Army Corps of Engineers, Bureau of Reclamation, National Wild and Scenic River, National Wildlife Refuge, Public Domain Land, Wilderness, Wilderness Study Area, Wildlife Management Area, Bureau of Indian Affairs, Bureau of Land Management, Department of Justice, Forest Service, Fish and Wildlife Service, National Park Service.

Date of Government Version: 04/02/2018
Date Data Arrived at EDR: 04/11/2018
Date Made Active in Reports: 11/06/2019
Number of Days to Update: 574

Source: U.S. Geological Survey
Telephone: 888-275-8747
Last EDR Contact: 10/02/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: N/A

SCRD DRYCLEANERS: State Coalition for Remediation of Drycleaners Listing

The State Coalition for Remediation of Drycleaners was established in 1998, with support from the U.S. EPA Office of Superfund Remediation and Technology Innovation. It is comprised of representatives of states with established drycleaner remediation programs. Currently the member states are Alabama, Connecticut, Florida, Illinois, Kansas, Minnesota, Missouri, North Carolina, Oregon, South Carolina, Tennessee, Texas, and Wisconsin.

Date of Government Version: 07/30/2021
Date Data Arrived at EDR: 02/03/2023
Date Made Active in Reports: 02/10/2023
Number of Days to Update: 7

Source: Environmental Protection Agency
Telephone: 615-532-8599
Last EDR Contact: 11/03/2025
Next Scheduled EDR Contact: 02/16/2026
Data Release Frequency: Varies

US FIN ASSUR: Financial Assurance Information

All owners and operators of facilities that treat, store, or dispose of hazardous waste are required to provide proof that they will have sufficient funds to pay for the clean up, closure, and post-closure care of their facilities.

Date of Government Version: 06/02/2025
Date Data Arrived at EDR: 06/03/2025
Date Made Active in Reports: 06/16/2025
Number of Days to Update: 13

Source: Environmental Protection Agency
Telephone: 202-566-1917
Last EDR Contact: 12/08/2025
Next Scheduled EDR Contact: 03/30/2026
Data Release Frequency: Quarterly

EPA WATCH LIST: EPA Watch List

EPA maintains a "Watch List" to facilitate dialogue between EPA, state and local environmental agencies on enforcement matters relating to facilities with alleged violations identified as either significant or high priority. Being on the Watch List does not mean that the facility has actually violated the law only that an investigation by EPA or a state or local environmental agency has led those organizations to allege that an unproven violation has in fact occurred. Being on the Watch List does not represent a higher level of concern regarding the alleged violations that were detected, but instead indicates cases requiring additional dialogue between EPA, state and local agencies - primarily because of the length of time the alleged violation has gone unaddressed or unresolved.

Date of Government Version: 08/30/2013
Date Data Arrived at EDR: 03/21/2014
Date Made Active in Reports: 06/17/2014
Number of Days to Update: 88

Source: Environmental Protection Agency
Telephone: 617-520-3000
Last EDR Contact: 10/22/2025
Next Scheduled EDR Contact: 02/09/2026
Data Release Frequency: No Update Planned

2020 COR ACTION: 2020 Corrective Action Program List

The EPA has set ambitious goals for the RCRA Corrective Action program by creating the 2020 Corrective Action Universe. This RCRA cleanup baseline includes facilities expected to need corrective action. The 2020 universe contains a wide variety of sites. Some properties are heavily contaminated while others were contaminated but have since been cleaned up. Still others have not been fully investigated yet, and may require little or no remediation. Inclusion in the 2020 Universe does not necessarily imply failure on the part of a facility to meet its RCRA obligations.

Date of Government Version: 09/30/2017
Date Data Arrived at EDR: 05/08/2018
Date Made Active in Reports: 07/20/2018
Number of Days to Update: 73

Source: Environmental Protection Agency
Telephone: 703-308-4044
Last EDR Contact: 10/30/2025
Next Scheduled EDR Contact: 02/09/2026
Data Release Frequency: Varies

TSCA: Toxic Substances Control Act

Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/2020
Date Data Arrived at EDR: 06/14/2022
Date Made Active in Reports: 03/24/2023
Number of Days to Update: 283

Source: EPA
Telephone: 202-260-5521
Last EDR Contact: 12/11/2025
Next Scheduled EDR Contact: 03/23/2026
Data Release Frequency: Every 4 Years

TRIS: Toxic Chemical Release Inventory System

Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/2023
Date Data Arrived at EDR: 08/11/2025
Date Made Active in Reports: 11/10/2025
Number of Days to Update: 91

Source: EPA
Telephone: 202-566-0250
Last EDR Contact: 11/10/2025
Next Scheduled EDR Contact: 02/23/2026
Data Release Frequency: Annually

SSTS: Section 7 Tracking Systems

Section 7 of the Federal Insecticide, Fungicide and Rodenticide Act, as amended (92 Stat. 829) requires all registered pesticide-producing establishments to submit a report to the Environmental Protection Agency by March 1st each year. Each establishment must report the types and amounts of pesticides, active ingredients and devices being produced, and those having been produced and sold or distributed in the past year.

Date of Government Version: 07/14/2025
Date Data Arrived at EDR: 07/14/2025
Date Made Active in Reports: 10/13/2025
Number of Days to Update: 91

Source: EPA
Telephone: 202-564-4203
Last EDR Contact: 10/14/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Annually

ROD: Records Of Decision

Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 10/30/2025
Date Data Arrived at EDR: 11/03/2025
Date Made Active in Reports: 11/18/2025
Number of Days to Update: 15

Source: EPA
Telephone: 703-416-0223
Last EDR Contact: 12/01/2025
Next Scheduled EDR Contact: 03/09/2026
Data Release Frequency: Annually

RMP: Risk Management Plans

When Congress passed the Clean Air Act Amendments of 1990, it required EPA to publish regulations and guidance for chemical accident prevention at facilities using extremely hazardous substances. The Risk Management Program Rule (RMP Rule) was written to implement Section 112(r) of these amendments. The rule, which built upon existing industry codes and standards, requires companies of all sizes that use certain flammable and toxic substances to develop a Risk Management Program, which includes a(n): Hazard assessment that details the potential effects of an accidental release, an accident history of the last five years, and an evaluation of worst-case and alternative accidental releases; Prevention program that includes safety precautions and maintenance, monitoring, and employee training measures; and Emergency response program that spells out emergency health care, employee training measures and procedures for informing the public and response agencies (e.g the fire department) should an accident occur.

Date of Government Version: 07/01/2025
Date Data Arrived at EDR: 07/29/2025
Date Made Active in Reports: 10/28/2025
Number of Days to Update: 91

Source: Environmental Protection Agency
Telephone: 202-564-8600
Last EDR Contact: 10/08/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Varies

RAATS: RCRA Administrative Action Tracking System

RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/1995
Date Data Arrived at EDR: 07/03/1995
Date Made Active in Reports: 08/07/1995
Number of Days to Update: 35

Source: EPA
Telephone: 202-564-4104
Last EDR Contact: 06/02/2008
Next Scheduled EDR Contact: 09/01/2008
Data Release Frequency: No Update Planned

PRP: Potentially Responsible Parties

A listing of verified Potentially Responsible Parties

Date of Government Version: 06/26/2025
Date Data Arrived at EDR: 07/01/2025
Date Made Active in Reports: 07/29/2025
Number of Days to Update: 28

Source: EPA
Telephone: 202-564-6023
Last EDR Contact: 12/01/2025
Next Scheduled EDR Contact: 02/09/2026
Data Release Frequency: Quarterly

PADS: PCB Activity Database System

PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 08/12/2025
Date Data Arrived at EDR: 09/30/2025
Date Made Active in Reports: 11/24/2025
Number of Days to Update: 55

Source: EPA
Telephone: 202-566-0500
Last EDR Contact: 09/30/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: Annually

ICIS: Integrated Compliance Information System

The Integrated Compliance Information System (ICIS) supports the information needs of the national enforcement and compliance program as well as the unique needs of the National Pollutant Discharge Elimination System (NPDES) program.

Date of Government Version: 11/18/2016
Date Data Arrived at EDR: 11/23/2016
Date Made Active in Reports: 02/10/2017
Number of Days to Update: 79

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 09/23/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: Quarterly

FTTS: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25

Source: EPA/Office of Prevention, Pesticides and Toxic Substances
Telephone: 202-566-1667
Last EDR Contact: 08/18/2017
Next Scheduled EDR Contact: 12/04/2017
Data Release Frequency: No Update Planned

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

A listing of FIFRA/TSCA Tracking System (FTTS) inspections and enforcements.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25

Source: EPA
Telephone: 202-566-1667
Last EDR Contact: 08/18/2017
Next Scheduled EDR Contact: 12/04/2017
Data Release Frequency: No Update Planned

MLTS: Material Licensing Tracking System

MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 08/11/2025
Date Data Arrived at EDR: 08/12/2025
Date Made Active in Reports: 11/04/2025
Number of Days to Update: 84

Source: Nuclear Regulatory Commission
Telephone: 301-415-0717
Last EDR Contact: 10/23/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Quarterly

COAL ASH DOE: Steam-Electric Plant Operation Data

A listing of power plants that store ash in surface ponds.

Date of Government Version: 12/31/2023
Date Data Arrived at EDR: 10/16/2024
Date Made Active in Reports: 01/14/2025
Number of Days to Update: 90

Source: Department of Energy
Telephone: 202-586-8719
Last EDR Contact: 11/19/2025
Next Scheduled EDR Contact: 03/09/2026
Data Release Frequency: Varies

COAL ASH EPA: Coal Combustion Residues Surface Impoundments List

A listing of coal combustion residues surface impoundments with high hazard potential ratings.

Date of Government Version: 01/12/2017
Date Data Arrived at EDR: 03/05/2019
Date Made Active in Reports: 11/11/2019
Number of Days to Update: 251
Source: Environmental Protection Agency
Telephone: N/A
Last EDR Contact: 11/18/2025
Next Scheduled EDR Contact: 03/09/2026
Data Release Frequency: Varies

PCB TRANSFORMER: PCB Transformer Registration Database
The database of PCB transformer registrations that includes all PCB registration submittals.

Date of Government Version: 09/13/2019
Date Data Arrived at EDR: 11/06/2019
Date Made Active in Reports: 02/10/2020
Number of Days to Update: 96
Source: Environmental Protection Agency
Telephone: 202-566-0517
Last EDR Contact: 10/30/2025
Next Scheduled EDR Contact: 02/09/2026
Data Release Frequency: Varies

RADINFO: Radiation Information Database
The Radiation Information Database (RADINFO) contains information about facilities that are regulated by U.S. Environmental Protection Agency (EPA) regulations for radiation and radioactivity.

Date of Government Version: 07/01/2019
Date Data Arrived at EDR: 07/01/2019
Date Made Active in Reports: 09/23/2019
Number of Days to Update: 84
Source: Environmental Protection Agency
Telephone: 202-343-9775
Last EDR Contact: 12/09/2025
Next Scheduled EDR Contact: 04/06/2026
Data Release Frequency: Quarterly

HIST FTTS: FIFRA/TSCA Tracking System Administrative Case Listing
A complete administrative case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40
Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2007
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

HIST FTTS INSP: FIFRA/TSCA Tracking System Inspection & Enforcement Case Listing
A complete inspection and enforcement case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40
Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2008
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

DOT OPS: Incident and Accident Data
Department of Transporation, Office of Pipeline Safety Incident and Accident data.

Date of Government Version: 06/30/2025
Date Data Arrived at EDR: 07/17/2025
Date Made Active in Reports: 10/13/2025
Number of Days to Update: 88
Source: Department of Transporation, Office of Pipeline Safety
Telephone: 202-366-4595
Last EDR Contact: 10/20/2025
Next Scheduled EDR Contact: 02/02/2026
Data Release Frequency: Quarterly

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

CONSENT: Superfund (CERCLA) Consent Decrees

Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: 06/30/2025
Date Data Arrived at EDR: 07/29/2025
Date Made Active in Reports: 10/28/2025
Number of Days to Update: 91

Source: Department of Justice, Consent Decree Library
Telephone: Varies
Last EDR Contact: 12/15/2025
Next Scheduled EDR Contact: 04/13/2026
Data Release Frequency: Varies

BRS: Biennial Reporting System

The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/31/2023
Date Data Arrived at EDR: 02/19/2025
Date Made Active in Reports: 03/07/2025
Number of Days to Update: 16

Source: EPA/NTIS
Telephone: 800-424-9346
Last EDR Contact: 12/08/2025
Next Scheduled EDR Contact: 03/30/2026
Data Release Frequency: Biennially

INDIAN RESERV: Indian Reservations

This map layer portrays Indian administered lands of the United States that have any area equal to or greater than 640 acres.

Date of Government Version: 12/31/2014
Date Data Arrived at EDR: 07/14/2015
Date Made Active in Reports: 01/10/2017
Number of Days to Update: 546

Source: USGS
Telephone: 202-208-3710
Last EDR Contact: 09/29/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: Semi-Annually

FUSRAP: Formerly Utilized Sites Remedial Action Program

DOE established the Formerly Utilized Sites Remedial Action Program (FUSRAP) in 1974 to remediate sites where radioactive contamination remained from Manhattan Project and early U.S. Atomic Energy Commission (AEC) operations.

Date of Government Version: 03/03/2023
Date Data Arrived at EDR: 03/03/2023
Date Made Active in Reports: 06/09/2023
Number of Days to Update: 98

Source: Department of Energy
Telephone: 202-586-3559
Last EDR Contact: 10/22/2025
Next Scheduled EDR Contact: 02/09/2026
Data Release Frequency: Varies

UMTRA: Uranium Mill Tailings Sites

Uranium ore was mined by private companies for federal government use in national defense programs. When the mills shut down, large piles of the sand-like material (mill tailings) remain after uranium has been extracted from the ore. Levels of human exposure to radioactive materials from the piles are low; however, in some cases tailings were used as construction materials before the potential health hazards of the tailings were recognized.

Date of Government Version: 05/15/2025
Date Data Arrived at EDR: 05/15/2025
Date Made Active in Reports: 07/29/2025
Number of Days to Update: 75

Source: Department of Energy
Telephone: 505-845-0011
Last EDR Contact: 11/10/2025
Next Scheduled EDR Contact: 02/23/2026
Data Release Frequency: Varies

LEAD SMELTER 1: Lead Smelter Sites

A listing of former lead smelter site locations.

Date of Government Version: 09/29/2025
Date Data Arrived at EDR: 10/01/2025
Date Made Active in Reports: 10/28/2025
Number of Days to Update: 27

Source: Environmental Protection Agency
Telephone: 703-603-8787
Last EDR Contact: 12/01/2025
Next Scheduled EDR Contact: 01/05/2026
Data Release Frequency: Varies

LEAD SMELTER 2: Lead Smelter Sites

A list of several hundred sites in the U.S. where secondary lead smelting was done from 1931and 1964. These sites may pose a threat to public health through ingestion or inhalation of contaminated soil or dust

Date of Government Version: 04/05/2001
Date Data Arrived at EDR: 10/27/2010
Date Made Active in Reports: 12/02/2010
Number of Days to Update: 36

Source: American Journal of Public Health
Telephone: 703-305-6451
Last EDR Contact: 12/02/2009
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

US AIRS (AFS): Aerometric Information Retrieval System Facility Subsystem (AFS)

The database is a sub-system of Aerometric Information Retrieval System (AIRS). AFS contains compliance data on air pollution point sources regulated by the U.S. EPA and/or state and local air regulatory agencies. This information comes from source reports by various stationary sources of air pollution, such as electric power plants, steel mills, factories, and universities, and provides information about the air pollutants they produce. Action, air program, air program pollutant, and general level plant data. It is used to track emissions and compliance data from industrial plants.

Date of Government Version: 10/12/2016
Date Data Arrived at EDR: 10/26/2016
Date Made Active in Reports: 02/03/2017
Number of Days to Update: 100

Source: EPA
Telephone: 202-564-2496
Last EDR Contact: 09/26/2017
Next Scheduled EDR Contact: 01/08/2018
Data Release Frequency: Annually

US AIRS MINOR: Air Facility System Data

A listing of minor source facilities.

Date of Government Version: 10/12/2016
Date Data Arrived at EDR: 10/26/2016
Date Made Active in Reports: 02/03/2017
Number of Days to Update: 100

Source: EPA
Telephone: 202-564-2496
Last EDR Contact: 09/26/2017
Next Scheduled EDR Contact: 01/08/2018
Data Release Frequency: Annually

MINES VIOLATIONS: MSHA Violation Assessment Data

Mines violation and assessment information. Department of Labor, Mine Safety & Health Administration.

Date of Government Version: 07/01/2025
Date Data Arrived at EDR: 07/01/2025
Date Made Active in Reports: 09/24/2025
Number of Days to Update: 85

Source: DOL, Mine Safety & Health Admi
Telephone: 202-693-9424
Last EDR Contact: 11/24/2025
Next Scheduled EDR Contact: 03/02/2026
Data Release Frequency: Quarterly

US MINES: Mines Master Index File

Contains all mine identification numbers issued for mines active or opened since 1971. The data also includes violation information.

Date of Government Version: 08/08/2025
Date Data Arrived at EDR: 08/18/2025
Date Made Active in Reports: 11/12/2025
Number of Days to Update: 86

Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959
Last EDR Contact: 12/04/2025
Next Scheduled EDR Contact: 03/02/2026
Data Release Frequency: Semi-Annually

US MINES 2: Ferrous and Nonferrous Metal Mines Database Listing

This map layer includes ferrous (ferrous metal mines are facilities that extract ferrous metals, such as iron ore or molybdenum) and nonferrous (Nonferrous metal mines are facilities that extract nonferrous metals, such as gold, silver, copper, zinc, and lead) metal mines in the United States.

Date of Government Version: 04/08/2025
Date Data Arrived at EDR: 05/20/2025
Date Made Active in Reports: 08/12/2025
Number of Days to Update: 84

Source: USGS
Telephone: 703-648-7709
Last EDR Contact: 11/12/2025
Next Scheduled EDR Contact: 03/02/2026
Data Release Frequency: Varies

US MINES 3: Active Mines & Mineral Plants Database Listing

Active Mines and Mineral Processing Plant operations for commodities monitored by the Minerals Information Team of the USGS.

Date of Government Version: 04/14/2011
Date Data Arrived at EDR: 06/08/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 97

Source: USGS
Telephone: 703-648-7709
Last EDR Contact: 11/20/2025
Next Scheduled EDR Contact: 03/02/2026
Data Release Frequency: Varies

MINES MRDS: Mineral Resources Data System

Mineral Resources Data System

Date of Government Version: 06/04/2024
Date Data Arrived at EDR: 11/22/2024
Date Made Active in Reports: 02/18/2025
Number of Days to Update: 88

Source: USGS
Telephone: 703-648-6533
Last EDR Contact: 11/20/2025
Next Scheduled EDR Contact: 03/02/2026
Data Release Frequency: Varies

ABANDONED MINES: Abandoned Mines

An inventory of land and water impacted by past mining (primarily coal mining) is maintained by OSMRE to provide information needed to implement the Surface Mining Control and Reclamation Act of 1977 (SMCRA). The inventory contains information on the location, type, and extent of AML impacts, as well as, information on the cost associated with the reclamation of those problems. The inventory is based upon field surveys by State, Tribal, and OSMRE program officials. It is dynamic to the extent that it is modified as new problems are identified and existing problems are reclaimed.

Date of Government Version: 09/10/2025
Date Data Arrived at EDR: 09/10/2025
Date Made Active in Reports: 11/12/2025
Number of Days to Update: 63

Source: Department of Interior
Telephone: 202-208-2609
Last EDR Contact: 12/03/2025
Next Scheduled EDR Contact: 03/16/2026
Data Release Frequency: Quarterly

FINDS: Facility Index System/Facility Registry System

Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 09/04/2025
Date Data Arrived at EDR: 10/01/2025
Date Made Active in Reports: 11/18/2025
Number of Days to Update: 48

Source: EPA
Telephone: (913) 551-7003
Last EDR Contact: 11/19/2025
Next Scheduled EDR Contact: 03/09/2026
Data Release Frequency: Quarterly

DOCKET HWC: Hazardous Waste Compliance Docket Listing

A complete list of the Federal Agency Hazardous Waste Compliance Docket Facilities.

Date of Government Version: 05/06/2021
Date Data Arrived at EDR: 05/21/2021
Date Made Active in Reports: 08/11/2021
Number of Days to Update: 82

Source: Environmental Protection Agency
Telephone: 202-564-0527
Last EDR Contact: 11/11/2025
Next Scheduled EDR Contact: 03/02/2026
Data Release Frequency: Varies

ECHO: Enforcement & Compliance History Information

ECHO provides integrated compliance and enforcement information for about 800,000 regulated facilities nationwide.

Date of Government Version: 09/20/2025
Date Data Arrived at EDR: 09/26/2025
Date Made Active in Reports: 11/24/2025
Number of Days to Update: 59

Source: Environmental Protection Agency
Telephone: 202-564-2280
Last EDR Contact: 09/26/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: Quarterly

UXO: Unexploded Ordnance Sites

A listing of unexploded ordnance site locations

Date of Government Version: 07/31/2025
Date Data Arrived at EDR: 08/14/2025
Date Made Active in Reports: 11/04/2025
Number of Days to Update: 82

Source: Department of Defense
Telephone: 703-704-1564
Last EDR Contact: 10/29/2025
Next Scheduled EDR Contact: 01/19/2026
Data Release Frequency: Varies

FUELS PROGRAM: EPA Fuels Program Registered Listing

This listing includes facilities that are registered under the Part 80 (Code of Federal Regulations) EPA Fuels Programs. All companies now are required to submit new and updated registrations.

Date of Government Version: 08/07/2025
Date Data Arrived at EDR: 08/07/2025
Date Made Active in Reports: 11/04/2025
Number of Days to Update: 89

Source: EPA
Telephone: 800-385-6164
Last EDR Contact: 11/06/2025
Next Scheduled EDR Contact: 02/23/2026
Data Release Frequency: Quarterly

PFAS NPL: Superfund Sites with PFAS Detections Information

EPA's Office of Land and Emergency Management and EPA Regional Offices maintain data describing what is known about site investigations, contamination, and remedial actions under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) where PFAS is present in the environment.

Date of Government Version: 06/23/2025
Date Data Arrived at EDR: 06/26/2025
Date Made Active in Reports: 08/27/2025
Number of Days to Update: 62

Source: Environmental Protection Agency
Telephone: 703-603-8895
Last EDR Contact: 09/26/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: Varies

PFAS FEDERAL SITES: Federal Sites PFAS Information

Several federal entities, such as the federal Superfund program, Department of Defense, National Aeronautics and Space Administration, Department of Transportation, and Department of Energy provided information for sites with known or suspected detections at federal facilities.

Date of Government Version: 06/23/2025
Date Data Arrived at EDR: 06/26/2025
Date Made Active in Reports: 08/27/2025
Number of Days to Update: 62

Source: Environmental Protection Agency
Telephone: 202-272-0167
Last EDR Contact: 09/26/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: Varies

PFAS TRIS: List of PFAS Added to the TRI

Section 7321 of the National Defense Authorization Act for Fiscal Year 2020 (NDAA) immediately added certain per- and polyfluoroalkyl substances (PFAS) to the list of chemicals covered by the Toxics Release Inventory (TRI) under Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) and provided a framework for additional PFAS to be added to TRI on an annual basis.

Date of Government Version: 06/23/2025
Date Data Arrived at EDR: 06/26/2025
Date Made Active in Reports: 08/27/2025
Number of Days to Update: 62

Source: Environmental Protection Agency
Telephone: 202-566-0250
Last EDR Contact: 09/26/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: Varies

PFAS TSCA: PFAS Manufacture and Imports Information

EPA issued the Chemical Data Reporting (CDR) Rule under the Toxic Substances Control Act (TSCA) and requires chemical manufacturers and facilities that manufacture or import chemical substances to report data to EPA. EPA publishes non-confidential business information (non-CBI) and includes descriptive information about each site, corporate parent, production volume, other manufacturing information, and processing and use information.

Date of Government Version: 06/23/2025
Date Data Arrived at EDR: 06/26/2025
Date Made Active in Reports: 08/27/2025
Number of Days to Update: 62

Source: Environmental Protection Agency
Telephone: 202-272-0167
Last EDR Contact: 09/26/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: Varies

PFAS RCRA MANIFEST: PFAS Transfers Identified In the RCRA Database Listing

To work around the lack of PFAS waste codes in the RCRA database, EPA developed the PFAS Transfers dataset by mining e-Manifest records containing at least one of these common PFAS keywords: PFAS, PFOA, PFOS, PERFL, AFFF, GENX, GEN-X (plus the VT waste codes). These keywords were searched for in the following text fields: Manifest handling instructions (MANIFEST_HANDLING_INSTR), Non-hazardous waste description (NON_HAZ_WASTE_DESCRIPTION), DOT printed information (DOT_PRINTED_INFORMATION), Waste line handling instructions (WASTE_LINE_HANDLING_INSTR), Waste residue comments (WASTE_RESIDUE_COMMENTS).

Date of Government Version: 06/23/2025
Date Data Arrived at EDR: 06/26/2025
Date Made Active in Reports: 09/24/2025
Number of Days to Update: 90

Source: Environmental Protection Agency
Telephone: 202-272-0167
Last EDR Contact: 09/26/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: Varies

PFAS ATSDR: PFAS Contamination Site Location Listing

PFAS contamination site locations from the Department of Health & Human Services, Center for Disease Control & Prevention. ATSDR is involved at a number of PFAS-related sites, either directly or through assisting state and federal partners. As of now, most sites are related to drinking water contamination connected with PFAS production facilities or fire training areas where aqueous film-forming firefighting foam (AFFF) was regularly used.

Date of Government Version: 11/12/2024
Date Data Arrived at EDR: 07/21/2025
Date Made Active in Reports: 10/13/2025
Number of Days to Update: 84

Source: Department of Health & Human Services
Telephone: 202-741-5770
Last EDR Contact: 10/15/2025
Next Scheduled EDR Contact: 02/02/2026
Data Release Frequency: Varies

PFAS WQP: Ambient Environmental Sampling for PFAS

The Water Quality Portal (WQP) is a part of a modernized repository storing ambient sampling data for all environmental media and tissue samples. A wide range of federal, state, tribal and local governments, academic and non-governmental organizations and individuals submit project details and sampling results to this public repository. The information is commonly used for research and assessments of environmental quality.

Date of Government Version: 06/23/2025
Date Data Arrived at EDR: 06/26/2025
Date Made Active in Reports: 08/27/2025
Number of Days to Update: 62

Source: Environmental Protection Agency
Telephone: 202-272-0167
Last EDR Contact: 09/26/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: Varies

PFAS NPDES: Clean Water Act Discharge Monitoring Information

Any discharger of pollutants to waters of the United States from a point source must have a National Pollutant Discharge Elimination System (NPDES) permit. The process for obtaining limits involves the regulated entity (permittee) disclosing releases in a NPDES permit application and the permitting authority (typically the state but sometimes EPA) deciding whether to require monitoring or monitoring with limits. Caveats and Limitations: Less than half of states have required PFAS monitoring for at least one of their permittees and fewer states have established PFAS effluent limits for permittees. New rulemakings have been initiated that may increase the number of facilities monitoring for PFAS in the future.

Date of Government Version: 06/23/2025
Date Data Arrived at EDR: 06/26/2025
Date Made Active in Reports: 08/27/2025
Number of Days to Update: 62

Source: Environmental Protection Agency
Telephone: 202-272-0167
Last EDR Contact: 09/26/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: Varies

PFAS PROJECT: NORTHEASTERN UNIVERSITY PFAS PROJECT

The PFAS Contamination Site Tracker records qualitative and quantitative data from each site in a chart, specifically examining discovery, contamination levels, government response, litigation, health impacts, media coverage, and community characteristics. All data presented in the chart were extracted from government websites, such as state health departments or the Environmental Protection Agency, and news articles.

Date of Government Version: 05/15/2024
Date Data Arrived at EDR: 03/06/2025
Date Made Active in Reports: 06/03/2025
Number of Days to Update: 89

Source: Social Science Environmental Health Research Institute
Telephone: N/A
Last EDR Contact: 11/25/2025
Next Scheduled EDR Contact: 03/16/2026
Data Release Frequency: Varies

PFAS ECHO: Facilities in Industries that May Be Handling PFAS Listing

Regulators and the public have expressed interest in knowing which regulated entities may be using PFAS. EPA has developed a dataset from various sources that show which industries may be handling PFAS. Approximately 120,000 facilities subject to federal environmental programs have operated or currently operate in industry sectors with processes that may involve handling and/or release of PFAS.

Date of Government Version: 06/23/2025
Date Data Arrived at EDR: 06/26/2025
Date Made Active in Reports: 08/27/2025
Number of Days to Update: 62

Source: Environmental Protection Agency
Telephone: 202-272-0167
Last EDR Contact: 09/26/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: Varies

PFAS ECHO FIRE TRAIN: Facilities in Industries that May Be Handling PFAS Listing

A list of fire training sites was added to the Industry Sectors dataset using a keyword search on the permitted facilitys name to identify sites where fire-fighting foam may have been used in training exercises. Additionally, you may view an example spreadsheet of the subset of fire training facility data, as well as the keywords used in selecting or deselecting a facility for the subset. as well as the keywords used in selecting or deselecting a facility for the subset. These keywords were tested to maximize accuracy in selecting facilities that may use fire-fighting foam in training exercises, however, due to the lack of a required reporting field in the data systems for designating fire training sites, this methodology may not identify all fire training sites or may potentially misidentify them.

Date of Government Version: 06/23/2025
Date Data Arrived at EDR: 06/26/2025
Date Made Active in Reports: 08/27/2025
Number of Days to Update: 62

Source: Environmental Protection Agency
Telephone: 202-272-0167
Last EDR Contact: 09/26/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: Varies

PFAS PT 139 AIRPORT: All Certified Part 139 Airports PFAS Information Listing

Since July 1, 2006, all certified part 139 airports are required to have fire-fighting foam onsite that meet military specifications (MIL-F-24385) (14 CFR 139.317). To date, these military specification fire-fighting foams are fluorinated and have been historically used for training and extinguishing. The 2018 FAA Reauthorization Act has a provision stating that no later than October 2021, FAA shall not require the use of fluorinated AFFF. This provision does not prohibit the use of fluorinated AFFF at Part 139 civilian airports; it only prohibits FAA from mandating its use. The Federal Aviation Administration?s document AC 150/5210-6D - Aircraft Fire Extinguishing Agents provides guidance on Aircraft Fire Extinguishing Agents, which includes Aqueous Film Forming Foam (AFFF).

Date of Government Version: 06/23/2025
Date Data Arrived at EDR: 06/26/2025
Date Made Active in Reports: 08/27/2025
Number of Days to Update: 62

Source: Environmental Protection Agency
Telephone: 202-272-0167
Last EDR Contact: 09/26/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: Varies

AQUEOUS FOAM NRC: Aqueous Foam Related Incidents Listing

The National Response Center (NRC) serves as an emergency call center that fields initial reports for pollution and railroad incidents and forwards that information to appropriate federal/state agencies for response. The spreadsheets posted to the NRC website contain initial incident data that has not been validated or investigated by a federal/state response agency. Response center calls from 1990 to the most recent complete calendar year where there was indication of Aqueous Film Forming Foam (AFFF) usage are included in this dataset. NRC calls may reference AFFF usage in the ?Material Involved? or ?Incident Description? fields.

Date of Government Version: 09/25/2025
Date Data Arrived at EDR: 09/26/2025
Date Made Active in Reports: 11/24/2025
Number of Days to Update: 59

Source: Environmental Protection Agency
Telephone: 202-267-2675
Last EDR Contact: 09/26/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: Varies

PCS: Permit Compliance System

PCS is a computerized management information system that contains data on National Pollutant Discharge Elimination System (NPDES) permit holding facilities. PCS tracks the permit, compliance, and enforcement status of NPDES facilities.

Date of Government Version: 12/16/2016
Date Data Arrived at EDR: 01/06/2017
Date Made Active in Reports: 03/10/2017
Number of Days to Update: 63

Source: EPA, Office of Water
Telephone: 202-564-2496
Last EDR Contact: 09/24/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: No Update Planned

PCS ENF: Enforcement data

No description is available for this data

Date of Government Version: 12/31/2014
Date Data Arrived at EDR: 02/05/2015
Date Made Active in Reports: 03/06/2015
Number of Days to Update: 29

Source: EPA
Telephone: 202-564-2497
Last EDR Contact: 09/24/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: Varies

BIOSOLIDS: ICIS-NPDES Biosolids Facility Data

The data reflects compliance information about facilities in the biosolids program.

Date of Government Version: 07/06/2025
Date Data Arrived at EDR: 07/10/2025
Date Made Active in Reports: 10/02/2025
Number of Days to Update: 84

Source: Environmental Protection Agency
Telephone: 202-564-4700
Last EDR Contact: 10/01/2025
Next Scheduled EDR Contact: 01/26/2026
Data Release Frequency: Varies

UST FINDER: UST Finder Database

EPA developed UST Finder, a web map application containing a comprehensive, state-sourced national map of underground storage tank (UST) and leaking UST (LUST) data. It provides the attributes and locations of active and closed USTs, UST facilities, and LUST sites from states and from Tribal lands and US territories . UST Finder contains information about proximity of UST facilities and LUST sites to: surface and groundwater public drinking water protection areas; estimated number of private domestic wells and number of people living nearby; and flooding and wildfires.

Date of Government Version: 06/08/2023
Date Data Arrived at EDR: 10/04/2023
Date Made Active in Reports: 01/18/2024
Number of Days to Update: 106

Source: Environmental Protection Agency
Telephone: 202-564-0394
Last EDR Contact: 11/06/2025
Next Scheduled EDR Contact: 02/16/2026
Data Release Frequency: Varies

UST FINDER RELEASE: UST Finder Releases Database

US EPA’s UST Finder data is a national composite of leaking underground storage tanks. This data contains information about, and locations of, leaking underground storage tanks. Data was collected from state sources and standardized into a national profile by EPA’s Office of Underground Storage Tanks, Office of Research and Development, and the Association of State and Territorial Solid Waste Management Officials.

Date of Government Version: 06/08/2023
Date Data Arrived at EDR: 10/31/2023
Date Made Active in Reports: 01/18/2024
Number of Days to Update: 79

Source: Environmental Protecton Agency
Telephone: 202-564-0394
Last EDR Contact: 11/06/2025
Next Scheduled EDR Contact: 02/16/2026
Data Release Frequency: Semi-Annually

E MANIFEST: Hazardous Waste Electronic Manifest System

EPA established a national system for tracking hazardous waste shipments electronically. This system, known as ?e-Manifest,? will modernize the nation?s cradle-to-grave hazardous waste tracking process while saving valuable time, resources, and dollars for industry and states.

Date of Government Version: 06/02/2025
Date Data Arrived at EDR: 06/04/2025
Date Made Active in Reports: 08/13/2025
Number of Days to Update: 70

Source: Environmental Protection Agency
Telephone: 833-501-6826
Last EDR Contact: 12/05/2025
Next Scheduled EDR Contact: 04/30/2026
Data Release Frequency: Varies

PFAS: PFAS Detections

PFAS detection list

Date of Government Version: 09/24/2025
Date Data Arrived at EDR: 10/21/2025
Date Made Active in Reports: 10/29/2025
Number of Days to Update: 8

Source: Department of Natural Resources
Telephone: 517-751-9857
Last EDR Contact: 12/15/2025
Next Scheduled EDR Contact: 04/13/2026
Data Release Frequency: Varies

AIRS: Permit Facility Listing

A listing of Air Pollution Control Program permits.

Date of Government Version: 08/26/2025
Date Data Arrived at EDR: 09/17/2025
Date Made Active in Reports: 12/11/2025
Number of Days to Update: 85

Source: Department of Natural Resources
Telephone: 573-751-4817
Last EDR Contact: 11/24/2025
Next Scheduled EDR Contact: 03/16/2026
Data Release Frequency: Varies

ASBESTOS: Asbestos Notification Listing

The department requires notification of demolitions and abatement projects involving regulated structures at least 10 working days before crews begin a project.

Date of Government Version: 06/24/2025
Date Data Arrived at EDR: 06/25/2025
Date Made Active in Reports: 09/19/2025
Number of Days to Update: 86

Source: Department of Natural Resources
Telephone: 573-751-4817
Last EDR Contact: 09/30/2025
Next Scheduled EDR Contact: 01/12/2026
Data Release Frequency: Varies

COAL ASH: Coal Ash Disposal Sites

A listing of power plants with coal ash ponds.

Date of Government Version: 01/03/2018
Date Data Arrived at EDR: 02/01/2018
Date Made Active in Reports: 03/22/2018
Number of Days to Update: 49

Source: Department of Natural Resources
Telephone: 573-526-1825
Last EDR Contact: 12/09/2025
Next Scheduled EDR Contact: 04/06/2026
Data Release Frequency: No Update Planned

DRYCLEANERS: Drycleaners in Missouri Listing

A listing of drycleaner facilities that are potentially eligible for reimbursement of department approved cleanup costs under the Drycleaning Environmental Response Trust Fund.

Date of Government Version: 08/26/2025
Date Data Arrived at EDR: 09/17/2025
Date Made Active in Reports: 12/11/2025
Number of Days to Update: 85

Source: Department of Natural Resources
Telephone: 573-526-8913
Last EDR Contact: 11/24/2025
Next Scheduled EDR Contact: 03/16/2026
Data Release Frequency: Quarterly

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

FIN ASSURANCE 1: Financial Assurance Information Listing
Financial Assurance information.

Date of Government Version: 09/11/2025
Date Data Arrived at EDR: 09/17/2025
Date Made Active in Reports: 09/23/2025
Number of Days to Update: 6

Source: Department of Natural Resources
Telephone: 573-751-3553
Last EDR Contact: 11/18/2025
Next Scheduled EDR Contact: 03/09/2026
Data Release Frequency: Annually

FIN ASSURANCE 2: Financial Assurance Information Listing
Financial assurance information for solid waste facilities. Financial assurance is intended to ensure that resources are available to pay for the cost of closure, post-closure care, and corrective measures if the owner or operator of a regulated facility is unable or unwilling to pay

Date of Government Version: 12/19/2022
Date Data Arrived at EDR: 02/28/2023
Date Made Active in Reports: 05/17/2023
Number of Days to Update: 78

Source: Department of Natural Resources
Telephone: 573-751-5401
Last EDR Contact: 11/26/2025
Next Scheduled EDR Contact: 03/09/2026
Data Release Frequency: Quarterly

MINES: Industrial Mineral Mines Database
This data set contains names, locations and additional data for active Industrial Mineral Mines permitted with the Missouri Department of Natural Resources, Division of Environmental Quality, Land Reclamation Program. Industrial Mineral Mines permitted are rock quarries, clay pits, sand and gravel pits, or in-stream sand and gravel operations.

Date of Government Version: 04/30/2021
Date Data Arrived at EDR: 07/14/2021
Date Made Active in Reports: 10/07/2021
Number of Days to Update: 85

Source: Department of Natural Resources
Telephone: 573-751-4041
Last EDR Contact: 10/09/2025
Next Scheduled EDR Contact: 01/19/2026
Data Release Frequency: Varies

NPDES: Permitted Facility Listing
A listing of permitted facilities from the Water Pollution Branch.

Date of Government Version: 09/17/2025
Date Data Arrived at EDR: 10/01/2025
Date Made Active in Reports: 10/09/2025
Number of Days to Update: 8

Source: Department of Natural Resources
Telephone: 573-751-7023
Last EDR Contact: 12/09/2025
Next Scheduled EDR Contact: 04/06/2026
Data Release Frequency: Quarterly

RRC: Certified Hazardous Waste Resource Recovery Facilities
Facilities that take hazardous waste material, either from on-site or off-site, and make it re-usable.

Date of Government Version: 09/30/2020
Date Data Arrived at EDR: 10/06/2020
Date Made Active in Reports: 12/28/2020
Number of Days to Update: 83

Source: Department of Natural Resources
Telephone: 573-751-3176
Last EDR Contact: 11/21/2025
Next Scheduled EDR Contact: 03/16/2026
Data Release Frequency: Annually

SMARS: Site Management and Reporting System
SMARS currently houses information for Superfund, Federal Facility, Brownfields Voluntary Cleanup Program and Missouri's other state response programs.

Date of Government Version: 07/11/2025
Date Data Arrived at EDR: 07/16/2025
Date Made Active in Reports: 08/19/2025
Number of Days to Update: 34

Source: Department of Natural Resources
Telephone: 573-751-3043
Last EDR Contact: 10/21/2025
Next Scheduled EDR Contact: 02/02/2026
Data Release Frequency: Quarterly

UIC: Underground Injection Wells Database
A listing of underground injection well locations. The UIC Program is responsible for regulating the construction, operation, permitting, and closure of injection wells that place fluids underground for storage or disposal.

Date of Government Version: 08/16/2025
Date Data Arrived at EDR: 08/11/2025
Date Made Active in Reports: 09/10/2025
Number of Days to Update: 30

Source: Department of Natural Resources
Telephone: 573-368-2183
Last EDR Contact: 11/06/2025
Next Scheduled EDR Contact: 02/23/2026
Data Release Frequency: Semi-Annually

EDR HIGH RISK HISTORICAL RECORDS

EDR Exclusive Records

EDR MGP: EDR Proprietary Manufactured Gas Plants
The EDR Proprietary Manufactured Gas Plant Database includes records of coal gas plants (manufactured gas plants) compiled by EDR's researchers. Manufactured gas sites were used in the United States from the 1800's to 1950's to produce a gas that could be distributed and used as fuel. These plants used whale oil, rosin, coal, or a mixture of coal, oil, and water that also produced a significant amount of waste. Many of the byproducts of the gas production, such as coal tar (oily waste containing volatile and non-volatile chemicals), sludges, oils and other compounds are potentially hazardous to human health and the environment. The byproduct from this process was frequently disposed of directly at the plant site and can remain or spread slowly, serving as a continuous source of soil and groundwater contamination.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

EDR Hist Auto: EDR Exclusive Historical Auto Stations
EDR has searched selected national collections of business directories and has collected listings of potential gas station/filling station/service station sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include gas station/filling station/service station establishments. The categories reviewed included, but were not limited to gas, gas station, gasoline station, filling station, auto, automobile repair, auto service station, service station, etc. This database falls within a category of information EDR classifies as "High Risk Historical Records", or HRHR. EDR's HRHR effort presents unique and sometimes proprietary data about past sites and operations that typically create environmental concerns, but may not show up in current government records searches.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

EDR Hist Cleaner: EDR Exclusive Historical Cleaners
EDR has searched selected national collections of business directories and has collected listings of potential dry cleaner sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include dry cleaning establishments. The categories reviewed included, but were not limited to dry cleaners, cleaners, laundry, laundromat, cleaning/laundry, wash & dry etc. This database falls within a category of information EDR classifies as "High Risk Historical Records", or HRHR. EDR's HRHR effort presents unique and sometimes proprietary data about past sites and operations that typically create environmental concerns, but may not show up in current government records searches.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

EDR RECOVERED GOVERNMENT ARCHIVES

Exclusive Recovered Govt. Archives

RGA HWS: Recovered Government Archive State Hazardous Waste Facilities List

The EDR Recovered Government Archive State Hazardous Waste database provides a list of SHWS incidents derived from historical databases and includes many records that no longer appear in current government lists. Compiled from Records formerly available from the Department of Natural Resources in Missouri.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 01/03/2014
Number of Days to Update: 186

Source: Department of Natural Resources
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

RGA LF: Recovered Government Archive Solid Waste Facilities List

The EDR Recovered Government Archive Landfill database provides a list of landfills derived from historical databases and includes many records that no longer appear in current government lists. Compiled from Records formerly available from the Department of Natural Resources in Missouri.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 01/15/2014
Number of Days to Update: 198

Source: Department of Natural Resources
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

RGA LUST: Recovered Government Archive Leaking Underground Storage Tank

The EDR Recovered Government Archive Leaking Underground Storage Tank database provides a list of LUST incidents derived from historical databases and includes many records that no longer appear in current government lists. Compiled from Records formerly available from the Department of Natural Resources in Missouri.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 01/03/2014
Number of Days to Update: 186

Source: Department of Natural Resources
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

OTHER DATABASE(S)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

CT MANIFEST: Hazardous Waste Manifest Data

Facility and manifest data. Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a tsd facility.

Date of Government Version: 07/30/2025
Date Data Arrived at EDR: 07/31/2025
Date Made Active in Reports: 10/16/2025
Number of Days to Update: 77

Source: Department of Energy & Environmental Protection
Telephone: 860-424-3375
Last EDR Contact: 11/03/2025
Next Scheduled EDR Contact: 02/16/2026
Data Release Frequency: No Update Planned

NY MANIFEST: Facility and Manifest Data

Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a TSD facility.

Date of Government Version: 12/31/2019
Date Data Arrived at EDR: 11/30/2023
Date Made Active in Reports: 12/01/2023
Number of Days to Update: 1

Source: Department of Environmental Conservation
Telephone: 518-402-8651
Last EDR Contact: 10/23/2025
Next Scheduled EDR Contact: 02/02/2026
Data Release Frequency: Quarterly

PA MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 06/30/2018
Date Data Arrived at EDR: 07/19/2019
Date Made Active in Reports: 09/10/2019
Number of Days to Update: 53

Source: Department of Environmental Protection
Telephone: 717-783-8990
Last EDR Contact: 10/01/2025
Next Scheduled EDR Contact: 01/19/2026
Data Release Frequency: Annually

RI MANIFEST: Manifest information
Hazardous waste manifest information

Date of Government Version: 12/31/2020
Date Data Arrived at EDR: 11/30/2021
Date Made Active in Reports: 02/18/2022
Number of Days to Update: 80

Source: Department of Environmental Management
Telephone: 401-222-2797
Last EDR Contact: 11/05/2025
Next Scheduled EDR Contact: 02/23/2026
Data Release Frequency: Annually

WI MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 05/31/2018
Date Data Arrived at EDR: 06/19/2019
Date Made Active in Reports: 09/03/2019
Number of Days to Update: 76

Source: Department of Natural Resources
Telephone: N/A
Last EDR Contact: 11/21/2025
Next Scheduled EDR Contact: 03/16/2026
Data Release Frequency: Annually

Oil/Gas Pipelines
Source: Endeavor Business Media
Petroleum Bundle (Crude Oil, Refined Products, Petrochemicals, Gas Liquids (LPG/NGL), and Specialty Gases (Miscellaneous)) N = Natural Gas Bundle (Natural Gas, Gas Liquids (LPG/NGL), and Specialty Gases (Miscellaneous)). This map includes information copyrighted by Endeavor Business Media. This information is provided on a best effort basis and Endeavor Business Media does not guarantee its accuracy nor warrant its fitness for any particular purpose. Such information has been reprinted with the permission of Endeavor Business Media.

Electric Power Transmission Line Data
Source: Endeavor Business Media
This map includes information copyrighted by Endeavor Business Media. This information is provided on a best effort basis and Endeavor Business Media does not guarantee its accuracy nor warrant its fitness for any particular purpose. Such information has been reprinted with the permission of Endeavor Business Media.

Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

AHA Hospitals:
Source: American Hospital Association, Inc.
Telephone: 312-280-5991
The database includes a listing of hospitals based on the American Hospital Association's annual survey of hospitals.

Medical Centers: Provider of Services Listing
Source: Centers for Medicare & Medicaid Services
Telephone: 410-786-3000
A listing of hospitals with Medicare provider number, produced by Centers of Medicare & Medicaid Services, a federal agency within the U.S. Department of Health and Human Services.

Nursing Homes
Source: National Institutes of Health
Telephone: 301-594-6248
Information on Medicare and Medicaid certified nursing homes in the United States.

Public Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on elementary and secondary public education in the United States. It is a comprehensive, annual, national statistical database of all public elementary and secondary schools and school districts, which contains data that are comparable across all states.

Private Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on private school locations in the United States.

Daycare Centers: Licensed Child Care Facilities
Source: Department of Health & Senior Services
Telephone: 573-751-2450

Flood Zone Data: This data was obtained from the Federal Emergency Management Agency (FEMA). It depicts 100-year and 500-year flood zones as defined by FEMA. It includes the National Flood Hazard Layer (NFHL) which incorporates Flood Insurance Rate Map (FIRM) data and Q3 data from FEMA in areas not covered by NFHL.
Source: FEMA
Telephone: 877-336-2627
Date of Government Version: 2003, 2015

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002, 2005, 2010 and 2015 from the U.S. Fish and Wildlife Service.

State Wetlands Data: National Wetland Inventory of Missouri
Source: Department of Natural Resources
Telephone: 573-751-5110

Current USGS 7.5 Minute Topographic Map
Source: U.S. Geological Survey

STREET AND ADDRESS INFORMATION

© 2015 TomTom North America, Inc. All rights reserved. This material is proprietary and the subject of copyright protection and other intellectual property rights owned by or licensed to Tele Atlas North America, Inc. The use of this material is subject to the terms of a license agreement. You will be held liable for any unauthorized copying or disclosure of this material.

GEOCHECK ®- PHYSICAL SETTING SOURCE ADDENDUM

TARGET PROPERTY ADDRESS

CLARENCE CANNON DAM
43691 POWER PLANT
PERRY, MO 63462

TARGET PROPERTY COORDINATES

Latitude (North):	39.523778 - 39˚ 31’ 25.60’’
Longitude (West):	91.645144 - 91˚ 38’ 42.52’’
Universal Tranverse Mercator:	Zone 15
UTM X (Meters):	616454.6
UTM Y (Meters):	4375570.5
Elevation:	606 ft. above sea level

USGS TOPOGRAPHIC MAP

Target Property Map:	24325594 CLARENCE CANNON DAM, MO
Version Date:	2021

EDR’s GeoCheck Physical Setting Source Addendum is provided to assist the environmental professional in forming an opinion about the impact of potential contaminant migration.

Assessment of the impact of contaminant migration generally has two principle investigative components:

1. Groundwater flow direction, and
2. Groundwater flow velocity.

Groundwater flow direction may be impacted by surface topography, hydrology, hydrogeology, characteristics of the soil, and nearby wells. Groundwater flow velocity is generally impacted by the nature of the geologic strata.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW DIRECTION INFORMATION

Groundwater flow direction for a particular site is best determined by a qualified environmental professional using site-specific well data. If such data is not reasonably ascertainable, it may be necessary to rely on other sources of information, such as surface topographic information, hydrologic information, hydrogeologic data collected on nearby properties, and regional groundwater flow information (from deep aquifers).

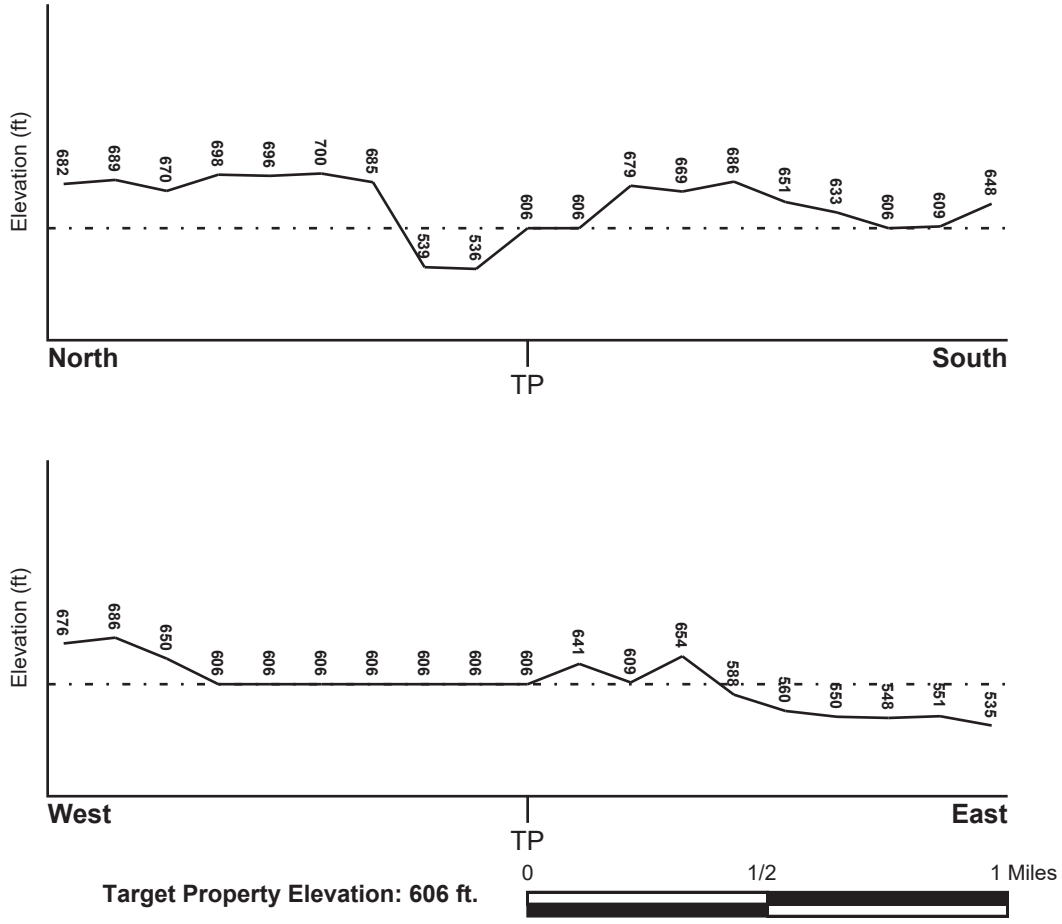
TOPOGRAPHIC INFORMATION

Surface topography may be indicative of the direction of surficial groundwater flow. This information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

TARGET PROPERTY TOPOGRAPHY

General Topographic Gradient: General NNE

SURROUNDING TOPOGRAPHY: ELEVATION PROFILES



Source: Topography has been determined from the USGS 7.5' Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

HYDROLOGIC INFORMATION

Surface water can act as a hydrologic barrier to groundwater flow. Such hydrologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Refer to the Physical Setting Source Map following this summary for hydrologic information (major waterways and bodies of water).

FEMA FLOOD ZONE

Flood Plain Panel at Target Property	FEMA Source Type
29173C0150C	FEMA FIRM Flood data

Additional Panels in search area:	FEMA Source Type
Not Reported	

NATIONAL WETLAND INVENTORY

NWI Quad at Target Property	NWI Electronic Data Coverage
JOANNA	YES - refer to the Overview Map and Detail Map

HYDROGEOLOGIC INFORMATION

Hydrogeologic information obtained by installation of wells on a specific site can often be an indicator of groundwater flow direction in the immediate area. Such hydrogeologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

AQUIFLOW®

Search Radius: 1.000 Mile.

EDR has developed the AQUIFLOW Information System to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted by environmental professionals to regulatory authorities at select sites and has extracted the date of the report, groundwater flow direction as determined hydrogeologically, and the depth to water table.

MAP ID	LOCATION FROM TP	GENERAL DIRECTION GROUNDWATER FLOW
Not Reported		

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW VELOCITY INFORMATION

Groundwater flow velocity information for a particular site is best determined by a qualified environmental professional using site specific geologic and soil strata data. If such data are not reasonably ascertainable, it may be necessary to rely on other sources of information, including geologic age identification, rock stratigraphic unit and soil characteristics data collected on nearby properties and regional soil information. In general, contaminant plumes move more quickly through sandy-gravelly types of soils than silty-clayey types of soils.

GEOLOGIC INFORMATION IN GENERAL AREA OF TARGET PROPERTY

Geologic information can be used by the environmental professional in forming an opinion about the relative speed at which contaminant migration may be occurring.

ROCK STRATIGRAPHIC UNIT

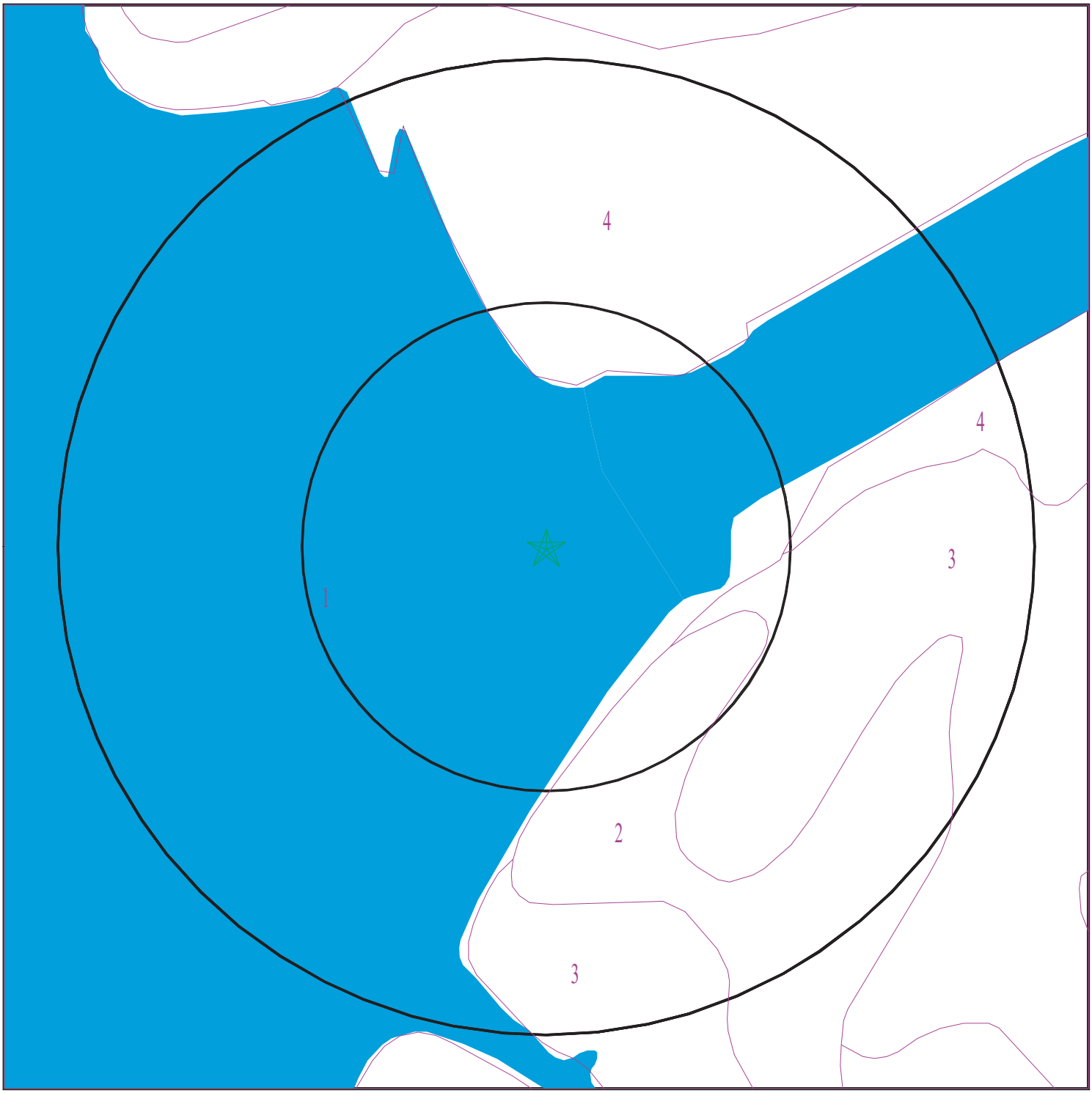
Era:	Paleozoic
System:	Mississippian
Series:	Osagean and Kinderhookian Series
Code:	M1 *(decoded above as Era, System & Series)*

GEOLOGIC AGE IDENTIFICATION

Category: Stratified Sequence

Geologic Age and Rock Stratigraphic Unit Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - a digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

SSURGO SOIL MAP - 8202033.2s



Target Property
SSURGO Soil
Water

0 1/16 1/8 1/4 Miles

N

SITE NAME:	Clarence Cannon Dam	CLIENT:	U.S. Army Corps of Engineers
ADDRESS:	43691 Power Plant Perry MO 63462	CONTACT:	Ben Greeling
		INQUIRY #:	8202033.2s
LAT/LONG:	39.523778 / 91.645144	DATE:	December 17, 2025 10:30 am

Copyright © 2025 EDR, Inc. © 2015 TomTom Rel. 2015.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

DOMINANT SOIL COMPOSITION IN GENERAL AREA OF TARGET PROPERTY

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) leads the National Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. The following information is based on Soil Conservation Service SSURGO data.

Soil Map ID: 1

Soil Component Name:	Water
Soil Surface Texture:	
Hydrologic Group:	Not reported
Soil Drainage Class:	
Hydric Status: Not hydric	
Corrosion Potential - Uncoated Steel:	Not Reported
Depth to Bedrock Min:	> 0 inches
Depth to Watertable Min:	> 0 inches

No Layer Information available.

Soil Map ID: 2

Soil Component Name:	Gorin
Soil Surface Texture:	silt loam
Hydrologic Group:	Class C - Slow infiltration rates. Soils with layers impeding downward movement of water, or soils with moderately fine or fine textures.
Soil Drainage Class:	Somewhat poorly drained
Hydric Status: Not hydric	
Corrosion Potential - Uncoated Steel:	High
Depth to Bedrock Min:	> 0 inches
Depth to Watertable Min:	> 92 inches

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	7 inches	silt loam	Not reported	Not reported	Max: 1.4 Min: 0.42	Max: 6 Min: 5.1
2	7 inches	12 inches	silty clay loam	Not reported	Not reported	Max: 1.4 Min: 0.42	Max: 6 Min: 5.1
3	12 inches	31 inches	silty clay	Not reported	Not reported	Max: 1.4 Min: 0.42	Max: 6 Min: 5.1
4	31 inches	66 inches	silty clay loam	Not reported	Not reported	Max: 1.4 Min: 0.42	Max: 6 Min: 5.1

Soil Map ID: 3

Soil Component Name: Goss

Soil Surface Texture: gravelly silt loam

Hydrologic Group: Class B - Moderate infiltration rates. Deep and moderately deep, moderately well and well drained soils with moderately coarse textures.

Soil Drainage Class: Well drained

Hydric Status: Not hydric

Corrosion Potential - Uncoated Steel: Moderate

Depth to Bedrock Min: > 0 inches

Depth to Watertable Min: > 0 inches

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	5 inches	gravelly silt loam	Not reported	Not reported	Max: 14 Min: 4	Max: 6 Min: 4.5
2	5 inches	61 inches	very gravelly silty clay	Not reported	Not reported	Max: 14 Min: 4	Max: 6 Min: 4.5

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Soil Map ID: 4

Soil Component Name: Landes

Soil Surface Texture: fine sandy loam

Hydrologic Group: Class B - Moderate infiltration rates. Deep and moderately deep, moderately well and well drained soils with moderately coarse textures.

Soil Drainage Class: Moderately well drained

Hydric Status: Partially hydric

Corrosion Potential - Uncoated Steel: Low

Depth to Bedrock Min: > 0 inches

Depth to Watertable Min: > 153 inches

Soil Layer Information							
	Boundary			Classification		Saturated hydraulic conductivity micro m/sec	Soil Reaction (pH)
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil		
1	0 inches	7 inches	fine sandy loam	Not reported	Not reported	Max: 141 Min: 42	Max: 8.4 Min: 5.6
2	7 inches	38 inches	fine sandy loam	Not reported	Not reported	Max: 141 Min: 42	Max: 8.4 Min: 5.6
3	38 inches	59 inches	sr to sand to silt loam	Not reported	Not reported	Max: 141 Min: 42	Max: 8.4 Min: 5.6

LOCAL / REGIONAL WATER AGENCY RECORDS

EDR Local/Regional Water Agency records provide water well information to assist the environmental professional in assessing sources that may impact ground water flow direction, and in forming an opinion about the impact of contaminant migration on nearby drinking water wells.

WELL SEARCH DISTANCE INFORMATION

DATABASE	SEARCH DISTANCE (miles)
Federal USGS	1.000
Federal FRDS PWS	Nearest PWS within 1 mile
State Database	1.000

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

FEDERAL USGS WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No Wells Found		

FEDERAL FRDS PUBLIC WATER SUPPLY SYSTEM INFORMATION

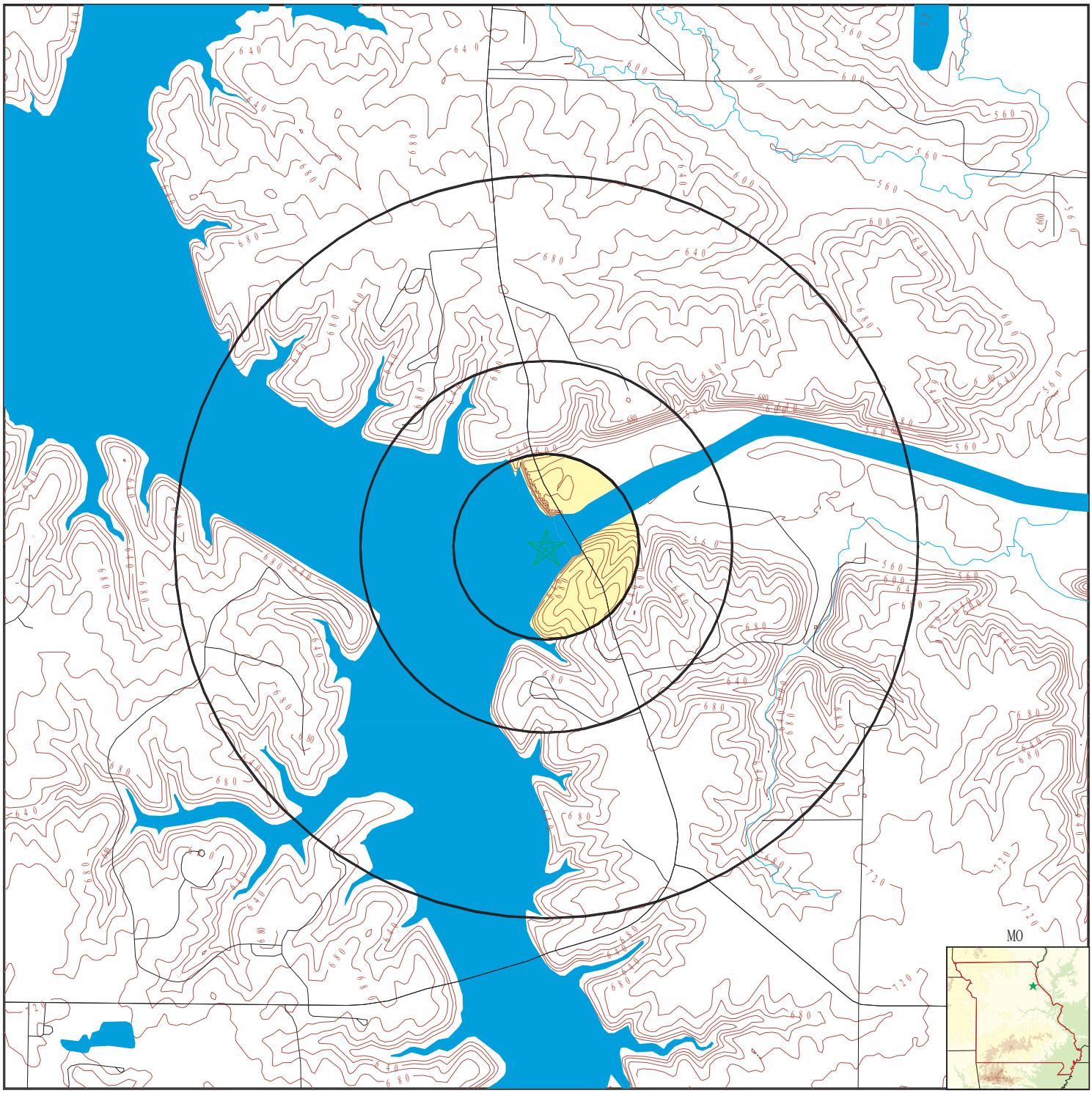
MAP ID	WELL ID	LOCATION FROM TP
No PWS System Found		

Note: PWS System location is not always the same as well location.

STATE DATABASE WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No Wells Found		

PHYSICAL SETTING SOURCE MAP - 8202033.2s



- County Boundary
- Major Roads
- Contour Lines
- Earthquake epicenter, Richter 5 or greater
- Water Wells
- Public Water Supply Wells
- Cluster of Multiple Icons
- Groundwater Flow Direction
- GI Indeterminate Groundwater Flow at Location
- GV Groundwater Flow Varies at Location
- Oil, gas or related wells

SITE NAME:	Clarence Cannon Dam	CLIENT:	U.S. Army Corps of Engineers
ADDRESS:	43691 Power Plant Perry MO 63462	CONTACT:	Ben Greeling
		INQUIRY #:	8202033.2s
LAT/LONG:	39.523778 / 91.645144	DATE:	December 17, 2025 10:29 am

Copyright © 2025 EDR, Inc. © 2015 TomTom Rel. 2015.

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS
RADON

AREA RADON INFORMATION

State Database: MO Radon

Radon Test Results

Zipcode	Test Date	Result
63462	01/25/07	32.9
63462	02/10/07	5.7
63462	03/30/09	????
63462	02/28/07	????
63462	02/28/07	< 0.3
63462	03/05/07	39.1
63462	07/20/07	< 0.3
63462	05/11/07	7.2

Federal EPA Radon Zone for RALLS County: 2

Note: Zone 1 indoor average level > 4 pCi/L.
: Zone 2 indoor average level >= 2 pCi/L and <= 4 pCi/L.
: Zone 3 indoor average level < 2 pCi/L.

Federal Area Radon Information for RALLS COUNTY, MO

Number of sites tested: 1

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	0.900 pCi/L	100%	0%	0%
Living Area - 2nd Floor	Not Reported	Not Reported	Not Reported	Not Reported
Basement	Not Reported	Not Reported	Not Reported	Not Reported

PHYSICAL SETTING SOURCE RECORDS SEARCHED

TOPOGRAPHIC INFORMATION

USGS 7.5' Digital Elevation Model (DEM)
Source: United States Geologic Survey
EDR acquired the USGS 7.5' Digital Elevation Model in 2002 and updated it in 2006. The 7.5 minute DEM corresponds to the USGS 1:24,000- and 1:25,000-scale topographic quadrangle maps. The DEM provides elevation data with consistent elevation units and projection.

Current USGS 7.5 Minute Topographic Map
Source: U.S. Geological Survey

HYDROLOGIC INFORMATION

Flood Zone Data: This data was obtained from the Federal Emergency Management Agency (FEMA). It depicts 100-year and 500-year flood zones as defined by FEMA. It includes the National Flood Hazard Layer (NFHL) which incorporates Flood Insurance Rate Map (FIRM) data and Q3 data from FEMA in areas not covered by NFHL.
Source: FEMA
Telephone: 877-336-2627
Date of Government Version: 2003, 2015

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002, 2005, 2010 and 2015 from the U.S. Fish and Wildlife Service.

State Wetlands Data: National Wetland Inventory of Missouri
Source: Department of Natural Resources
Telephone: 573-751-5110

HYDROGEOLOGIC INFORMATION

AQUIFLOW^{R} Information System
Source: EDR proprietary database of groundwater flow information
EDR has developed the AQUIFLOW Information System (AIS) to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted to regulatory authorities at select sites and has extracted the date of the report, hydrogeologically determined groundwater flow direction and depth to water table information.

GEOLOGIC INFORMATION

Geologic Age and Rock Stratigraphic Unit
Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - A digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

STATSGO: State Soil Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Service (NRCS)
The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) leads the national Conservation Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps.

SSURGO: Soil Survey Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Service (NRCS)
Telephone: 800-672-5559
SSURGO is the most detailed level of mapping done by the Natural Resources Conservation Service, mapping scales generally range from 1:12,000 to 1:63,360. Field mapping methods using national standards are used to construct the soil maps in the Soil Survey Geographic (SSURGO) database. SSURGO digitizing duplicates the original soil survey maps. This level of mapping is designed for use by landowners, townships and county natural resource planning and management.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

LOCAL / REGIONAL WATER AGENCY RECORDS

FEDERAL WATER WELLS

PWS: Public Water Systems
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SDWIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

USGS Water Wells: USGS National Water Inventory System (NWIS)
This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on wells, springs, and other sources of groundwater.

STATE RECORDS

Missouri Public Drinking Water Wells
Source: Department of Natural Resources
Telephone: 573-526-5448

Missouri Geologic Well Log Database
Source: Department of Natural Resources
Telephone: 573-526-5448

OTHER STATE DATABASE INFORMATION

Oil and Gas Well Database
Source: Department of Natural Resources
Telephone: 573-368-2143

RADON

Area Radon Information
Source: USGS
Telephone: 703-356-4020
The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

EPA Radon Zones
Source: EPA
Telephone: 703-356-4020
Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

OTHER

Airport Landing Facilities: Private and public use landing facilities
Source: Federal Aviation Administration, 800-457-6656

Epicenters: World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

Earthquake Fault Lines: The fault lines displayed on EDR's Topographic map are digitized quaternary faultlines, prepared in 1975 by the United State Geological Survey

PHYSICAL SETTING SOURCE RECORDS SEARCHED

STREET AND ADDRESS INFORMATION

© 2015 TomTom North America, Inc. All rights reserved. This material is proprietary and the subject of copyright protection and other intellectual property rights owned by or licensed to Tele Atlas North America, Inc. The use of this material is subject to the terms of a license agreement. You will be held liable for any unauthorized copying or disclosure of this material.

Clarence Cannon Dam
43691 Power Plant
Perry, MO 63462

Inquiry Number: 8202033.3
December 17, 2025

Certified Sanborn® Map Report

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

Certified Sanborn® Map Report

12/17/25

Site Name:

Clarence Cannon Dam
43691 Power Plant
Perry, MO 63462
EDR Inquiry # 8202033.3

Client Name:

U.S. Army Corps of Engineers
Svc. Base,
St. Louis, MO 63118
Contact: Ben Greeling

The Sanborn Library has been searched by EDR and maps covering the target property location as provided by U.S. Army Corps of Engineers were identified for the years listed below. The Sanborn Library is the largest, most complete collection of fire insurance maps. The collection includes maps from Sanborn, Bromley, Perris & Browne, Hopkins, Barlow, and others. Only Environmental Data Resources Inc. (EDR) is authorized to grant rights for commercial reproduction of maps by the Sanborn Library LLC, the copyright holder for the collection. Results can be authenticated by visiting www.edrnet.com/sanborn.

The Sanborn Library is continually enhanced with newly identified map archives. This report accesses all maps in the collection as of the day this report was generated.

Certified Sanborn Results:

Certification # 104B-4859-8860

PO # NA

Project Clarence Cannon Dam

UNMAPPED PROPERTY

This report certifies that the complete holdings of the Sanborn Library, LLC collection have been searched based on client supplied target property information, and fire insurance maps covering the target property were not found.

Sanborn® Library search results

Certification #: 104B-4859-8860

The Sanborn Library includes more than 1.2 million fire insurance maps from Sanborn, Bromley, Perris & Browne, Hopkins, Barlow and others which track historical property usage in approximately 12,000 American cities and towns. Collections searched:

- ✓ Library of Congress
- ✓ University Publications of America
- ✓ EDR Private Collection

The Sanborn Library LLC Since 1866™

Limited Permission To Make Copies

U.S. Army Corps of Engineers (the client) is permitted to make up to FIVE photocopies of this Sanborn Map transmittal and each fire insurance map accompanying this report solely for the limited use of its customer. No one other than the client is authorized to make copies. Upon request made directly to an EDR Account Executive, the client may be permitted to make a limited number of additional photocopies. This permission is conditioned upon compliance by the client, its customer and their agents with EDR's copyright policy; a copy of which is available upon request.

Disclaimer - Copyright and Trademark Notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, LLC. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. This Report is provided on an "AS IS", "AS AVAILABLE" basis. NO WARRANTY EXPRESS OR IMPLIED IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT. ENVIRONMENTAL DATA RESOURCES, LLC AND ITS SUBSIDIARIES, AFFILIATES AND THIRD PARTY SUPPLIERS DISCLAIM ALL WARRANTIES, OF ANY KIND OR NATURE, EXPRESS OR IMPLIED, ARISING OUT OF OR RELATED TO THIS REPORT OR ANY OF THE DATA AND INFORMATION PROVIDED IN THIS REPORT, INCLUDING WITHOUT LIMITATION, ANY WARRANTIES REGARDING ACCURACY, QUALITY, CORRECTNESS, COMPLETENESS, COMPREHENSIVENESS, SUITABILITY, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, NON-INFRINGEMENT, MISAPPROPRIATION, OR OTHERWISE. ALL RISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, LLC OR ITS SUBSIDIARIES, AFFILIATES OR THIRD PARTY SUPPLIERS BE LIABLE TO ANYONE FOR ANY DIRECT, INCIDENTAL, INDIRECT, SPECIAL, CONSEQUENTIAL OR OTHER DAMAGES OF ANY TYPE OR KIND (INCLUDING BUT NOT LIMITED TO LOSS OF PROFITS, LOSS OF USE, OR LOSS OF DATA), ARISING OUT OF OR IN ANY WAY CONNECTED WITH THIS REPORT OR ANY OF THE DATA AND INFORMATION PROVIDED IN THIS REPORT. Any analyses, estimates, ratings, environmental risk levels, or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providing any facts regarding, or prediction or forecast of, any environmental risk for any property. Only an assessment performed by a qualified environmental professional can provide findings, opinions or conclusions regarding the environmental risk or conditions in, on or at any property.

Copyright 2025 by Environmental Data Resources, Inc. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, Inc., or its affiliates, is prohibited without prior written permission.

EDR and its logos (including Sanborn and Sanborn Map) are trademarks of Environmental Data Resources, LLC or its affiliates. All other trademarks used herein are the property of their respective owners.

Clarence Cannon Dam
43691 Power Plant
Perry, MO 63462

Inquiry Number: 8202033.6
December 17, 2025

The EDR Property Tax Map Report

EDR® Environmental Data Resources Inc

6 Armstrong Road
Shelton, CT 06484
800.352.0050
www.edrnet.com

EDR Property Tax Map Report

Environmental Data Resources, Inc.'s EDR Property Tax Map Report is designed to assist environmental professionals in evaluating potential environmental conditions on a target property by understanding property boundaries and other characteristics. The report includes a search of available property tax maps, which include information on boundaries for the target property and neighboring properties, addresses, parcel identification numbers, as well as other data typically used in property location and identification.

NO COVERAGE

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

Disclaimer - Copyright and Trademark Notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, Inc. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. **NO WARRANTY EXPRESSED OR IMPLIED, IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT. ENVIRONMENTAL DATA RESOURCES, INC. SPECIFICALLY DISCLAIMS THE MAKING OF ANY SUCH WARRANTIES, INCLUDING WITHOUT LIMITATION, MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE. ALL RISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, INC. BE LIABLE TO ANYONE, WHETHER ARISING OUT OF ERRORS OR OMISSIONS, NEGLIGENCE, ACCIDENT OR ANY OTHER CAUSE, FOR ANY LOSS OR DAMAGE, INCLUDING, WITHOUT LIMITATION, SPECIAL, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES. ANY LIABILITY ON THE PART OF ENVIRONMENTAL DATA RESOURCES, INC. IS STRICTLY LIMITED TO A REFUND OF THE AMOUNT PAID FOR THIS REPORT.** Purchaser accepts this Report "AS IS". Any analyses, estimates, ratings, environmental risk levels or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providing any facts regarding, or prediction orforecast of, any environmental risk for any property. Only a Phase I Environmental Site Assessment performed by an environmental professional can provide information regarding the environmental risk for any property. Additionally, the information provided in this Report is not to be construed as legal advice.

Copyright 2022 by Environmental Data Resources, Inc. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, Inc. or its affiliates is prohibited without prior written permission.

EDR and its logos (including Sanborn and Sanborn Map) are trademarks of Environmental Data Resources, Inc. or its affiliates. All other trademarks used herein are the property of their respective owners.

SUPPLEMENTARY MATERIALS C: CORRESPONDENCE

From: Greeling, Benjamin A CIV USARMY CEMVS (USA)
To: "rallsemd@rallscountymo.gov"
Subject: US Army Corps of Engineers St. Louis District - Information Request
Date: Wednesday, December 31, 2025 8:46:00 AM
Attachments: image001.png
image002.png

Good Morning Mr. Murfin,

Happy Holidays and Happy New Year!

My name is Ben Greeling. I work for the environmental quality section of the US Army Corps of Engineers and I am conducting a Phase I Environmental Site Assessment to fulfill the policy requirement of completing environmental due diligence for the potential improvement project at Mark Twain Lake. This project is in it's feasibility phase, but aims to improve water quality releases through Clarence Cannon Dam by raising the existing temperature control weir (by placing rock) just upstream of the dam. This method is only a "tentatively selected plan" thus far and not finalized. As part of this environmental due diligence effort, I am asking local owners/operators and government officials (knowledgeable persons) to respond to a few questions related to potential releases to the environment. Would you be able to answer the below questions and return via email at your earliest convenience? Please feel free to email or call if you have any questions.

The following questions are only intended for the areas identified by the yellow polygons on the two below maps.

1. Clarence Cannon Dam (under water weir just upstream of the dam)
2. Boat ramp and parking lot at Ray Behrens recreation area (potential staging area for the construction project)

US Army Corps of Engineers Mark Twain…
Hwy J
Clarence Cannon Dam
MW Boudreaux Memorial Visitor Center

Emergency Response Questionnaire – Ralls Count Emergency Management

1. Are you aware of any spills or releases of hazardous substances or petroleum products at or near the subject property?

2. Are you aware of the subject property ever being used as a dump site (excessive metals, tires, glass, chemical containers, old drums, etc.) either household or industrial?

3. Are you aware of any type of illegal activities at or near the subject property involving hazardous substances (drug manufacturing or other)?

4. Are you aware of the property being the subject of any environmental sampling or studies?

5. Are you aware of any additional environmental conditions that are not listed that you feel are relevant at the subject property?

Thank you,

Ben Greeling
Supervisory Environmental Specialist
Environmental Quality

St. Louis District
U.S. Army Corps of Engineers
100 Arsenal St
St. Louis, MO, 63118
314-331-8768
636-399-5105
benjamin.greeling@usace.army.mil

From: Mehrer, Allen E CIV USARMY CEMVS (USA)
To: Greeling, Benjamin A CIV USARMY CEMVS (USA)
Subject: RE: ESA Phase I Questionnaire and Site Visit - Clarence Cannon CAP - NLT 14JAN2026
Date: Tuesday, January 27, 2026 10:19:35 AM
Attachments: image001.png
image002.png
image003.png

Ben,
It was a misprint. It should read "Since 1984, no oil spills documented. Prior to 1984, unknown."

Allen

From: Greeling, Benjamin A CIV USARMY CEMVS (USA) <Benjamin.Greeling@usace.army.mil>
Sent: Tuesday, January 27, 2026 10:07 AM
To: Mehrer, Allen E CIV USARMY CEMVS (USA) <Allen.Mehrer@usace.army.mil>
Cc: Bishop, Deric K CIV USARMY CEMVS (USA) <Deric.K.Bishop@usace.army.mil>
Subject: RE: ESA Phase I Questionnaire and Site Visit - Clarence Cannon CAP - NLT 14JAN2026

Allen,

Apologies, upon my second read of your responses I realized I missed something. You said that there were 2 documented oil spills at Frank Russell Staging area since 1984. Can you provide any more details on those? Dates, quantity of oil, response from spill response or State or other regulator (NFA letter), any docs that are relevant – so that we can document it in the report. We don't have anything in our ERGO records and Mike did not recall anything.

3. Has there ever been any type of spill (oil products, chemicals, etc.) on the property?
If so, what was spilled an approximately how many gallons?
Did spill reach surface waters?

TCW – Since 1984, no spills documented.

Frank Russell Staging Area – Since 1984, to oil spills documented. Prior to 1984, unknown.

Ray Behrens – No significant spills noted. Insignificant quantities generated by recreational use of visitors.

From: Mehrer, Allen E CIV USARMY CEMVS (USA) <Allen.Mehrer@usace.army.mil>
Sent: Monday, January 5, 2026 2:19 PM
To: Greeling, Benjamin A CIV USARMY CEMVS (USA) <Benjamin.Greeling@usace.army.mil>
Cc: Bishop, Deric K CIV USARMY CEMVS (USA) <Deric.K.Bishop@usace.army.mil>
Subject: RE: ESA Phase I Questionnaire and Site Visit - Clarence Cannon CAP - NLT 14JAN2026

Let me know if you have questions.

Allen

From: Greeling, Benjamin A CIV USARMY CEMVS (USA) <Benjamin.Greeling@usace.army.mil>
Sent: Monday, January 5, 2026 10:33 AM
To: Mehrer, Allen E CIV USARMY CEMVS (USA) <Allen.Mehrer@usace.army.mil>; Bishop, Deric K CIV USARMY CEMVS (USA) <Deric.K.Bishop@usace.army.mil>
Subject: RE: ESA Phase I Questionnaire and Site Visit - Clarence Cannon CAP - NLT 14JAN2026

Good Morning,

I'm hoping to schedule a site visit for next week – looking at Tuesday or Wednesday. I'll shoot to get to the Project Office around 0930 and then drive around those areas/polygons below and take pictures, etc. It should only take a few hours. I don't necessarily have to have an escort to all the places, but would like to go through the locked gate and check out the road that is directly opposite the project office if possible.

Let me know if either day works better for you (or different time/day).

Thanks!
Ben

From: Greeling, Benjamin A CIV USARMY CEMVS (USA)
Sent: Wednesday, December 31, 2025 7:52 AM
To: Mehrer, Allen E CIV USARMY CEMVS (USA) <Allen.Mehrer@usace.army.mil>; Bishop, Deric K CIV USARMY CEMVS (USA) <Deric.K.Bishop@usace.army.mil>
Cc: Henry, Michael L CIV USARMY CEMVS (USA) <Michael.L.Henry@usace.army.mil>
Subject: ESA Phase I Questionnaire and Site Visit - Clarence Cannon CAP - NLT 14JAN2026

Gentlemen,

I hope you've had a great holiday and new year!

As we now have a tentatively selected plan for the Clarence Cannon CAP to improve water quality releases I am conducting a Phase I Environmental Site Assessment. As you're likely aware, it is Corps policy to establish and facilitate early identification and appropriate consideration of potential HTRW in reconnaissance, feasibility, preconstruction engineering and design, land acquisition, construction, operations and maintenance, repairs, replacement, and rehabilitation phases of water resources studies or projects by conducting a Phase I ESA.

I'll be conducting this phase I on the TSP we've selected which includes raising the weir by placing rock (widening it up/downstream and raising it). This Phase I will also include any construction related impacts such as the staging area and boat ramp. Since we are still in feasibility and plans can change, please include the areas near the dam and Ray Behrens – as shown in the 2 polygons below. When we spoke about staging areas briefly before, Ray Behrens was mentioned as a likely candidate, but I think there will be more discussion in the design phase on that.

Allen, I think you've filled these out before and Deric, you may have seen them as well. I'll reach out to Mike Henry separately regarding the power plant's hazardous waste generator status and history (though I do not anticipate any major impacts from that end). I have attached a standardized questionnaire for you to fill out and send back as part of this effort. I think some of these questions likely won't apply (especially for the 'in the lake' work) and that's fine. Please just answer to the best of your ability (put no or NA as needed). If there are any other potential environmental issues that you think may impact the project, please include those as well. I've asked for a response by 14JAN so I can try and complete this by EOM.

Please advise if you have any questions.

Thanks!

Ben Greeling
Supervisory Environmental Specialist
Environmental Quality
St. Louis District
U.S. Army Corps of Engineers
100 Arsenal St
St. Louis, MO, 63118
314-331-8768
636-399-5105
benjamin.greeling@usace.army.mil

US Army Corps of Engineers Mark Twain…
Hwy J
Hwy J
Clarence Cannon Dam
MW Boudreaux Memorial Visitor Center

Ray Behrens Recreation Area
e Access Trail
Blackjack Marina
Ray Behrens camp

From: Henry, Michael L CIV USARMY CEMVS (USA)
To: Greeling, Benjamin A CIV USARMY CEMVS (USA)
Cc: Henry, Michael L CIV USARMY CEMVS (USA)
Subject: RE: ESA Phase I Questionnaire and Site Visit - Clarence Cannon CAP - NLT 14JAN2026
Date: Monday, January 5, 2026 8:05:16 AM
Attachments: Legacy Quest CCDMTL 8-17 MLH.pdf
HVI2015_IndustryExperiencewithAeratingTurbines.pdf
image001.png
image002.png
ERGO TEAM Compliance Categories.pdf
MTL CAP ESA Questionnaire MLH.docx
image003.png

Mr. Greeling,

Operations Chiefs and Operations Project Managers at all levels of the Corps are responsible for environmental compliance at their respective projects, districts, divisions, and HQUSACE. At the District level, projects undergo self-assessments of compliance on a 5 year external, and 1-year internal assessment cycle of civil works facilities and applicable outgrants of real property on civil works projects. These assessments are performed in general accordance with the Corps' Environmental Compliance Assessment Program.

The Environmental Compliance Assessment Program was initiated by the Corps as a comprehensive self-evaluation and program management system for achieving, maintaining, and monitoring compliance with applicable environmental laws and regulations at USACE facilities and operating projects. The acronym, ERGO, has become synonymous with the assessment process. ERGO stands for the Environmental Review Guide for Operations. It is the Corps specific tool used to conduct environmental compliance assessments. Attached are the environmental compliance categories with governing federal and state regulations, policies, and guidance reviewed as part of the assessments.

For the last 20 plus years, my role as IH RTE has been to serve as the technical lead for annual and external assessments, as well as the POC for all HTRW related issues with regards to the operations and maintenance of the project and out grants. I also serve in the capacity as an Environmental Professional as defined under ASTM -1527 Phase I ESA.

EXSUM: With regards to the two polygons - RECs would be limited to Clarence Cannon Dam Operations & Maintenance (CCD O&M) and Blackjack Marina at the Ray Behrens Recreation Area . In my professional opinion - all historic and present potential RECs have been/are being managed in such a manner that they have either been mitigated, or are being managed in such a way that they are considered a de-minimus risk not impacting the proposed CAP. The following are the historic potential RECs for the subject areas taken from past ERGO Reports and IH interactions with the Project Office over the years:

Ray Behrens Recreation Area (Blackjack Marina)

Historic potential RECs include Aboveground Storage Tanks (ASTs) for petroleum and propane, and a local Water Supply Tower. Propane AST's are being managed properly- only issues are related to signage. Petroleum AST's are being managed in accordance with a site specific Spill Prevention, Control, and Countermeasure Plan (SPCCP) with adequate spill control and emergency response measures in place. The concern raised with the water tower deals with the presence of lead based paint - however a recent assessment has determined the condition to not present a risk to the public or environment, thus not a risk to the CAP.

CCD O&M

Hazardous Waste (HW)/Hazardous Materials (HM)- The project is listed as a Conditionally Exempt Small Quantity Generator as they do not generate sufficient quantities of HW to required permits or reporting. De-minimus quantities HW/HM generated on site are being managed appropriately and do not present a risk to the CAP.

Non-Hazardous Waste (NHW) - Used oil associated with power turbines are being stored, managed, recycled in accordance with the site SPCCP - thus not a REC.

Solid Waste (SW) - SW is being managed accordingly- thus not a REC.

Universal Waste (UW) - UW (batteries/lamps) are being managed accordingly - thus not a REC.

Transformer Stations - A large transformer bank exists at the CCP PP, and smaller station proximate to the facility (both downstream and non-PCB). Releases could present a REC to downstream public and the environment - However historic improvements to spill containment and management are reflected in their current SPCCP and are being managed accordingly - thus not a REC.

Lead Based Paint (LBP) - LBP surveys have been done at various times throughout the history of the project and managed accordingly. There are no LBP issues present that would present a REC to the CAP.-

Asbestos Containing Material (ACM) - ACM has been limited to electrical systems and turbine gaskets. All of which have been abated - thus not a REC.

Mold - Mold issues existed historically associated with the dam gallery and flood impacted unoccupied office space. All of which have been mitigated/managed and do not present a REC.

Electromagnetic Field Survey (EMF) - An EMF survey was performed to determine if the power plant were emitting EMF that could impact occupational health - the survey identified no issues- thus not a REC.

Fish Kill (food grade vegetable oil release) - A historic release in the generator bay caused a fish kill - Modifications to the plant operating and maintenance practices and reflected in their SPCCP have mitigated the potential for recurrence- thus not a REC.

Dive Safety Operations - Bouy Line - As part of the upstream buoy line installation, dive operations were required to support the work effort . No environmental concerns were identified during the planning or execution of the dive - thus not a REC.

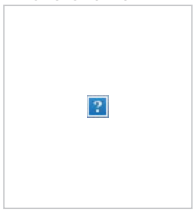
Legacy Contamination - In 2019, USACE was required to identify legacy HTRW contamination issues at the project level (See attached). Issues identified relate to ACM- which have been mitigated - thus not a REC.

Attached is the requested completed questionnaire as well.

Please let me know if you have any questions or require additional information.

v/r

Michael L Henry, Industrial Hygienist (MVD RTE)
District Dive Coordinator
Environmental Quality Section
Environmental & Munitions Branch
St. Louis District CE-MVS-EC-EQ
US Army Corps of Engineers
Michael.l.henry@usace.army.mil
M: 618-570-2842



-

From: Greeling, Benjamin A CIV USARMY CEMVS (USA) <Benjamin.Greeling@usace.army.mil>
Sent: Wednesday, December 31, 2025 8:13 AM

To: Henry, Michael L CIV USARMY CEMVS (USA) <Michael.L.Henry@usace.army.mil>
Subject: FW: ESA Phase I Questionnaire and Site Visit - Clarence Cannon CAP - NLT 14JAN2026

Mr. Henry,

Would you be able to provide details, as the USACE MVS Industrial Hygienist and environmental compliance representative, regarding the Clarence Cannon Dam power plant's history? I'm looking for any pertinent details you can provide regarding the hazardous generator status, environmental compliance, and historical releases to the environment which may have occurred there – as part of our environmental due diligence for the feasibility phase of the construction project referred to in the below email. We have a 3rd party environmental records package for this effort which should cover some of this information, so you're response need not be a large effort. The construction area is on the existing temperature control weir, just upstream of the dam, so it is likely that any releases which may have occurred at the dam would only have "potential" impacts at the dam and/or downstream. Additionally, if you are aware of any potential Recognized Environmental Conditions that may impact the project (other than the dam operations), please share.

Please provide your response by 14JAN2026 – if possible.

Thank you,

Ben Greeling
Supervisory Environmental Specialist
Environmental Quality
St. Louis District
U.S. Army Corps of Engineers
100 Arsenal St
St. Louis, MO, 63118
314-331-8768
636-399-5105
benjamin.greeling@usace.army.mil

From: Greeling, Benjamin A CIV USARMY CEMVS (USA)
Sent: Wednesday, December 31, 2025 7:52 AM
To: Mehrer, Allen E CIV USARMY CEMVS (USA) <Allen.Mehrer@usace.army.mil>; Bishop, Deric K CIV USARMY CEMVS (USA) <Deric.K.Bishop@usace.army.mil>
Cc: Henry, Michael L CIV USARMY CEMVS (USA) <Michael.L.Henry@usace.army.mil>
Subject: ESA Phase I Questionnaire and Site Visit - Clarence Cannon CAP - NLT 14JAN2026

Gentlemen,

I hope you've had a great holiday and new year!

As we now have a tentatively selected plan for the Clarence Cannon CAP to improve water quality releases I am conducting a Phase I Environmental Site Assessment. As you're likely aware, it is Corps policy to establish and facilitate early identification and appropriate consideration of potential HTRW in reconnaissance, feasibility, preconstruction engineering and design, land acquisition, construction, operations and maintenance, repairs, replacement, and rehabilitation phases of water resources studies or projects by conducting a Phase I ESA.

I'll be conducting this phase I on the TSP we've selected which includes raising the weir by placing rock (widening it up/downstream and raising it). This Phase I will also include any construction related impacts such as the staging area and boat ramp. Since we are still in feasibility and plans can change, please include the areas near the dam and Ray Behrens – as shown in the 2 polygons below. When we spoke about staging areas briefly before, Ray Behrens was mentioned as a likely candidate, but I think there will be more discussion in the design phase on that.

Allen, I think you've filled these out before and Deric, you may have seen them as well. I'll reach out to Mike Henry separately regarding the power plant's hazardous waste generator status and history (though I do not anticipate any major impacts from that end). I have attached a standardized questionnaire for you to fill out and send back as part of this effort. I think some of these questions likely won't apply (especially for the 'in the lake' work) and that's fine. Please just answer to the best of your ability (put no or NA as needed). If there are any other potential environmental issues that you think may impact the project, please include those as well. I've asked for a response by 14JAN so I can try and complete this by EOM.

Please advise if you have any questions.

Thanks!

Ben Greeling
Supervisory Environmental Specialist
Environmental Quality
St. Louis District

Continuing Authorities Program (CAP) 1135

Clarence Cannon Dam at Mark Twain Lake

Appendix I: Cost

St. Louis District
Project Sponsor: Missouri Department of Conservation
January 2026

(NOTE: This page intentionally left blank.)

Table of Contents

1 COST ESTIMATE SUMMARY 4
1.1 GENERAL 4
1.2 BASIS OF COST ESTIMATE 5
1.3 CONTINGENCIES 5
1.4 PLANNING, ENGINEERING, AND DESIGN (PED) 5
1.5 CONSTRUCTION MANAGEMENT 5

1 COST ESTIMATE SUMMARY

1.1 GENERAL

Mark Twain Lake is located in northeastern Missouri on the Salt River in the Salt River Basin. Mark Twain Lake spans both Ralls and Monroe Counties, is located approximately 20 miles southwest of Hannibal, MO and 140 miles north of St. Louis, MO. Clarence Cannon Dam and its associated re-regulation dam are located in Ralls County, MO, upstream from the confluence with the Mississippi River at river miles (RM) 63.0 and 53.5, respectively.

The USACE national objective for ecosystem restoration is to contribute to the Nation's ecosystems by restoring degraded ecosystem structure, function, and dynamic processes. This study was conducted to examine the feasibility of an ecosystem restoration project in the area. Specific study objectives are created to determine whether individual management measures can solve the study area's problems while taking advantage of the opportunities identified and avoiding the constraints. The following study objective was developed based on study area problems, opportunities, and goals, as well as the Federal objective and regulations:

- Reduce regular occurrences of DO measuring below 5 mg/L to reduce stress on fish species and decrease the frequency and size of fish mortality events within the study area over the period of analysis.

The final array of alternatives include:

- No Action
- Alternative 1 – Temperature Control Curtain
- Alternative 8a – Raise TCW (585 Elevation)
- Alternative 8b – Raise TCW (588 Elevation)

A summary of each Alternative is listed below:

Alternative 1 – Temperature Control Weir:

- A fixed temperature control curtain system consists of an impermeable curtain attached to a surface floating boom with heavy duty chains anchored to the banks and stabilized at the bottom, in this case the top of the TCW, with weighted tanks and ballast weighted chains

Alternative 8a & 8b– Raise TCW (585 Elevation & 588 Elevation):

- The TCW was constructed as a skimming weir to prevent cold, poorly oxygenated water from passing through Clarence Cannon Dam and was designed to an elevation of 580ft. During the summer months however, the lake is stratified and often rises to the point at which the thermocline – the depth at which temperature and oxygen content decline drastically - is above the TCW. Additionally, recent bathymetric surveys of the forebay and TCW show one to two feet of degradation on the southern half of the weir.

- Raising the TCW could include restoring the weir to initial design elevations of 580ft or building it up higher to decrease the frequency and duration of low dissolved oxygen releases through Clarence Cannon Dam. The higher the weir is raised corresponds to higher protection from low DO water passing over the weir; however,

a maximum elevation to which the weir may be raised without impacting power generation will need to be modeled. USACE is currently coordinating with SWPA and HDC for this effort. However, for the purposes of alternative evaluation, the PDT identified 585ft as a tentatively acceptable elevation.

Alternative level cost estimates were produced for each alternative and an abbreviated risk analysis was conducted to develop project contingency. The tentatively selected plan is: Alternative 8a – Raise TCW (585 Elevation).

1.2 BASIS OF COST ESTIMATE

The cost estimates have been prepared based on current concept designs and site-specific information available to date. Quantities were developed by the MVS Civil Design Section. The cost estimates were developed using MCACES and Microsoft Excel. The wage rates were developed using Davis Bacon, Heavy & Highway construction for Ralls County, MO MO20260001 Last Revised January 09, 2026. The MII 2024 Equipment Region 5 was used for equipment rates. The 2025 Cost Book was used.
It is assumed that all stone for the project will be furnished and delivered via truck to the project area and loaded onto barge via a boat ramp near the Clarence Cannon Dam. It is currently assumed that C-Stone will be used to raise the temperature control weir to the 585 elevation. A 50% increase in quantities was included due to underwater placement of the stone.

1.3 CONTINGENCIES

The Abbreviated Risk Analysis process indicated a total project contingency of 38%. The construction estimate indicated a contingency of 44%. Planning, engineering and design indicated a contingency of 18% and construction management indicated a contingency of 22%.

1.4 PLANNING, ENGINEERING, AND DESIGN (PED)

Planning, engineering, and design costs are based on historical data of similar projects in the St. Louis District. Recommended percentages by the cost MCX were taken into consideration as well. 18% of the construction cost was used to determine the PED costs. The Monitoring and Adaptive Management (MAM) costs were developed by the PDT and will be included in the PED account.

1.5 CONSTRUCTION MANAGEMENT

Construction Management costs are based on historical data of similar projects in the St. Louis District. Recommended percentages by the cost MCX were taken into consideration as well. 10% of the construction cost was used to determine the CM costs.

Clarence Cannon CAP 1135

Raise Temperature Control Weir to Elev 588 2/12/2026

ITEM	ESTIMATED AMOUNT	
Mobilization and Demobilization	$739,000	
Site Access		
Clearing & Grubbing	$5,000	
Crushed Stone	$132,000	
Establishment of Turf	$10,000	
C-Stone	$14,642,000	
SUBTOTAL:	$15,528,000	
Contingency:	$5,901,000	38%
SUBTOTAL:	$21,429,000	
E & D	$3,857,000	18%
S & A	$2,143,000	10%
MAM	$857,000	4%
TOTAL COST:	**$28,286,000**	

O&M Costs: $4,462,500

Clarence Cannon CAP 1135

Raise Temperature Control Weir to Elev 585 2/12/2026

ITEM	ESTIMATED AMOUNT	
Mobilization and Demobilization	$456,000	
Site Access		
Clearing & Grubbing	$5,000	
Crushed Stone	$132,000	
Establishment of Turf	$10,000	
C-Stone	$8,966,000	
SUBTOTAL:	$9,569,000	
Contingency:	$3,636,000	38%
SUBTOTAL:	$13,205,000	
E & D	$2,377,000	18%
S & A	$1,321,000	10%
MAM	$528,000	4%
TOTAL COST:	**$17,431,000**	

O&M Costs: $2,730,000

Clarence Cannon CAP 1135

Adjustable Flexible Temperature Curtain 2/12/2026

ITEM	ESTIMATED AMOUNT
Mobilization and Demobilization - Curtain	$262,000
Mobilization and Demobilization - TCW Raise	$400,000
Site Access	
Clearing & Grubbing	$5,000
Crushed Stone	$132,000
Establishment of Turf	$10,000
Raise Weir to Elevation 580	
C-Stone	$1,032,000
Curtain	$1,231,000
Upper Boom Buoys/Floating tanks	$1,800,000
Foam (To Fill Tanks)	$314,000
Bumpers	$105,000
Lower Boom Weighted Tanks	$68,000
Stabilizing Tanks	$495,000
Stabilizing Tanks Bottoms Anchorage	$22,000
Sand Socks	$20,000
Shore Anchors	$2,000
SUBTOTAL:	$5,898,000
Contingency:	$5,131,000 87%
SUBTOTAL:	$11,029,000
E & D	$1,985,000 18%
S & A	$1,103,000 10%
MAM	$441,000 4%
TOTAL COST:	**$14,558,000**

O&M Costs: $11,090,000

Abbreviated Risk Analysis

Project (less than $40M): **Clarence Cannon CAP 1135**
Project Development Stage/Alternative: **Feasibility (Alternatives)**
Risk Category: **Moderate Risk: Typical Project Construction Type**

Alternative: **Raise Temperature Control Weir Alternative (585)**
Meeting Date: **10/27/2025**

Total Estimated Construction Contract Cost = **$ 9,569,000**

	CWWBS	Feature of Work	Estimated Cost	% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate		0%	$ -	$ -
1	06 FISH AND WILDLIFE FACILITIES	**Mob/Demob**	**$ 456,000**	37%	$ 170,703	$ 626,703
2	06 FISH AND WILDLIFE FACILITIES	**Site Access**	**$ 147,000**	47%	$ 68,656	$ 215,656
3	06 FISH AND WILDLIFE FACILITIES	**C-Stone**	**$ 8,966,000**	44%	$ 3,974,865	$ 12,940,865
4				0%	$ -	$ -
5				0%	$ -	$ -
6				0%	$ -	$ -
7				0%	$ -	$ -
8				0%	$ -	$ -
9				0%	$ -	$ -
10				0%	$ -	$ -
11				0%	$ -	$ -
12				0%	$ -	$ -
13	30 PLANNING, ENGINEERING, AND DESIGN	**Planning, Engineering, & Design**	**$ 2,250,420**	18%	$ 396,608	$ 2,647,028
14	31 CONSTRUCTION MANAGEMENT	**Construction Management**	**$ 956,900**	22%	$ 208,314	$ 1,165,214
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)				**$ -**	

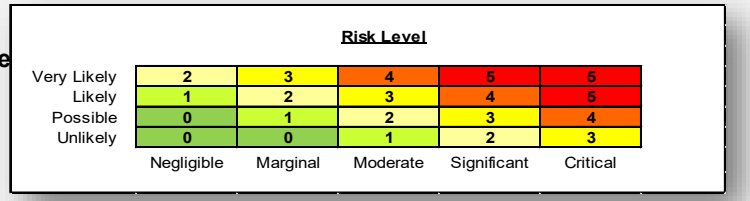
Totals					
Real Estate	$ -	0%	$ -	$ -
Total Construction Estimate	$ 9,569,000	44.04%	$ 4,214,223	$ 13,783,223
Total Planning, Engineering & Design	$ 2,250,420	17.62%	$ 396,608	$ 2,647,028
Total Construction Management	$ 956,900	21.77%	$ 208,314	$ 1,165,214
Total Excluding Real Estate	**$ 12,776,320**	**38%**	**$ 4,819,146**	**$ 17,595,466**
		Base	**50%**	**80%**
Confidence Level Range Estimate ($000's)		$12,776k	$15,667k	$17,595k

* 50% based on base is at 5% CL.

Fixed Dollar Risk Add: (Allows for additional risk to be added to the risk analsyis. Must include justification. Does not allocate to Real Estate.	

Clarence Cannon CAP 1135 Raise Temperature Control We

Feasibility (Alternatives)
Abbreviated Risk Analysis
Meeting Date: 27-Oct-25



Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Project Management & Scope Growth				**Maximum Project Growth**		**75%**
PS-1	Mob/Demob	No concerns.	No concerns about Mob/Demob from a project management/scope growth standpoint.	Negligible	Unlikely	0
PS-2	Site Access	Potential for scope growth, added features and quantities?	Potential for staging area to require more stone than what is currently anticipated. The impact would be marginal. Access roads are currently on paved roadways (state highways) before it transitions into gravel roads. Unless, more robust material is needed this quantity is unlikely to change.	Marginal	Possible	1
PS-3	C-Stone	Potential for scope growth, added features and quantities?	Stone quantity is already increased by 150% due to underwater placement. There is low risk of this quantity increasing as design progresses.	Moderate	Unlikely	1
PS-13	Planning, Engineering, & Design	Potential for scope growth, added features and quantities?	Added features and quantities will increase PED.	Moderate	Possible	2
PS-14	Construction Management	Potential for scope growth, added features and quantities?	MVS construction office could potentially contract out the construction management to a CMS contractor due to insufficient staffing. This has led to a cost increase on prior projects for construction management.	Moderate	Possible	2
Acquisition Strategy				**Maximum Project Growth**		**30%**
AS-1	Mob/Demob	Contracting plan firmly established?	MVS acquisition per Contracting Division is typically to award as 8a or small business for non-complex contracts unless they require a specialty contractor.	Marginal	Likely	2
AS-2	Site Access	Contracting plan firmly established?	MVS acquisition per Contracting Division is typically to award as 8a or small business for non-complex contracts unless they require a specialty contractor.	Marginal	Likely	2
AS-3	C-Stone	Contracting plan firmly established?	MVS acquisition per Contracting Division is typically to award as 8a or small business for non-complex contracts unless they require a specialty contractor.	Marginal	Likely	2
AS-13	Planning, Engineering, & Design	Contracting plan firmly established?	Acquisition strategy should not impact Planning, Engineering, and Design.	Marginal	Unlikely	0
AS-14	Construction Management	Contracting plan firmly established?	Acquisition strategy should not impact Construction Management	Marginal	Unlikely	0
Construction Elements				**Maximum Project Growth**		**25%**

CON-1	Mob/Demob	No concerns.	Concern for this feature captured under EST-1 for mob/demob of floating plant.	Negligible	Unlikely	0
CE-2	Site Access	No concerns.	No concerns.	Moderate	Likely	3
CE-3	C-Stone	• Accelerated schedule or harsh weather schedule? • Potential for construction modification and claims? • Water care and diversion plan?	Slight concern for placing rock due to high water events. Not necessarily from a construction feasibility standpoint, but from a safety standpoint. It's currently anticipated that events such as this would not occur often. Uncertain at this time if there is a need for turbidity curtains or other means for ensuring settlement does not impact dam operations.	Moderate	Likely	3
CE-13	Planning, Engineering, & Design	No concerns.	No concerns.	Negligible	Unlikely	0
CE-14	Construction Management	No concerns.	No concerns.	Negligible	Unlikely	0
Specialty Construction or Fabrication				**Maximum Project Growth**		**65%**
SC-1	Mob/Demob	No concerns.	No concerns.	Negligible	Unlikely	0
SC-2	Site Access	No concerns.	No concerns.	Negligible	Unlikely	0
SC-3	C-Stone	No concerns.	No concerns.	Negligible	Unlikely	0
SC-13	Planning, Engineering, & Design	No concerns.	No concerns.	Negligible	Unlikely	0
SC-14	Construction Management	No concerns.	No concerns.	Negligible	Unlikely	0
Technical Design & Quantities				**Maximum Project Growth**		**30%**
T-1	Mob/Demob	No concerns.	Assumed 5% of construction contract. Will need to build project specific crew as design progresses.	Marginal	Possible	1
T-2	Site Access	• Possibility for increased quantities due to loss, waste, or subsidence?	No contingency for waste/loss included for site access. Expect waste/loss for gravel to minimal.	Marginal	Possible	1
T-3	C-Stone	• Level of confidence based on design and assumptions? • Possibility for increased quantities due to loss, waste, or subsidence?	Included 150% contingency on c-stone quantity for underwater placement. Modeling used to generate quantities was relatively recent and shouldn't have a large impact on quantities as design progresses. Tie-in to northern bank line could be different than what is currently modeled which could slightly increase quantities. Geotechnical will not need to do any further analysis for placing rock on top of the existing temperature control weir.	Moderate	Possible	2
T-13	Planning, Engineering, & Design	No concerns.	No concerns.	Negligible	Unlikely	0
T-14	Construction Management	No concerns.	No concerns.	Negligible	Unlikely	0

Cost Estimate Assumptions				**Maximum Project Growth**		**35%**
EST-1	Mob/Demob	• Overuse of Cost Book, lump sum, allowances?	Assumed 5% of construction contract. Will need to build project specific crew as design progresses. This cost will likely grow as a floating plant will have to be mobilized and demobilized to the site by trucks as there is no way to mobilize in a floating plant via barge in this location.	Moderate	Likely	3
EST-2	Site Access	Assumptions regarding crew, productivity, overtime?	Currently estimate only has CSI task for base drainage layers (crushed stone) while a material quote was received for this, there will likely be added features as design progresses (subbase, geotextile, maintenance of haul roads) therefore, the cost growth for this item is moderate and likely.	Moderate	Likely	3
EST-3	C-Stone	• Site accessibility, transport delays, congestion? • Assumptions regarding crew, productivity, overtime?	The estimate accounts for a material quote for C-stone with dump truck hauling. With the amount of material that needs to be hauled to the site, and the congestion of the laydown area for material transfer to barges, it is difficult at this time to estimate an accurate production rate for hauling/placing the stone in the river. Also, this work will require placing rock on top of the existing temperature control weir, which is rather deep. Quantities have been increased by 150% to account for in water placement based on recommendation from materials engineer which does relatively lower the risk of this feature as there is already so much contingency placed on the quantities of stone.	Marginal	Likely	2
EST-13	Planning, Engineering, & Design	No concerns.	No concerns.	Negligible	Unlikely	0
EST-14	Construction Management	• Assumptions regarding crew, productivity, overtime?	Performing quality assurance on this work could require a significant amount of time out on the water assuring that the rock is being placed according to the plans and specifications, therefore, there is a moderate risk of cost growth for the CM on this work rather than a typical MVS construction project.	Moderate	Possible	2
External Project Risks				**Maximum Project Growth**		**40%**
EX-1	Mob/Demob	Potential for Severe Adverse Weather? Unanticipated inflations in fuel, key materials?	Adverse weather could effect the contract duration impacting the overall cost of construction. Escalation of material costs and labor rates would increase overall costs. Fuel rates could increase over time.	Moderate	Likely	3
EX-2	Site Access	Potential for Severe Adverse Weather? Unanticipated inflations in fuel, key materials?	Adverse weather could effect the contract duration impacting the overall cost of construction. Escalation of material costs and labor rates would increase overall costs. Fuel rates could increase over time.	Moderate	Likely	3
EX-3	C-Stone	Potential for Severe Adverse Weather? Unanticipated inflations in fuel, key materials? Cultural/HTRW concerns?	Adverse weather could effect the contract duration impacting the overall cost of construction. Escalation of material costs and labor rates would increase overall costs. It is likely that there is a cultural site under the existing TCW. While it's unlikely that this project will impact the cultural site, a cultural survey will be completed prior to PED beginning. An HTRW study will also be completed prior to PED, and is also unlikely to have any negative impacts on the project.	Moderate	Likely	3
EX-13	Planning, Engineering, & Design	No concerns.		Negligible	Unlikely	0

EX-14	Construction Management	No concerns.		Negligible	Unlikely	**0**

Continuing Authorities Program (CAP) 1135

Clarence Cannon Dam at Mark Twain Lake

Appendix J: Economics

St. Louis District
Project Sponsor: Missouri Department of Conservation
March 2026

List of Figures

Figure 1 CE/ICA Outputs – Incremental Cost Box Graph 6
Figure 2 CE/ICA Outputs – Cartesian Graph 6

List of Tables

Table 1 Alternatives 4
Table 2 Total Costs for Alternative Plans ($) 4
Table 3 Annualized Costs for Alternative Plans ($) 4
Table 4 Cost Effective Plans. 5
Table 5 Incremental Cost of Best Buy Plans. 5

1 PURPOSE

U.S. Army Corps of Engineers (USACE) guidance requires a cost effectiveness analysis and an incremental cost analysis (CE/ICA) for recommended environmental restoration and mitigation plans. A cost effectiveness analysis is conducted to ensure that the least cost solution is identified for each possible level of environmental output. An incremental cost analysis of the solutions is conducted to reveal changes in costs for increasing levels of environmental outputs. In the absence of a common measurement unit for comparing the nonmonetary benefits with the monetary costs of environmental plans, CE/ICA are valuable tools to assist in decision making. This appendix presents the results of the CE/ICA of the Clarence Cannon CAP 1135 Project (Project), Ralls County, Missouri.

2 METHOD

The Project was evaluated using guidance documents and software prepared by the USACE Institute for Water Resources (IWR). IWR - Planning Suite Software (Version 2.0), a USACE-certified model, was used to automate steps in the cost effectiveness and incremental cost analysis. Much of the text of this appendix was borrowed from IWR Report (IWR 94-PS-2), *Cost Effectiveness Analysis for Environmental Planning: Nine EASY Steps*[1]. The CE/ICA procedures are presented in nine steps, which are grouped into four tasks, listed below:

Formulation of Combinations
Step 1 Display outputs and costs
Step 2 Identify combinable management measures
Step 3 Calculate outputs and costs of combinations

Cost Effectiveness Analysis
Step 4 Eliminate economically inefficient solutions
Step 5 Eliminate economically ineffective solutions

Development of Incremental Cost Curve
Step 6 Calculate average costs
Step 7 Recalculate average costs for additional outputs

Incremental Cost Analysis
Step 8 Calculate incremental costs
Step 9 Compare successive outputs and incremental costs

The results of these analyses are displayed as graphs and tables at the end of this appendix. They allow decisionmakers to progressively compare alternative levels of environmental outputs and ask if the next level is “worth it” – that is, is the additional environmental output in the next level worth its additional monetary costs? It is important to note that these analyses will not usually lead, and are not intended to lead, to a single best solution as in economic cost-benefit analyses. They will improve the quality of decision making by ensuring that a rational, supportable, focused, and traceable approach is used for considering and selecting alternative methods to produce environmental outputs.

2.1 Formulation of Combinations

Step 1. Display outputs and costs. Outputs were determined using Habitat Evaluation Procedures and are presented as net Average Annual Habitat Units (for further detail see

[1] Orth, K. D. 1994. Cost Effectiveness Analysis for Environmental Planning: Nine EASY Steps. No. IWR-94-PS-2. Army Engineers Institute for Water Resources. Ft. Belvoir, VA.

Appendix B, Habitat Evaluation and Quantification). Costs were annualized over a 50-year period of analysis at an interest rate of 3.25% for Fiscal Year (FY) 2026. These costs include initial construction with mobilization and demobilization, contingency (38% - 87% depending on alternative), planning, engineering, and design (18%), and construction management (10%) above the actual estimated cost for construction. Operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs for the 50-year period of analysis, and Adaptive Management and Monitoring costs over the first 10 years post-construction were also calculated for each alternative and included in the total annualized costs used in the CE/ICA.

Step 2. Identify combinable management measures. The management measures were evaluated to determine which were dependent on other measures. Using the evaluation results, the project delivery team (PDT) combined measures into feasible alternatives. Alternatives that did not meet the project objective or the four principles and guidelines criteria were not retained for further evaluation. Table 1 describes the measures that were included in each alternative moved forward for detailed evaluation.

Table 1 Alternatives

Alternative	Description
No Action	-
1	Temperature Control Curtain
8a	Raise Temperature Control Weir, 585 ft Elevation
8b	Raise Temperature Control Weir, 588 ft Elevation

Step 3. Calculate output and costs of combinations. Table 2 displays the outputs and costs of alternatives.

Table 2 Total Costs for Alternative Plans ($)

Alternative	Output (AAHUs)	Output, Gross (AAHUs)	Construction Cost	OMRR&R	MAM	Interest During Construction
No Action	52	0	-	-	-	
1 (Curtain)	81	29	$14,117,000	$11,090,000	$441,000	$462,530
8a (585)	79	27	$16,903,000	$2,730,000	$528,000	$553,811
8b (588)	81	29	$30,429,000	$4,462,500	$857,000	$996,978

Table 3 Annualized Costs for Alternative Plans ($)

Alternative	Output (AAHUs)	Output, Gross (AAHUs)	Annualized Construction Cost	Annualized OMRR&R	Annualized MAM	Annualized Interest During Construction	Total Annualized Cost
No Action	52	0	-	-	-	-	-
1 (Curtain)	81	29	$574,989	$196,035	$14,888	$18,839	$804,751
8a (585)	79	27	$688,464	$46,478	$17,826	$22,557	$775,325
8b (588)	81	29	$1,239,382	$75,975	$28,933	$40,607	$1,384,897

2.2 Cost Effectiveness Analysis

Steps 4 and 5. Eliminate economically inefficient solutions and economically ineffective solutions. Steps 4 and 5 were carried out using the IWR-Planning Suite software. Step 4 eliminates economically inefficient solutions and identifies the least cost solution for each level of output. *Non Cost Effective* is defined as any alternative where the same output level can be generated at a lesser cost by another alternative. The alternatives are evaluated and wherever there are two or more alternatives providing the same output level, aside from any other considerations (i.e., uncertainty about the reliability of cost or output estimates), the more costly alternative(s) generating that same output level is eliminated. For example, if two plans produce two AAHUs and one costs $3,000 while the other costs $4,000, the more expensive plan is eliminated.

Step 5 eliminates the economically ineffective solutions by identifying and deleting those solutions that will produce less output at equal or greater cost than subsequently ranked solutions. Of the alternatives evaluated, two plans were considered cost effective (Table 4).

Table 4 Cost Effective Plans.

Alternative	Output (AAHUs)	Total Annualized Cost ($)	Average Cost per Unit ($/AAHU)
No Action	52	-	-
1 (Curtain)	81	$804,751	$9,935
8a (585)	79	$775,325	$9,814

2.3 Development of Incremental Cost Curve

Step 6. Calculate average costs. Average costs for each least-cost, cost-effective plan are determined by dividing the cost of the plan by the output (AAHUs). Average costs are expressed in cost per AAHU ($/AAHU). The plan with the lowest average cost is identified. Plans with less output at a higher average cost are eliminated.

Step 7. Recalculate average costs for additional outputs. This step asks the question: “of the remaining levels of output, which has the lowest additional cost for additional output?” Using levels of output from Step 6, the average annual costs for additional output are calculated. The previous step’s lowest average cost level of output is used as the “zero level.” Levels of output less than the lowest average cost level are dropped from further analysis, while levels of output greater than the lowest average cost level advance to the next recalculation. Recalculations are then made using the new lowest average cost level as the “zero level” until the highest level of output is reached. Steps 6 and 7 were carried out using the IWR-Planning Suite software. The outcome of this evaluation is displayed in Table 5.

Table 5 Incremental Cost of Best Buy Plans.

Alternative	Output (AAHUs)	Average Cost per Unit ($/AAHU)	Incremental Output over No Action (AAHUs)	Incremental Cost over No Action ($)	Incremental Cost/Output over No Action ($/AAHU)
No Action	52	-	-	-	-
1 (Curtain)	81	$9,935	29	$804,751	$27,750

2.4 Incremental Cost Analysis

Step 8. Calculate incremental costs. Step 8 was carried out using the IWR-Planning Suite software. Incremental cost is the additional cost incurred by selecting one alternative over another and is computed by subtracting the cost of one alternative from another. Alternative 1 is the “best buy” meaning this plans produce the most AAHUs per dollar. The incremental costs shown in Table 5 are calculated by dividing the difference between the different plans’ output. and Figure 2 and Figure 3 are graphs of the incremental costs of alternatives as listed in Table 5. Alternative 8a is still considered cost effective, despite not being a best buy.

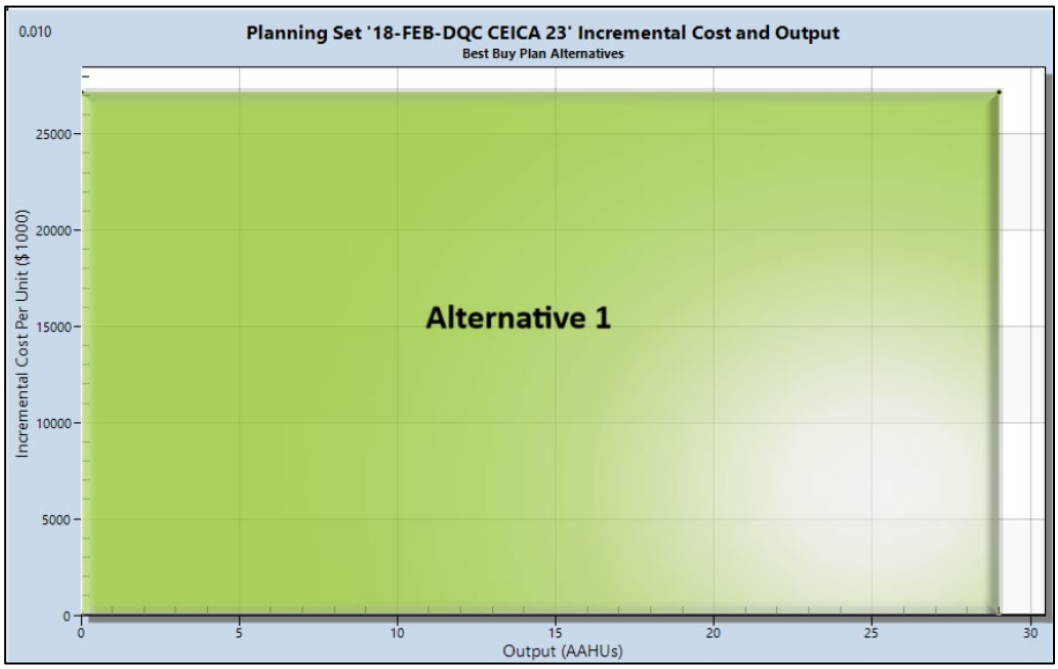


Figure 1 CE/ICA Outputs – Incremental Cost Box Graph

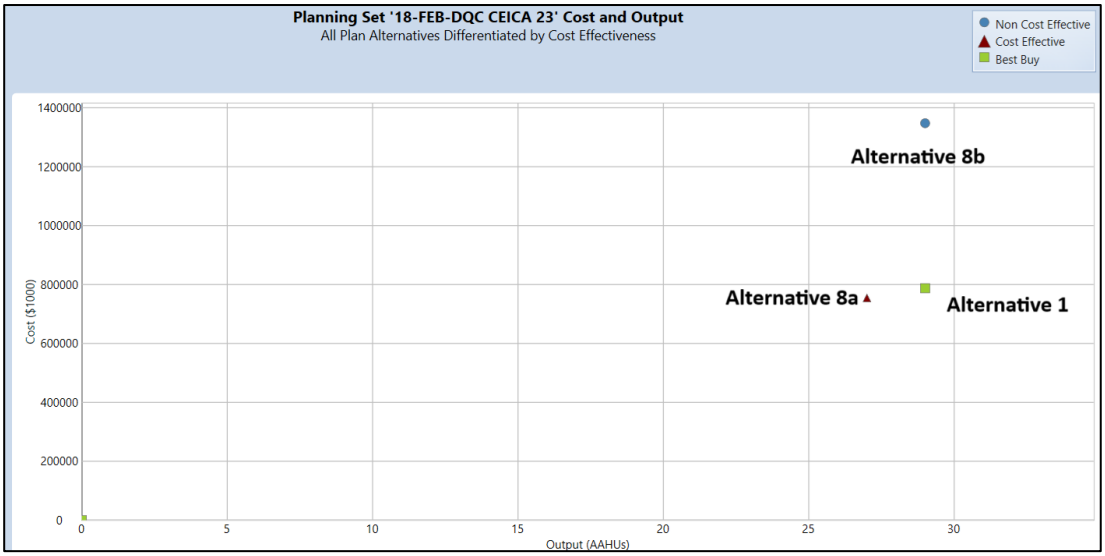


Figure 2 CE/ICA Outputs – Cartesian Graph

Step 9. Compare successive outputs and incremental costs. Table 5 and Figure 2 CE/ICA Outputs – Cartesian Graph were used as decision making tools by progressively proceeding through available levels of output and determining if the next level is worth its additional monetary costs. This step examined the additional habitat value, as featured by increased AAHU output, for an increase in monetary costs. Federal planning for water resources development is conducted in accordance with the requirements of the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G). The P&G provides a decision rule for selecting a tentatively selected plan (TSP) where both outputs and costs are featured in dollars. This rule states: "The alternative plan with the greatest net economic benefit consistent with protecting the Nation's environment (National Economic Development Plan, NED Plan) is to be selected…(Paragraph 1.10.2)". There is no similar rule for plan selection where the outputs are not featured in dollars, as is the case in planning for restoration and mitigation. In the absence of such a decision-making rule, CEICA helps to better understand the consequences of the preferred plan in relation to other choices.

3 ICA CONCLUSIONS AND SELECTION OF TENTATIVELY SELECTED PLAN

The best buy alternatives presented provide the information necessary to make well-informed decisions regarding desired project scale (Table 5,

Figure 2 CE/ICA Outputs – Cartesian Graph

). Progressing through the increasing levels of output for the alternatives in Table 5 helps determine whether the increase in net AAHUs is worth the additional cost. As long as decision makers consider a level of output to be "worth it", subsequent levels of outputs are considered. When a level of output is determined to be "not worth it", then subsequent levels of output will also likely be "not worth it", and the final decision regarding desired project scale for environmental restoration planning will have been reached.

Typically in the evaluation of Best Buy alternatives, 'break points' are identified in either the last column in Table 5, or in the stair-step progression from left to right in

Figure 2 CE/ICA Outputs – Cartesian Graph

. Break points are defined as significant increases or jumps in incremental cost per output, such that subsequent levels of output may not be considered "worth it". Identification of such break points can be subjective. For Clarence Cannon Dam, there was one cost effective plan and one best buy.

For the Best Buy Plan, Alternative 1, differs from Alternative 8a by having a temperature control curtain versus the elevation of the weir to 585 ft. The PDT determined that although there would be some additional benefits, Alternative 1 would not be considered further since its impact is similar to Alternative 8a, only providing an additional two AAHUs at a high incremental cost relative to Alternative 1. The PDT and the MDC deemed this alternative to "not be worth it" and this alternative was not selected.

4 SUMMARY

The results of the incremental cost analysis and habitat evaluation in this chapter were considered with other factors, including physical features on the site, management objectives of the resources agencies, critical needs of the region, and ecosystem needs. The Clarence Cannon Dam CAP 1135 team concluded that the alternative plan that best meets the goals and objectives of each agency is alternative 8a. This alternative is cost-effective. Alternative 8a has an overall output of 79 AAHUs and was identified as the TSP. While the other "Best Buy" alternatives evaluated for this project would partially address the goals and objectives of

the project, the consensus of the interagency team was that Alternative 8a would reasonably maximize ecosystem restoration benefits for the greatest diversity of fish and wildlife, and that other considered alternatives would be less effective in meeting project objectives.

For these reasons, Alternative 8b is identified as both the National Ecosystem Restoration plan (e.g. the plan that reasonably maximizes ecosystem restoration benefits) as well as the project sponsor’s preferred plan.

Continuing Authorities Program (CAP) 1135

Clarence Cannon Dam at Mark Twain Lake

Appendix K: Resiliency Analysis

St. Louis District
Project Sponsor: Missouri Department of Conservation
March 2026

ECB 2026-1 Tier 1 Assessment of Long-Term Hydrometeorological Conditions

This assessment is performed to highlight existing and future challenges facing the study area due to hydrometeorological conditions and is conducted in accordance with United States Army Corps of Engineers' (USACE) Engineering Construction Bulletin (ECB) 2026-1, *Incorporating Resilience to Nonstationary Hydrometeorological Conditions in USACE Civil Works Studies, Designs, and Projects*, issued the 9th of January 2026. In accordance with ECB 2026-1, this evaluation identifies potential vulnerabilities for the Continuing Authorities Program (CAP) 1135 Clarence Cannon Dam and Mark Twain Lake, MO Project.

Mark Twain Lake is in northeastern Missouri on the Salt River within the Salt River Basin. Clarence Cannon Dam and the re-regulation dam are in Ralls County at Salt River Miles (RMs) 63.0 and 53.5, respectively, upstream from the confluence with the Mississippi River. Mark Twain Lake is in both Ralls and Monroe Counties and approximately 20 miles southwest of Hannibal and 140 miles north of St. Louis. This assessment highlights existing and future risks for the study area due to hydrometeorological conditions. Study background information can be found in the main feasibility report, and more general background information on hydrometeorological factors and their relevance to civil works projects can be found in ECB 2026-1.

Decision Context

The first step of conducting a tier 1 assessment is establishing decision context for which relevant hydrometeorological factors (RHFs) have the potential to impact the project's problems, opportunities, objectives, and constraints over its service life. The RHFs are chosen based on the key project components, decisions, and performance objectives outlined in this section.

Study Background

Section 1135 of the Water Resources Development Act (WRDA) of 1986 allows the United States Army Corps of Engineers (USACE) to study, design, and construct environmental restoration projects adjacent to and near Corps projects. The primary environmental concern identified by the non-Federal sponsor (NFS), the Missouri Department of Conservation (MDC), and USACE is the issue of low dissolved oxygen (DO) concentrations in the re-regulation pool caused by lake water with low oxygen moving through the turbines, resulting in stress to fish.

The physical components of the project include Clarence Cannon Dam, and associated features such as the Hydroelectric Power Plant, Water Temperature Control Weir (TCW), and re-regulation dam. The total length of the dam is 1,940 feet with the centerline of the dam running in a near north-south direction. The concrete portion of the dam is 846 feet in length and abuts the southern rim of the valley. The earthen portion of the dam is 1,094 feet in length and abuts the north side of the basin. The dam has two hydropower units capable of producing 58,000 kilowatts of electricity. A second dam (re-regulation dam) is about 9.5 miles downstream of the main dam and serves to impound water for storage and to control downstream release volumes and intensities. A TCW, consisting of approximately 780 feet of rolled earth embankment, is located approximately 400 feet upstream of the main dam with a crest elevation of 580 feet NGVD29 (for reference, the top of the dam is at elevation 653 feet NGVD29, see Figure 2).

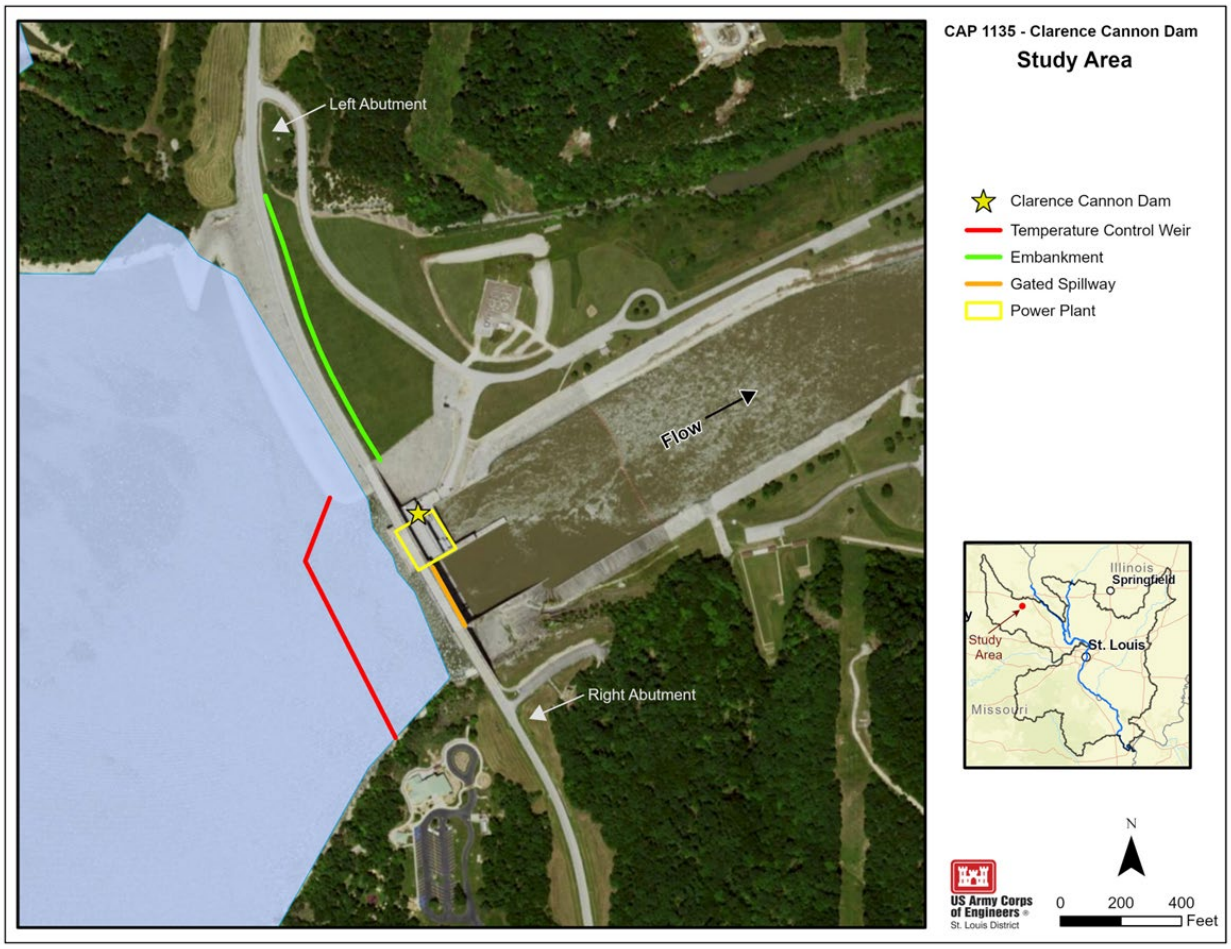


Figure 1 Overview of the Study Area

The TCW acts as a skimming weir which allows warmer oxygenated water to be released through the turbines during periods of lake stratification (Figure 2). However, when the water (lake) level is high, cooler poorly oxygenated water passes through the turbines and into the re-regulation pool during power generation. During periods of non-generation at this elevation, low oxygenated water fills the forebay between the TCW and main dam. This water leaks through the wicket gates into the re-regulation pool. Upon startup of generation, this poor-quality water is flushed downstream below the dam and within the re-regulation pool.

Hydropeaking is practiced at this dam, which means that power is generated on-demand during peak hours. This results in large amounts of water being released downstream and then tapered off when the demand for power subsides. This can occur coincident with the disadvantageous conditions explained previously. Any time a weather-related event causes low-DO levels in the reservoir upstream of the dam, these hydropeaking practices stay in place.

Flood control operations can also result in low-DO water being released downstream. On August 8th, 2015, a major die-off event was reported. During this time, the lake was under flood control operations following a significant rain event that caused the lake elevation to crest at 630.32 feet NGVD29 on July 10th. From June 25th to August 21st, releases from Mark Twain Lake averaged 8,000-10,000 cubic feet per second (CFS) each day until the lake dropped

below 615 feet NGVD29. These releases were determined by Water Control in accordance with the Project's Water Control Manual while in coordination with SWPA and downstream stakeholders. During this mortality event, a Missouri Conservation Agent reported a high number of deceased fish located in the backwater slough on the left descending bank of the re-regulation pool, approximately one-half mile downstream of Clarence Cannon Dam. In the preceding week, the water level elevation in Mark Twain Lake was approximately 620 feet, which would have likely placed the oxycline well above the TCW, thus rendering it ineffective. Any water flowing through the turbines was anoxic. During this time, the total flow as measured by the gage at Norton Bridge below the re-regulation dam ranged between 5,000 CFS and 10,000 CFS. Generally, this flow was constant and balanced (approximately equal parts released from the turbines and spilled through the Tainter gates) with few exceptions. On August 2 and August 6, turbine releases were temporarily stopped while spill flow continued, which allowed the DO gage located in the turbine bay at Clarence Cannon Dam to increase from less than 1 mg/L to greater than 8 mg/L. Weather conditions were typical for August and no substantial rain was recorded on the days leading up to and including August 8 through August 10.

A DO concentration of 5mg/L is generally thought to be the minimum threshold to sustain freshwater fish populations. Concentrations at or below 5 mg/L often occur during the summer months in the tailwater and throughout the re-regulation pool. The DO concentration in this area results in stress in aquatic organisms and fish mortality events. MDC has documented numerous fish kill events over the years below Clarence Cannon Dam. Summary reports from MDC, with data going back to 1994, show that approximately 28,000 fish have been killed as a direct result of low DO concentrations in the water being discharged through Clarence Cannon Dam. Fish species identified in the kill reports include crappie, walleye, largemouth bass, bluegill, catfish, carp, buffalo, gizzard shad, and freshwater drum.

The State of Missouri has requested the St. Louis District evaluate a long-term solution to address the lake discharge continually failing to meet the State of Missouri Water Quality Standards in accordance with the Clean Water Act (CWA). Failure to seek resolution to low DO concentrations could subject USACE to a notice of violation from the State.

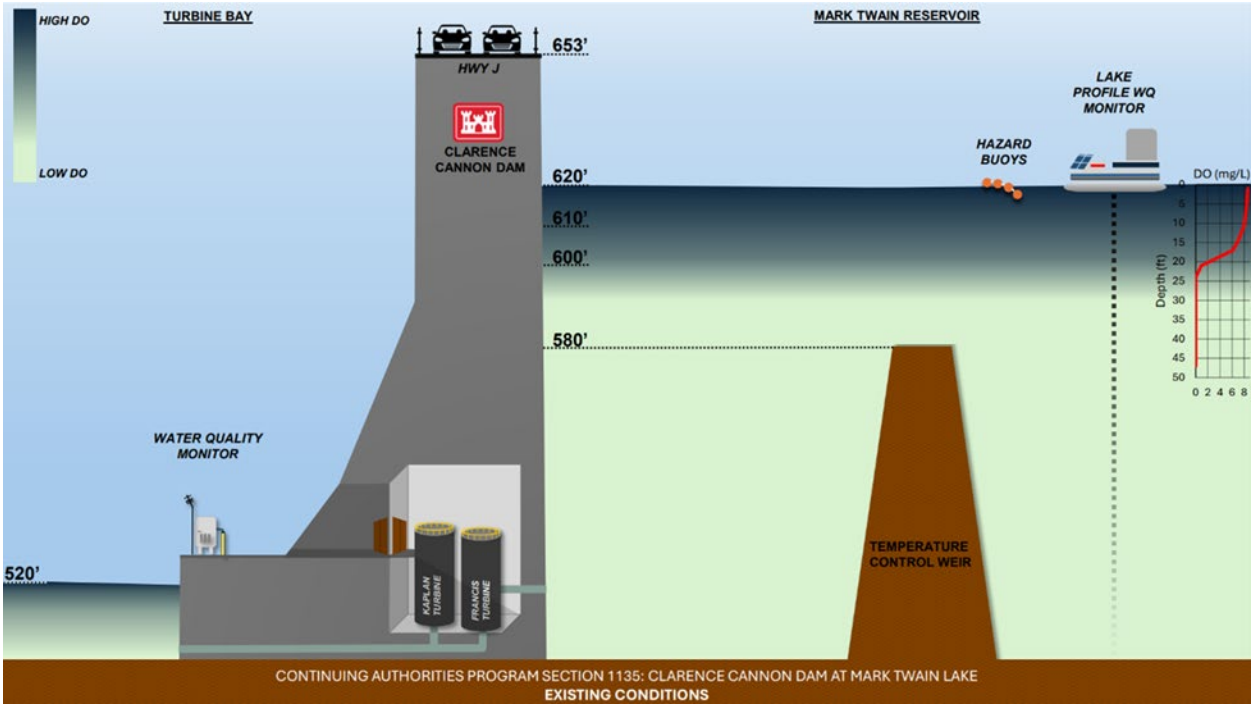


Figure 2 Cross Section of Existing Site Features (Elevation in Feet NGVD29)

Relevant Hydrometeorological Factors

RHFs are categories of hydrometeorological variables (e.g., temperature, precipitation, streamflow) or processes (e.g., snowmelt, wildfire) that reflect potential changes to hydrology (USACE, 2026). The following RHFs are exacerbating or ameliorating watershed conditions and/or identified problems and opportunities:

- Temperature
    - Changes in temperature will affect the energy demand for heating and cooling buildings during peak hours, which will determine how often power generation is required at the dam. More frequent power generation will release more low-DO water downstream.
- Precipitation
    - Increased precipitation that must be held by the lake for flood control will affect the DO of water that is discharged. When the lake is high for long periods of time, the DO of water discharged from the dam decreases.
- Streamflow
    - Like precipitation, if streamflow increases enough that the lake must be filled to control floods for longer periods of time, the DO of water released from the dam will decrease.

Evidence

Multiple lines of evidence were investigated for trends in observed and future hydrometeorology and resulting shifts in weather-related vulnerabilities. Analyses consisted of applying the methods in the suite of USACE IIR CoP tools that are available via USACE's IIR CoP Applications Portal. Tools include the Time Series Toolbox (TST), Comprehensive Hydrology

Assessment Tool (CHAT), and CWVAT. Use of USACE IIR tools (CHAT, TST, CWVAT) was limited to critical variables tied to the identified RHFs.

Literature Review

The *Fifth National Climate Assessment* (NCA5) and the USACE *Civil Works Technical Report CWTS-2015-13,* as well as state and watershed specific resources published by the National Oceanic and Atmospheric Administration (NOAA) and the USACE are the basis for this literature review. The focus of these references is on summarizing trends in historic and observed temperature, precipitation, and streamflow records.

The NCA5 considers research at both a national and regional scale (USGCRP, 2023). *Civil Works Technical Report CWTS-2015-13* was published as part of a series of regional summary reports covering peer-reviewed literature (USACE, 2015). The 2015 USACE Technical Reports cover 2-digit, United States Geological Survey (USGS), hydrologic unit code (HUC) watersheds in the United States (US). Clarence Cannon Dam and Mark Twain Lake are located in 2-digit HUC 07, the Upper Mississippi Region (USACE, 2015) and in the NCA5 Midwest climate region (USGCRP, 2023).

In many areas, temperature, precipitation, and streamflow have been measured since the late 1800s and provide insight into how the hydrology in the study area has changed over the past century. CMIP5s are used in combination with different representative concentration pathways (RCPs) reflecting projected radiative forcings up to year 2100 to model future meteorological conditions. Radiative forcings encompass the change in net radiative flux due to external drivers, such as changes in carbon dioxide or land use/land cover. Uncertainty is inherent to projections of temperature and precipitation due to the CMIP5s, RCPs, downscaling methods, and many assumptions needed to create projections (USGCRP, 2023). When applied, precipitation-runoff models introduce an additional layer of uncertainty. However, these methods represent the best available science to predict changes in future hydrologic variables. The following subsections discuss relevant hydrometeorological variables to this project with support from existing literature.

Temperature

The average annual temperature in the Midwest has increased by about 2°F since the first half of the 20th century (USGCRP, 2023).Temperatures in Missouri have risen almost 1°F since the beginning of the 20th century (NOAA, 2022). Winter warming in Missouri is exhibited by a below-average occurrence of very cold nights since 1990 (NOAA, 2022). Assuming a low-emissions pathway, annual-mean temperatures could increase in the range of 2°F to 8°F (NOAA, 2022).

Increasing temperatures can accelerate snowmelt and lengthen the frost-free season (Carelton & Hsiang, 2019) (Liu, Goodrick, & Stanturf, 2013) (Woodward, Perkins, & Brown, 2010). Many studies indicate a change in seasonality in the region, marked by increasing winter temperatures and early spring melt (Schwartz, Ault, & Betancourt, 2013) (Wang, et al., 2009) (Westby, Lee, & Black, 2013). CMIP5 based projections of temperature for the Midwest show a statistically significant increase in both annual average temperature and the number of extreme heat days over the next century (Vavrus & Behnke, 2014). *CWTS-2015-13* says the main points to be taken from its meta-analysis are that:

- Increasing trends in air temperature in the HUC-07 basin, including daily mean and minimum temperatures, were reported by multiple studies.

- Strong consensus exists in the literature that projected temperatures are increasing over the next century.

Historically unprecedented warming is projected during this century under a higher emissions pathway (NOAA, 2022).

Precipitation

Average annual precipitation from 2002-2021 was 5-15% higher than the average from 1901-1960 in the central United States (USGCRP, 2023). Due to higher temperatures, more of this precipitation is falling as rain than snow, which contributes to reductions in snowpack and maximum annual snow equivalent (USGCRP, 2023). The number of extreme precipitation days (defined as the top 1% of heavy precipitation events) has increased in the Midwest by 45% since the 1950s, along with increases of more than 10% in the annual and 5-year maximum amounts (USGCRP, 2023). Missouri has experienced an increase in extreme precipitation events, a trend that is projected to continue (NOAA, 2022). Future increases in winter precipitation will pose a continued risk of spring planting delays and increased flooding along rivers and streams (NOAA, 2022).

The meta-analysis within *CWTS-2015-13* found that a mild upward trend in precipitation within the HUC-07 basin was identified by multiple studies. Studies included in the meta-analysis also had a consensus of projected future annual precipitation increasing, and the amount of extreme precipitation events becoming more frequent (USACE, 2015).

Streamflow

Observed streamflow trends are strongly influenced by precipitation, temperature, and other factors such as land use and land cover in a region, groundwater dynamics, drainage patterns, channel geomorphology, and regulation. Annual water yield, annual maximum daily water yield, and annual maximum seven-day water yield are increasing throughout the Upper Mississippi River Basin (Simon, Artita, & Simon, 2020). Water yield represents discharge per unit of watershed area. For the 2020 USGS study, water yield was normalized by total annual precipitation to differentiate between the influence of altered precipitation versus other drivers of change in hydrologic response. Evaluations of precipitation-normalized water yield indicate that changes to water management and land use/cover in the Upper Mississippi River Basin are exacerbating increases in water yield (Simon, Artita, & Simon, 2020). The annual average streamflow has increased over time as well, along with increases in annual seven-day minimum low flows in the fall (Small, Islam, & Vogel, 2006). There is strong consensus between studies that mean, low, and peak streamflow within the HUC-07 Upper Mississippi Region are increasing based on observed data (USACE, 2015). There is little consensus on the trends of streamflow in the future (USACE, 2015).

Summary

Within the literature reviewed, there is evidence that temperature, precipitation, and streamflow have increased over the observed period of record within the Upper Mississippi Watershed. Projections of future climate show strong consensus on increases in future temperature, and moderate consensus on increases in future precipitation. There is little to no consensus related to trends in future streamflow. If Increased precipitation leads to increased streamflow, there would be greater nutrient loading on the lake and accelerated eutrophication. Flood storage capacity and the operational rules of the dam would also be challenged. More frequent droughts will also affect ecosystem health. Low water levels would prevent the implementation of planned

environmental flow management for fish spawning (USACE, 2025). Figure 3 from the 2015 USACE *Civil Works Technical Report CWTS-2015-13* provides a visual summary of the trends in observed and projected hydrometeorological variables for 2-digit HUC 07, the Upper Mississippi Region.

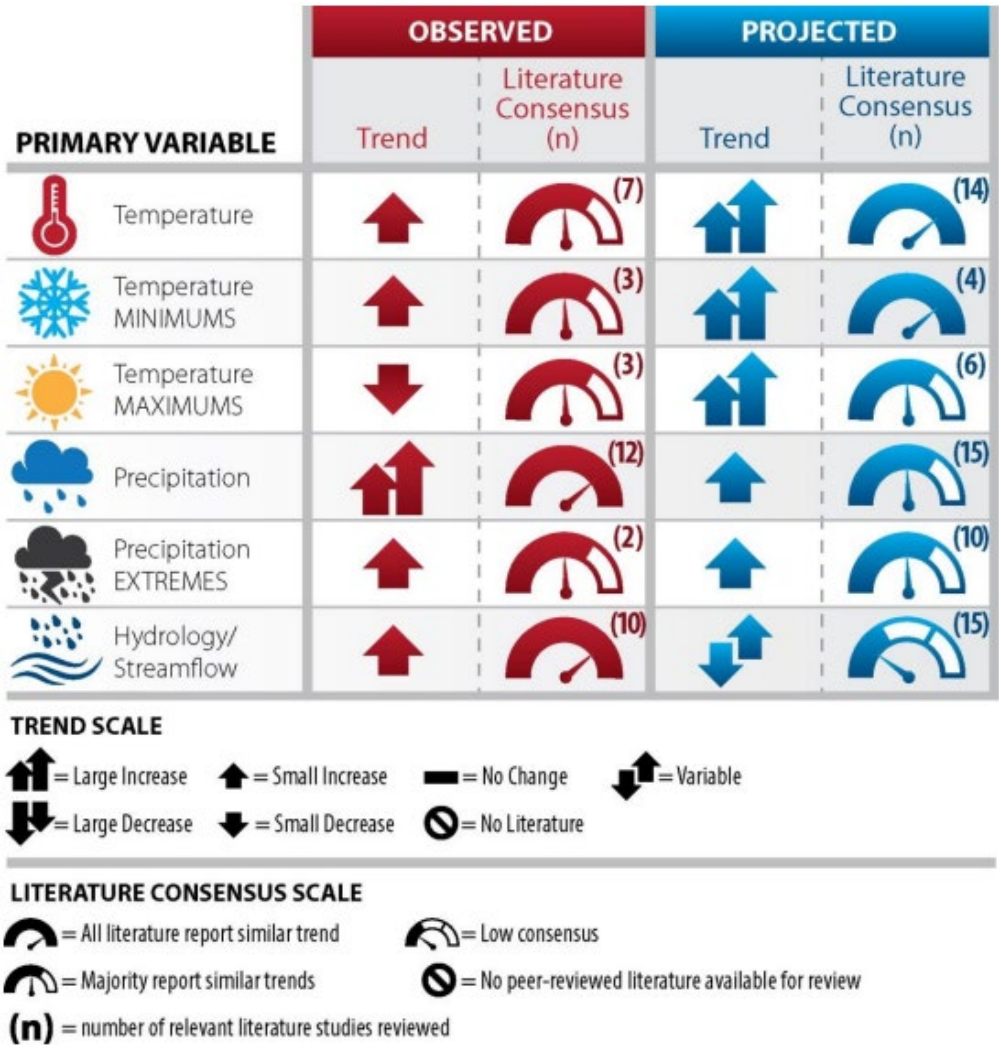


Figure 3. Summary matrix of UMR (HUC 07) observed and projected climate trends (USACE, 2015)

Trend and Nonstationarity Detection Statistical Analysis

The assumption that hydrologic time series are stationary (their statistical characteristics are unchanging) in time underlies many traditional hydrologic analyses. Statistical tests can be used to test this assumption using the techniques outlined in ECB 2026-1. The USACE TST is a web-based tool that performs the statistical tests described in ECB 2026-1. For this analysis, the data will be analyzed for statistically significant trends in the observed period of record, and for any changes in mean or standard deviation (nonstationarity).

Annual peak streamflow was chosen for analysis. This was chosen as it can indicate if the flood storage demands and/or the intensity of floods are changing over time. Since Mark Twain Lake has such a large watershed with many tributaries, different sets of observed annual streamflow on different gaged tributaries were analyzed:

- USGS 05507600 – Lick Creek at Perry, MO
- USGS 05505000 – South Fork Salt River at Santa Fe, MO
- USGS 05506500 – Middle Fork Salt River at Paris, MO
- USGS 05502300 – North Fork Salt River at Hagers Grove, MO

These gages were all chosen since they are upstream of Clarence Cannon Dam and less affected by flow regulation at the dam. For completeness though, a gage downstream from the dam was also analyzed. This gage is indicative of the total flow discharged from the dam but is subject to the manual regulation of flow and is not necessarily a reflection of weather-related changes in hydrology:

- USGS 05507800 – Salt River near Center, MO

Not all the datasets analyzed were normally distributed. This matters because some statistical tests require an assumption of normality. Since some of the datasets were normal, the Bayesian Changepoint test was not applied to them.

Figure 4 Locations of Gages Chosen for Analysis

Lick Creek at Perry, MO

USGS Gage 05507600 – Lick Creek at Perry, MO has a drainage area of 104 square miles. There are 45 years of observed data at the gage from 1980-2024. This is below the recommended minimum period of 50 years, but close enough that it was still analyzed. This dataset is normally distributed with an AD test statistic of A*2 = 0.289. The trends in the dataset found by Traditional and Sen's Slope methods were both negative, as shown in Figure 5 and Table 1. P-Values of the trend hypothesis tests fell between 0.1-0.33, indicating there is weak evidence of a trend. Kendall's Tau (τ) is a measure of the trend's direction and strength, ranging

from -1 (perfect decreasing trend) to +1 (perfect increasing trend). The τ value for this dataset was -0.134, which indicates a very slight decreasing trend (Table 2).

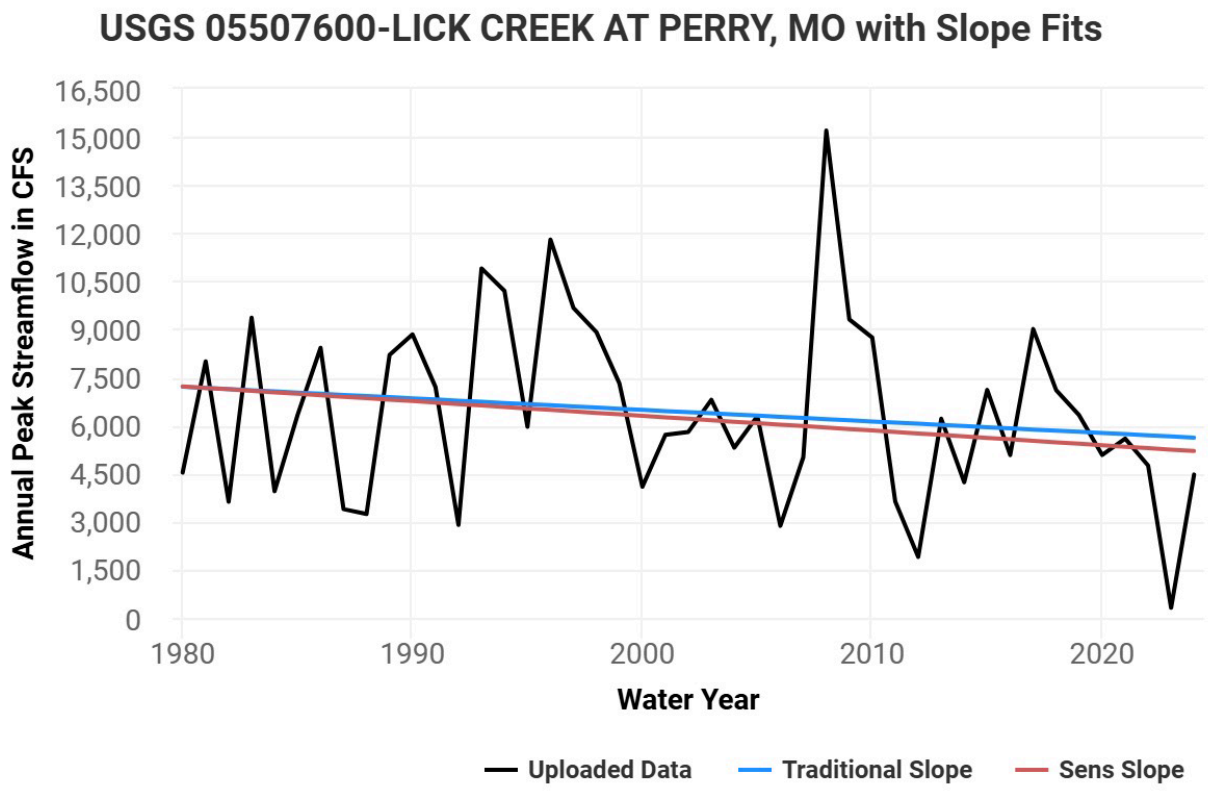


Figure 5. Trend Analysis for Annual Peak Streamflow at USGS Gage 05507600 – Lick Creek at Perry, MO

Table 1. Trend Line Coefficients of Annual Peak Streamflow at USGS Gage 05507600 – Lick Creek at Perry, MO

Method	Directionality	Slope (CFS per year)	Intercept (CFS)
Traditional Slope	Negative	-36	78,496
Sen's Slope	Negative	-46	98,016

Table 2. Trend Hypothesis Tests of Annual Peak Streamflow at USGS Gage 05507600 – Lick Creek at Perry, MO

Test	P-Value	Kendall's Tau
***t*-Test**	0.276	
Mann-Kendall	0.197	-0.134
Spearman Rank-Order	0.288	

Since the assumption of normality was met, the Bayesian Changepoint test was applied to this dataset. Only this test detected an abrupt nonstationarity in 2007, with a Bayesian Posterior Threshold of 0.564 (the changepoint is statistically significant if this value exceeds 0.5). There was a decrease in mean from 6,593 CFS to 6,120 CFS (-7%) in the dataset before and after the nonsationarity. No breakpoints were found in the time series. Since this abrupt nonstationarity

lacks consensus between different statistical tests, is not particularly robust, and does not have an operationally significant change in mean, this nonstationarity should not be considered.

South Fork Salt River at Santa Fe, MO

USGS Gage 05505000 – South Fork Salt River at Santa Fe, MO has a drainage area of 298 square miles. There are 47 years of observed data at the gage from 1940-1986. This is below the recommended minimum period of 50 years, but close enough that it was still analyzed. This dataset was not normally distributed (AD test statistic A*2 = 1.096). The trends in the dataset found by Traditional and Sen's Slope methods were both positive, as shown in Figure 6 and Table 3. P-Values of the *t*-Test and Spearman Rank-Order test for trend hypothesis were less than 0.05, indicating strong evidence of a trend. The Mann-Kendall trend hypothesis test has a P-value of 0.0576, indicating moderate evidence of a trend. Kendall's Tau (τ) is a measure of the trend's direction and strength, ranging from -1 (perfect decreasing trend) to +1 (perfect increasing trend). The τ value for this dataset was +0.193, which indicates a slight increasing trend (Table 4).

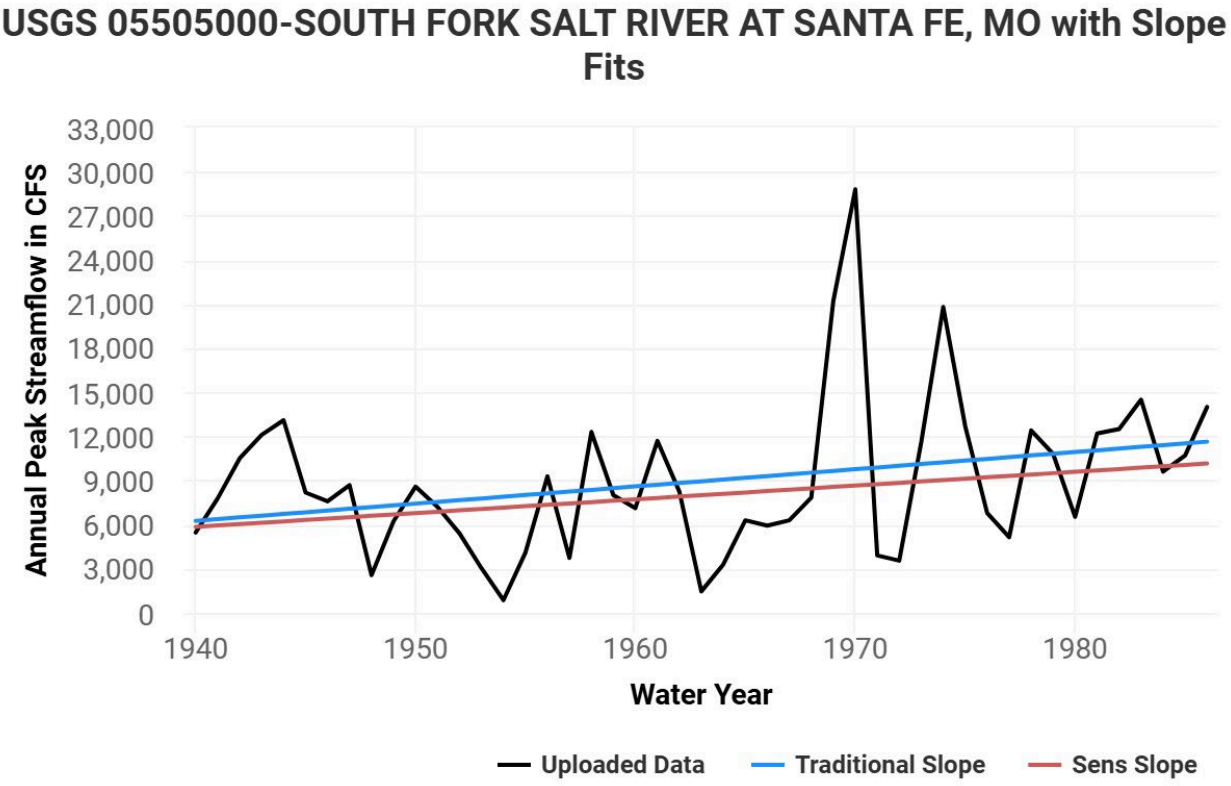


Figure 6. Trend Analysis for Annual Peak Streamflow at USGS Gage 05505000 – South Fork Salt River at Santa Fe, MO

Table 3. Trend Line Coefficients of Annual Peak Streamflow at USGS Gage 05505000 – South Fork Salt River at Santa Fe, MO

Method	Directionality	Slope (CFS per year)	Intercept (CFS)
Traditional Slope	Positive	+117	-220,813
Sen's Slope	Positive	+94	-175,808

Table 4. Trend Hypothesis Tests of Annual Peak Streamflow at USGS Gage 05505000 – South Fork Salt River at Santa Fe, MO

Test	P-Value	Kendall's Tau
***t*-Test**	0.0376	
Mann-Kendall	0.0576	+0.193
Spearman Rank-Order	0.0285	

Since the assumption of normality was not bet, the Bayesian Changepoint test was not applied. There is some evidence of nonstationarity in the data. Both the Lombard Wilcoxon and Pettit tests identified evidence of an abrupt change in mean in 1967 and 1968, respectively (Figure 7). The mean changed from 6,965 CFS to 12,100 CFS, which is a significant change. A breakpoint was also identified in 1968, which indicates a sharp change in behavior (Figure 8). Since two different statistical tests detected an abrupt change in mean and a breakpoint was identified within a 5-year period, there is consensus that the time series is non-homogenous (nonstationary). The Lombard Wilcoxon test produced a Tn1 value of 9.2458. The Lombard Mood/Wilcoxon statistic (Tn1) is a rank-based changepoint statistic that captures departures in location (Wilcoxon) or scale (Mood) between data segments before and after a candidate changepoint (Olson, et al., 2025). Its value is compared to a critical threshold at a chosen significance level (0.05) to determine whether a changepoint is detected. Larger Tn1 values reflect stronger departures from the null hypothesis, but do not correspond to p-values or increasing levels of statistical significance. The Pettit test produced a p-value of 0.026852, which is less than the significance threshold of 0.05. These tests and their statistical significance give robust evidence of nonstationarity.

The large flood in 1970 could be the cause of the nonstationarity in the data. It could just be an outlier throwing off the data analysis, but it could have also caused a hydrogeomorphic shift in the system, resulting in degradation and channelization which increased the measured flow rate. Geomorphic changes can be drivers for nonstationarity. Land use changes like clearing forests for farmland can also cause shifts in runoff and streamflow. According to agricultural census data from Audrain County, the total acreage of cropland in the county increased from 297,039 acres in 1964 to 332,408 acres in 1969 (USDA, 1969). This was a 12% increase and could have been a catalyst for change in runoff volume. Overall changes in land use in conjunction with weather-related changes in hydrology are the most likely causes of this nonstationarity.

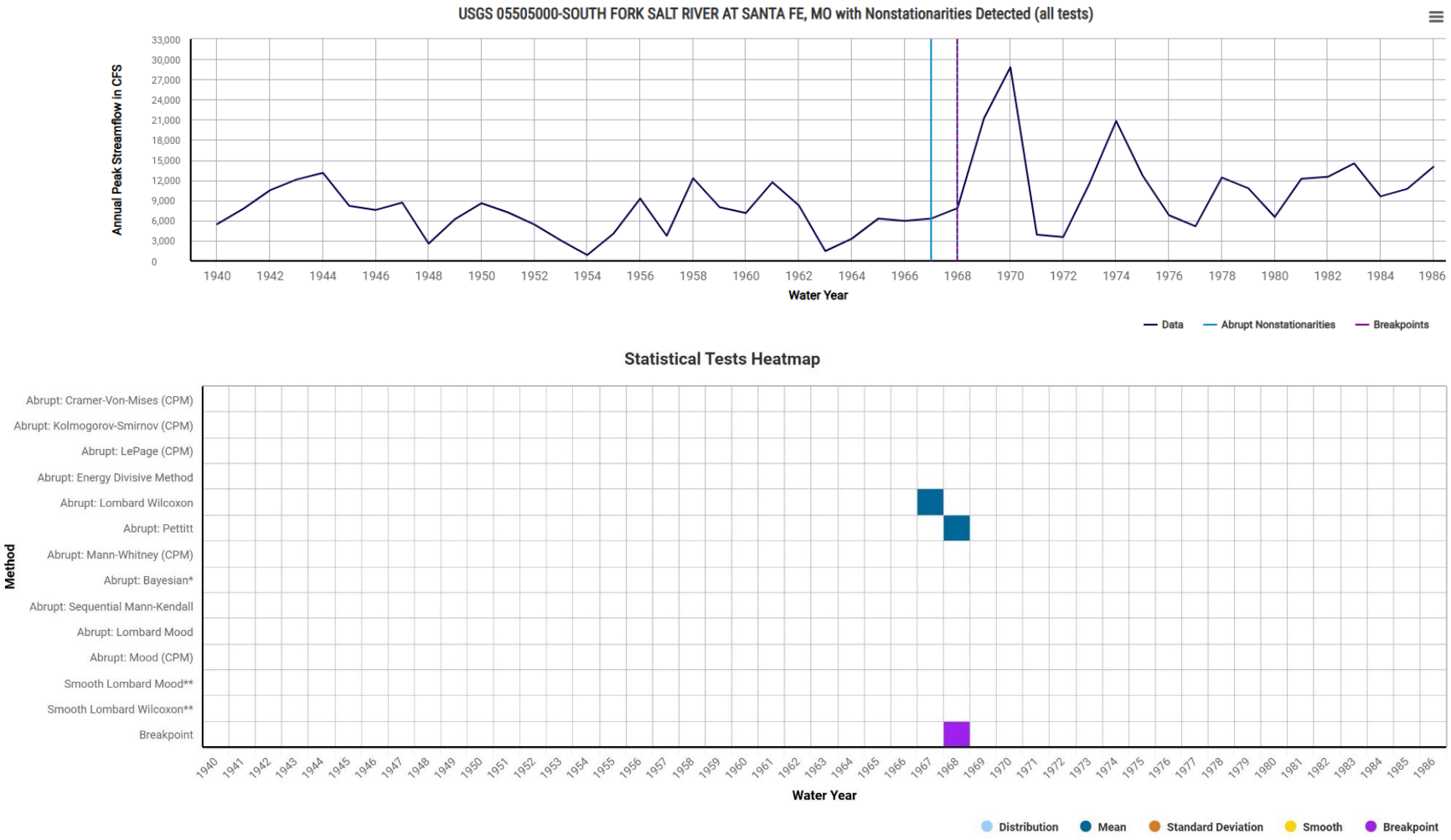


Figure 7. Nonstationarity Analysis of Annual Peak Streamflow at USGS Gage 05505000 – South Fork Salt River at Santa Fe, MO

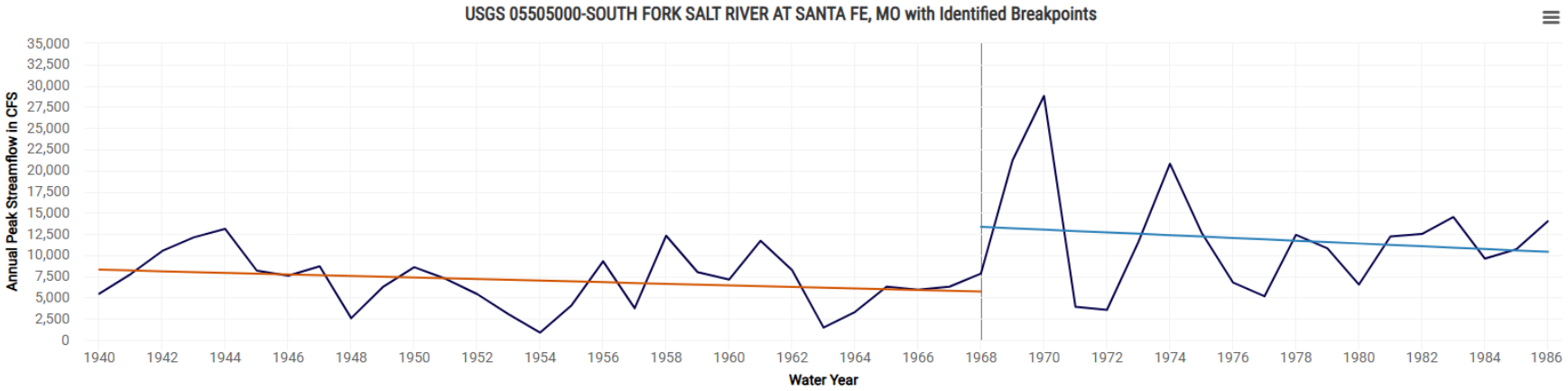


Figure 8. Breakpoint Analysis of Annual Peak Streamflow at USGS Gage 05505000 – South Fork Salt River at Santa Fe, MO

Table 5. Breakpoint Segment Details for Annual Peak Streamflow at USGS Gage 05505000 – South Fork Salt River at Santa Fe, MO

Date Range	Directionality	*t*-Test P-Value	Slope (CFS per year)	Intercept (CFS)
1940-1967	Negative	0.198	-92	8,380
1968-1986	Negative	0.553	-164	13,507

Middle Fork Salt River at Paris, MO

USGS Gage 05506500 – Middle Fork Salt River at Paris, MO has a drainage area of 356 square miles. There are 59 years of data observed at the gage from 1940-1998. The dataset is not normally distributed (AD test statistic A*2 = 4.206). The trends in the dataset found by Traditional and Sen's Slope methods were both positive, as shown in Figure 9 and Table 6. The *t*-Test trend hypothesis P-Value was 0.141, indicating weak evidence of a trend. The Spearman Rank-Order and Mann-Kendall trend hypothesis tests both had P-Values less than 0.05, indicating strong evidence of a trend. Kendall's Tau (τ) is a measure of the trend's direction and strength, ranging from -1 (perfect decreasing trend) to +1 (perfect increasing trend). The τ value for this dataset was +0.238, which indicates an increasing trend (Table 7).

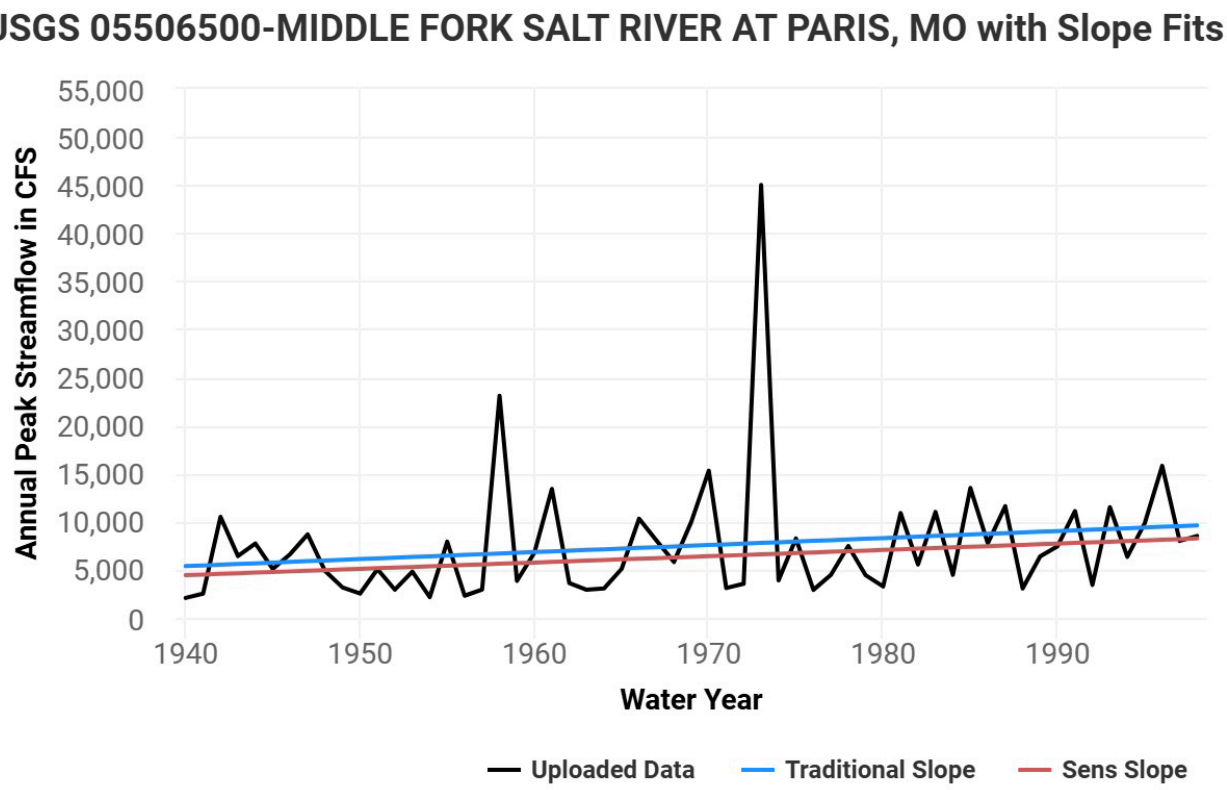


Figure 9. Trend Analysis for Annual Peak Streamflow at USGS Gage 05505000 –Middle Fork Salt River at Paris, MO

Table 6. Trend Line Coefficients of Annual Peak Streamflow at USGS Gage 05505000 –Middle Fork Salt River at Paris, MO

Method	Directionality	Slope (CFS per year)	Intercept (CFS)
Traditional Slope	Positive	+73	-136,042
Sen's Slope	Positive	+66	-122,803

Table 7. Trend Hypothesis Tests of Annual Peak Streamflow at USGS Gage 05505000 –Middle Fork Salt River at Paris, MO

Test	P-Value	Kendall's Tau
***t*-Test**	0.141	

Test	P-Value	Kendall's Tau
Mann-Kendall	0.00793	+0.238
Spearman Rank-Order	0.00719	

Since the assumption of normality was not met, the Bayesian Changepoint test was not applied. No nonstationarity was detected within the dataset of annual peak streamflow at the gage. There was no change in the mean or standard deviation in the dataset over the 59 years of observations. No breakpoints were found in the time series either.

North Fork Salt River at Hagers Grove, MO

USGS Gage 05502300 – North Fork Salt River at Hagers Grove, MO has a drainage area of 365 square miles. There are 50 years of observed data at the gage from 1975-2024. The dataset is not normally distributed (AD test statistic A*2 = 1.753) The trends in the dataset found by Traditional and Sen's Slope methods were both positive, as shown in Figure 10and Table 8. The *t*-Test trend hypothesis P-Value fell between 0.1-0.33, indicating there is weak evidence of a trend. The Spearman Rank-Order and Mann-Kendall trend hypothesis tests both had P-Values greater than 0.33, which indicates insufficient evidence of a trend. Kendall's Tau (τ) is a measure of the trend's direction and strength, ranging from -1 (perfect decreasing trend) to +1 (perfect increasing trend). The τ value for this dataset was +0.0703, which indicates almost no trend (Table 9).

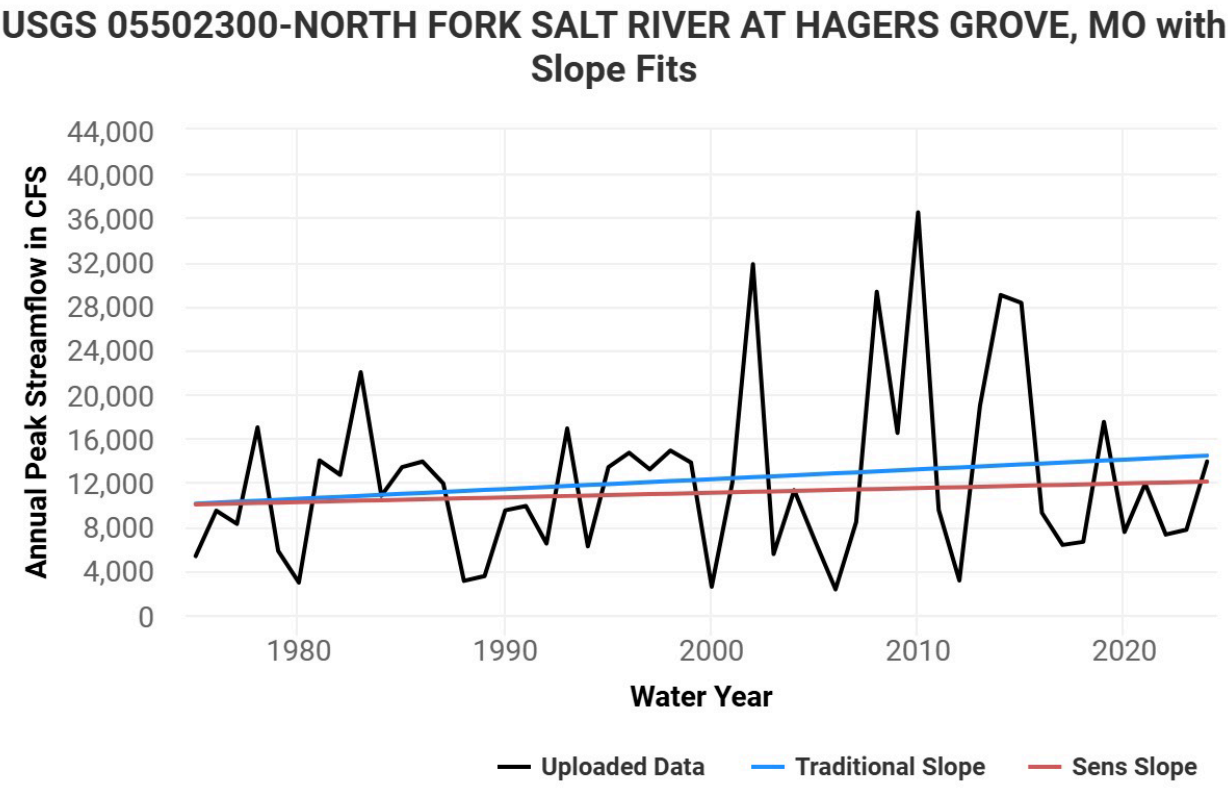


Figure 10. Trend Analysis for Annual Peak Streamflow at USGS Gage 05502300 –North Fork Salt River at Hagers Grove, MO

Table 8. Trend Line Coefficients of Annual Peak Streamflow at USGS Gage 05502300 –North Fork Salt River at Hagers Grove, MO

Method	Directionality	Slope (CFS per year)	Intercept (CFS)
Traditional Slope	Positive	+89	-165,455
Sen's Slope	Positive	+42	-73,319

Table 9. Trend Hypothesis Tests of Annual Peak Streamflow at USGS Gage 05502300 –North Fork Salt River at Hagers Grove, MO

Test	P-Value	Kendall's Tau
***t*-Test**	0.252	
Mann-Kendall	0.477	+0.0703
Spearman Rank-Order	0.474	

Since the assumption of normality was not met, the Bayesian Changepoint test was not applied. No nonstationarity was detected within the dataset of annual peak streamflow at the gage. There was no change in the mean or standard deviation in the dataset over the 50 years of observations. No breakpoints were found in the time series either.

Salt River near Center, MO

USGS Gage 05507800 – Salt River near Center, MO has a drainage area of 2,350 square miles. There are 45 years of observed data at the gage from 1980-2024. This is below the recommended minimum period of 50 years, but close enough that it was still analyzed. This dataset is not normally distributed (AD test statistic A*2 = 9.013). The trends in the dataset found by Traditional and Sen's Slope methods were both negative, as shown in Figure 11 and Table 10. P-Values of the Mann-Kendall and Spearman Rank-Order trend hypothesis tests fell under 0.05, indicating there is strong evidence of a trend. Kendall's Tau (τ) is a measure of the trend's direction and strength, ranging from -1 (perfect decreasing trend) to +1 (perfect increasing trend). The τ value for this dataset was -0.272, which indicates a very slight decreasing trend. The t-test produced a P-value of 0.0567, which indicates moderate bordering on strong evidence of a trend (Table 11).

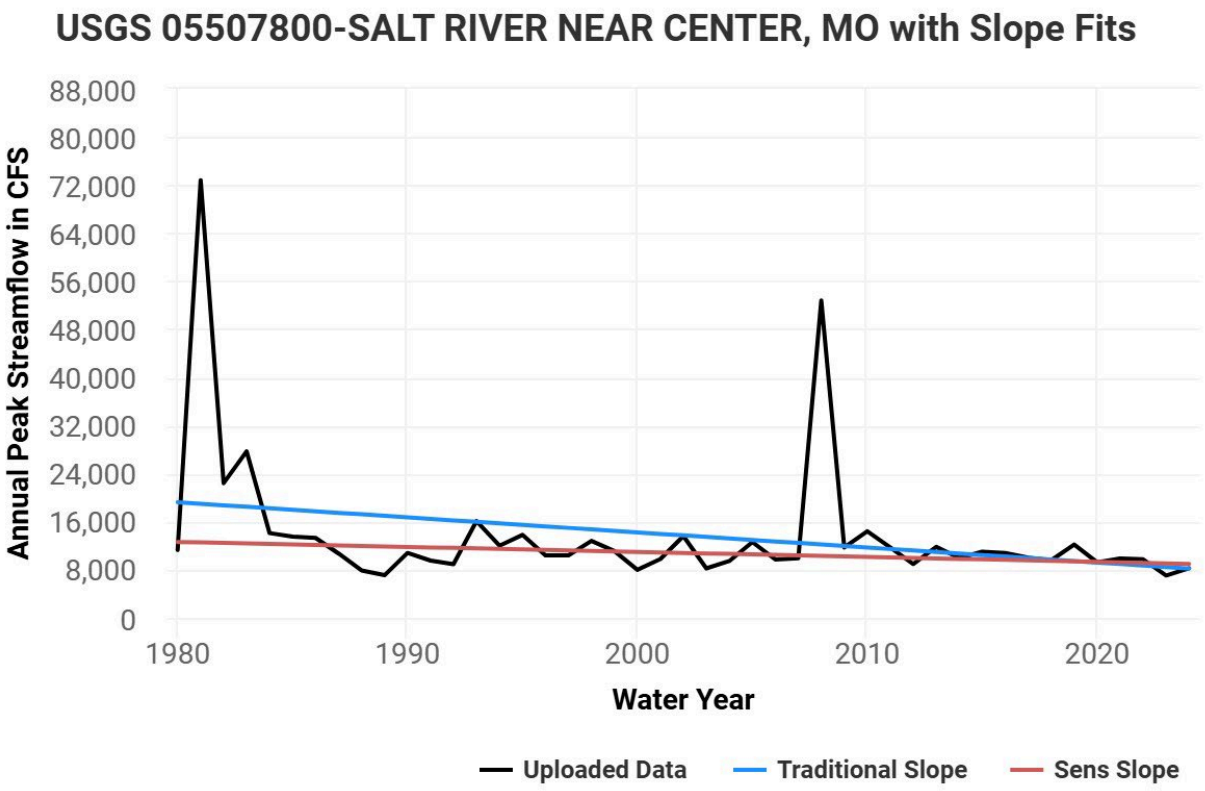


Figure 11 Trend Analysis for Annual Peak Streamflow at USGS Gage 05507800 – Salt River near Center, MO

Table 10. Trend Line Coefficients of Annual Peak Streamflow at USGS Gage 05507800 – Salt River near Center, MO

Method	Directionality	Slope (CFS per year)	Intercept (CFS)
Traditional Slope	Negative	-251	515,395
Sen's Slope	Negative	-83	176,652

Table 11. Trend Hypothesis Tests of Annual Peak Streamflow at USGS Gage 05507800 – Salt River near Center, MO

Test	P-Value	Kendall's Tau
***t*-Test**	0.0567	
Mann-Kendall	0.00874	-0.272
Spearman Rank-Order	0.0131	

Since the assumption of normality was not met, the Bayesian Changepoint test was not applied. No nonstationarity was detected within the dataset of annual peak streamflow at the gage. There was no change in the mean or standard deviation in the dataset over the 45 years of observations. A breakpoint was detected in 1985 though. There is a sharp change in behavior at the breakpoint that is visible in Figure 12. Before and after the breakpoint, annual peak streamflow is trending down, but neither of these trends were statistically significant according to their P-values (Table 12). Notably, Clarence Cannon Dam finished construction in 1983,

which roughly coincides with the breakpoint in annual peak streamflow. This is the most likely reason for the change in behavior.

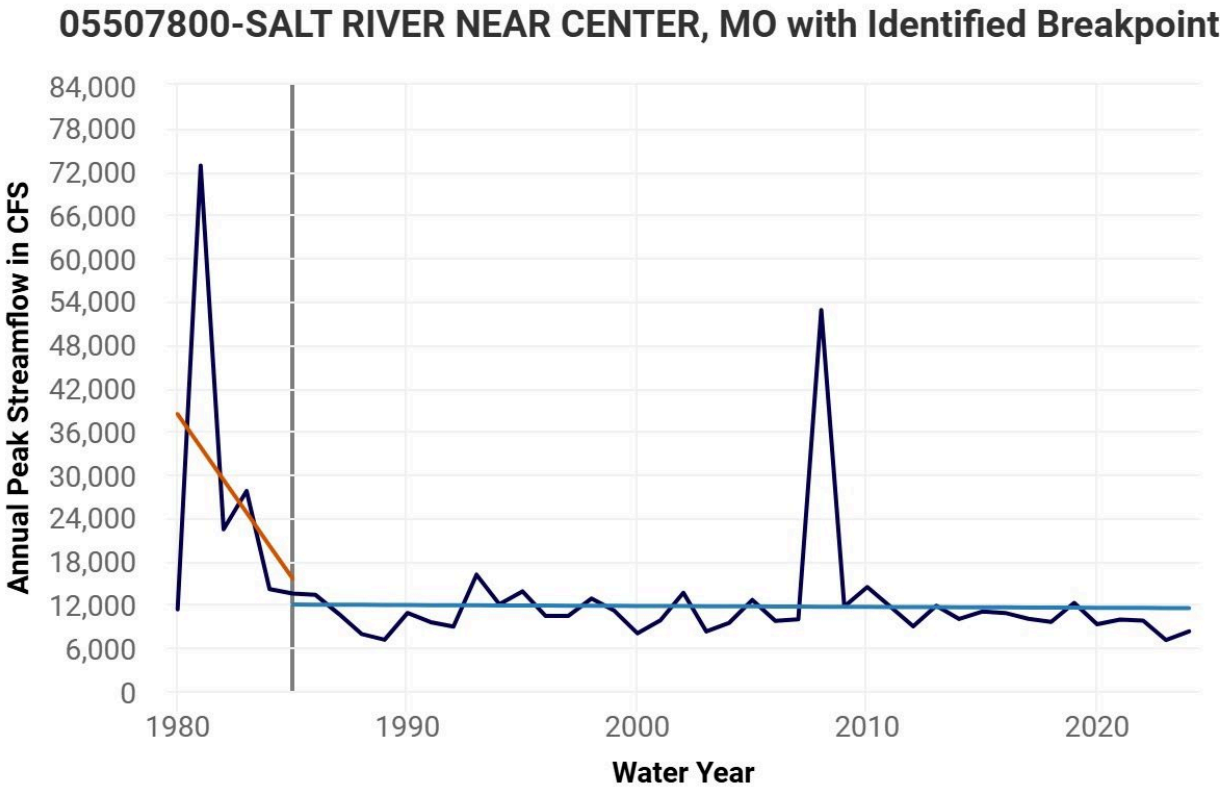


Figure 12. Breakpoint Analysis of Annual Peak Streamflow at USGS Gage 05507800 – Salt River near Center, MO

Table 12. Breakpoint Segment Details for Annual Peak Streamflow at USGS Gage 05507800 – Salt River near Center, MO

Date Range	Directionality	*t*-Test P-Value	Slope (CFS per year)	Intercept (CFS)
1980-1985	Negative	0.47474	-4,566	42,947
1985-2024	Negative	0.89548	-13	11,979

Future Hydrometeorology Evaluation

The USACE CHAT displays various simulated historic and future streamflow, temperature, and precipitation statistically downscaled outputs derived from 32 Coupled Model Intercomparison Project Phase 5 (CMIP5) designated models. Streamflow values represent unregulated basin conditions and have been generated using a VIC model and the MizuRoute routing method. The tool displays the ensemble range of CMIP model-based outputs for water years 1951-2099 and includes robustness metrics which gives users insight into the inter-model agreement and the robustness of the change signal modeled for a selected variable relative to historic variability. Outputs are presented for two assumed scenarios representing pathways to a moderate (RCP 4.5) and high (RCP 8.5) increase in radiative forcings by the end of the century. Trend evaluation is performed on the annual, inter-model means for both a historic period (water years 1951-2005) and a future period (water years 2006-2099). Additionally, the tool provides a

visualization of epoch-based differences in simulated monthly and annual historic versus future period streamflow, precipitation, and temperature model outputs.

For two subset epochs of the simulated future time series, the CHAT also computes robustness metrics for the trends demonstrated. Robustness is determined by the agreement of various statistical models (for more information on the models used, refer to the CHAT User Guide (Patel, et al., 2025)). Robust signals show agreement in the direction of a trend for over 80% of models, and over 66% of models with magnitudes of change in mean greater than the calculated variability threshold. Weak signals demonstrate only one of these, and conflicting signals have disagreement between the two metrics. In the following Figure 14, Figure 18, and Figure 22, these symbols are used to indicate robustness:

Figure 13 Robustness Symbology

Clarence Cannon Dam is in the Salt watershed (HUC 07110007) at the end of stream segment 07001139. The CHAT was applied to analyze simulated time series of annual-maximum mean monthly streamflow, annual-maximum 3-day precipitation, and annual-maximum one-day temperature to investigate how they may change in the future.

Annual-Maximum of Mean Monthly Streamflow

Figure 14 shows the mean and range of the simulated time series. For the RCP 4.5 scenario, both tested epochs (2035-2064 and 2070-2099) showed weak increasing signals. In the RCP 8.5 scenario, the 2035-2064 epoch showed a weak increasing signal, while the 2070-2099 epoch demonstrated a robust increasing signal.

Figure 15 shows the observed trends in the simulated data. The historical period of simulated data shows almost no trend with an insufficient level of significance; however, both simulated future periods show increasing trends. Both RCP scenarios have upward trends with strong statistical significance. The slopes of each trend and the P-values associated with each statistical significance test performed are listed in Table 13.

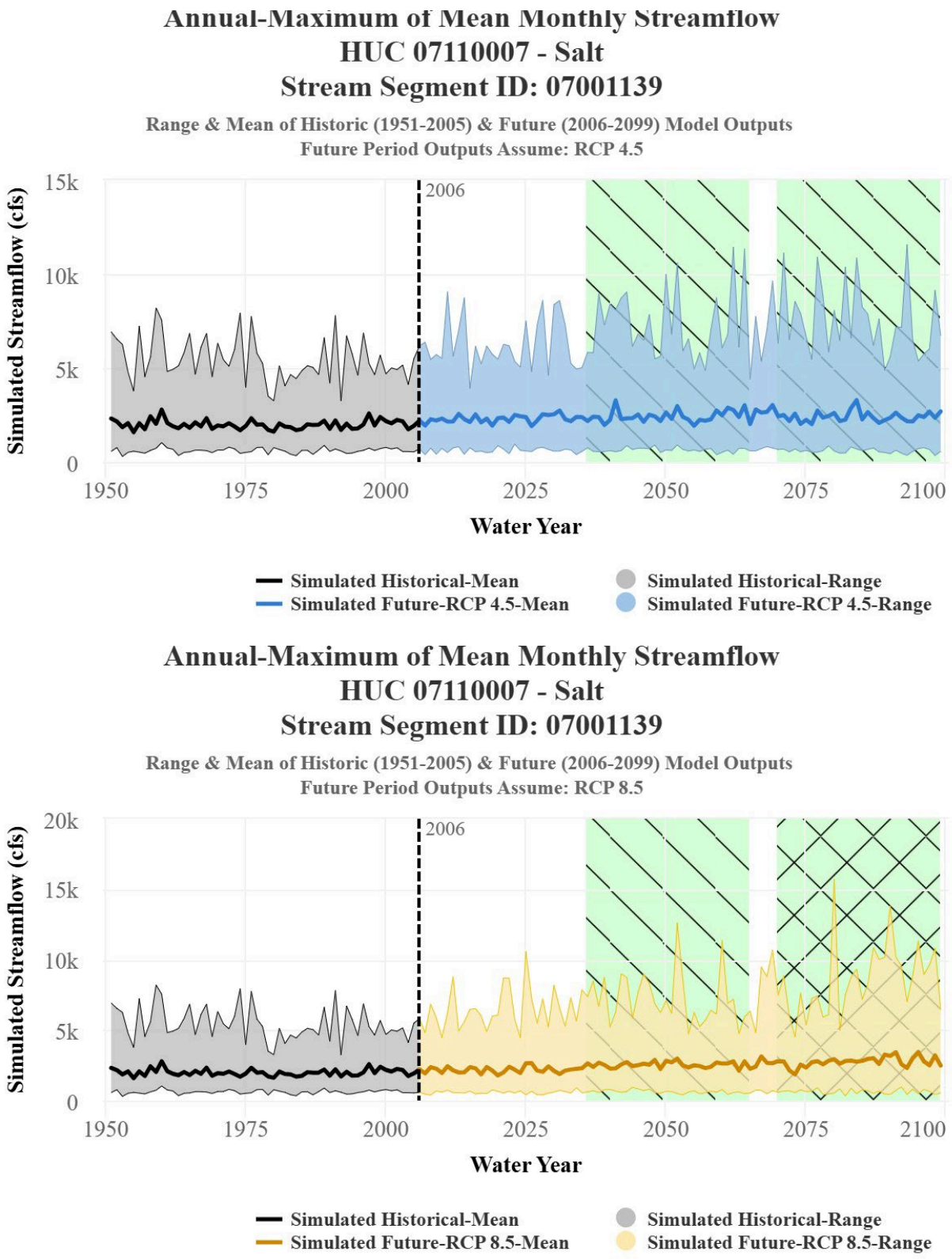


Figure 14. Annual-Maximum of Mean Monthly Streamflow Modeled Time Series

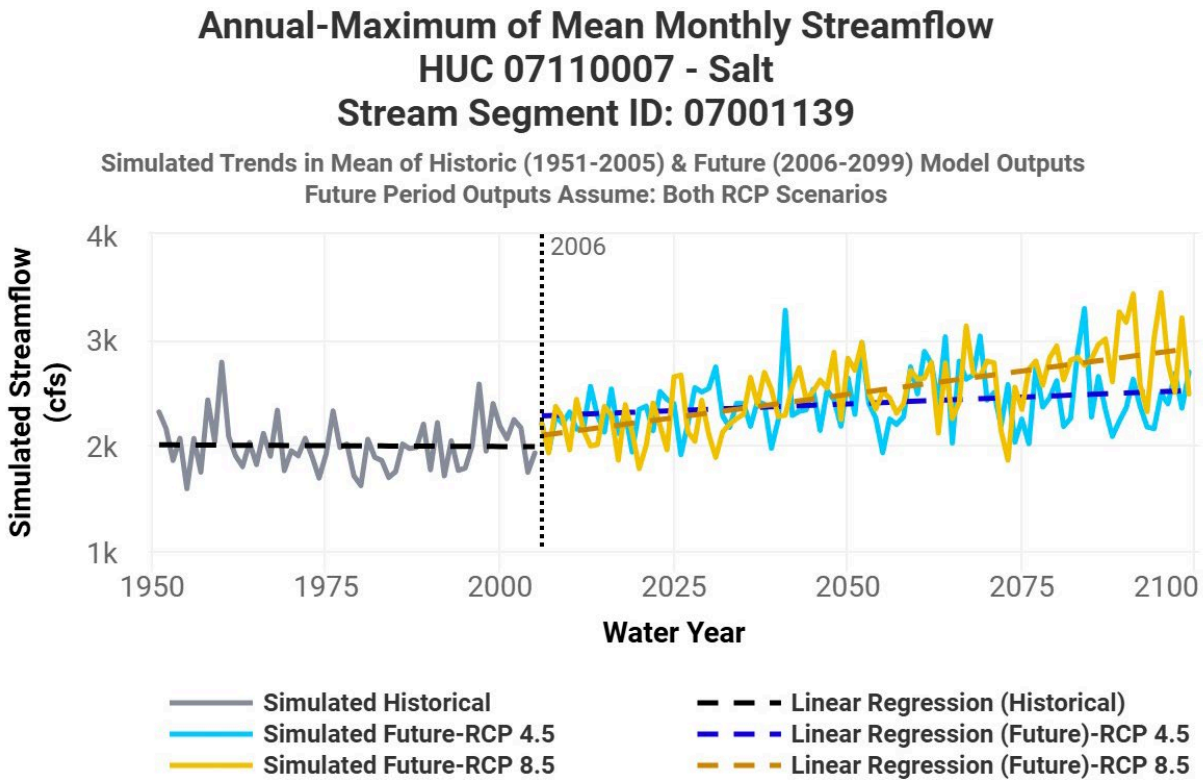


Figure 15. Modeled Time Series Trend Analysis of Annual-Maximum of Mean Monthly Streamflow

Table 13. Modeled Trend Line Statistical Significance Tests for Annual-Maximum of Mean Monthly Streamflow

Significance Test	P-Value: Simulated Historical	P-Value: Simulated Future RCP 4.5	P-Value: Simulated Future RCP 8.5
***t*-Test**	0.878	0.0149	<0.001
Mann-Kendall	0.908	0.018	<0.001
Spearman Rank-Order	0.924	0.0177	<0.001
Slope (CFS per year)	-0.3191	+2.5737	+8.8394

Figure 16 presents changes in simulated annual-maximum of mean monthly streamflow for RCPs 4.5 and 8.5 for the two future epochs relative to the historic period. By mid-century the annual-maximum mean of monthly streamflow increases by about 20% regardless of whether RCP 4.5 (Median: 22%) or RCP 8.5 is assumed (Median: 25%). By the end of the century, if RCP 4.5 is assumed the increase is still around 20% (Median 20%). For RCP 8.5 this change could be considerably greater (Median: 41%) with a large range of uncertainty.

Figure 17 presents changes in epoch-mean of simulated monthly mean streamflow for RCPs 4.5 and 8.5 for the two future epochs relative to the historical period. For both RCPs and epochs, the monthly mean streamflow increases in every month except from August to November when it stays mostly unchanged. There is a slight indication that monthly mean streamflow could decrease from August to November. The largest increases occur during late winter to early spring. The changes between the base epoch and end-century epoch have a very large range of uncertainty.

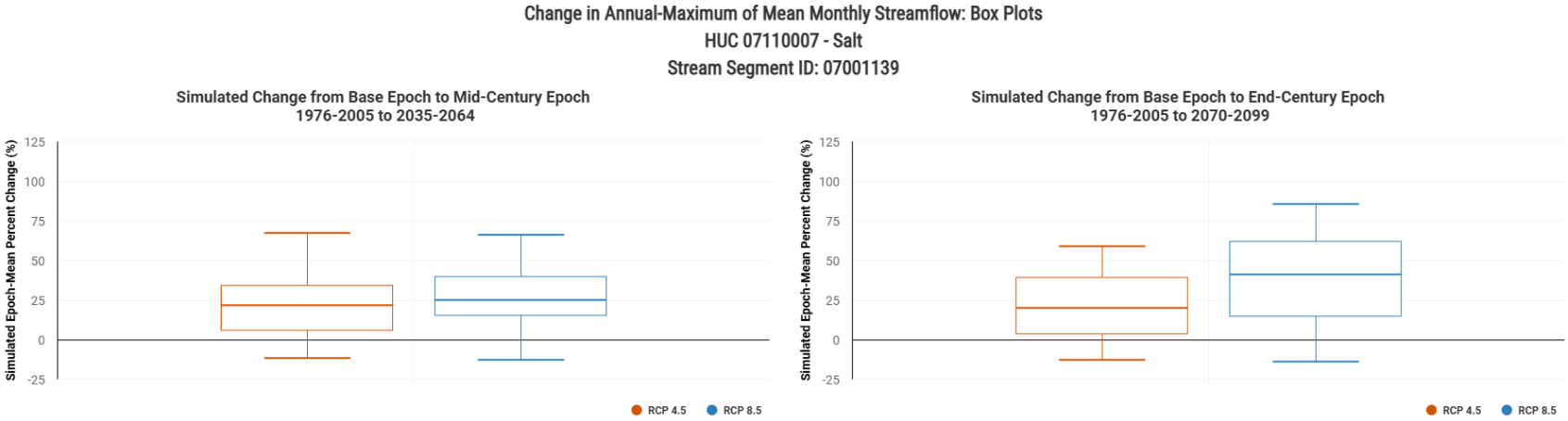


Figure 16. Change in Epoch-Mean of Simulated Annual-Maximum of Mean Monthly Streamflow

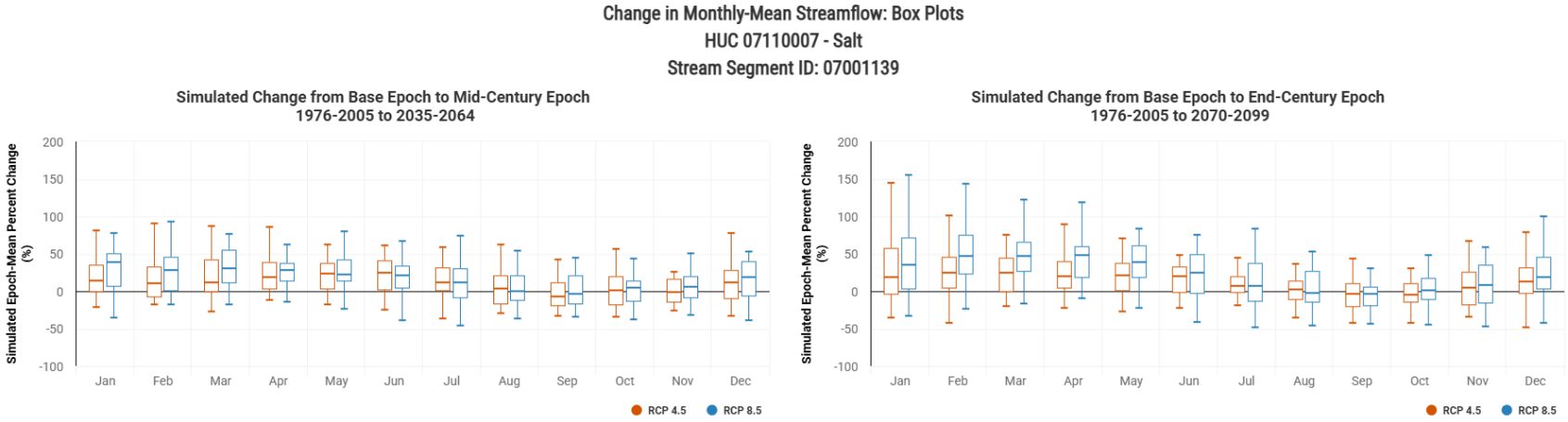
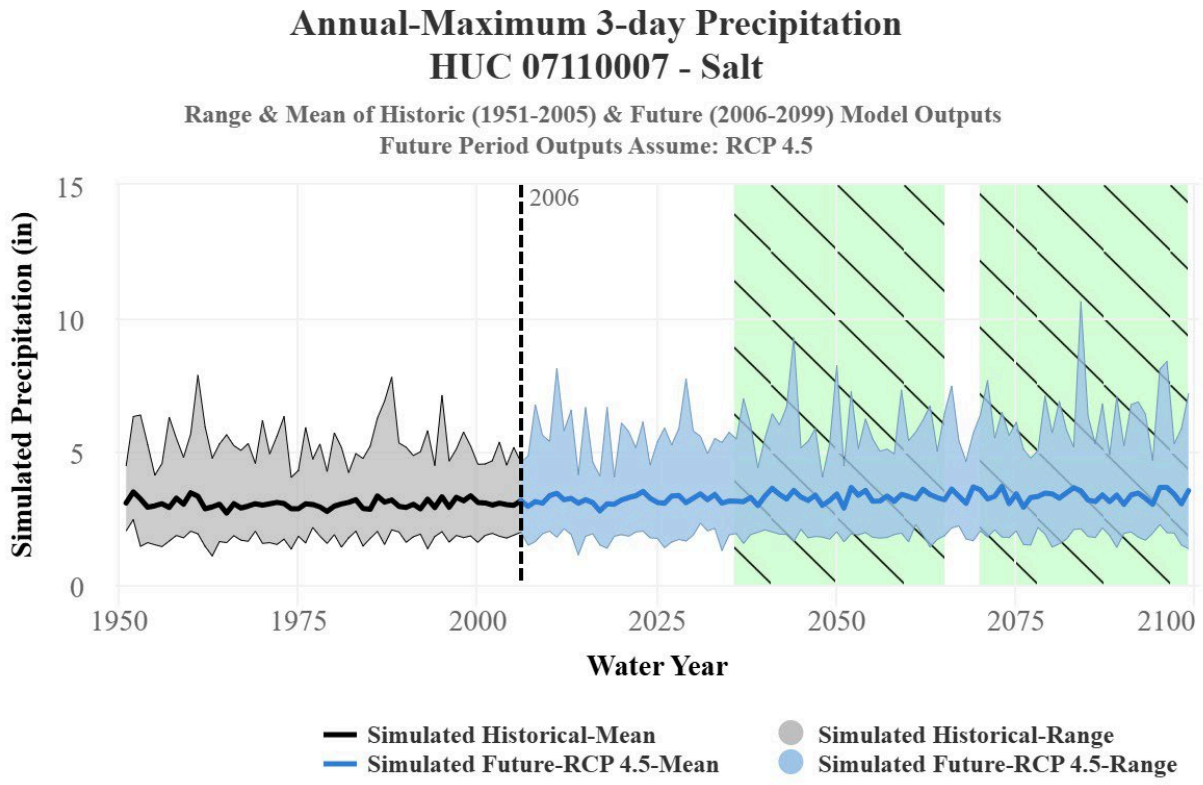


Figure 17. Change in Epoch-Mean of Simulated Monthly-Mean Streamflow

Annual-Maximum 3-day Precipitation

Figure 18 shows the mean and range of the simulated time series. For the RCP 4.5 scenario, both tested epochs (2035-2064 and 2070-2099) showed weak increasing signals. In the RCP 8.5 scenario, the 2035-2064 epoch showed a weak increasing signal, while the 2070-2099 epoch demonstrated a robust increasing signal.

Figure 19 shows the observed trends in the simulated data. The historical period of simulated data shows almost no trend with an insufficient level of significance; however, both simulated future periods show increasing trends with strong statistical significance. The slopes of each trend and the P-values associated with each statistical significance test performed are listed in Table 14.



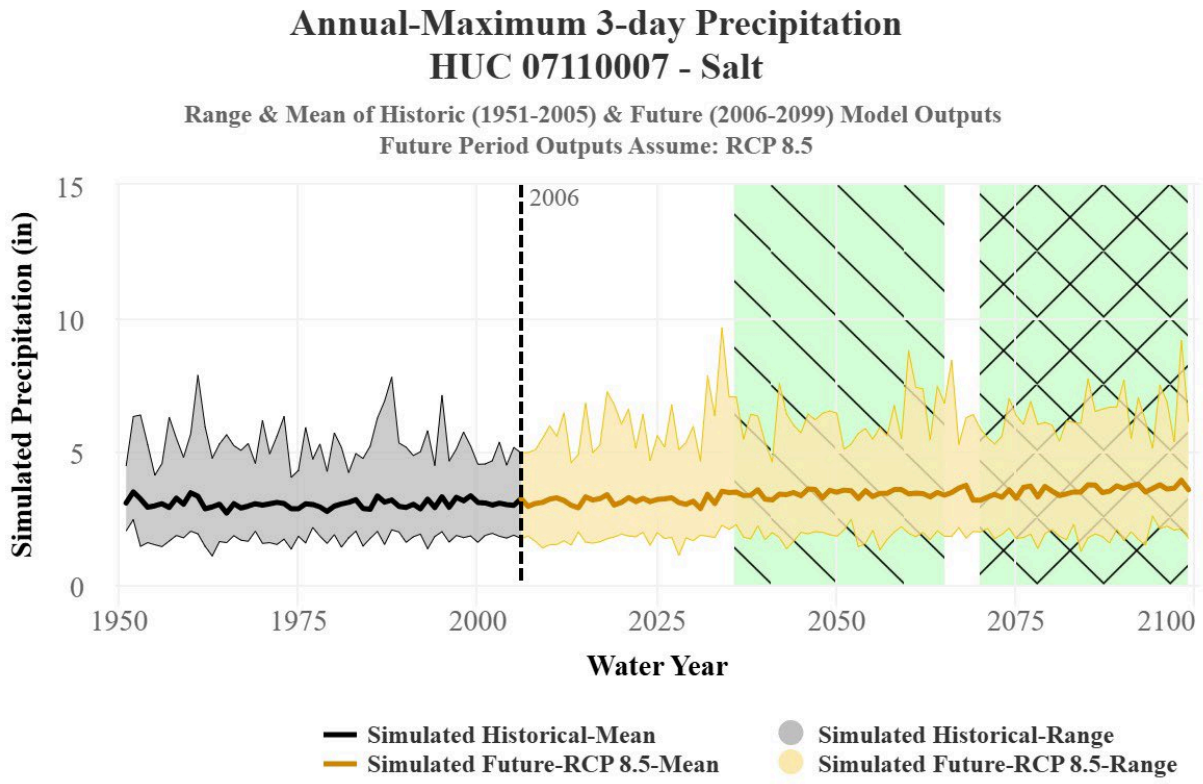


Figure 18. Annual-Maximum 3-day Precipitation Modeled Time Series

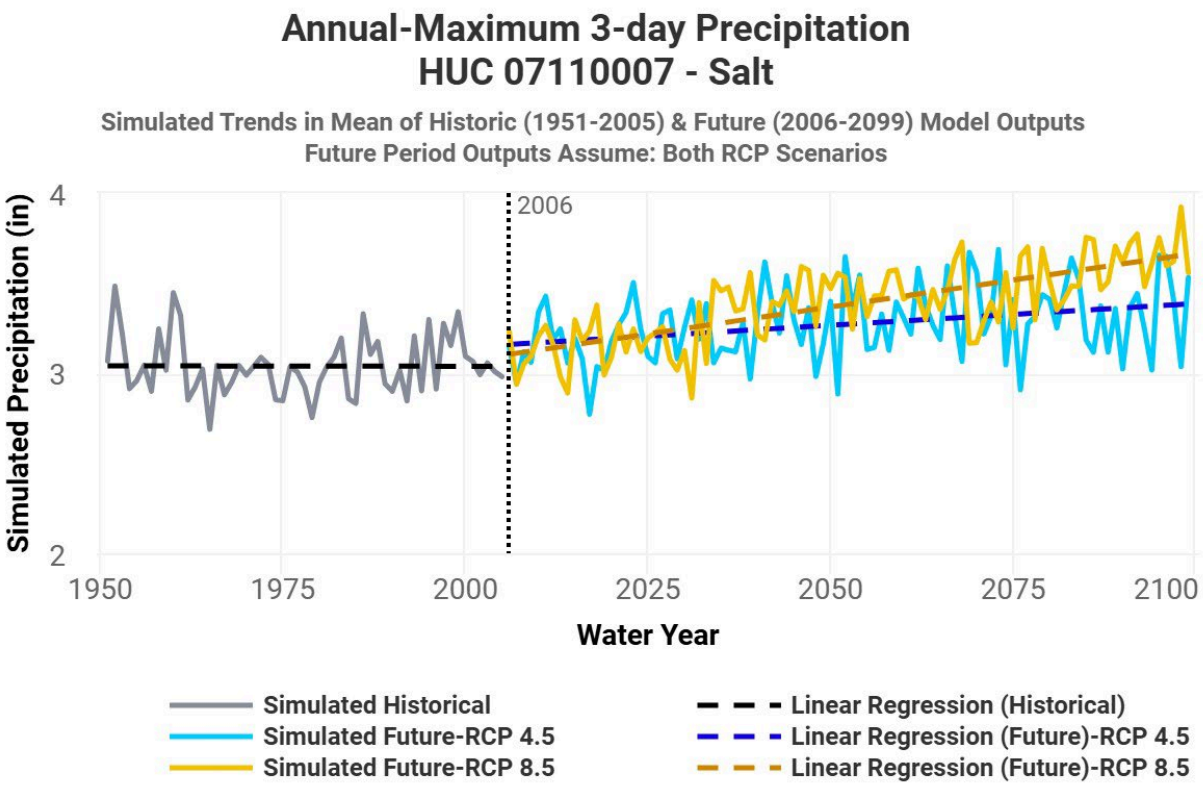


Figure 19. Modeled Time Series Trend Analysis of Annual-Maximum 3-day Precipitation

Table 14. Modeled Trend Line Statistical Significance Tests for Annual-Maximum 3-day Precipitation

Significance Test	P-Value: Simulated Historical	P-Value: Simulated Future RCP 4.5	P-Value: Simulated Future RCP 8.5
***t*-Test**	0.973	0.00125	<0.001
Mann-Kendall	0.828	0.00183	<0.001
Spearman Rank-Order	0.81	0.00204	<0.001
Slope (in per year)	0	+0.0024	+0.006

Figure 20 presents changes in simulated annual-maximum 3-day precipitation for RCPs 4.5 and 8.5 for the two future epochs relative to the historic period. By mid-century the annual-maximum 3-day precipitation increases about 10% regardless of whether RCP 4.5 (Median: 6%) or RCP 8.5 is assumed (Median: 12%). By the end of the century, if RCP 4.5 is assumed the increase is still around 10% (Median 10%). For RCP 8.5 this change could be greater (Median: 16%) with a large range of uncertainty.

Figure 21 presents changes in epoch-mean of simulated monthly-maximum 3-day precipitation for RCPs 4.5 and 8.5 for the two future epochs relative to the historical period. For both RCPs and epochs, there is little change in the late summer and early autumn precipitation; however, there is slight indications that the monthly-maximum 3-day precipitation could decrease this time

of year. Marked increases in precipitation occur during the late winter and early spring, with February showing the largest increase for all RCPs in both epochs.

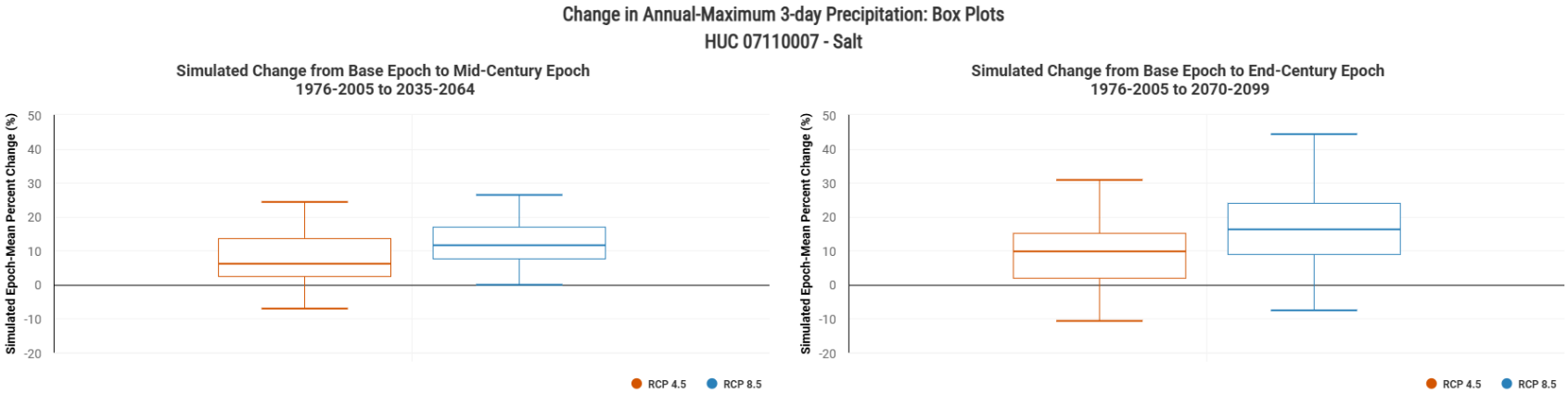


Figure 20. Change in Epoch-Mean of Simulated Annual-Maximum 3-day Precipitation

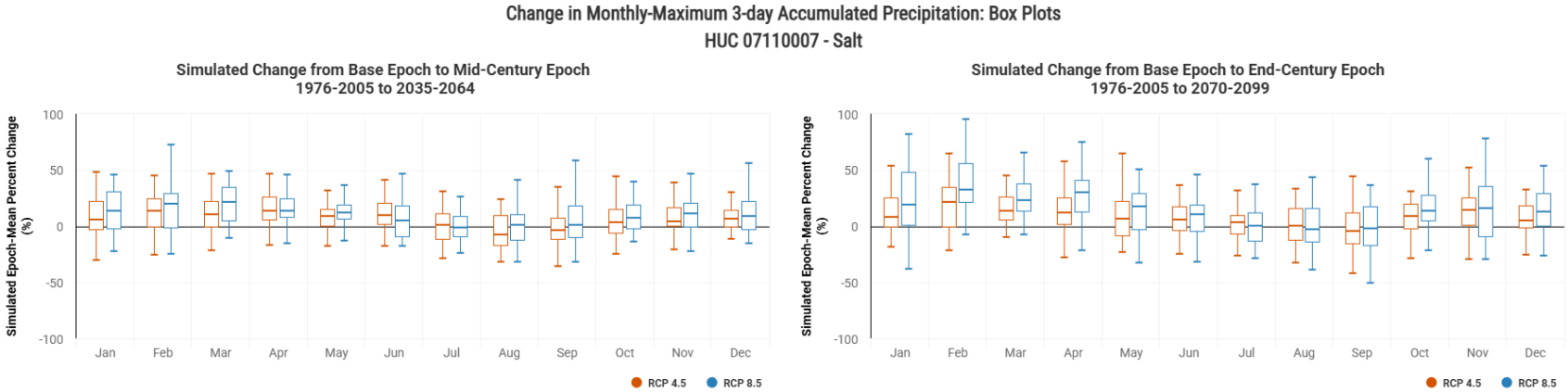


Figure 21. Change in Epoch-Mean of Simulated Monthly-Maximum 3-day Accumulated Precipitation

Annual-Maximum One-day Temperature

Figure 22 shows the mean and range of the simulated time series. For both RCP 4.5 and 8.5 scenarios, both tested epochs (2035-2064 and 2070-2099) showed robust increasing signals.

Figure 23 shows the observed trends in the simulated data. Historical and future time periods (for both RCP scenarios) all show statistically significant increasing trends in annual-maximum one-day temperature. The slopes of each trend and the P-values associated with each statistical significance test performed are listed in Table 15.

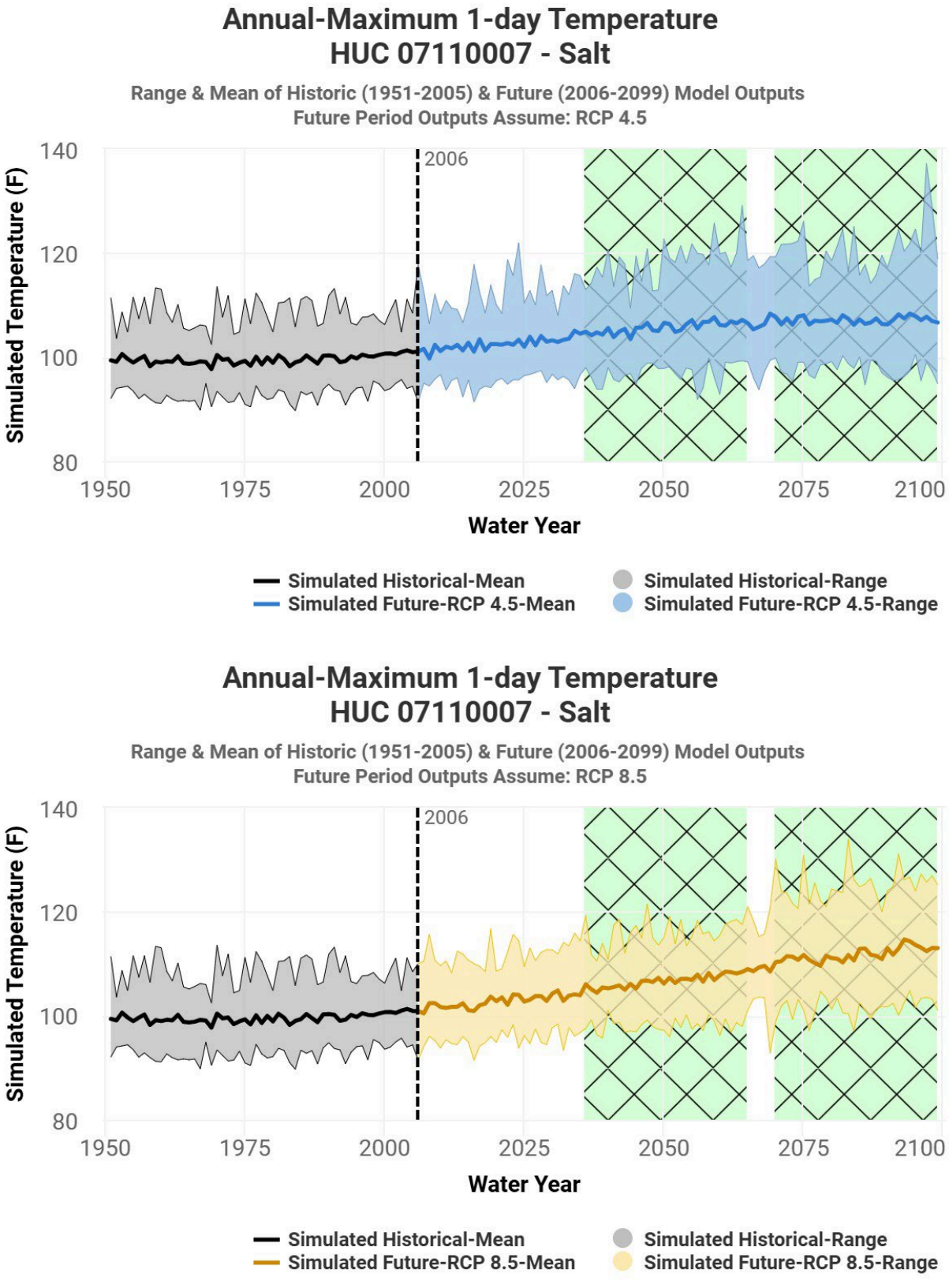


Figure 22. Annual-Maximum 1-day Temperature Modeled Time Series

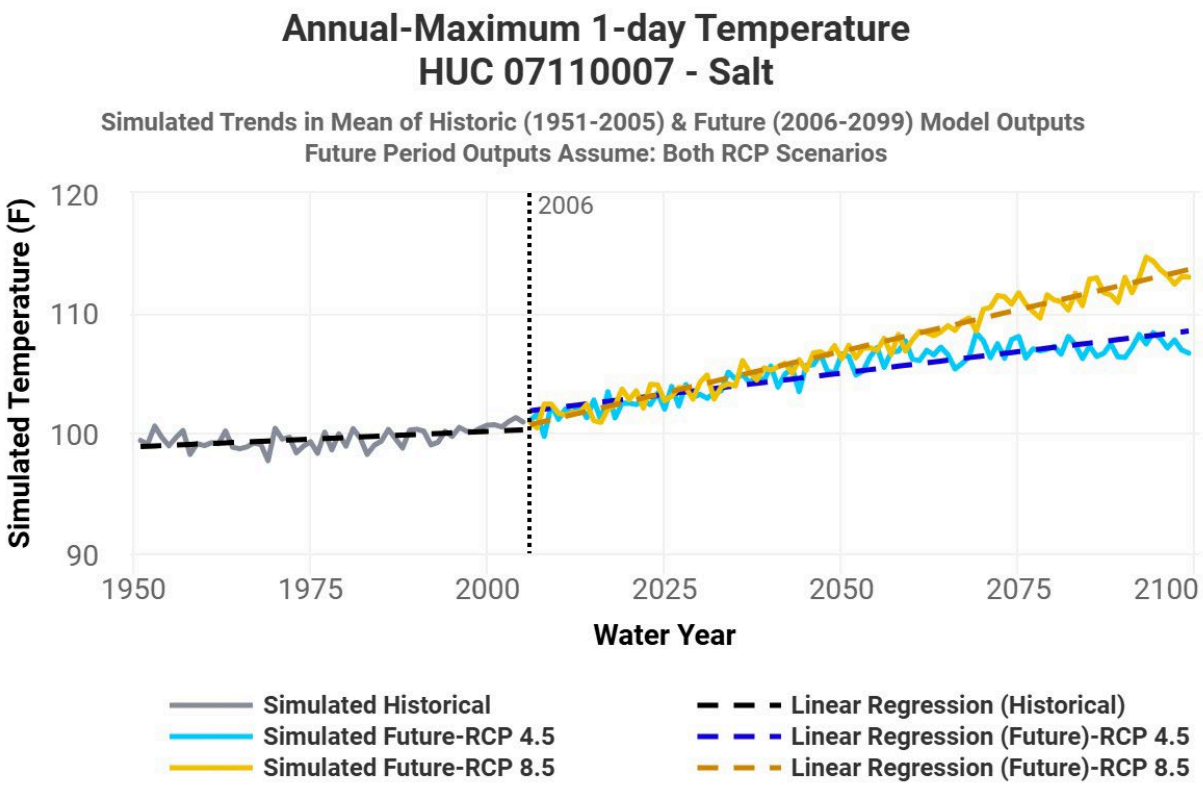


Figure 23. Modeled Time Series Trend Analysis of Annual-Maximum 1-day Temperature

Table 15. Modeled Trend Line Statistical Significance Tests for Annual-Maximum 1-day Temperature

Significance Test	P-Value: Simulated Historical	P-Value: Simulated Future RCP 4.5	P-Value: Simulated Future RCP 8.5
***t*-Test**	<0.001	<0.001	<0.001
Mann-Kendall	<0.001	<0.001	<0.001
Spearman Rank-Order	<0.001	<0.001	<0.001
Slope (°F per year)	+0.0259	+0.0714	+0.1389

Figure 24 presents changes in simulated annual-maximum 1-day temperature for RCPs 4.5 and 8.5 for the two future epochs relative to the historic period. By mid-century the annual-maximum one-day temperature increases about 6°F under RCP 4.5 (Median: 5.73°F) and RCP 8.5 (Median: 6.40°F). By the end of the century, if RCP 4.5 is assumed the increase is still about 6°F (Median 6.42°F). For RCP 8.5 this change could be greater (Median: 11.29°F) with a large range of uncertainty.

Figure 25 presents changes in epoch-mean of simulated monthly-maximum temperature for RCPs 4.5 and 8.5 for the two future epochs relative to the historical period. For both epochs under both RCP scenarios, temperatures increased during every month. The most extreme increases occur in the summer and early autumn, but the end century epoch also shows large increases in January and February. Even with the large ranges shown in both epochs, it is

evident that temperatures will likely increase in every month (only February, March, and April show very little signs of decreasing temperatures).

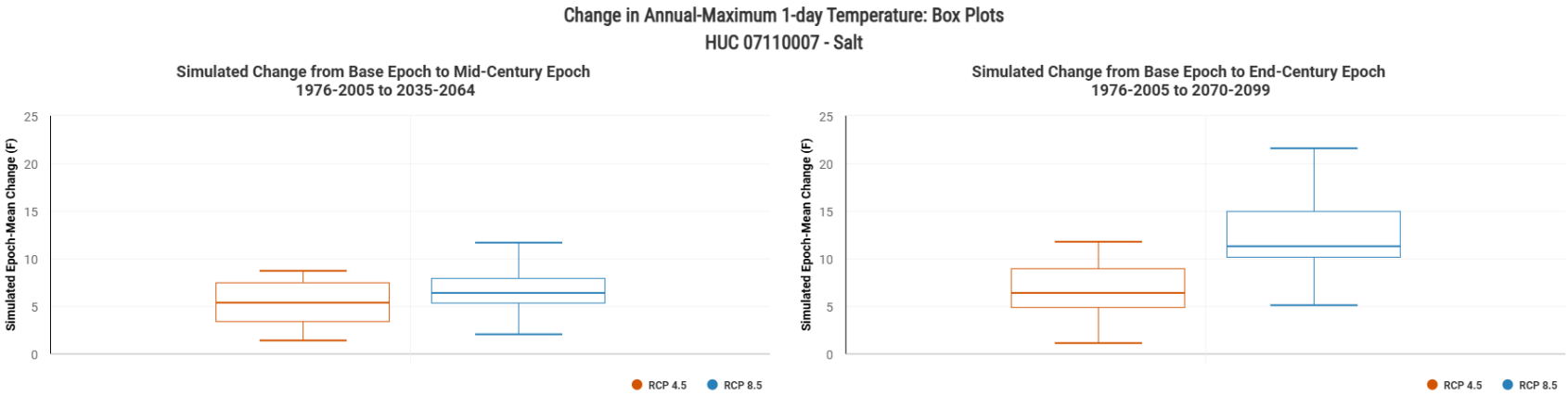


Figure 24. Change in Epoch-Mean of Simulated Annual-Maximum 1-day Temperature

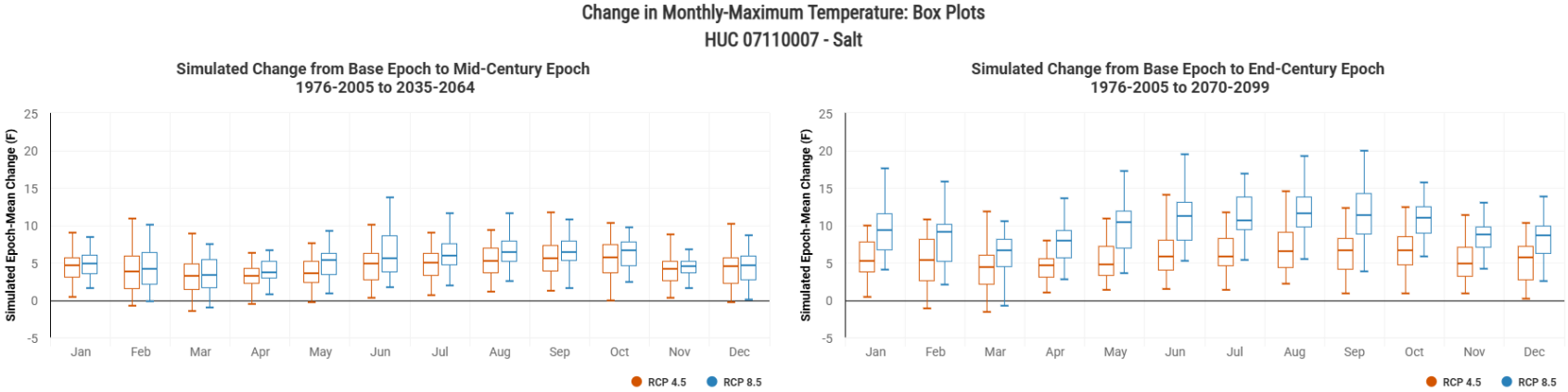


Figure 25. Change in Epoch-Mean of Simulated Monthly-Maximum Temperature

Screening-Level Vulnerability Assessment

The USACE Screening-Level Civil Works Vulnerability Assessment Tool (CWVAT) is applied to assess relative exposure and sensitivity of the project area to current and future natural hazards. Based on the purpose and relevant hydrometeorological factors for the project, the selected hazard category analyzed for this project is energy demand. The energy demand hazard was chosen since fish mortality increases when energy needs to be generated via hydropower, and low DO water is released downstream of the dam.

The project area is within the Salt - 07110007 HUC-8 watershed. The CWVAT measures the exposure for a selected 8-digit HUC watershed by using a "Z-Score." This score shows how much the exposure to a hazard (e.g., Riverine Flooding) in one watershed differs from the median of all HUC-8 watersheds across the U.S. Each hazard in CWVAT is assessed using a combination of indicators variables (e.g., extreme precipitation days) (USACE, 2025).

The tool computes indicator variable output and hazard scores for two future epochs, defined as 30-year periods centered on either 2050 or 2085. The 2050 epoch is consistent with medium-range planning (mid-century), while the 2085 epoch is used for long-range planning (late-century). The tool also contains a Base epoch (1950-2005) representing historical information as a baseline. In addition to presenting exposure scores and indicator variable output by epoch, the tool also features two scenarios (low and high) to capture the range of potential future conditions that projects might experience.

Figure 26 shows that the selected project area has an overall (total) exposure rating of medium for the base period, and a medium-high rating for the 2050 low and high scenarios and the 2085 low scenario. The 2085 high scenario has a high overall exposure rating. Hazards included in the total score are coastal flooding, drought, energy demand, extreme temperature, historical extreme conditions, land degradation, riverine flooding, and wildfire.

Figure 26. Overall (Total) Exposure for the Project Area

This vulnerability assessment focuses on the riverine flooding and energy demand hazards, as they are most closely related to the function of project features and associated with the identified RHFs.

Riverine Flooding

The project area currently has a riverine flooding hazard Z-score with a medium exposure rating. All future epoch-scenarios have a medium-high qualitative exposure rating. The Z-score values and their ratings for the riverine flooding hazard are listed in Table 16. Riverine flooding

hazard indicator variables include extreme precipitation days, flood magnification factor, maximum one-day precipitation, maximum five-day precipitation, and riverine flood extent.

Figure 27 breaks down the indicator variable contributions to the riverine flooding hazard score for the project area, illustrating how they change with time. Extreme precipitation days have the highest impact on the overall Z-score, while changes in the other indicator variable Z-scores are comparatively modest.

The relevant indicator values for riverine flooding are listed in Table 17. While the Z-score for extreme precipitation days was very high for the watershed, this just means that it is at greater risk of exposure compared to the median watershed in the United States. The actual percent change in the number of extreme precipitation days in the watershed could range from 18-40%, or an increase of about two days per year compared to the base epoch. The most dramatic percent change in the indicator variable values was the flood magnification factor. This is a ratio of current flood discharge to future flood discharge and indicates how much larger or smaller future floods may be (USACE, 2025). It is the ratio of the daily cumulative runoff exceeded 10% of the time in the future compared to this value in the historic period. The values in the table indicate that floods in the future could have a peak discharge roughly three to five times larger than the base epoch. The Z-score for this indicator was only so low because the flood magnification factor changes in a very similar way for the median watershed in the United States. Maximum one-day and five-day precipitation could increase in the range of 5% to 18%. Riverine flooding extents may increase from 5% to 10%.

Table 16. Riverine Flooding Hazard Scores and Qualitative Ratings for the Project Area

Epoch-Scenario	Riverine Flooding Z-Score	Qualitative Exposure Rating
Base	0.17	Medium
2050 Low	0.60	Medium-High
2050 High	0.77	Medium-High
2085 Low	0.75	Medium-High
2085 High	1.18	Medium-High

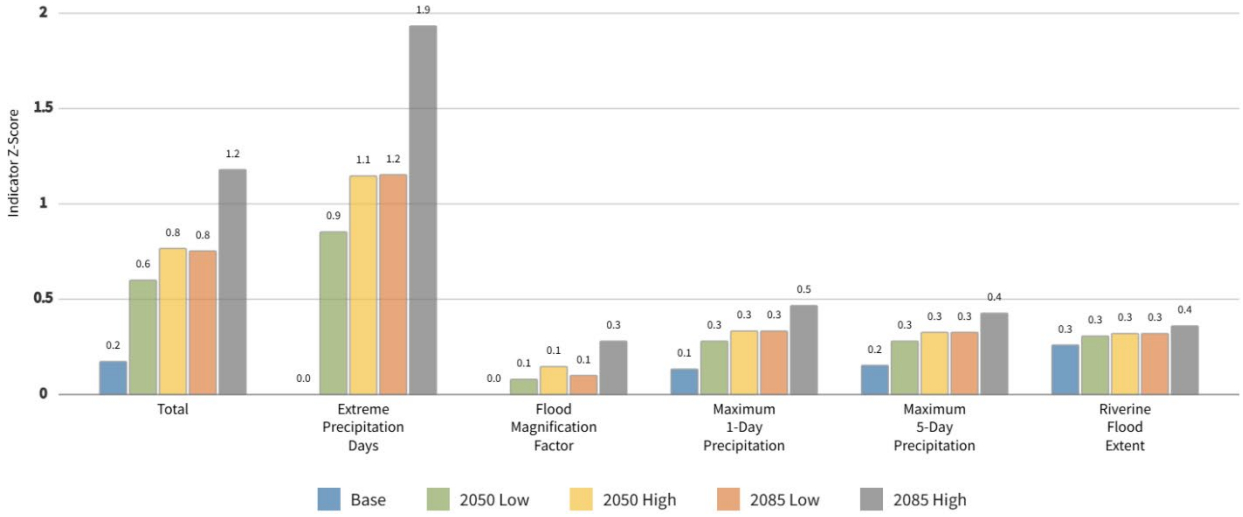


Figure 27. CWVAT Indicator Contributions to the Riverine Flooding Hazard Z-Score for Each Epoch-Scenario

Table 17. Riverine Flooding Relevant Indicator Values for the Project Area and Purpose

Epoch-Scenario	Extreme Precipitation Days	Extreme Precipitation Days	Flood Magnification Factor	Flood Magnification Factor	Max 1-Day Precipitation	Max 1-Day Precipitation	Max 5-Day Precipitation	Max 5-Day Precipitation	Riverine Flood Extent	Riverine Flood Extent
	days/year	% Change	Unitless	% Change	in	% Change	in	% Change	acres	% Change
Base	3.65		1.00		4.53		12.96		23,348	
2050 Low	4.30	17.56%	2.78	178.02%	4.77	5.29%	13.73	5.93%	24,541	5.11%
2050 High	4.52	23.69%	3.65	264.56%	4.97	9.56%	14.03	8.26%	24,817	6.29%
2085 Low	4.52	23.78%	3.65	264.56%	4.88	7.76%	14.08	8.60%	24,829	6.34%
2085 High	5.11	39.88%	5.08	407.82%	5.34	17.79%	15.34	18.36%	25,688	10.02%

Energy Demand

The project area has a medium energy demand hazard exposure rating for all time periods and scenarios evaluated except for the 2085 high epoch-scenario, which has a medium-high exposure rating. Table 18 summarizes the CWVAT energy demand hazard analysis for the project area. Indicator variables under the energy demand hazard category include 5-day maximum temperature, 5-day minimum temperature, cooling degree days, and heating degree days.

A breakdown of indicator variable contributions to the energy demand hazard score for the project area illustrating how they change with time is displayed in Figure 28. 5-Day Maximum Temperature and Cooling Degree Days contribute most significantly to the energy demand hazard for all epoch-scenarios. Cooling Degree Days is the annual sum of degrees that every day's average temperature is above 65°F and represents the impacts to energy requirements to cool buildings (USACE, 2025).

The relevant indicator values for energy demand are listed in Table 19. The most significant percentage change occurs in the 5-day minimum temperatures, which increase in the range of 500% to 1,000%. This is echoed by the decrease in the amount of heating degree days. This increase in the minimum temperature lowers the heating requirements and thus the energy demand during the colder parts of the year. These variables decrease the Z-score of the energy demand hazard.

The indicator variables that increase the exposure score are the 5-day maximum temperatures, and the cooling degree days. While 5-day maximum temperatures increase modestly, the amount of cooling degree days increased 50% to 130% over the various epoch-scenarios. Increases in temperature will increase the energy demand for cooling buildings during hot days. Only the 2085 High scenario reaches an exposure rating of Medium-High, but increasing trends in these variables could pose a risk to the project objectives by causing higher energy demand.

In summary, the outcomes of this vulnerability assessment show that the project area is not especially exposed to increases in energy demand. However, increasing trends in some project-relevant indicator variables show there could be increased risk to project objectives in the future. The results of the vulnerability assessment are combined with the multiple lines of evidence comprising the risk-based resilience assessment approach to assess future hydrometeorological risks to measures, alternatives, and overall project objectives.

Table 18. Energy Demand Hazard Scores and Qualitative Ratings for the Project Area

Epoch-Scenario	Energy Demand Z-Score	Qualitative Exposure Rating
Base	0.05	Medium
2050 Low	0.29	Medium
2050 High	0.37	Medium
2085 Low	0.37	Medium
2085 High	0.72	Medium-High

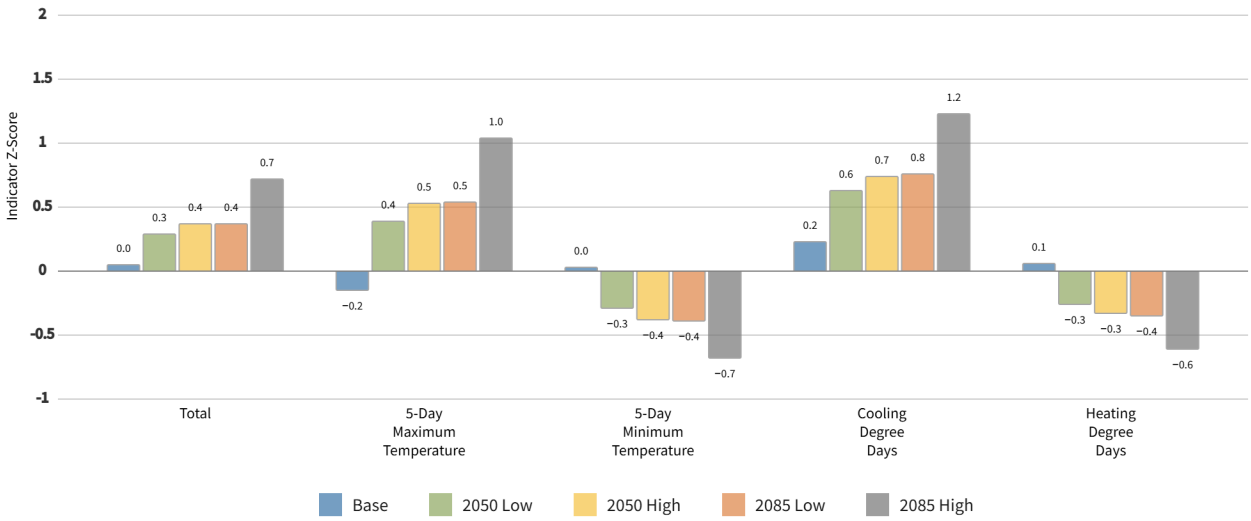


Figure 28. CWVAT Indicator Contributions to the Energy Demand Hazard Z-Score for Each Epoch-Scenario

Table 19. Energy Demand Relevant Indicator Values for the Project Area and Purpose

Epoch-Scenario	5-Day Max Temperature	5-Day Max Temperature	5-Day Min Temperature	5-Day Min Temperature	Cooling Degree Days	Cooling Degree Days	Heating Degree Days	Heating Degree Days
	°F	% Change	°F	% Change	°F days	% Change	°F days	% Change
Base	112.20		1.14		979.03		6,254.73	
2050 Low	116.69	4.00%	6.57	474.64%	1,492.27	52.42%	5,260.28	-15.90%
2050 High	117.53	4.75%	7.99	599.62%	1,636.68	67.17%	5,029.97	-19.58%
2085 Low	117.70	4.91%	8.30	626.17%	1,661.23	69.68%	4,959.31	-20.71%
2085 High	121.91	8.65%	13.14	1,050.12%	2,269.87	131.85%	4,167.18	-33.38%

Dynamic Weather-Related Risks

There is moderate risk to project goals due to changes in the identified RHFs. This conclusion was made based on the evidence documented in this analysis using the tools and methods outlined in ECB 2026-1 (USACE, 2026).

Evidence was aggregated to develop an overall likelihood score for each identified hazard. Then, the rubric shown in Table 20 was used to determine the maximum risk score among 4 important categories: life safety, economic, environmental, and social effects. The maximum risk score for each category is the overall likelihood score multiplied by the impact score. This method of identifying risks is qualitative and comes with inherent uncertainties. It is important to be viewed in the context of the information it was built from (presented in this report) and the uncertainties associated with that information as well.

For environmental concerns, there is one identified risk with a minor impact score and one with a moderate impact score. For both the risks of greater floods and higher temperatures in the future, the environmental impact of concern is the same – that these circumstances will lead to decreased DO levels in the water released downstream. For increased discharge and precipitation, this impact was rated as minor. While greater floods pose a risk to the efficacy of the project, any sufficient flood will cause a decrease in DO downstream. Increases in the future will only slightly increase the duration and frequency of these occurrences. The impact of increase in temperature was rated as moderate, however. Increases in temperature, the number of hot days per year, and the frequency of heat waves will increase energy demand in kind. Hydropeaking at the dam will increase to meet this demand, which will result in more water being released downstream without consideration of the DO levels.

Each risk has a minor impact score for economic impacts. If DO requirements are not met, there may be lawsuits and fines to be paid. This would occur as a result of the environmental impact, but the financial impact of failing to meet these requirements should not be ignored.

The overall risk has been characterized as moderate, because while the changes in RHFs that will determine the outcome are likely based on the evidence, the actual impact compared to current activities is relatively moderate. There are already DO issues with the water released from the dam. While this project aims to increase DO levels, it is possible that with changes in hydrometeorological factors in the future, the project's efficacy will be challenged by systemic changes.

In short, there is a moderate level of risk that over the next 50 years, changes in hydrometeorological factors will make it more difficult for the project features to serve their purpose. Increased flood volume and frequency could cause more water to be held in the lake for longer periods of time, which will lower the DO of water before it can be released. Higher temperatures in the future will cause higher energy demand during peak hours, which if met with power generation at the dam will result in more low-DO water released downstream.

Opportunities for Resilience and Dynamic Adaptation

Due to the limited scope of this project and its proposed measures, there is little opportunity for additional features to improve resiliency. However, the proposed increase to the elevation of the temperature control weir will explicitly improve the project's resiliency. The higher weir will provide more headroom for meeting the minimum DO level required for releases into the re-

regulation pool. If increasing temperatures induce higher energy demand, this change to the TCW will have made the project more resilient to meet release requirements in the future.

There is opportunity for dynamic adaptation of the operating procedures at the dam. The rules for water level management in the lake and power generation could be modified to mitigate the amount of low-DO water released downstream.

Table 20. Project Risk Rubric

ID	Project Feature	Trigger	Hazard	Harm	Likelihood	Life Safety		Economic		Environmental		Social Effects		RISK SCORE
1	Raising TCW	Discharge and/or Precipitation Increase	Flood magnitude and/or duration increase	High water for longer durations leads to decreased DO levels	4	None		Failing to meet DO requirements could result in lawsuits and fines		Decreased DO levels will lead to fish kill		Corps reputation may be degraded		Max Individual Score
						Impact	Risk	Impact	Risk	Impact	Risk	Impact	Risk	
						1 (Insignificant)	4	2 (Minor)	8	2 (Minor)	8	1 (Insignificant)	4	**8-Economic-Environmental**
2	Raising TCW	Temperature Increase	Energy demand increase	More frequent power generation during peak hours will release more low-DO water downstream	4	None		Failing to meet DO requirements could result in lawsuits and fines		Decreased DO levels will lead to fish kill		Corps reputation may be degraded		Max Individual Score
						Impact	Risk	Impact	Risk	Impact	Risk	Impact	Risk	
						1 (Insignificant)	4	2 (Minor)	8	3 (Moderate)	12	1 (Insignificant)	4	**12-Environmental**

Table 21. Project Risk Table

ID	Project Feature	Trigger	Hazard	Hazard Likelihood Score	Harm	Overall Likelihood Score	Resilient Features	Max. Impact Rating (From Risk Rubric)	Risk (Max. Risk Score from Risk Rubric)	Evaluation	Recommended Actions to Maintain Acceptable Risk Level
1	Raising TCW	Discharge and/or Precipitation Increase	Flood magnitude and/or duration increase	Likely (4)	High water for longer durations leads to decreased DO levels	Likely (4)	Raising the TCW will increase DO levels downstream	2 (Minor)	**Moderate (8-Economic-Environmental)**	Acceptable	Consider changes to the operating rules of power generation and flood control releases when DO levels are low
2	Raising TCW	Temperature Increase	Energy demand increase	Highly Likely (5)	More frequent power generation during peak hours will release more low-DO water downstream	Likely (4)	Raising the TCW will increase DO levels downstream	3 (Moderate)	**Moderate (12-Environmental)**	Acceptable	Consider changes to the operating rules of power generation and flood control releases when DO levels are low

References

Carelton, T. A., & Hsiang, S. M. (2019). *Social and Economic Impacts of Climate Science 353: 6304.*

Liu, Y., Goodrick, S., & Stanturf, J. (2013). Future U.S. Wildfire Potential Trends Projected Using a Dynamically Downscaled Climate Change Scenario. *Forest Ecology and Management, 294*(15), 120-135.

NOAA. (2022). *Missouri State Climate Summary.* NOAA National Centers for Environmental Information.

Olson, S., Nguyen, M., Sant-Miller, A., Mueller, C., Veatch, W., & White, K. (2025). *U.S. Army Corps of Engineers Time Series Toolbox User Guide.* Washington, D.C.: U.S. Army Corps of Engineers.

Patel, H. H., Russel, A. M., Nguyen, M. C., Haynes, K., Kim, G., Olson, S., . . . White, K. D. (2025). *Comprehensive Hydrology Assessment Tool (CHAT) User Guide.* Washington, D.C.: U.S. Army Corps of Engineers.

Schwartz, M. D., Ault, T. R., & Betancourt, J. L. (2013). Spring onset variations and trends in th econtinental United States: past and regional assessment using temperature-based indices. *International Journal of Climatology, 33*, 2917-2922.

Simon, A., Artita, K., & Simon, G. (2020). *Changes in Hydrology and Suspended-Sediment Transport in the Mississippi River Basin over the Past Century.* Mississippi River Geomorphology & Potomology Program. Washington, D.C.: United States Army Corps of Engineers.

Small, D., Islam, S., & Vogel, R. M. (2006). Trends in Precipitation and Streamflow in the Eastern U.S.: Paradox or Perception? *Geophysical Letters*(33).

USACE. (2015). *Recent US Climate Change and Hydrology Literature Applicable to US Army Corps of Engineers Missions - Water Resources Region 07, Upper Mississippi.* (K. D. White, & J. R. Arnold, Eds.) Washington, D.C., United States of America: United States Army Corps of Engineers.

USACE. (2025). *Civil Works Vulnerability Assessment Tool User Manual.* Washington, D.C., United States of America: United States Army Corps of Engineers.

USACE. (2025). *Clarence Cannon Dam and Mark Twain Lake Master Plan.* St. Louis, Missouri: U.S. Army Corps of Engineers St. Louis District.

USACE. (2026). *ECB 2026-1 Incorporating Resilience to Nonstationary Hydrometeorological Conditions in USACE Civil Works Studies, Designs, and Projects.* Washington, D.C.: U.S. Army Corps of Engineers.

USGCRP. (2023). *Fifth National Climate Assessment.* (A. R. Crimmins, C. W. Avery, D. R. Easterling, K. E. Kunkel, B. C. Stewart, & T. K. Maycock, Eds.) Washington, D.C., United States of America: U.S. Global Change Research Program. doi:10.7930/NCA5.2023.FM

Vavrus, S. J., & Behnke, R. J. (2014). A comparison of projected future precipitation in Wisconsin using global and downscaled climate model simulations for public health. *International Journal of Climatology, 34*(10), 3106-3124.

Wang, H., Schubert, S., Suarez, S., Chen, J., Hoerling, M., Kumar, A., & Pegion, P. (2009). Attribution of the seasonality and regionality in climate trends over the United States during 1950-2000. *Journal of Climate, 22*, 2571-2590.

Westby, R. M., Lee, Y. -Y., & Black, R. X. (2013). Anomalous temperature regimes during the cool season: long-term trends, low-frequency mode modulation, and representation in CMIP5 simulations. *Journal of Climate, 26*(22), 9061-9076.

Woodward, G., Perkins, D. M., & Brown, L. E. (2010). Climate change and freshwater ecosystems: impacts across multiple levels of organization. *Philosophical Transactions of the Royal Society Biological Sciences, 365*(1549), 2093-2106.

Continuing Authorities Program (CAP) 1135

Clarence Cannon Dam at Mark Twain Lake

Appendix L: Real Estate Plan

St. Louis District
Project Sponsor: Missouri Department of Conservation
March 2026

1. Purpose 3
1.1 Project Area 3
1.2 Authority 7
2. Lands, Easements and Rights-of-way (LER) 7
3. Sponsor-Owned LER 9
4. Non-Standard Estates 9
6. Federally Owned Lands 9
7. Navigation Servitude 16
8. Mapping 16
9. Induced Flooding 16
10. Baseline Cost Estimate 16
11. Relocation Assistance Benefits 16
12. Mineral Activity 16
13. Sponsor Assessment 16
14. Zoning 17
15. Schedule of Land Acquisition Milestones 17
16. Facility or Utility Relocations 17
17. HTRW 17
18. Landowner Attitude 17
19. Notification to the Sponsor Regarding the Risks Associated with Land Acquisition Before Execution of the Project Partnership Agreement (PPA) 17
20. Other Relevant Real Estate Issues 17

1. Purpose

This Real Estate Plan (REP) defines the real estate requirements for the Clarence Cannon Dam at Mark Twain Lake environmental restoration project. The purpose of this project is to restore the aquatic ecosystem by addressing recurring periods of low dissolved oxygen (DO) below 5 mg/L, thereby reducing stress on fish species and decreasing the frequency and magnitude of fish mortality events.

The project was developed in partnership with the Missouri Department of Conservation (MDC) as the non-Federal sponsor (NFS). Project implementation is contingent upon a signed Project Partnership Agreement (PPA), for which MDC has provided a letter of intent, and will be cost-shared 75% Federal and 25% non-Federal.

1.1 Project Area

Mark Twain Lake is located in northeastern Missouri on the Salt River, in the Salt River Basin. Mark Twain Lake is in both Ralls and Monroe Counties and approximately 20 miles southwest of Hannibal, MO and 140 miles north of St. Louis. Clarence Cannon Dam and its associated re-regulation dam are located in Ralls County, MO, upstream from the confluence with the Mississippi River at River Miles (RM) 63.0 and 53.5, respectively. Figure 1 shows the site in relation to St Louis, and Figure 2 and Figure 3 show the general study area location.

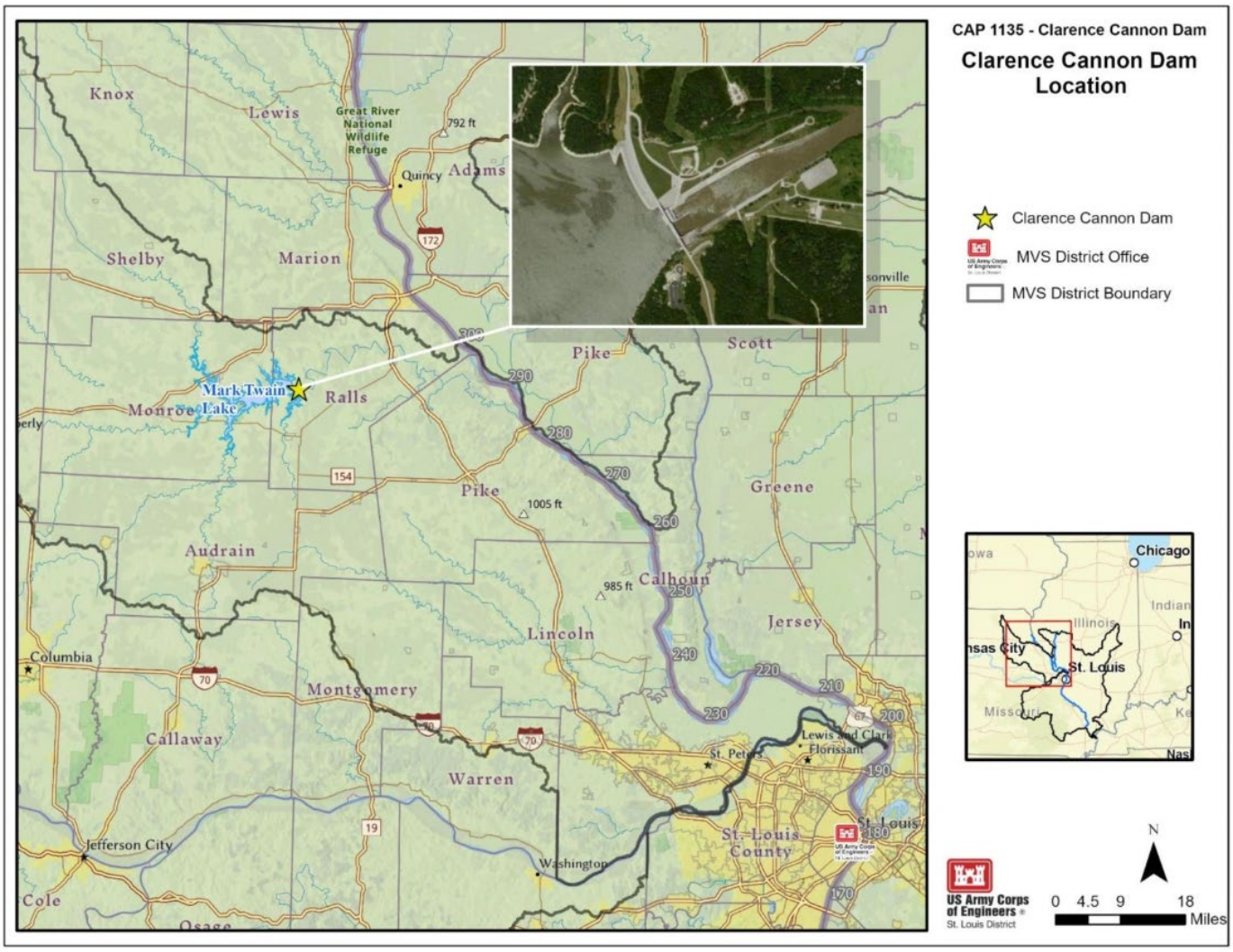

CAP 1135 - Clarence Cannon Dam
Clarence Cannon Dam Location
Clarence Cannon Dam
MVS District Office
MVS District Boundary
Knox
Lewis
Great River National Wildlife Refuge
792 ft
Quincy
Adams
Shelby
Marion
Mark Twain Lake
Monroe
Ralls
Pike
Scott
Greene
Audrain
1005 ft
985 ft
Calhoun
Jersey
Lincoln
Columbia
Montgomery
Callaway
Warren
Jefferson City
Cole
Washington
St. Louis County
St. Louis
Florissant
Lewis and Clark
Chicago
Illinois
St. Louis
US Army Corps of Engineers
St. Louis District
N
0 4.5 9 18
Miles

Figure 1

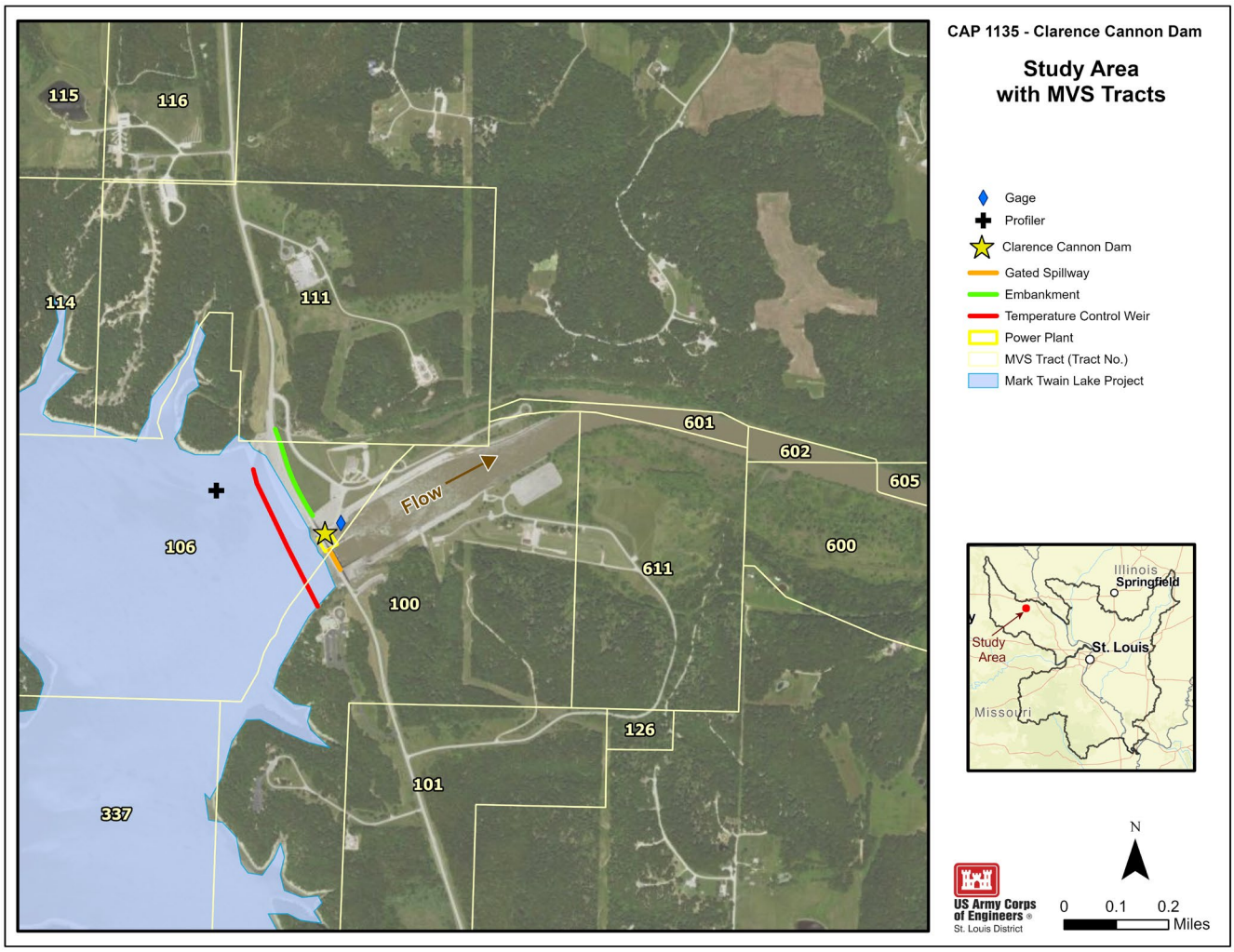

CAP 1135 - Clarence Cannon Dam
Study Area with MVS Tracts
Gage
Profiler
Clarence Cannon Dam
Gated Spillway
Embankment
Temperature Control Weir
Power Plant
MVS Tract (Tract No.)
Mark Twain Lake Project
115
116
114
111
601
602
605
Flow
106
600
611
100
126
101
337
Illinois
Springfield
Study Area
St. Louis
Missouri
N
US Army Corps of Engineers
St. Louis District
0
0.1
0.2
Miles

Figure 2

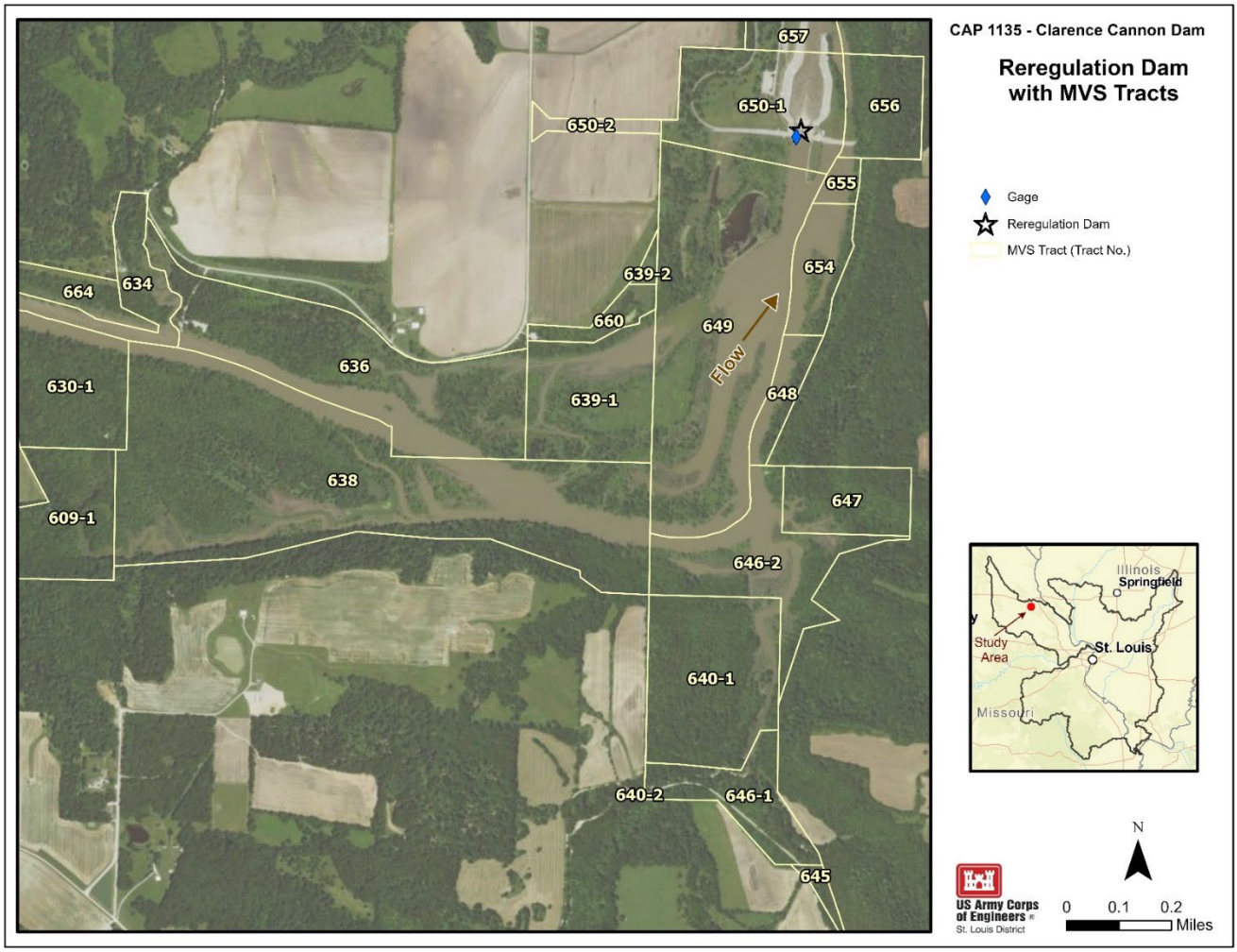

CAP 1135 - Clarence Cannon Dam
Reregulation Dam with MVS Tracts
Gage
Reregulation Dam
MVS Tract (Tract No.)
657
650-1
656
650-2
655
654
639-2
664
634
660
649
Flow
636
630-1
639-1
648
638
647
609-1
646-2
640-1
640-2
646-1
645
Illinois
Springfield
Study Area
St. Louis
Missouri
N
US Army Corps of Engineers
St. Louis District
0 0.1 0.2
Miles

Figure 3

1.2 Authority

This project is authorized under Section 1135 of the Water Resources Development Act of 1986, as amended (Continuing Authorities Program). This authority grants the United States Army Corps of Engineers (USACE) the ability to modify its completed projects to improve environmental quality or to restore areas degraded by a project's original construction and operation. Any modifications must be feasible, consistent with the original project purposes, and in the public interest.

The specific project being modified, the Clarence Cannon Dam at Mark Twain Lake, was itself originally authorized by Section 203 of the Flood Control Act of 1962 (PL 87-874) and was completed in 1983. The application of the Section 1135 authority allows for the currently proposed environmental restoration work.

2. Lands, Easements and Rights-of-way (LER)

The Clarence Cannon Dam at Mark Twain Lake CAP 1135 project is located entirely on federally owned land managed by USACE. The core of the study area consists of three crucial tracts acquired in fee simple in 1966: Tract 100 (239 acres), Tract 106 (267.3 acres), and Tract 111 (277.7 acres). The dam structure itself is situated on Tract 106 and partially on Tract 100 (See Figure 2).

The government’s fee simple title is subject to several existing encumbrances. These rights do not interfere with current or planned project operations and are detailed below:

- Easement (Electric): An easement on Tract 100 granted to Northeast Missouri Electric Power Cooperative for the construction, operation, and maintenance of electric power transmission lines and related facilities (See Figure 4).
- Easement (Telecommunications): A right-of-way easement on portions of Tracts 100, 106, and 111 granted to Continental Telephone of Missouri for an underground fiber optic telephone cable. This right-of-way runs along Missouri State Highway J.
- Lease (Waterline): A lease granted by USACE to the Cannon Water Supply District No.1 for a waterline that travels along the highway and stretches across Tracts 100, 106, and 111 (See Figure 5).

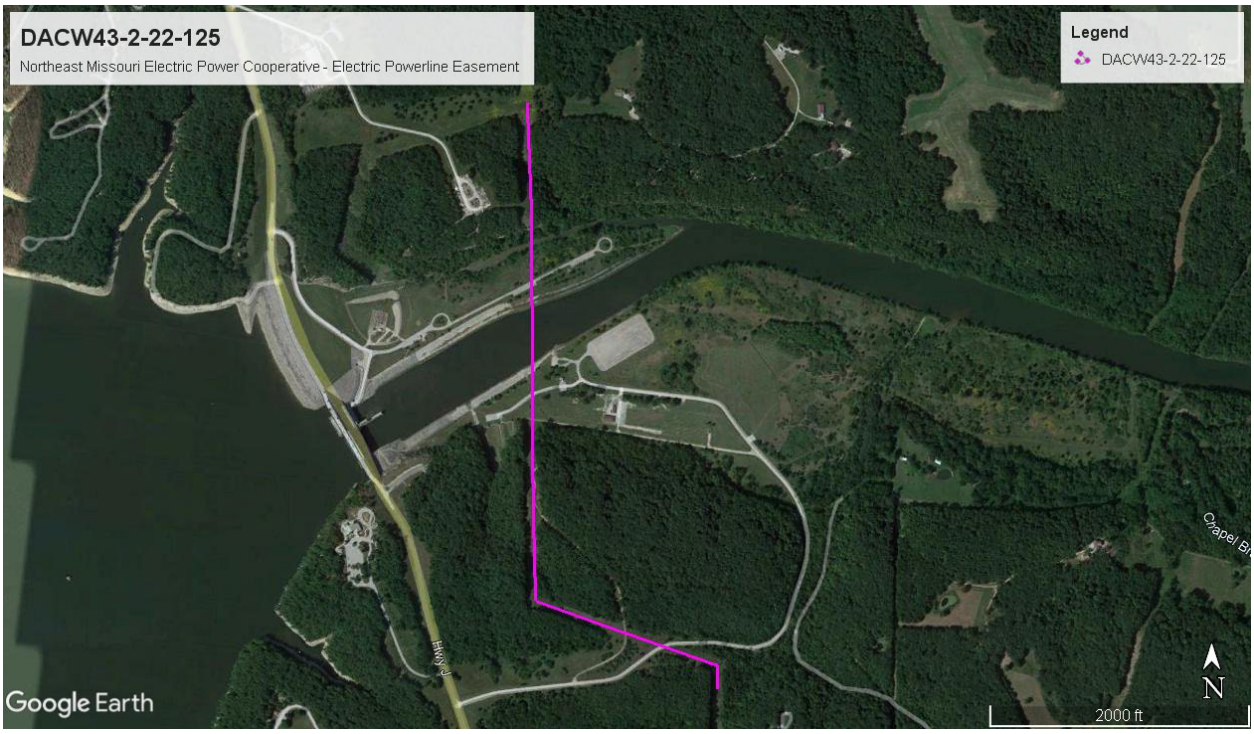

DACW43-2-22-125
Northeast Missouri Electric Power Cooperative - Electric Powerline Easement
Legend
DACW43-2-22-125
Google Earth
2000 ft
N

Figure 4

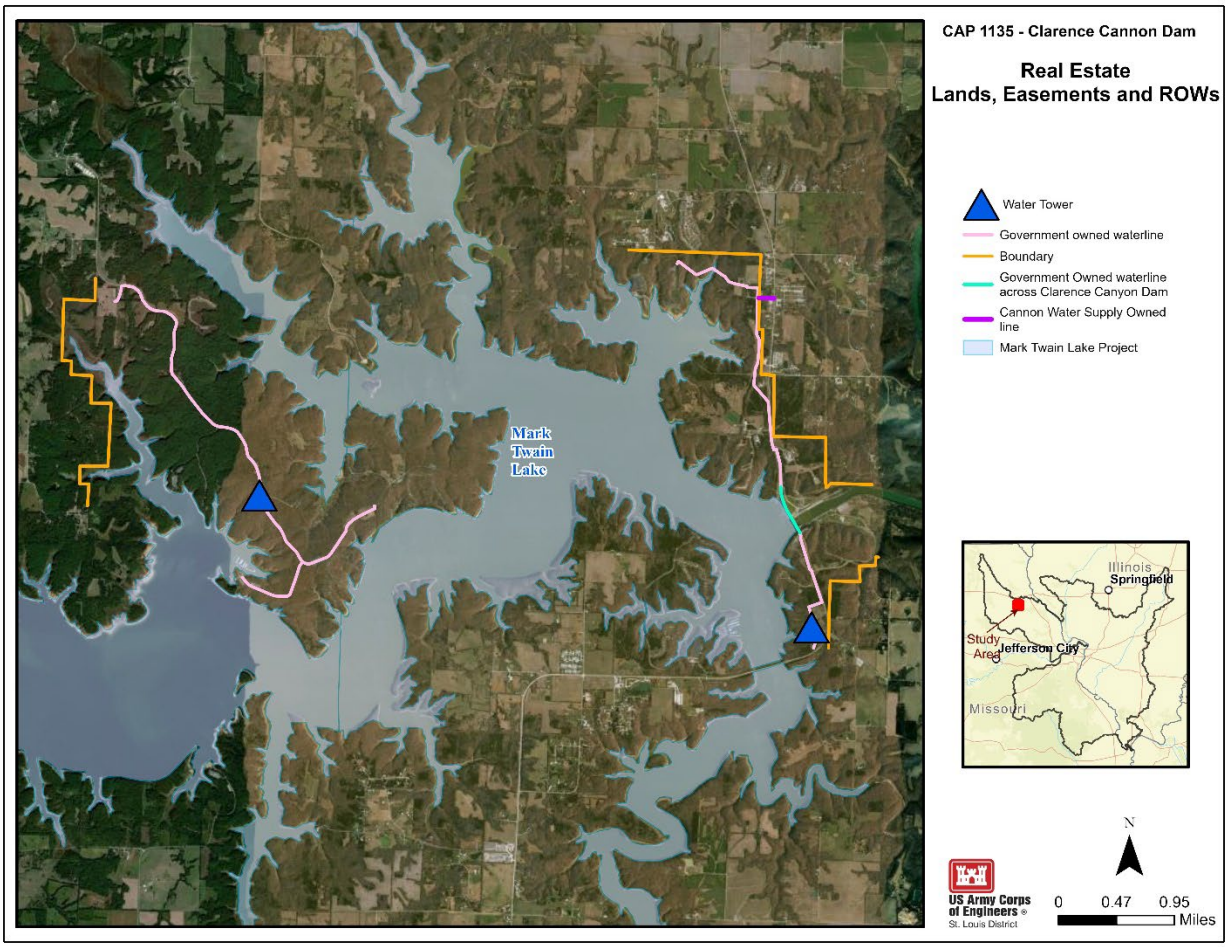


Figure 5

3. Sponsor-Owned LER

There is no sponsor owned LER in the project area.

4. Non-Standard Estates

No non-standard estates are required for implementation of this Project.

5. Existing Federal Projects

See section 1.6 subtitle “Prior Reports and Existing Projects in Vicinity” in the main report for information on the other projects in the area.

6. Federally Owned Lands

The Project features proposed are located on lands owned by the United States of America, and managed by USACE, as shown in Figure 1 and Figure 2 and detailed in Table 1: Tracts Managed by USACE.

Table 1: Tracts Managed by USACE

LAND PARCEL ID	USACE TRACT NO.	RPUID	Estate	Acreage
CC302-LP-5	100	844793	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	239+-
CC302-LP-9437	101	844800	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc. Easement of Northeast Missouri Electric Power Cooperative	112.08+-
CC302-LP-10	106	844815	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	267.33+-
CC302-LP-13	111	828700	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc. Easement to NE Mo. Electric Power Corporation.	227.70+-
CC302-LP-25	126	838263	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	5.40+-
CC302-LP-183	337	843489	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	160.00+-
CC302-LP-421	600	825911	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc. Easement granted Stanolin Easement to City of Monroe for gas and oil pipeline	86.87+-
CC302-LP-422	601	825912	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	8.85+-

LAND PARCEL ID	USACE TRACT NO.	RPUID	Estate	Acreage
CC302-LP-423	602	825913	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	21.93+-
CC302-LP-424	603	825914	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	7.85+-
CC302-LP-433	604	825915	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	20.08+-
CC302-LP-434	605	825916	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	110.33+-
CC302-LP-438	606	825917	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	3.62+-
CC302-LP-440	607	825918	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	8.24+-
CC302-LP-441	608	825919	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	10.83+-
CC302-LP-447	611	843707	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	111.20+-
CC302-LP-449	612	843708	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	39.74+-
CC302-LP-451	614	843709	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	1.71+-
CC302-LP-452	615	843710	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	35.77+-
CC302-LP-454	616	843711	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	12.44+-
CC302-LP-496	617	843712	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	46.30+-
CC302-LP-497	618	843713	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	114.34+-

LAND PARCEL ID	USACE TRACT NO.	RPUID	Estate	Acreage
CC302-LP-501	619	843714	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	94.50+-
CC302-LP-503	624	843716	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	1.25+-
CC302-LP-504	625	843717	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	.86+-
CC302-LP-505	626	843718	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	24.01+-
CC302-LP-508	628	843721	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	75.76+-
CC302-LP-509	629	843722	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	13.84+-
CC302-LP-512	631	843725	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	.66+-
CC302-LP-513	634	843726	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc. Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	33.29+-
CC302-LP-139688	636		Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	77.7+-
CC302-LP-515	638	843727	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	165.47+-
CC302-LP-523	645	843732	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	2.57+-

LAND PARCEL ID	USACE TRACT NO.	RPUID	Estate	Acreage
CC302-LP-526	647	844725	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	20.08+-
CC302-LP-527	648	844726	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	8.64+-
CC302-LP-528	649	844727	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	107.76+-
CC302-LP-531	654	844730	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	14.88+-
CC302-LP-532	655	844731	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	3.73+-
CC302-LP-533	656	844732	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	20.10+-
CC302-LP-534	657	844733	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	19.96+-
CC302-LP-535	658	844734	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	15.04+-
CC302-LP-537	660	844736	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	9.33+-
CC302-LP-563	664	844737	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	16.50+-
CC302-LP-538	665	844738	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	3.15+-
CC302-LP-565	666	844739	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	67.42+-
CC302-LP-539	668	839171	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	11.15+-
CC302-LP-540	670	839172	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	9.47+-

LAND PARCEL ID	USACE TRACT NO.	RPUID	Estate	Acreage
CC302-LP-443	609-1	825920	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	51.11+-
CC302-LP-444	609-2	825921	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	.55+-
CC302-LP-445	610-1	825922	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	47.05+-
CC302-LP-446	610-2	843706	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	58.17+-
CC302-LP-507	627-2	843720	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	12.66+-
CC302-LP-510	630-1	843723	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	154.38+-
CC302-LP-511	630-2	843724	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	.60+-
CC302-LP-517	639-1	843728	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	36.86+-
CC302-LP-519	639-2	843729	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	1.47+-
CC302-LP-521	640-1	843730	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	50.02+-
CC302-LP-522	640-2	843731	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	0.16+-
CC302-LP-524	646-1	843733	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	22.58+-
CC302-LP-525	646-2	844724	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	39.13+-
CC302-LP-529	650-1	844728	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	41.48+-

LAND PARCEL ID	USACE TRACT NO.	RPUID	Estate	Acreage
CC302-LP-530	650-2	844729	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	3.52+-
CC302-LP-536	658-2	844735	Fee Simple Estate - subject, however, to existing easements for public roads and highways, utilities: railroads and pipelines. Etc.	2.81+-

7. Navigation Servitude

This project and proposed features do not require the exercise of navigational servitude.

8. Mapping

Mapping of the site locations are shown in Figure 1, Figure 2, & Figure 3.

9. Induced Flooding

The potential for induced flooding from this project is negligible. A preliminary analysis shows that placement of rock would displace 35,236 cubic yards of water, leading to a rise of approximately 0.001173 feet, spread across the lake. A formal 'no-rise' analysis will be completed during the PED phase to certify this condition.

10. Baseline Cost Estimate

The total estimated cost during PED and Construction is $25,000. USACE St Louis District Real Estate involvement during the planning and design phase and construction phase.

Table 2

Clarence Cannon Dam at Mark Twain	**Estimate**
01: Lands and Damages	$0
Total L&D (FY30$)	$0
02: Relocations	$0
Total Relocations (FY30$)	$0
30/31: PED/Construction	FY30$
Federal Real Estate Oversight	$20,000
Estimated TC (FY30$)	
Contingency @25%	$5,000
Total (FY30$)	$25,000

11. Relocation Assistance Benefits

The tentatively selected plan does not require the project to provide temporary or permanent relocation benefits to residential, farm or business entities.

12. Mineral Activity

There are no known mineral rights or activities affecting the study area.

13. Sponsor Assessment

The NFS for this project is MDC. MDC will be responsible for 25% of the total design and implementation costs, while the federal share will be 75%.

14. Zoning

No known zoning ordinances are proposed.

15. Schedule of Land Acquisition Milestones

The lands, easements, or rights-of-way required for this project are already owned by the United States of America and managed by USACE, so there is no land acquisition required for this project.

16. Facility or Utility Relocations

There are no requirements for facility or utility relocations.

17. HTRW

Based on USACE historical and institutional knowledge of the study area and a preliminary review of available environmental data resources, the Project Delivery Team (PDT) did not identify any sites of concern regarding HTRW.

18. Landowner Attitude

This project will be constructed entirely on lands owned by the United States of America and managed by USACE. No acquisition of any privately-owned real property interests is required. Therefore, an analysis of landowner attitude is not applicable.

19. Notification to the Sponsor Regarding the Risks Associated with Land Acquisition Before Execution of the Project Partnership Agreement (PPA)

No land acquisition is required for this project; therefore, there are no associated risks to report to the NFS prior to PPA execution.

20. Other Relevant Real Estate Issues

No other known relevant real estate issues exist.

Prepared By:

Deion McCray
Realty Specialist
Planning & Acquisition Branch
Saint Louis District
Mississippi Valley Division
U.S. Army Corps of Engineers

Reviewed by:

Jennifer Wilson
Real Estate Contracting Officer
Chief, Real Estate Division
Saint Louis District
Mississippi Valley Division
U.S. Army Corps of Engineers

Continuing Authorities Program (CAP) 1135

Clarence Cannon Dam at Mark Twain Lake

Appendix M: Hydraulics and Hydrology

St. Louis District
Project Sponsor: Missouri Department of Conservation
March 2026

Table of Contents

1 Hydraulics, Hydrology, and Water Control 3
1.1 Hydropower 3
1.2 Flows and Pool Data 4
1.3 Navigation 6
1.4 Operations 6

List of Tables

Table 1 Inactive Storage Pool 4
Table 2 Conservation Pool 4
Table 3 Regulated Discharge 4
Table 4 Hydroelectric Power Pool 5
Table 5 Flood Control Pool (Lower Zone) 5
Table 6 Regulated Discharge 5
Table 7 Flood Control Pool (Upper Zone) 5
Table 8 Regulated Discharge 6

1 HYDRAULICS, HYDROLOGY, AND WATER CONTROL

Clarence Cannon Dam is located within the Salt River Basin. The project consists of a compacted earth embankment, grated concrete spillway, concrete hydroelectric power plant, and a temperature control weir. The 1,094-foot long, compacted earth embankment has a crest elevation of 653 feet NGVD29. The spillway is part of the concrete portion of the dam and is 230 feet long and begins 360 feet from the southern rim of the valley. The ogee spillway is topped by four 50-feet wide by 39-feet high Tainter gates separated by a 10-foot long stilling basin with two rows of baffle piers and an end sill. The stilling basin floor is at elevation 508 feet NGVD29.

The TCW is constructed of rolled earth and has a crest elevation of 580 feet NGVD29 and runs 780 feet long, 400 feet upstream of the centerline of the concrete portion of the dam and ties into the earthen embankment.

The power plant is part of the concrete portion of the dam and is located north of the spillway. It is 223 feet in length and contains a Kaplan 27,000 kW turbine generator and a Francis 31,000 kW pump turbine generator. The invert elevation of the intake structure is 520 feet NGVD29, and the outlet elevation is 483 feet NGVD29.

The re-regulation dam consists of compacted earth embankment, gated concrete spillway, sluice gate, and an operating house. The dam is 1515 feet long. The nature of hydroelectric power generation is such that the release rate from Cannon Dam will normally vary between 0 cfs and 12,000 cfs. These fluctuations can be dampened but not eliminated by the operation of the re-regulation dam, minimizing downstream bank erosion.

1.1 Hydropower

Hydropower is an authorized purpose of Mark Twain Lake and Clarence Cannon Dam and provides peaking power to the regional market of the Southwestern Power Administration (SWPA), the power marketing administration that delivers power from USACE hydropower plants to power cooperatives and municipalities within the southwestern region in Missouri, Arkansas, Kansas, Oklahoma, Louisiana, and Texas (MTL Master Plan, 2025). The Clarence Cannon Dam contains a hydroelectric power plant, approximately 223 feet in length, within the concrete portion of the dam located immediately north of the spillway. The hydroelectric power plant, which is powered by falling water, is capable of producing up to 58,000 kilowatts of power, or enough to supply a town of 20,000 people. The tremendous force of the water sets the turbine blades in motion which turns the shafts connecting each turbine to a generator. The power plant contains a Kaplan 27,000-Kilowatt (kW) turbine generator and a Francis 31,000-KW pump turbine generator. When both units are operating at capacity, as much as 5,400,000 gallons of water pass through the turbines each minute. The invert elevation of the intake structure is 520 feet NGVD. The invert elevation of the outlet structure is 483 feet NGVD. A re-regulation dam, located 9.5 miles downstream from the main dam, creates a storage pool that impounds water for storage and controlled releases, mitigating downstream fluctuations, thus helping improve water quality and assisting with wetland management.

An interagency effort established procedures which improved communication and coordination when the DO recedes to 5mg/L or below. This effort provides a framework and guide for interagency coordination and actions as conditions require by establishing procedures for improved communications and coordination between the cooperating agencies. The long-term operational objective is to maintain DO concentrations in the re-regulation pool at 5 mg/L or greater as much as possible. The objective aims to optimize DO

levels throughout the re-regulation pool through the use of operational actions listed below. The plan to accomplish this consists of an enhanced DO monitoring program as follows and operational response actions scaled to the severity of DO depletions in the lake water and the current hydropower requirements. Tainter gate releases and/or hydropower generation may be utilized in order to optimize the DO concentration at the downstream monitoring station. The implementation of the plan is the responsibility of the following agencies: USACE, MDC, MoDNR, and the SWPA. These agencies comprise the Mark Twain DO Working Group and meet weekly from May through September to discuss current and forecasted flow conditions, water management constraints, power needs, water quality, and operational constraints.

1.2 Flows and Pool Data

The Clarence Cannon Dam has an average daily flowrate of 1,570 cfs, a maximum flowrate of 104,500 cfs, and minimum flowrate of 50 cfs. A full table of flow and discharge regulations can be found in the Water Control Manual for Mark Twain Lake (2011).

Releases from the dam are dependent on a variety of factors, including but not limited to lake level and hydropower demands.

The impounded waters within Mark Twain Lake and the re-regulation pool are managed by the District Water Control section. When the lake level is between 590 feet and 606 feet, hydroelectric power generation is scheduled so as to meet the needs of SWPA in conjunction with other project purposes. The frequency of hydropower generation decreases as the lake drops below 606 feet to conserve water in the hydropower pool, defined in Table 14 below.

The following tables below show Mark Twain Lake's pool allocations and release limits within each pool.

Table 1 Inactive Storage Pool

Item	Initial Value	After 100-Year Sedimentation	Units
Elevation	520.0 – 567.2		Feet NGVD
Top Surface Area	5,900	4,400	Acres
Storage	87,000	44,300	Acre-Feet
Storage (runoff)	0.7	0.36	Inches

Table 2 Conservation Pool

Item	Initial Value	After 100-Year Sedimentation	Units
Elevation	567.0 – 606.0	-	Feet NGVD
Top Surface Area	18,600	17,400	Acres
Storage	457,000	399,500	Acre-Feet
Storage (runoff)	3.70	3.23	Inches

Table 3 Regulated Discharge

Item	Initial Value	Units
Dormant Season (Nov 1 – Mar 31)		
Maximum	12,000	CFS
Minimum	50	CFS

Item	Initial Value	Units
Maximum	10,000	CFS
Minimum	50	CFS

Table 4 Hydroelectric Power Pool

Item	Initial Value	Units
Elevation	590.0 – 606.0	Feet NGVD

Table 5 Flood Control Pool (Lower Zone)

Item	Initial Value	After 100-Year Sedimentation	Units
Elevation	606.0 – 624.8	-	Feet NGVD
Top Surface Area	28,600	28,500	Acres
Storage	442,000	426,200	Acre-Feet
Storage (runoff)	3.58	3.45	Inches

Table 6 Regulated Discharge

Item	Initial Value	Units
Maximum	12,000	CFS
Minimum	50	CFS

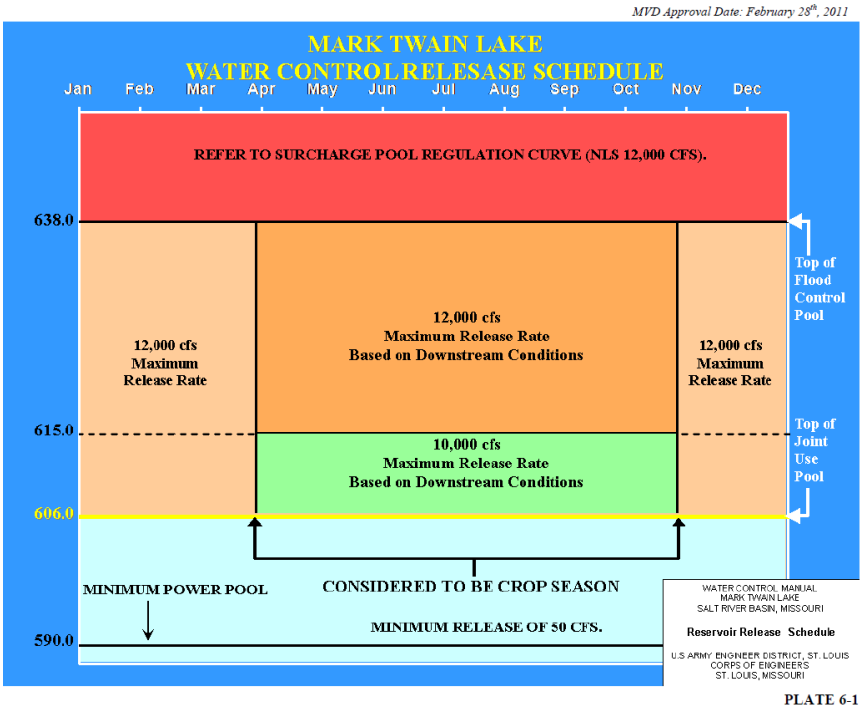


Figure 1 Reservoir Release Schedule (Source: Mark Twain Lake Water Control Manual)

Table 7 Flood Control Pool (Upper Zone)

Item	Initial Value	After 100-Year Sedimentation	Units
Elevation	624.8 – 638.0	-	Feet NGVD
Top Surface Area	38,600	-	Acres
Storage	442,000	-	Acre-Feet
Storage (runoff)	3.58	3.57	Inches

Table 8 Regulated Discharge

Item	Initial Value	After 100-Year Sedimentation	Units
Maximum	12,000	-	CFS
Minimum	50	-	CFS
Elevation	606.0 – 624.8	-	Feet NGVD
Top Surface Area	28,600	28,500	Acres
Storage	442,000	426,200	Acre-Feet
Maximum	12,000	-	CFS
Minimum	50	-	CFS

1.3 Navigation

The Clarence Cannon Dam and Mark Twain Lake navigation project purpose is achieved incidentally on the Mississippi River during low-flow periods by the release of water for non-consumptive water supply, water quality enhancement, improvement of downstream fisheries, and hydroelectric power generation.

1.4 Operations

Mark Twain Lake is regulated by the Water Control Section within the Hydrologic and Hydraulics Branch of the District.

Clarence Cannon Dam is the impoundment for Mark Twain Lake. There are two functions to release water downstream to the re-regulation pool: through the spillway structure, which consists of four Tainter gates, or through the intake gates by means of the hydropower units.

The re-regulation dam releases a minimum of 50 cfs at all times. During releases at Clarence Cannon Dam, the re-regulation pool fills and the two Tainter gates at the re-regulation dam operate to release flows from either generation or spillway operations.

Mark Twain Lake is operated utilizing a release schedule developed to provide flood control benefits and achieve other project objectives. All project objectives are benefited to some degree by regulating reservoir elevations using the guide curves. The preferred method of release is through the turbines first and Tainter gates second, if able to do so while maintaining state standards for water quality, protecting turbines from damage, ensuring personnel safety and/or avoiding other issues that may occur during an event. In coordination between the Environmental Quality Office and the Water Control Office, releases from Mark Twain Lake may be required to improve downstream water quality conditions in the re-regulation pool and lower Salt River. Release decisions are based on DO data collected in real-time within the re-regulation pool from the re-regulation pool stream gage. If DO concentrations drop below the 5 mg/l criteria based on 10 CSR 20-7.031, subsection (4) part (J) Dissolved Oxygen, the preferred method of release to increase DO concentrations into the re-regulation pool is discharging water through the Tainter gates solely or in combination with hydroelectric power generation units.

The two components of this project (Clarence Cannon Dam and re-regulation dam) are operated as one project. Releases depend on the pool elevation of Mark Twain Lake, inflow rate, downstream runoff, river stages on the Lower Salt River, tributaries of the Salt River and stages on the Mississippi River at Louisiana and/or St. Louis, MO. During the growing season, releases normally average 10,000 csf or less (based on downstream conditions) from Clarence Cannon Dam daily until an elevation of 615 feet is exceeded. The growing season is typically considered from April 1st to October 31st but may vary depending on seasonal conditions. The growing season is considered complete when a significant amount of crops have been harvested as determined by the Chief of Water Control Operations after consultation with local farming interests. Releases may be restricted because of flooding on the Lower Salt River or on the Mississippi River at Louisiana and/or St. Louis, MO. The nature of hydroelectric power generation is such that the release rate from Clarence Cannon Dam will normally vary between 0 to 12,000 cfs. These fluctuations can be dampened but not eliminated by operation of the Reregulation Dam. A freeboard of two feet is provided at the low embankment of the Reregulation Dam. Hydroelectric power generation releases from Clarence Cannon Dam are passed through the re-regulation dam in such a way as to minimize the potential for downstream bank caving. The re-regulation pool attenuates the rate of release from Cannon Dam so hydroelectric power is generated at a more efficient rate without exceeding the downstream channel capacity, and flow fluctuations can be reduced to a reasonable rate. The re-regulation dam gates control the rate at which water is released from the re-regulation pool.

The Clarence Cannon Dam Power Plant includes one 27,000 kW Kaplan conventional generator and one 31,000 kW Francis reversible motor/generator that has the capability to pump water from the re-regulation pool back into Mark Twain Lake. This capability has been tested in the past but is not currently utilized. The Clarence Cannon Dam Power Plant controls the rate at which water is released from Mark Twain Lake and generates electrical power. The need may exist to curtail hydroelectric power generation on an immediate basis for downstream conditions. The re-regulation pool provides a permanent afterbay pool for the pumpback capability. Typically, a pumpback operation would occur during low-flow periods, pumping water from the re-regulation pool back into Mark Twain Lake, during low electrical power demands, to be used for electrical power generation during peak electrical power demands. The re-regulation pool provides about 3,000 acre-feet of storage between 528 feet and 521 feet for pumping. That storage volume, if pumped back into Mark Twain Lake, can generate approximately 200,000 kWh of energy. The maximum net head against which the reversible unit can pump is 75 feet. Therefore, the lake level must be at or below 596 feet NGVD 29 to fully utilize the re-regulation pool storage. The minimum elevation at which hydroelectric power can be generated is 590 feet NGVD 29.

When within the joint-use pool, hydroelectric power generation will be scheduled to meet the needs of SWPA in conjunction with other project purposes. Normal lake drawdown within the joint-use pool as the result of hydroelectric power generation is limited to two feet per calendar week (i.e., Sunday through Saturday) or four feet per month (i.e., any consecutive four calendar week period) during May through October. During the remainder of the year, normal lake drawdown is limited to two feet per week with no monthly maximum. Care is taken to meet the hydroelectric power generation needs of SWPA, but final control rests with the Water Control Office. At times, the Water Control Office has given SWPA the option to generate power (a limited amount, approximately 200 to 500 dsf) in order to maintain the required minimum water level in the re-regulation pool. If SWPA does not choose this option, water is spilled. In either case, this water is not attributed to hydroelectric power generation as it pertains to lake drawdown limits. The portion of the maximum release that can be used

for power generation is passed through the turbines and the remainder is passed through the Tainter gates. The total release is limited as necessary to prevent adverse impact to both the Salt and the Mississippi Rivers downstream of the project.