USDA United States Department of Agriculture

Natural Resources Conservation Service

# SUPPLEMENTAL WATERSHED PLAN NO. I and Environmental Assessment for the Rehabilitation of Floodwater Retarding Structures No. 4 & 5 of the Kickapoo Creek Watershed Coke County, Texas



Prepared By:
U.S. Department of Agriculture - Natural Resources Conservation Service

In Cooperation With:
Coke County Soil and Water Conservation District
Coke County Kickapoo Water Control and Improvement District No. 1
City of Bronte
Coke County Commissioners Court

May 2024

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## Authority

The original watershed work plan was prepared, and works of improvement have been installed, under the authority of the Flood Control Act of 1944 (Public Law 78-534) as amended. The rehabilitation of Floodwater Retarding Structure (FRS) No. 4 and FRS No. 5 is authorized under Public Law 83-566 (as amended), and as further amended by Section 313 of Public Law 106-472

## Abstract

Kickapoo Creek Watershed FRS No. 4 and FRS No. 5 (downstream of FRS No. 4) were constructed as significant hazard potential dams in 1962 and 1963, respectively. Residential development has occurred downstream of the dams and an increase in traffic has occurred downstream of FRS No. 5. These factors have caused concerns regarding the hydraulic capacity of the dams and human health and safety. As a result, the dams have been reclassified as high hazard potential dams. They do not comply with current NRCS high hazard potential dam safety and performance criteria and have been prioritized for evaluation and rehabilitation. The proposed decommission of FRS No. 4 would alleviate the concerns regarding the dam embankment and would remove the risk of catastrophic breach and the SLO Sponsored rehabilitation of FRS No. 5 would allow the structure to comply with current TCEQ performance and safety standards and provide continued flood control benefits downstream of FRS No. 5. The proposed decommissioning of FRS No. 4 will include removing the storage function of the dam, in addition to providing flood warning systems at two downstream crossings and one road segment that would be impacted by the decommissioning. The proposed SLO Sponsored rehabilitation of FRS No. 5 to TCEQ standards will include re-grading the dam crest to raise the effective crest to 1916.19 feet (0.29 foot raise), which will be below the as-built top of dam elevation of 1916.79. The total project installation cost is estimated to be $2,159,000 of which $1,401,000 will be paid from the Small Watershed Rehabilitation funds and $758,000 from local funds. Note that because the improvements to FRS No. 5 would not be to NRCS standards, they are not eligible for cost share under the Small Watershed Rehabilitation Program.

## Comments and Inquiries

Comments and inquires must be received by June 05, 2024. Submit comments and inquiries to: Mark Northcut, Natural Resources Planning Manager, USDA/NRCS, 101 South Main, Temple, Texas 76501 (254-742-9824).

## Non-Discrimination Statement

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident. Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English. To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at How to File a Program Discrimination Complaint and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov. USDA is an equal opportunity provider, employer, and lender.

**KICKAPOO CREEK WATERSHED**
**SUPPLEMENTAL WATERSHED AGREEMENT NO. I**

between the

**Coke County Soil and Water Conservation District (SWCD)**
Sponsoring Local Organization

**Coke County Kickapoo Water Control and Improvement District No. 1 (WCID)**
Sponsoring Local Organization

**City of Bronte (City)**
Sponsoring Local Organization

**Coke County Commissioners Court (County)**
Sponsoring Local Organization

(Referred to herein as Sponsors)

and the

**UNITED STATES DEPARTMENT OF AGRICULTURE**
**NATURAL RESOURCES CONSERVATION SERVICE**
**Formerly the Soil Conservation Service (SCS)**

(Referred to herein as NRCS)

**Whereas**, the original Watershed Work Plan Agreement for Kickapoo Creek Watershed, State of Texas, executed by the Sponsors named therein and the NRCS, became effective on the 19th day of May 1960; and

**Whereas**, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the NRCS; and

**Whereas,** application has heretofore been made to the Secretary of Agriculture by the Sponsors for assistance in preparing a plan for works of improvement for Floodwater Retarding Structures (FRS) No. 4 and FRS No. 5 in the Kickapoo Creek Watershed, State of Texas, under the authority of the Watershed Protection and Flood Prevention Act, as amended (16 U.S.C. Sections 1001 to 1008, 1010, and 1012); and

**Whereas,** there has been developed through the cooperative efforts of the Sponsors and NRCS a Supplemental Watershed Work Plan No. I and Environmental Assessment for works of improvement for the rehabilitation of FRS No. 4 and FRS No. 5 of the Kickapoo Creek Watershed, State of Texas, hereinafter referred to as the Plan-EA or plan, which plan is annexed to and made a part of this agreement;

**Now**, therefore, in view of the foregoing considerations, the Secretary of Agriculture, through NRCS, and the Sponsors hereby agree on this watershed project plan and that the works of improvement for this project will be installed, operated, and maintained in accordance with the terms, conditions, and stipulations provided for in this plan and including the following:

1. **Term.** The term of this agreement is for the installation period and evaluated life of the project (103 years) and does not commit NRCS to assistance of any kind beyond the end of the evaluated life.

2. **Costs.** The costs shown in this plan are preliminary estimates. Final costs to be borne by the parties hereto will be the actual costs incurred in the installation of works of improvement.

3. **Real Property.** The Sponsors will acquire such real property as will be needed in connection with the works of improvement. The amounts and percentages of the real property acquisition costs to be borne by the Sponsors and NRCS are as shown in the Cost-share table in item 5 hereof.

   The Sponsors agree that all land acquired for measures, other than land treatment practices, with financial or credit assistance under this agreement will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency which will continue to maintain and operate the development in accordance with the Operation and Maintenance Agreement

4. **Uniform Relocation Assistance and Real Property Acquisition Policies Act.** The Sponsors hereby agree to comply with all of the policies and procedures of the Uniform Relocation Assistance and Real Property Acquisition Policies Act (42 U.S.C. Section 4601 et seq. as further implemented through regulations in 49 CFR Part 24 and 7 CFR Part 21) when acquiring real property interests for this federally assisted project. If the Sponsors are legally unable to comply with the real property acquisition requirements, it agrees that, before any Federal financial assistance is furnished, it will provide a statement to that effect, supported by an opinion of the chief legal officer of the state containing a full discussion of the facts and law involved. This statement may be accepted as constituting compliance.

5. **Cost-share for Watershed Work Plan.** The following table shows cost-share percentages and amounts for Watershed Work Plan implementation.

| **Cost-share Table for Rehabilitation Projects** | | | | | |
|---|---|---|---|---|---|
| | NRCS | | **Sponsors** | | **Total** |
| | Percent | Cost[1/] | Percent | Cost[1/] | Cost[1/] |
| **Works of Improvement Cost-Shareable Items** | | | | | |
| Decommission of FRS No. 4 | 65% | $807,000 | 35% | $434,000 | $1,241,000 |
| Mitigation | 65% | $234,000 | 35% | $126,000 | $360,000 |
| **Subtotal: Cost-Sharable Costs** | 65% | $1,041,000 | 35% | $560,000 | $1,601,000 |
| | | | | | |
| **Non-Cost-Sharable Items [2/]** | | | | | |

| Cost-share Table for Rehabilitation Projects | | | | | |
|---|---|---|---|---|---|
| Rehabilitation of FRS No. 5 to State Standards | | $0 | | $113,000 | $113,000 |
| NRCS Technical Assistance/Engineering for Decommission of FRS No. 4 | | $234,000 | | $0 | $234,000 |
| Engineering for SLO Sponsored Rehab of FRS No. 5 to State Standards | | $0 | | $21,000 | $21,000 |
| Project Administration 3/ | | $126,000 | | $11,000 | $137,000 |
| Land Rights | | $0 | | $30,000 | $30,000 |
| Federal, State, and Local Permits | | $0 | | $ 23,000 | $23,000 |
| **Subtotal: Non-Cost-Share Costs** | | $360,000 | | $198,000 | $558,000 |
| | | | | | |
| **Total:** | | $1,401,000 | | $758,000 | $2,159,000 |

1/ All costs rounded to nearest $1,000.
2/ If actual non-cost-sharable item expenditures vary from these figures, the responsible party will bear the change.
3/ The sponsors and NRCS will each bear the costs of project administration that each incurs. Sponsor costs for project administration include relocation assistance advisory service.

6. **Land Treatment Agreements.** The Sponsors will obtain agreements from owners of not less than 50 percent of the land above each multiple-purpose and floodwater-retarding structure. These agreements must provide that the owners will carry out farm or ranch conservation plans on their land. The Sponsors will ensure that 50 percent of the land upstream of any retention reservoir site is adequately protected before construction of the dam. The Sponsors will provide assistance to landowners and operators to ensure the installation of the land treatment measures shown in the watershed project plan. The Sponsors will encourage landowners and operators to continue to operate and maintain the land treatment measures after the long-term contracts expire, for the protection and improvement of the watershed.

7. **Floodplain Management.** Before construction of any project for flood prevention, the Sponsors must agree to participate in and comply with applicable Federal floodplain management and flood insurance programs. The Sponsors are required to have development controls in place below low and significant hazard potential dams prior to NRCS or the Sponsors entering into a construction contract.

8. **Water and Mineral Rights.** The Sponsors will acquire or provide assurance that landowners or resource users have acquired such water, mineral, or other natural resources rights pursuant to State law as may be needed in the installation and operation of the works of improvement. Any costs incurred must be borne by the Sponsors and these costs are not eligible as part of the Sponsors' cost-share.

9. **Permits.** The Sponsors will obtain and bear the cost for all necessary Federal, State, and local permits required by law, ordinance, or regulation for installation of the works of improvement. These costs are not eligible as part of the Sponsors' cost-share.

10. **NRCS Assistance.** This agreement is not a fund-obligating document. Financial and other assistance to be furnished by NRCS in carrying out the plan is contingent upon the fulfillment of applicable laws and regulations and the availability of appropriations for this purpose.

11. **Additional Agreements**. A separate agreement will be entered into between NRCS and the Sponsors before either party initiates work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

12. **Amendments.** This plan may be amended or revised only by mutual agreement of the parties hereto, except that NRCS may deauthorize or terminate funding at any time it determines that the Sponsors have failed to comply with the conditions of this agreement or when the program funding or authority expires. In this case, NRCS must promptly notify the Sponsors in writing of the determination and the reasons for the deauthorization of project funding, together with the effective date. Payments made to the Sponsors or recoveries by NRCS must be in accordance with the legal rights and liabilities of the parties when project funding has been deauthorized. An amendment to incorporate changes affecting a specific measure may be made by mutual agreement between NRCS and the Sponsors having specific responsibilities for the measure involved.

13. **Prohibitions.** No member of or delegate to Congress, or resident commissioner, may be admitted to any share or part of this plan, or to any benefit that may arise therefrom; but this provision may not be construed to extend to this agreement if made with a corporation for its general benefit.

14. **Operation and Maintenance (O&M).** The Sponsors will be responsible for the operation, maintenance, and any needed replacement of the works of improvement by actually performing the work or arranging for such work, in accordance with an O&M Agreement. An O&M agreement will be entered into before Federal funds are obligated and will continue for the project life (100 years). Although the Sponsors' responsibility to the Federal Government for O&M ends when the O&M agreement expires upon completion of the evaluated life of measures covered by the agreement, the Sponsors acknowledge that continued liabilities and responsibilities associated with works of improvement may exist beyond the evaluated life.

15. **Emergency Action Plan.** Prior to construction, the Sponsors must prepare an Emergency Action Plan (EAP) for each dam or similar structure where failure may cause loss of life or as required by state and local regulations. The EAP must meet the minimum content specified in the NRCS Title 180, National Operation and Maintenance Manual (NOMM), Part 500, Subpart F, Section 500.52, and meet applicable State agency dam safety requirements. The NRCS will determine that an EAP is prepared prior to the execution of fund obligating documents for construction of the structure. EAPs must be reviewed and updated by the Sponsors annually.

16. **Nondiscrimination Provisions**. In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at How to File a Program Discrimination Complaint and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

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By signing this agreement the recipient assures the Department of Agriculture that the program or activities provided for under this agreement will be conducted in compliance with all applicable Federal civil rights laws, rules, regulations, and policies.

17. **Certification Regarding Drug-Free Workplace Requirements** (7 CFR Part 3021). By signing this Watershed Agreement, the Sponsors are providing the certification set out below. If it is later determined that the Sponsors knowingly rendered a false certification, or otherwise violated the requirements of the Drug-Free Workplace Act, the NRCS, in addition to any other remedies available to the Federal Government, may take action authorized under the Drug-Free Workplace Act.

    *Controlled substance* means a controlled substance in Schedules I through V of the Controlled Substances Act (21 U.S.C. Section 812) and as further defined by regulation (21 CFR Sections 1308.11 through 1308.15);

    *Conviction* means a finding of guilt (including a plea of *nolo contendere*) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the Federal or State criminal drug statutes;

    *Criminal drug statute* means a Federal or non-Federal criminal statute involving the manufacturing, distribution, dispensing, use, or possession of any controlled substance;

    *Employee* means the employee of a grantee directly engaged in the performance of work under a grant, including: (i) all direct charge employees; (ii) all indirect charge employees unless their impact or involvement is insignificant to the performance of the grant; and, (iii) temporary personnel and consultants who are directly engaged in the performance of work under the grant and who are on the grantee's payroll. This definition does not include workers not on the payroll of the grantee (e.g., volunteers, even if used to meet a matching requirement; consultants or independent contractors not on the grantees' payroll; or employees of subrecipients or subcontractors in covered workplaces).

**Certification:**

A. The Sponsors certify that they will or will continue to provide a drug-free workplace by—

(1) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition.

(2) Establishing an ongoing drug-free awareness program to inform employees about—

(a) The danger of drug abuse in the workplace;
(b) The grantee's policy of maintaining a drug-free workplace;
(c) Any available drug counseling, rehabilitation, and employee assistance programs; and
(d) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace

(3) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (1).

(4) Notifying the employee in the statement required by paragraph (1) that, as a condition of employment under the grant, the employee must—

(a) Abide by the terms of the statement; and
(b) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction.

(5) Notifying the NRCS in writing, within 10 calendar days after receiving notice under paragraph (4)(b) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to every grant officer or other designee on whose grant activity the convicted employee was working, unless the Federal agency has designated a central point for the receipt of such notices. Notice must include the identification numbers of each affected grant.

(6) Taking one of the following actions, within 30 calendar days of receiving notice under paragraph (4) (b), with respect to any employee who is so convicted—

(a) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or
(b) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency.

(7) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (1), (2), (3), (4), (5), and (6).

B. The Sponsors may provide a list of the sites for the performance of work done in connection with a specific project or other agreement.

C. Agencies will keep the original of all disclosure reports in the official files of the agency.

18. **Certification Regarding Lobbying** (7 CFR Part 3018) (for projects > $100,000)

A. The Sponsors certify to the best of their knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the Sponsors, to any person for influencing or attempting to influence an officer or employee of an agency, Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned must complete and submit Standard Form LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The Sponsors must require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients must certify and disclose accordingly.

B. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by U.S. Code, Title 31, Section 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

19**. Certification Regarding Debarment, Suspension, and Other Responsibility Matters—Primary Covered Transactions (7 CFR Part 3017).**

A. The Sponsors certify to the best of their knowledge and belief, that they and their principals:

(1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

(2) Have not within a 3-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph A(2) of this certification; and

(4) Have not within a 3-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

B. Where the primary sponsors are unable to certify to any of the statements in this certification, such prospective participant must attach an explanation to this agreement.

20. **Clean Air and Water Certification.**

A. The project sponsoring organizations signatory to this agreement certify as follows:

(1) Any facility to be utilized in the performance of this proposed agreement is (____), is not (x) listed on the Environmental Protection Agency List of Violating Facilities.

(2) To promptly notify the NRCS-State administrative officer prior to the signing of this agreement by NRCS, of the receipt of any communication from the Director, Office of Federal Activities, U.S. Environmental Protection Agency, indicating that any facility which is proposed for use under this agreement is under consideration to be listed on the Environmental Protection Agency List of Violating Facilities.

(3) To include substantially this certification, including this subparagraph, in every nonexempt sub-agreement.

B. The project sponsoring organizations signatory to this agreement follows:

(1) To comply with all the requirements of section 114 of the Clean Air Act as amended (42 U.S.C. Section 7414) and section 308 of the Federal Water Pollution Control Act (33 U.S.C. Section 1318), respectively, relating to inspection, monitoring, entry, reports, and information, as well as other requirements specified in section 114 and section 308 of the Air Act and the Water Act, issued there under before the signing of this agreement by NRCS.

(2) That no portion of the work required by this agreement will be performed in facilities listed on the EPA List of Violating Facilities on the date when this agreement was signed by NRCS unless and until the EPA eliminates the name of such facility or facilities from such listing.

(3) To use their best efforts to comply with clean air standards and clean water standards at the facilities in which the agreement is being performed.

(4) To insert the substance of the provisions of this clause in any nonexempt subagreement.

C. The terms used in this clause have the following meanings:

(1) The term “Air Act” means the Clean Air Act, as amended (42 U.S.C. Section 7401 et seq.).

(2) The term "Water Act" means Federal Water Pollution Control Act, as amended (33 U.S.C. Section 1251 et seq.).

(3) The term "clean air standards" means any enforceable rules, regulations, guidelines, standards, limitations, orders, controls, prohibitions, or other requirements which are contained in, issued under, or otherwise adopted pursuant to the Air Act or Executive Order 11738, an applicable implementation plan as described in section 110 of the Air Act (42 U.S.C. Section 7414) or an approved implementation procedure under section 112 of the Air Act (42 U.S.C. Section 7412).

(4) The term "clean water standards" means any enforceable limitation, control, condition, prohibition, standards, or other requirement which is promulgated pursuant to the Water Act or contained in a permit issued to a discharger by the Environmental Protection Agency or by a State under an approved program, as authorized by section 402 of the Water Act (33 U.S.C. Section 1342), or by a local government to assure compliance with pretreatment regulations as required by section 307 of the Water Act (33 U.S.C. Section 1317).

(5) The term "facility" means any building, plant, installation, structure, mine, vessel, or other floating craft, location or site of operations, owned, leased, or supervised by a sponsor, to be utilized in the performance of an agreement or subagreement. Where a location or site of operations contains or includes more than one building, plant, installation, or structure, the entire location will be deemed to be a facility except where the Director, Office of Federal Activities, Environmental Protection Agency, determines that independent facilities are collocated in one geographical area.

**21. Assurances and Compliance.** As a condition of the grant or cooperative agreement, the Sponsors assure and certifies that they are in compliance with and will comply in the course of the agreement with all applicable laws, regulations, Executive orders and other generally applicable requirements, including those set out below which are hereby incorporated in this agreement by reference, and such other statutory provisions as a specifically set forth herein.

State, Local, and Indian Tribal Governments: OMB Circular Nos. A-87, A-102, A-129, and A-133; and 7 CFR Parts 3015, 3016, 3017, 3018, 3021, and 3052.

Nonprofit Organizations, Hospitals, Institutions of Higher Learning: OMB Circular Nos. A-110, A-122, A-129, and A-133; and 7 CFR Parts 3015, 3017, 3018, 3019, 3021 and 3052.

**22. Examination of Records.** The Sponsors must give the NRCS or the Comptroller General, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to this agreement, and retain all records related to this agreement for a period of three years after completion of the terms of this agreement in accordance with the applicable OMB Circular.

**23. Signatures.** The signing of this Public Law 83-566 Watershed Agreement by an authorized representative of the Sponsors indicates that the Sponsors have reviewed this Agreement and the Kickapoo Creek Watershed Supplemental Watershed Work Plan No. I-Environmental Assessment and concur with the intent and contents of each.

**Coke County Soil and Water Conservation District**
Local Organization
P.O. Box 50
Robert Lee, TX 76945-005

By _____
Mike Arrott

Title Chairman

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Coke County Soil and Water Conservation District adopted at a meeting held on _____.

_____
Shane Webb, Secretary, Coke County Soil and Water Conservation District

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**Coke County Kickapoo Water Control and Improvement District No. 1**
Local Organization
P.O. Box 0677
Bronte, TX 76933

By _____
Mark Duncan

Title President

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Coke County Kickapoo Water Control and Improvement District No. 1 adopted at a meeting held on _____.

_____
Secretary, Coke County Kickapoo Water Control and Improvement District No. 1

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**City of Bronte**
Local Organization
P O Box 370
Bronte, TX 76933

By _____
Paul Gohman

Title Mayor

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the City of Bronte adopted at a meeting held on _____.

_____
Teresa Ballard, Secretary, City of Bronte

---

**Coke County Commissioners Court**
Local Organization
13 E 7th
Robert Lee, TX 76945

By _____
Hal Spain, Coke County Judge

Title _____

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the Coke County Commissioners Court adopted at a meeting held on _____.

_____
Monica Reyes, County Clerk, Coke County

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**Natural Resources Conservation Service**
**United States Department of Agriculture**

Approved By _____
Kristy Oates, State Conservationist

Date _____

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# SUMMARY– OFFICE OF MANAGEMENT AND BUDGET (OMB) FACT SHEET

**DRAFT SUPPLEMENTAL WATERSHED PLAN NO. I – ENVIRONMENTAL ASSESSMENT**
**for the**
**Rehabilitation of Floodwater Retarding Structures No. 4 & 5**
**of the**
**Kickapoo Creek Watershed**
**Coke County, Texas**
**11th Congressional District**

## S.1 Authority

The original watershed work plan was prepared, and works of improvement have been installed, under the authority of the Flood Control Act of 1944 (Public Law 78-534) as amended. The rehabilitation of Floodwater Retarding Structure (FRS) No. 4 and FRS No. 5 is authorized under Public Law 83-566 (as amended), and as further amended by Section 313 of Public Law 106-472.

## S.2 Sponsors

The project sponsors are the Coke County Soil and Water Conservation District, Coke County Kickapoo Water Control and Improvement District No. 1, the City of Bronte, and the Coke County Commissioners Court.

## S.3 Proposed Action

The proposed action is the decommission of FRS No. 4 and the SLO Sponsored rehabilitation of FRS No. 5 to meet current TCEQ standards for an intermediate size high hazard potential dam.

## S.4 Purpose and Need for Action

The original purpose of the Kickapoo Creek Watershed Plan was watershed protection and flood prevention. The authorized purpose of these dams is flood prevention, and the purpose of this action is to address potential safety concerns associated with FRS No. 4 and FRS No. 5 and to continue to provide downstream flood prevention (flood damage reduction). Due to downstream development, both dams have been reclassified as high hazard potential dams, yet they do not meet the current NRCS safety and design criteria and performance standards for the high hazard potential classification. Both dams meet TCEQ hydrologic criteria for intermediate size high hazard dams, but FRS No. 4 would experience integrity issues in the TCEQ design storm. In addition, FRS No. 4 is listed as being in unsatisfactory condition (A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution). While there is a need for action to reduce safety risks to meet current safety standards, there is also a need for continued flood protection in the Kickapoo Creek Watershed from these dams.

The Federal Objective "specifies that federal water resource investments shall reflect national priorities, encourage economic development, and protect the environment;" the Guiding Principles are Healthy and Resilient Ecosystems, Sustainable Economic Development, Floodplains, Public Safety, Environmental Justice, and Watershed Approach (USDA 2017).
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## S.5 Description of Preferred Alternative

The recommended plan will be a decommission FRS No. 4 (upstream) and a SLO Sponsored rehabilitation of FRS No. 5 (downstream) to meet current state standards for an intermediate size high hazard potential dam.

Measures for the decommission of FRS No. 4 include:

- Excavating a breach in the dam of sufficient size to safely pass the 1% AEP flood;
- Placing the excavated material in the easement area;
- Removal of the principal spillway components;
- Vegetating all exposed areas; and
- Reconnecting the stream channel through the sediment pool;
- Establishing riparian vegetation along the stream channel; and
- Installing a grade stabilization structure
- Installing flood warning systems with barricades and warning lights on portions of McDonald Road, Nipple Peak Road, and NW Railroad Road.

After the implementation of these planned works, the "unsatisfactory condition" listing of FRS No. 4 will no longer be applicable, and the liability associated with the potential failure of FRS No. 4 will be eliminated for the Sponsors.

Measures for the SLO Sponsored rehabilitation of FRS No. 5 to TCEQ standards include:

- Re-grading the dam crest to raise the effective crest to elevation 1916.19, a 0.29 foot raise.

## S.6 Resource Information

Kickapoo Creek Watershed FRS No. 4 and FRS No. 5 are located in Coke County, Texas on Middle Kickapoo Creek, a tributary of Kickapoo Creek, and a tributary to the Colorado River, and are located approximately 8 and 5 miles north, respectively, of Bronte, Texas.

FRS No. 4 was constructed in 1962 to provide flood damage reduction. The embankment is single zone, compacted earthfill dam. A 12-foot-wide core trench with 1:1 side slopes was constructed at the centerline of the dam. The dam was designed to be approximately 28 feet tall and 2,200 feet long. The upstream and downstream slopes of the embankment have a design slope of approximately 2.5H:1V (horizontal:vertical). The design top width of the structure is approximately 14 feet. The land upstream of FRS No. 4 is predominantly private ownership.

Significant cracking and open holes have been observed along the top of the dam embankment. The cracking/holes are concentrated within approximately the middle 2/3 of the embankment alignment, extending both left and right of the PSW conduit by several hundred feet. Approximately 80 individual holes were observed during AECOM's site visit on October 16, 2020. The holes range from about 2 inches in diameter to 3 feet wide at the ground surface, with measured depths ranging from approximately 3 feet to 10 feet deep. No transverse cracking has been observed to date, and no lateral cracking that would outlet to either slope has been observed. A deficiency report prepared in 1967 (USDA-SCS, 1967a) indicates the first crack was noticed in 1965, and subsequent inspections noted the crack was becoming more extensive with crack depths up to about 20 feet below surface. Survey measurements taken in 1966 indicated the centerline of the embankment in the area of cracking had settled about 0.8 feet. The 1967 report suggested the most plausible source of embankment cracking was differential settlement at the interface between the upstream shell and central core zones of the embankment due to hydro-collapsible foundations soils. Specifically, the 1967 report postulated that the sandy foundation materials under the upstream shell experienced collapse settlement after wetting due to initial reservoir filling, whereas the central zone experienced little settlement due to the excavation of the core through most of the upper collapsible soils, thereby producing cracking through the brittle embankment material in response to the differential settlement. A subsequent embankment repair report (USDA-SCS, 1967b) documented filling of the cracks that took place October 30 through November 3, 1967. According to the report, the cracks were filled to within 1.5 to 2 feet of the embankment crest using a slurry of soil and water mixed at the surface and poured into the crack, and the upper 2 feet was filled with soil and compacted by passes of a tractor wheel and/or dual wheel truck. However, recurrence of cracking has occurred in the years since the original 1967 repair. A 2014 field investigation report (NRCS, 2014) suggested that the cracking and development of holes along the crack line may have been caused by wet/dry cycles that allow intermittent settlement within the underlying collapsible/compressible soils that act as the foundation for the embankment. The 2014 report also indicates that it is suspected longitudinal cracking has not occurred on the downstream portion of the embankment as a result of the core trench. Supplemental investigation of cracking and potential sources of cracking was performed in a joint study by NRCS and Angelo State University in 2017, which reached similar conclusions as the prior work (i.e., settlement within collapsible foundation soils are responsible for cracking). A field investigation was performed in 2021 and generally confirmed the previous findings.

FRS No. 5 was constructed in 1963 to provide flood damage reduction. The embankment is a zoned, compacted earthfill dam. A 12-foot-wide core trench with 1H:1V side slopes was constructed at the centerline of the dam. The dam is approximately 32 feet tall and 8,096 feet long. The upstream and downstream slopes of the embankment have a slope of approximately 2.5H:1V, with a 12-foot-wide berm on the upstream slope and a 17-foot wide berm on the downstream slope. The top width of the structure is approximately 16 feet. The land upstream of FRS No. 5 is predominantly private ownership.

Climate:

- Temperature: The average coolest month is January with temperatures ranging from 29 degrees Fahrenheit (ºF) to 59ºF. The average warmest month is August with temperatures ranging from 70ºF to 97°F.

- Precipitation: Total annual precipitation is approximately 22.8 inches. The wettest month of the year is June, averaging 3.11 inches. The driest month of the year is January, averaging 0.88 inch.
- Topography: The area of interest is located in northeastern Coke County, Texas, within the Blackwell and Bronte Quadrangles from the United States Geological Survey (USGS) 7.5-minute topographic map series. The elevations in the Quadrangles range from approximately 1,705 to 2,243 feet above mean sea level and topography through the area ranges from nearly level to strongly sloping.

**Table S-1** lists the resource information for FRS No. 4 and FRS No. 5 and the land use upstream from FRS No. 4 and FRS No. 5.

**Table S-1. Resource Information**

| **Resource** | | **Description** | |
|---|---|---|---|
| | | **FRS No. 4** | **FRS No. 5** |
| Latitude / Longitude | | 32.0030° / -100.2964° | 31.9590° / -100.2984° |
| Hydrologic Unit Code | | 12080008 | |
| Hydrologic Unit Code Name | | Upper Colorado River Watershed | |
| Watershed Size (square miles) | | 3.95 | 8.68 |
| Land Use (acres) | Open Water | 0.2 | 24.9 |
| | Developed, Open Space | 20.0 | 110.5 |
| | Developed, Low Intensity | 0.7 | 4.7 |
| | Developed, Medium Intensity | -- | 0.7 |
| | Developed, High Intensity | -- | 0.2 |
| | Deciduous Forest | 242.5 | 319.7 |
| | Evergreen Forest | 179.2 | 151.2 |
| | Mixed Forest | 5.3 | 6.4 |
| | Shrub/Scrub | 1977.1 | 4754.8 |
| | Grassland/Herbaceous | 2.4 | 2.2 |
| | Cultivated Crops | 95.1 | 175.4 |
| | **Total** | **2525.5** | **5550.7** |

## S.7 Population and Demographics

**Table S-2** provides population and demographics characteristics of Census Tract 9501 Block Group 1, Census Tract 9501 Block Group 2, Coke County, and Texas.

**Table S-2. Population and Demographics Characteristics**

| **Characteristic** | **Census Tract 9501 Block Group 1** | **Census Tract 9501 Block Group 2** | **Coke County** | **Texas** |
|---|---|---|---|---|
| Population | 534 | 1,050 | 3,298 | 28,635,442 |
| Median Age | 63.6 | 34.1 | 47.9 | 34.8 |

| Characteristic | Census Tract 9501 Block Group 1 | Census Tract 9501 Block Group 2 | Coke County | Texas |
|---|---|---|---|---|
| Median Household Income | $42,045 | $50,795 | $45,072 | $63,826 |
| Poverty Rate (all people) | 7.9% | 7.2% | 12.5% | 14.2% |
| Unemployment Rate | 3.1% | 0.0% | 2.3% | 5.3% |

Source: 2016-2020 American Community Survey 5-Year Estimates

## S.8 Scoping Concerns

Resource concerns identified through scoping are summarized in **Table S-3**.

**Table S-3. Resource Concerns Identified Through Scoping**

| ITEM/CONCERN | RATIONALE |
|---|---|
| **SOILS** | |
| Prime and Unique Farmland | There are areas of Prime Farmland downstream of both FRSs that are potentially at risk of flooding from Middle Kickapoo Creek should the FRSs be removed. There are also areas of Prime Farmland within and immediately adjacent to the floodpool for FRS No. 4 that could be impacted by modifications to the FRS. Potential impacts to these areas resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |
| Erosion and Sediment | The impact of sediment accumulation in FRS No. 4 and FRS No. 5 is relevant to the existing and future service life of the FRSs. In addition, downstream erosion and sedimentation could be impacted by modifications to the FRSs. Potential erosion and sedimentation impacts resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |
| **WATER** | |
| Floodplain Management | FRS No. 4 and FRS No. 5 are located in areas that are not covered by mapped regulatory floodplains. Bronte, TX, located downstream of FRS No. 5, does have a mapped regulatory floodplain. Modifications to FRS No. 4 and FRS No. 5 could impact the effective floodplain and the regulatory floodplain (where mapped) and these impacts will be considered. |
| Streams, Lakes, and Wetlands/Waters of the U.S. | Middle Kickapoo Creek, an ephemeral tributary to Kickapoo Creek, flows through FRS No. 4 and FRS No. 5. Wetland areas have been identified within the reservoir area and downstream of FRS No. 5. Potential impacts to the wetland plant communities and functional values resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |
| Water Quality | Construction activities and the resulting modifications could have impacts to downstream water quality. Potential impacts to water quality resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |

| ITEM/CONCERN | RATIONALE |
|---|---|
| **PLANTS** | |
| Threatened and Endangered Species | Federally and/or state-listed threatened or endangered plant species have the potential to occur within the project area, so this item is considered to be relevant to the proposed action. |
| Woodland Vegetation/Forest Resources | Woodland vegetation is present in the project area. Potential impacts resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |
| Invasive Species | Invasive plant species have the potential to occur within the project area and could be transported into or out of the project area or could be spread within the project area by construction activities. Potential impacts resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |
| Riparian Areas | Riparian areas were identified along Middle Kickapoo Creek at FRS No. 5. Potential impacts to riparian areas resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |
| **ANIMALS** | |
| Threatened and Endangered Species | Federally-listed threatened or endangered species have the potential to occur within the project area.<br>State-listed threatened or endangered species have the potential to occur within the project area.<br>Potential impacts resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |
| Fish and Wildlife | It is unlikely that FRS No. 4 provides habitat for fish as the dam does not impound water consistently throughout the year, but it does provide habitat for other wildlife. FRS No. 5 could potentially provide habitat for fish and provides habitat for other wildlife. Potential impacts to fish and wildlife resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |
| Migratory Birds/Bald and Golden Eagles | Migratory bird pathways, stopover habitats, wintering areas, and breeding areas occur within and/or adjacent to the project area and may be associated with wetlands, ponds, riparian corridors, fallow fields, grasslands, and woodlands.<br>Bald Eagles/Golden Eagles were not observed in the project area during a site visit. However, Bald Eagles occur throughout the state and therefore have the potential to utilize the site for hunting and/or stopover.<br>Potential impacts to Migratory Birds/Bald and Golden Eagles resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |

| ITEM/CONCERN | RATIONALE |
|---|---|
| **HUMANS** | |
| Costs/Public Benefits | Per PR&G, Public Benefits relative to costs will be considered in the evaluation of potential modifications to FRS No. 4 and FRS No. 5. |
| Cultural Resources | Cultural resources have the potential to occur within the area of potential effect (APE) for the dams and could be impacted by modifications to them. Consultation with the Texas State Historic Preservation Office (SHPO) and relevant Tribes has been completed, see **Appendix A**. As a result of consultation and historic and prehistoric identification studies, NRCS has determined there will be no effect to historic properties as planned. |
| Environmental Justice and Civil Rights | After comparing U.S. Census and EJScreen data to that of Coke County and the State of Texas as a whole, there is the potential for impacts to high minority populations and EJ concerns should be a consideration when evaluating the proposed action. |
| Land Use | There is a residence located adjacent to the floodpool for FRS No. 4 and access to the residence is through the auxiliary spillway of FRS No. 4. Potential impacts to the residence, access to the residence, and private property could result from modifications to FRS No. 4. Potential impacts to land use adjacent to and downstream of FRS No. 4 and FRS No. 5 resulting from modifications to the structures will be considered. |
| Public Health and Safety | FRS No. 4 and FRS No. 5 are classified as high hazard potential dams and in their existing condition are a risk to the public. Potential impacts to Public Health and Safety resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |
| Community Cohesion | Potential impacts to community cohesion could result from modifications to FRS No. 4 and FRS No. 5 and will be considered. |

## S.9 Alternative Plans Considered

As FRS No. 4 and FRS No. 5 are located in-series along Middle Kickapoo Creek (FRS No. 4 is upstream of FRS No. 5), proposed modifications to one structure had to be considered in the context of the proposed modifications to the other structure. Each "alternative" described below refers to a combination of a "choice" of a modification type for each FRS No. 4 and FRS No. 5

**Alternatives Considered but Eliminated from Detailed Study**

Some of the alternatives considered in the planning process were eliminated from detailed consideration because these alternatives were found to be unreasonable due to cost or because they were considered logistically impractical to implement. The alternatives below were considered, but eliminated from detailed study:

Alternative 1: Federal Decommission of FRS No. 4 and Federal Decommission of FRS No. 5.
This alternative meets the Purpose and Need of the Project but is not considered reasonable due to the high cost of implementation, potential disruption of community cohesion due to major roadway modifications and 4 home acquisitions, and potential logistics issues associated with significant road raises. Preliminary cost estimates indicate that the cost of this alternative would

be approximately $20,000,000, with a large portion of that cost being roadway improvements to prevent induced (increased) flooding on US 277 and NW Railroad Rd from the decommissioning of FRS No. 5. The length and height of the road raises required could cause logistical challenges. This alternative is also expected to cause a potential disruption to community cohesion as a result of road raises and habitable structure buyouts, and a risk to loss of life would remain with this alternative as the roadway modifications would only prevent an increase in flooding over the 1% AEP existing condition. This alternative was therefore eliminated from further evaluation.

Alternative 2: Federal Decommission of FRS No. 4 and Significant Hazard Potential Rehabilitation of FRS No. 5 with Nonstructural Measures.

This alternative meets the Purpose and Need of the Project but is not considered reasonable due to the high cost of implementation, the potential disruption of community cohesion due to the 9 home acquisitions and the significant roadway modifications downstream of FRS No. 5, and potential logistics issues associated with significant road raises that would be required to reduce the potential for loss of life in the event of catastrophic breach of FRS No. 5. Preliminary cost estimates indicate that the cost of this alternative would be approximately $34,000,000, with a large portion of that being roadway modifications downstream of FRS No. 5 that would be required to allow FRS No. 5 to be reclassified to significant hazard potential. It is also expected that the logistics of the significant modifications to the 5 road crossings and 2 road segments that would be required for this alternative would result in the alternative being unreasonable. These measures would be required for the dam to be reclassified as a Significant Hazard Potential Dam. This alternative was therefore eliminated from further evaluation.

Alternative 4: Significant Hazard Potential Rehabilitation of FRS No. 4 with Nonstructural Measures and Federal Decommission of FRS No. 5.

This alternative meets the Purpose and Need of the Project but is not considered reasonable due to the high cost of implementation, the potential disruption of community cohesion due to the 13 home acquisitions and the significant roadway modifications downstream of FRS No. 4, and potential logistics issues associated with significant road raises that would be required to allow FRS No. 4 to be reclassified to significant hazard potential. Preliminary cost estimates indicate that the cost of this alternative would be approximately $55,200,000, with a large portion of that being roadway modifications downstream of FRS No. 4 that would be required to allow FRS No. 4 to be reclassified to significant hazard potential. It is also expected that the logistics of the significant modifications to the 7 road crossings and 3 road segments that would be required for this alternative would result in the alternative being unreasonable. These measures would be required for the dam to be reclassified as a significant hazard potential dam. This alternative was therefore eliminated from further evaluation.

Alternative 5: Significant Hazard Potential Rehabilitation of FRS No. 4 with Nonstructural Measures and Significant Hazard Potential Rehabilitation of FRS No. 5 with Nonstructural Measures.

This alternative meets the purpose and need of the Project but is not considered reasonable due to the high cost of implementation, the potential disruption of community cohesion due to the 13 home acquisitions and the significant roadway modifications downstream of FRS No. 4, and potential logistics issues associated with significant road raises that would be required to allow FRS No. 4 and FRS No. 5 to be reclassified to significant hazard potential dams. Preliminary

cost estimates indicate that the cost of this alternative would be approximately $56,100,000, with a large portion of that being roadway modifications downstream of FRS No. 4 and FRS No. 5 that would be required to allow the dams to be reclassified to significant hazard potential. It is also expected that the logistics of the significant modifications to the 7 road crossings and 3 road segments that would be required for this alternative would result in the alternative being unreasonable. These measures would be required for the dams to be reclassified as significant hazard potential dams. This alternative was therefore eliminated from further evaluation.

Alternative 6: Significant Hazard Potential Rehabilitation of FRS No. 4 with Nonstructural Measures and High Hazard Potential Rehabilitation of FRS No. 5.

Per TR-210-60 (USDA NRCS, 2019): The hydrologic criteria and procedures for the design of an upper dam in a system of dams in series must be the same as, or more conservative than, those for dams downstream if failure of the upper dam could contribute to failure of the lower dam. Therefore, this alternative was eliminated for detailed study.

Alternative 7: High Hazard Potential Rehabilitation of FRS No. 4 and Federal Decommission of FRS No. 5.

While the High Hazard Potential Rehabilitation of FRS No. 4 is considered a viable alternative, the high cost of implementation, the potential for disruption of community cohesion, and the logistics associated with the significant road raises required to not cause induced (increased) flooding from the decommission of FRS No. 5 make this Alternative unreasonable. Preliminary cost estimates indicate that the cost of this alternative would be approximately $33,200,000, with a large portion of that cost being roadway improvements to prevent induced (increased) flooding on US 277 and NW Railroad Rd from the decommissioning of FRS No. 5. It is expected that the logistics of the significant modifications to the road crossings and road segments that would be required for this alternative would result in the alternative being unreasonable. This alternative is also expected to cause a potential disruption to community cohesion as a result of road raises and habitable structure buyouts, and a risk to loss of life would remain with this alternative as the roadway modifications would only prevent an increase in flooding over the 1% AEP existing condition. This alternative was therefore eliminated from further evaluation.

Alternative 8: High Hazard Potential Rehabilitation of FRS No. 4 and Significant Hazard Potential Rehabilitation of FRS No. 5 with Nonstructural Measures.

This alternative meets the purpose and need of the Project but is not considered reasonable due to the high cost of implementation, the potential disruption of community cohesion due to the 9 home acquisitions, the significant roadway modifications downstream of FRS No. 5, and potential logistics issues associated with significant road raises that would be required to allow FRS No. 5 to be reclassified to significant hazard potential dam. Preliminary cost estimates indicate that the cost of this alternative would be approximately $54,800,000, with a large portion of that being roadway modifications downstream of FRS No. 5 that would be required to allow FRS No. 5 to be reclassified to significant hazard potential. It is also expected that the logistics of the significant modifications to the 5 road crossings and 2 road segments that would be required for this alternative would result in the alternative being unreasonable. These measures would be required for the dam to be reclassified as a significant hazard potential dam. This alternative was therefore eliminated from further evaluation.

Alternative 11: SLO Sponsored Decommission of FRS No. 4 and SLO Sponsored Rehab of FRS No. 5 to TCEQ Standards

This alternative meets the purpose and need of the Project but is not considered reasonable due to the lack of state-level funding sources available to the Sponsors for funding the project. The SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ standards would be eligible for funding through the State of Texas, as the dam has exceeded its service life, but the SLO Sponsored Decommissioning of FRS No. 4 would not be eligible for state-level funding. An alternative considering the Federal Decommissioning of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ standards would have the similar impacts and benefits, but would be eligible for State funding, as the State could provide funding to support a federal project, even if it includes decommissioning of a dam, so such an alternative has been included as Alternative 10 and this alternative has been eliminated from Detailed Study.

**No Action Alternative**

The No Action alternative documents baseline conditions against which all other alternatives are analyzed. It does not involve federal action or federal investment and assumes that the existing dams would remain in place without any action that would improve the dams from their original designs or correct safety deficiencies beyond maintenance or replacements performed in accordance with the operations and maintenance plans for the dams. It is assumed that the dams will fail in the future and not be subsequently rebuilt or rehabilitated.

No Action Alternative for FRS No. 4

The most likely failure modes for FRS No. 4 are hydrologic failure (overtopping) and spillway integrity failure (breach of the auxiliary spillway). The probability of failure of these events was estimated by reducing the Probable Maximum Precipitation (PMP) values until they were at the minimum values that would cause each type of failure. Frequency rainfall events were plotted and a power function trendline equation was used to estimate the return interval for the rainfall events that would result in each failure type. Hydrologic failure is estimated to occur as a result of the 94% PMP event, which is estimated to have a return interval of 25,295-years. Integrity failure is estimated to occur as a result of the 52% PMP event, which is estimated to have a return interval of 2,136-years.

Catastrophic failure of the dam could result in damages to four residences, two downstream road crossings and multiple road segments, other infrastructure, and small areas of agricultural lands. Both catastrophic failures scenarios would pose a significant risk of loss of life.

Following catastrophic failure of the dam, downstream flooding conditions would be similar to those that existed prior to the construction of the dam. Existing and proposed floodplains were mapped approximately 14,800 feet downstream of FRS No. 4, ending upstream of the normal pool of FRS No. 5. The 1% AEP floodplain downstream would be enlarged. Since the 1% AEP floodplain downstream would be enlarged due to the absence of flood protection, future downstream development would be restricted by floodplain zoning. Floodwaters from a 1% AEP storm event would overtop McDonald Rd by 5.7 feet (versus 0.4 feet in existing conditions) and Nipple Peak Rd by 2.9 feet (versus 1.6 feet in existing conditions).

No Action Alternative for FRS No. 5

The most likely failure modes for FRS No. 5 are hydrologic failure (overtopping) and spillway integrity failure (breach of the auxiliary spillway). The probability of failure of these events was estimated by reducing the Probable Maximum Precipitation values until they were at the minimum values that would cause each type of failure. Frequency rainfall evented were plotted and a power function trendline equation was used to estimate the return interval for the rainfall events that would result in each failure type. Hydrologic failure is estimated to occur as a result of the 80% PMP event, which is estimated to have a return interval of 12,118-years. Integrity failure would not occur until the 90% PMP event and the dam would have overtopped at the 80% PMP event, so integrity failure was not included in the No Action alternative for FRS No. 5.

Catastrophic failure of the dam could result in damages to ten residences, five downstream road crossings and multiple road segments, other infrastructure, and agricultural lands. The catastrophic failure scenario would pose a significant risk of loss of life.

Following catastrophic breach, downstream flooding conditions would be similar to those that existed prior to the construction of the dam. Existing and proposed floodplains were mapped approximately 10.8 miles downstream of FRS No. 5, ending at the confluence of Middle Kickapoo Creek and West Kickapoo Creek. The four houses already in the 1% AEP floodplain would experience an increase in the frequency and depth of flood damages, and additional houses would be added to the 1% AEP floodplain. The stream crossings on E. Main Street and E. Oliver Street would experience an increase in the depth and frequency of overtopping. Railroad Road at three crossing locations would be overtopped in the 1% AEP event due to this alternative. Two segments of US 277 and a segment of NW Railroad Rd that run parallel to Middle Kickapoo Creek would be inundated in this alternative. Since the 1% AEP floodplain downstream would be enlarged due to the absence of flood protection, future downstream development would be restricted by floodplain zoning.

**Alternative 3 - Decommission of FRS No. 4 with Federal Assistance and High Hazard Potential Rehabilitation of FRS No. 5**

Decommission of FRS No 4

Decommissioning consists of removing the storage function of the dam and reconnecting, restoring, and stabilizing the stream and floodplain functions. Although complete removal of the embankment is sometimes required for decommissioning, only partial removal of the embankment was evaluated in this alternative. It includes excavating a breach in the dam of sufficient size to safely pass the 1% AEP flood through the dam. This breach would be a minimum size opening in the dam from top of dam to the valley floor which would eliminate the structure's ability to store water and would have a bottom width of approximately 84 feet. To not impede flows through the breached embankment and to reduce certain safety and health factors, the principal spillway components would also be removed.

The excavated material (about 23,000 cubic yards) would be placed in the present easement area and the remaining portion of the embankment and all exposed areas would be vegetated as needed for erosion control (approximately 8 acres). Channel work would be performed to reconnect the stream channel through the sediment pool. Riparian vegetation would be established along the stream channel (approximately 1.4 acres). A grade stabilization structure would be installed to stabilize sediment and prevent stream headcutting. Construction activities would require that a Storm Water Pollution Prevention Plan (SWPPP) be in effect.

Downstream flooding conditions from a 1% AEP, 24-hour storm would be similar to those that existed prior to the dam being construction. In order to continue to provide downstream flood protection as required to meet the Purpose and Need of the project, mitigation for additional flood impacts would be included in this alternative. Existing and proposed floodplains were mapped approximately 14,800 feet downstream of FRS No. 4, ending upstream of the normal pool of FRS No. 5. The 1% AEP floodplain downstream would be enlarged. Since the 1% AEP floodplain downstream would be enlarged due to the absence of flood protection, future downstream development would be restricted by floodplain zoning. Floodwaters from a 1% AEP storm event would overtop McDonald Rd by 5.7 feet (versus 0.4 feet in existing conditions) and Nipple Peak Rd by 2.9 feet (versus 1.6 feet in existing conditions). These road crossings would be subject to greater flood depths during the 1% AEP storm event and would also be subject to more frequent flooding (i.e. they would be impacted at more frequent storm event). In addition, NW Railroad Road, which runs parallel to Middle Kickapoo Creek would be subject to more extensive and more frequent flooding with this alternative than it would be under current conditions. To continue to provide downstream flood protection as required to meet the Purpose and Need for the project, mitigation for additional flood impacts at these roads would be included in this alternative. This alternative assumes that these impacted roads would have barricades with flood warning lights installed at both sides of the modeled flood extents to prevent an unsafe and potentially deadly situation that could occur as a result of the dam removal. The estimated cost to decommission the dam is $1,652,000. Additional roadway mitigation costs are estimated to be at least $360,000, for a total estimated cost of $2,012,000.

<u>High Hazard Potential Rehabilitation of FRS No 5</u>

Two high hazard potential rehabilitation options were considered for FRS No. 5 for Alternative 3 as presented below:

Option A: Raise the top of dam, raise the auxiliary spillway crest and add a 100-ft wide RCC overtopping spillway at the elevation of the raised auxiliary spillway crest, and raise the principal spillway crest

- Replace principal spillway riser with new crest at 1894.5 feet (4.5 feet lower than existing crest at 1899.0 feet and at same elevation of existing low-level ports);
- Install a 48-inch-diameter RCP conduit;
- Regrade auxiliary spillway crest to 1909.7 feet (0.1 foot raise);
- Line upper 355 feet of existing auxiliary spillway slope with articulated concrete blocks;

- Install 100 foot wide RCC step overtopping spillway at elevation on 1909.7; and
- Raise the top of dam crest from the as-built elevation of 1915.9 feet to 1918.7 feet (2.8 feet raise).
- Estimated Cost: $23,690,000

Option B: Raise the top of dam, raise the auxiliary spillway crest and widen by 100-ft, and raise the principal spillway crest.

- Replace principal spillway riser with new crest at 1894.5 feet (4.5 feet lower than existing crest at 1899.0 feet and at same elevation of existing low-level ports);
- Install a 48-inch-diameter RCP conduit;
- Regrade auxiliary spillway crest to 1909.7 feet (0.1 foot raise);
- Widen auxiliary spillway to approximately 500 feet (100 foot increase);
- Line upper 355 feet of existing auxiliary spillway slope with articulated concrete blocks; and
- Raise the top of dam crest from the as-built elevation of 1915.9 feet to 1918.7 feet (2.8 feet raise).
- Estimated Cost: $21,719,000

Option A is considered the most optimal option and was carried forward for Alternative 3 because of logistics. It was determined that Option B would require the addition of a splitter dike to the auxiliary spillway since the auxiliary spillway currently exceeds 200 feet wide and would be widened under this alternative, which would increase the cost and would also require the spillway to be widened to accommodate the width of the splitter dike. The increase in cost is expected to exceed $2,000,000 and the additional widening of the auxiliary spillway (approximately 50 feet, in addition to the proposed 100-foot widening) would impact a habitable structure located adjacent to the spillway. The cost of Option A is $23,660,000.

**Alternative 9 - High Hazard Potential Rehabilitation of FRS No. 4 and FRS No. 5**

High Hazard Potential Rehabilitation of FRS No. 4

Two high hazard potential rehabilitation options were considered for FRS No.4 for Alternative 9 as presented below:

Option A: Construct 340-foot wide RCC overtopping spillway at elevation of 1994.3.

- Lower crest elevation of vegetated auxiliary spillway to 1994.3 feet (2.1 feet lower than as-built);
- Construct 340-foot wide RCC overtopping spillway at elevation of 1994.3;
- Excavate all existing rock blanket and a minimum 5-feet of existing embankment material;

- Construct a new chimney filter/toe drain at a 2:1 slope on the downstream embankment;
- Add new embankment fill on the upstream and downstream embankment at a 3:1 slope with minimum 5 feet cover over filter; and
- Add rock riprap over geotextile over new fill on the upstream slope.
- Estimated Cost: $23,824,000

Option B: Construct 200-foot wide RCC overtopping spillway at elevation of 1994.3 feet and line upper 270 feet of existing vegetated auxiliary spillway slope with articulated concrete blocks (ACB).

- Lower crest elevation of vegetated auxiliary spillway to 1994.3 feet (2.1 feet lower than as-built);
- Line upper section of existing auxiliary spillway slope with articulated concrete blocks;
- Construct 200-foot wide RCC overtopping spillway at elevation of 1994.3;
- Excavate all existing rock blanket and a minimum 5-feet of existing embankment material;
- Construct a new chimney filter/toe drain at a 2:1 slope on the downstream embankment;
- Add new embankment fill on the upstream and downstream embankment at a 3:1 slope with minimum 5 feet cover over filter; and
- Add rock riprap over geotextile over new fill on the upstream slope.
- Estimated Cost: $22,897,000

This alternative assumes that the existing principal spillway riser, conduit, and impact basin remain in place. Exterior inspection of the riser and impact basin showed these structures to be in good condition, but an inspection of the conduit would be recommended before any action associated with this alternative is undertaken.

During construction, best management practices will be utilized to avoid and minimize any potential adverse impacts. Construction activities will require that a SWPPP be in effect. All disturbed areas will be revegetated using adapted and/or non-invasive native species. Planting equipment will be cleaned and certified seed will be used as measures to prevent the spread of invasive species. No compensatory mitigation will be required as a result of implementing this alternative. All work of disturbance, including stockpiling, equipment staging, and ingress/egress, will occur on the embankment, the auxiliary spillway, and previously disturbed areas.

Because of the cost, Option B is considered the most optimal option and was carried forward for Alternative 9.

High Hazard Potential Rehabilitation of FRS No. 5

Two high hazard potential rehabilitation options were considered for FRS No. 5 for Alternative 9 as presented below:

Option C: Raise the top of dam and construct RCC overtopping spillway.

- Replace principal spillway riser with new crest at 1894.5 feet (4.5 feet lower than existing crest at 1899.0 feet and at same elevation of existing low-level ports);
- Lower crest elevation of vegetated auxiliary spillway to 1908.4 feet (1.2 feet lower than as-built);
- Line upper 350 feet of existing auxiliary spillway slope with articulated concrete blocks;
- Over-excavation of the downstream slope of the embankment to a depth of approximately 3 feet and replacement of new fill material as well as flattening the upstream and downstream embankments to 3:1 slopes; and
- Raise the top of dam crest from the as-built elevation of 1915.9 feet to 1916.9 feet (1.0 foot raise).
- Estimated Cost: $15,708,000

Option D: Raise top of dam and widen existing vegetated auxiliary spillway.

- Replace principal spillway riser with new crest at 1894.5 feet (4.5 feet lower than existing crest at 1899.0 feet and at same elevation of existing low-level ports);
- Lower crest elevation of vegetated auxiliary spillway to 1908.4 feet (1.2 feet lower than as-built);
- Widen vegetated auxiliary spillway from 400-feet to 500-feet width;
- Line upper section of existing auxiliary spillway slope with articulated concrete blocks;
- Over-excavation of the downstream slope of the embankment to a depth of approximately 3 feet and replacement of new fill material as well as flattening the upstream and downstream embankments to 3:1 slopes; and
- Raise the top of dam crest from the as-built elevation of 1915.9 feet to 1916.8 feet (0.9 foot raise).
- Estimated Cost: $20,046,000

For both rehabilitation configurations, best management practices during construction will be utilized to avoid and minimize any potential adverse impacts. Construction activities will require that a SWPPP be in effect. All disturbed areas will be revegetated using adapted and/or non-invasive native species. Planting equipment will be cleaned and certified seed will be used as measures to prevent the spread of invasive species. No compensatory mitigation will be required as a result of implementing this alternative. All work of disturbance, including stockpiling,

equipment staging, and ingress/egress, will occur on the embankment, the auxiliary spillway, and previously disturbed areas. No major change in reservoir or downstream operation will result from this alternative.

It was determined that Option D would require the addition of a splitter dike to the auxiliary spillway since the auxiliary spillway currently exceeds 200 feet wide and would be widened under this alternative, which would increase the cost and would also require the spillway to be widened to accommodate the width of the splitter dike. The increase in cost is expected to exceed $2,000,000 and the additional widening of the auxiliary spillway (approximately 50 feet, in addition to the proposed 100-foot widening) would impact a habitable structure located adjacent to the spillway. Because of cost, Option C is considered the most optimal option and was carried forward for Alternative 9. The cost of this choice is $15,708,000.

**Alternative 10 –Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to State Standards**

Decommission of FRS No 4

Decommissioning consists of removing the storage function of the dam and reconnecting, restoring, and stabilizing the stream and floodplain functions. Although complete removal of the embankment is sometimes required for decommissioning, only partial removal of the embankment was evaluated in this alternative. It includes excavating a breach in the dam of sufficient size to safely pass the 1% AEP flood through the dam. This breach would be a minimum size opening in the dam from top of dam to the valley floor which would eliminate the structure's ability to store water and would have a bottom width of approximately 84 feet. To not impede flows through the breached embankment and to reduce certain safety and health factors, the principal spillway components would also be removed.

The excavated material (about 23,000 cubic yards) would be placed in the present easement area and the remaining portion of the embankment and all exposed areas would be vegetated as needed for erosion control (approximately 8 acres). Channel work would be performed to reconnect the stream channel through the sediment pool. Riparian vegetation would be established along the stream channel (approximately 1.4 acres). A grade stabilization structure would be installed to stabilize sediment and prevent stream headcutting. Construction activities would require that a Storm Water Pollution Prevention Plan (SWPPP) be in effect.

Downstream flooding conditions from a 1% AEP, 24-hour storm would be similar to those that existed prior to the dam being construction. In order to continue to provide downstream flood protection as required to meet the Purpose and Need of the project, mitigation for additional flood impacts would be included in this alternative. Existing and proposed floodplains were mapped approximately 14,800 feet downstream of FRS No. 4, ending upstream of the normal pool of FRS No. 5. The 1% AEP floodplain downstream would be enlarged. Since the 1% AEP floodplain downstream would be enlarged due to the absence of flood protection, future downstream development would be restricted by floodplain zoning. Floodwaters from a 1% AEP storm event would overtop McDonald Rd by 5.7 feet (versus 0.4 feet in existing conditions) and Nipple Peak Rd by 2.9 feet (versus 1.6 feet in existing conditions). These road crossings would

be subject to greater flood depths during the 1% AEP storm event and would also be subject to more frequent flooding (i.e. they would be impacted at more frequent storm event). In addition, NW Railroad Road, which runs parallel to Middle Kickapoo Creek would be subject to more extensive and more frequent flooding with this alternative than it would be under current conditions. To continue to provide downstream flood protection as required to meet the Purpose and Need for the project, mitigation for additional flood impacts at these roads would be included in this alternative. This alternative assumes that these impacted roads would have barricades with flood warning lights installed at both sides of the modeled flood extents to prevent an unsafe and potentially deadly situation that could occur as a result of the dam removal. The estimated cost to decommission the dam is $1,652,000. Additional roadway mitigation costs are estimated to be at least $360,000, for a total estimated cost of $2,012,000.

SLO Sponsored Rehab of FRS No. 5 to TCEQ Standards

Without FRS No. 4 in place, minor modifications to FRS No. 5 would be required for the dam to meet TCEQ standards for an intermediate size high hazard dam. The crest of FRS No. 5 would need to be re-graded to fill in depressions and raise the effective dam crest by 0.29 foot to an elevation of 1916.19 feet. The raise would be to an elevation below the as-built top-of-dam elevation (1916.79). It should be noted that although the auxiliary spillway would not experience integrity issues (headcutting) in the TCEQ design storm it would experience stability (erosion) issues, if engaged. Although not required to meet TCEQ hydrologic criteria, the Sponsors may want to make modifications to the auxiliary spillway to protect it against erosion. The estimated cost for the Sponsor to regrade the dam crest and raise the effective crest 0.29 foot is $147,000.

## Recommended Plan

Alternative 10, which includes the Decommissioning of FRS No. 4 and SLO Sponsored rehabilitation of FRS No. 5 to TCEQ standards, has been selected as the Preferred Alternative. Alternative 10 meets the Purpose and Need for the project, is the Environmentally and Economically preferred alternative, and while not the Locally Preferred alternative, has support from the Sponsors. Of the alternatives considered, this alternative provides the least negative economic net benefits with few environmental and social impacts. The project costs for the recommended plan are provided in **Table S-4**. The most likely scenario is for the project to be implemented over 36 months, including design and construction.

**Table S-4. Project Costs (Dollars)**

| **Cost-share Table for Rehabilitation Projects** | | | | | |
|---|---|---|---|---|---|
| | NRCS | | **Sponsors** | | **Total** |
| | Percent | Cost[1/] | Percent | Cost[1/] | Cost[1/] |
| **Works of Improvement Cost-Shareable Items** | | | | | |
| Federal Decommission of FRS No. 4 | 65% | $807,000 | 35% | $434,000 | $1,241,000 |
| Mitigation | 65% | $234,000 | 35% | $126,000 | $360,000 |

| Cost-share Table for Rehabilitation Projects | | | | | |
|---|---|---|---|---|---|
| **Subtotal: Cost-Sharable Costs** | 65% | $1,041,000 | 35% | $560,000 | $1,601,000 |
| | | | | | |
| **Non-Cost-Sharable Items** [2/] | | | | | |
| Rehabilitation of FRS No. 5 to State Standards | | $0 | | $113,000 | $113,000 |
| NRCS Technical Assistance/Engineering for Decommission of FRS No. 4 | | $234,000 | | $0 | $234,000 |
| Engineering for SLO Sponsored Rehab of FRS No. 5 to State Standards | | $0 | | $21,000 | $21,000 |
| Project Administration [3/] | | $126,000 | | $11,000 | $137,000 |
| Land Rights | | $0 | | $30,000 | $30,000 |
| Federal, State, and Local Permits | | $0 | | $23,000 | $23,000 |
| **Subtotal: Non-Cost-Share Costs** | | $360,000 | | $198,000 | $558,000 |
| | | | | | |
| **Total:** | | $1,401,000 | | $758,000 | $2,159,000 |

1/ All costs rounded to nearest $1,000.
2/ If actual non-cost-sharable item expenditures vary from these figures, the responsible party will bear the change.
3/ The sponsors and NRCS will each bear the costs of project administration that each incurs. Sponsor costs for project administration include relocation assistance advisory service.

## S.10 Project Benefits

The Decommissioning of FRS No. 4 and the SLO Sponsored Rehabilitation of FRS No. 5 to state standards reduces the potential for loss of life from catastrophic breach and maintains protection of existing infrastructure downstream of the FRS No.5. Additional average annual net benefits between the No Action Alternative and the recommended plan is -$77,000.

**Number of Direct Beneficiaries FRS No. 4:** 16 (Population at Risk)

**Number of Direct Beneficiaries FRS No. 5:** 37 (Population at Risk)

**Other Beneficial Effects:**

- Complies with performance standards established and TCEQ;
- Reduces the potential for loss of life by reducing the possibility of FRS No. 4 dam failure;
- Reduces the Sponsors' liability associated with continuing to operate a dam that is listed as being in "unsatisfactory condition"; and

- Continues to provide flood protection downstream of FRS No. 5 .

**Benefit-to-Cost Ratio (discount rate of 2.75%)**: -0.2:1.0

**National Economic Benefits**: - $15,000 for FRS No. 4 and FRS No. 5

**Selected Plan:** $2,159,000 for FRS No. 4 and FRS No. 5

### S.11 Funding Schedule

- Federal Funds (budget year): $234,000
- Federal Funds (year after budget year): $0
- Federal Funds (year 2 after budget year): $1,167,000
- Non-Federal Funds (budget year): $51,000
- Non-Federal Funds (year after budget year): $707,000
- Non-Federal Funds (future O&M): $8,000 annually

### S.12 Period of Analysis

FRS No. 4 and FRS No. 5 were analyzed for a benefit period of 100 years following the 1-year design and 2-year construction periods. Therefore, the period of analysis is 103 years.

### S.13 Project Life

FRS No. 4: 100 years
FRS No. 5: 100 years

### S.14 Environmental Impacts

Temporary and minor adverse impacts associated with the construction phase of the preferred alternative for both dams are provided in **Table S-5**.

## Table S-5. Summary of Environmental Effects for the Preferred Alternatives

| ITEM/CONCERN | ALTERNATIVE 10 | |
|---|---|---|
| | **FRS NO. 4 - SUMMARY OF EFFECTS OF DECOMMISSIONING ALTERNATIVE** | **FRS NO. 5 - SUMMARY OF EFFECTS OF SLO SPONSORED REHABILITATION TO STATE STANDARDS ALTERNATIVE** |
| Prime and Unique Farmland | Removal of flood storage would eliminate flood protection for downstream prime farmlands currently provided by FRS No. 4. Impacted farmland within modeled 1% AEP floodplain would be increased from 146 to 184 acres for prime farmland, and from 71 to 149 acres for farmland of statewide importance, if irrigated. The decommission would also remove risk of flooding farmlands (32 acres of prime farmland and 14 acres of statewide importance, if irrigated) currently within top of dam backwater elevation. | Would continue to provide similar level of flood protection for prime farmlands as existing conditions. |
| Erosion and Sediment | Would eliminate the current function of the dam to collect and retain sediment and would increase the potential for downstream erosion and sedimentation from large storm events. Natural sediment regime would be restored over time following decommission of dam. | Would continue to allow the dam to collect/retain sediment. Would reduce the downstream erosion potential by safely passing controlled storm flows through existing PS conduit. |
| Floodplain Management | No regulatory floodplain exists for the reach segment between FRS No. 4 and FRS No. 5. Removal of storage function would result in expansion of the 1% AEP floodplain. Modeled 1% AEP floodplain would be increased from 467 to 680 acres with decommission of FRS No. 4, but no additional habitable structures would be added to it. | Existing regulatory floodplain in Bronte would need to be updated through a CLOMR. The existing downstream 1% AEP floodplain would be expanded from 915 to 939 acres, but no additional structures would be added to it. Would continue to provide flood protection benefits. |
| Streams, Lakes, and Wetlands/Waters of the U.S. | Would result in discharge of fill into potentially jurisdictional waters of U.S. during decommissioning and would result in more frequent flooding of downstream streams and wetlands. Natural flow regime would be restored over time following decommission of dam. | Would maintain upstream wetlands and continue to provide protection for downstream streams and wetlands. |
| Water Quality | Removal of storage function would allow accumulated and watershed sediment to move downstream potentially impacting the downstream water quality. Minor, temporary impacts to water quality during construction. Natural sediment regime would be restored over time following decommission of dam. | No impacts. |

| ITEM/CONCERN | ALTERNATIVE 10 | |
|---|---|---|
| | **FRS NO. 4 - SUMMARY OF EFFECTS OF DECOMMISSIONING ALTERNATIVE** | **FRS NO. 5 - SUMMARY OF EFFECTS OF SLO SPONSORED REHABILITATION TO STATE STANDARDS ALTERNATIVE** |
| Woodland Vegetation/Forest Resources | Would result in the removal of approximately 7.5 acres of vegetation including trees. In addition, forest resources downstream would be subject to more frequent flooding. | FRS No. 5<br>No impacts |
| Invasive Species - Plants | During construction, efforts will be made to ensure invasive species are not introduced. All disturbed areas will be revegetated using adapted and/or non-invasive native species. All tools, equipment, and vehicles will be cleaned before transporting materials and before entering and leaving the worksite to prevent the introduction and spread of invasive plant species. | During regrading of dam crest, efforts will be made to ensure invasive species are not introduced. All disturbed areas will be revegetated using adapted and/or non-invasive native species. All tools, equipment, and vehicles will be cleaned before entering and leaving the worksite to prevent the introduction and spread of invasive plant species. |
| Riparian Areas | The removal of flood storage would restore the downstream flow regime to pre-impoundment conditions, which could result in the establishment of riparian areas. | Would result in minor temporary impacts during construction. Riparian areas would establish surrounding the normal pool/sediment pool area following construction activities. |
| Threatened and Endangered Species | Could impact the monarch butterfly and tricolored bat during construction. These species are not currently afforded protection under the federal Endangered Species Act. Coordination with the USFWS may be required if these species become listed prior to construction. No potentially suitable habitat was identified for any additional federally listed species. BMPs would be implemented to avoid harming state-listed species during construction. Information on agency consultation can be found in Section 6.3. | Could impact the monarch butterfly and tricolored bat during construction. These species are not currently afforded protection under the federal Endangered Species Act. Coordination with the USFWS may be required if these species become listed prior to construction. No potentially suitable habitat was identified for any additional federally listed species. BMPs would be implemented to avoid harming state-listed species during construction. Information on agency consultation can be found in Section 6.3 |
| Fish and Wildlife | Removal of storage function would eliminate downstream protection from flooding which would result in impacts to downstream aquatic and terrestrial wildlife and their habitat due to flooding events. Natural flow regime and historic riparian habitat areas would be restored over time following decommission of dam. | Would maintain the existing terrestrial wildlife and their habitat in the long term. Downstream aquatic and terrestrial wildlife and habitat would continue to be maintained and protected by controlling the stream flow and flood protection. Minor, temporary impacts to terrestrial habitat may occur during regrading. Less-mobile species may be lost due to equipment during construction. |

| ITEM/CONCERN | ALTERNATIVE 10 | |
|---|---|---|
| | **FRS NO. 4 - SUMMARY OF EFFECTS OF DECOMMISSIONING ALTERNATIVE** | **FRS NO. 5 - SUMMARY OF EFFECTS OF SLO SPONSORED REHABILITATION TO STATE STANDARDS ALTERNATIVE** |
| Migratory Birds/Bald and Golden Eagles | May temporarily affect migratory birds if construction activities occur between March 1 and August 31. Appropriate measures will be implemented in accordance with the MBTA. Natural flow regime and historic riparian habitat areas would be restored over time following decommission of dam. | May temporarily affect migratory birds if construction activities occur between March 1 and August 31. Appropriate measures will be implemented in accordance with the MBTA. |
| Land Use | Modeled 1% AEP floodplain would be increased from 467 to 680 acres, resulting in land use changes due to more frequent flooding and development restrictions. | Modeled 1% AEP floodplain would be increased from 915 to 939 acres, resulting in land use changes due to more frequent flooding and development restrictions. Would result in minimal changes to land use and vegetation cover due to dam raise. |
| Public Health and Safety | Would remove the risk associated with the potential for dam failure, after the dam has been removed. The modeled 1% AEP floodplain would be increased from 467 to 680 acres, and increased development restrictions would need to be implemented to protect public health and safety within the enlarged floodplain area. Flood depths and frequency would increase at two road crossings and a road segment and flood warning systems would be installed. Modifications to FRS No. 5 would be performed prior to decommission of FRS No. 4. | Upstream of the dam, no homes will be at risk as a result of the dam raise. Modeled downstream 1% AEP floodplain would be increased from 915 to 939 acres. Minor increase in flood depth and frequency at two road crossings. The threat to loss of life from failure of the dam would be greatly reduced in relation to existing conditions. |
| Social Issues/ Community Cohesion | Could result in loss of community cohesion due to flooding on three roads (flood warning systems with barricades would be installed) and development restrictions that may be imposed following decommission of dam. | Could result in minor loss of community cohesion due to development restrictions that may be imposed. |

## S.15 Major Conclusions

Alternative 10, which includes the Decommissioning of FRS No. 4 and SLO Sponsored rehabilitation of FRS No. 5 to TCEQ standards, has been selected as the Preferred Alternative. Alternative 10 meets the Purpose and Need for the project, is the Environmentally and Economically preferred alternative, and while not the Locally Preferred alternative, has support from the Sponsors. Of the alternatives considered, this alternative provides the least negative economic net benefits with few environmental impacts. It will be recommended for implementation.

## S.16 Areas of Controversy and Issues to be Resolved

Controversial Issues:

- Decommissioning of FRS No. 4 may be controversial to residents with homes downstream of FRS No. 4 and upstream of FRS No. 5 or that commute through the area due to increased flooding (depth and frequency) of roads.

- The recommended alternative includes a Federal Decommission of FRS No. 4 and a SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ standards. The SLO Sponsored Rehabilitation of FRS No. 5 must occur prior to the Federal Decommission of FRS No. 4.

Issues to be Resolved: The anticipated issues to be resolved for the decommission of FRS No. 4 and the rehabilitation of FRS No. 5 include:

- Coordination with and education of landowners downstream of FRS No. 4 and upstream of FRS No. 5 on the potential impacts of the Decommissioning of FRS No. 4. The Sponsors will acquire the necessary easements for the project.
- Resolution of current legal ambiguity of existing easement extents for FRS No. 5. The original easements procured for the watershed prior to FRS construction do not refer to specific elevations upstream of each structure for which a flow easement has been procured. There is general language which provides a broadly worded description of the easement. This broad wording will require greater definition by the Sponsors before the construction of the project can proceed. Specifically, the new easements must refer to a specific flow easement elevation in the backwater of FRS No. 5.
- For projects with disturbances equal to or greater than five acres, such as the Decommission of FRS No. 4 it is necessary to have a Storm Water Pollution Prevention Plan (SWPPP) in place at least 48 hours prior to and during construction of the proposed project and filing Notice of Intent with the Texas Commission on Environmental Quality is required. A Notice of Termination (NOT) must be filed once the site has reached final stabilization.
- The Sponsors will be responsible for updating the Emergency Action Plan (EAP) for FRS No. 5 prior to construction and will review and update the EAP annually with local emergency response officials.
- Continued coordination with the United States Army Corps of Engineers (USACE) will be required during the design phase of this project.
- Continued coordination with the United States Fish and Wildlife Service (USFWS) and Texas Parks and Wildlife Department (TPWD) will be required throughout the design phase of this project.

- If, during the design phase of this project, it is determined that work will be performed outside of the areas previously surveyed for cultural resources, appropriate cultural resources investigations procedures will be initiated for these areas.

This Plan recommends the following backwater flow easement elevation for each structure:

- FRS No. 4 – No additional easement required, as the preferred alternative is decommission of the FRS, and
- FRS No. 5 – 1916.19 feet (proposed effective crest elevation).

## S.17 Evidence of Unusual Congressional or Local Interest

No evidence of unusual Congressional or local interests was identified.

## S.18 Compliance Certificate

Is this report in compliance with executive order, public laws, and other statues governing the formulation of water resource projects? Yes _X_ No ___

# 1.0 PURPOSE AND NEED FOR ACTION

## 1.1 Purpose and Need for Action

The original purpose of the Kickapoo Creek Watershed Plan was watershed protection and flood prevention. The authorized purpose of these dams is flood prevention, and the purpose of this action is to address potential safety concerns associated with FRS No. 4 and FRS No. 5 and to continue to provide downstream flood prevention (flood damage reduction). Due to downstream development, both dams have been reclassified as high hazard potential dams, yet they do not meet the current NRCS safety and design criteria and performance standards for the high hazard potential classification. Both dams meet TCEQ hydrologic criteria for intermediate size high hazard dams, but FRS No. 4 would experience integrity issues in the TCEQ design storm. In addition, FRS No. 4 is listed as being in unsatisfactory condition (A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution). While there is a need for action to reduce safety risks to meet current safety standards, there is also a need for continued flood protection in the Kickapoo Creek Watershed from these dams.

The Federal Objective "specifies that federal water resource investments shall reflect national priorities, encourage economic development, and protect the environment;" the Guiding Principles are Healthy and Resilient Ecosystems, Sustainable Economic Development, Floodplains, Public Safety, Environmental Justice, and Watershed Approach (USDA 2017).

## 1.2 Changes Requiring Preparation of a Supplement

This Supplemental Watershed Plan No. I and Environmental Assessment formulated, evaluated, and resolved alternatives for the rehabilitation of Kickapoo Floodwater Retarding Structure (FRS) No. 4 and FRS No. 5 located within the Kickapoo Creek Watershed, a subwatershed of the Colorado River, in Coke County, Texas (see Project Map in **Appendix B**).

FRS No. 4 and FRS No. 5 are single purpose dams that were designed and constructed as significant hazard potential class structures. The classification of both dams was changed to high hazard potential in 2018 due to the presence of downstream development and roads that would be impacted in the event of a dam failure. FRS No. 4 and FRS No. 5 do not meet current NRCS dam design and safety criteria and performance standards for high hazard potential class dams. Emergency Action Plans (EAPs) were prepared for FRS No. 4 and FRS No. 5 in 2019 and have been reviewed and updated each year by the Sponsors and appropriate emergency response agencies. FRS No. 4 and FRS No. 5 are classified as intermediate-size high hazard dams by the Texas Commission on Environmental Quality's (TCEQ) Dam Safety Division and meet hydrologic criteria for dams of that classification, but Dam 4 would experience integrity issues during the TCEQ design storm. In addition, FRS No. 4 is listed as being in unsatisfactory condition (A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution).

## 1.3 Project History/Background

The original Kickapoo Creek Watershed work plan was prepared, and works of improvement were installed, under the authority of the Flood Control Act of 1944 (Public Law 534, 78th Congress) as amended and supplemented. The original watershed work plan was developed in March 1960 and became effective in May of that same year. The evaluated life of the project was 50 years. A series of six FRSs were constructed in the Kickapoo Creek Watershed between the years of 1962 and 1964.

United States Department of Agriculture (USDA)-Natural Resources Conservation Service (NRCS) completed assessments of FRS No. 4 and FRS No. 5 (in-series dams) in September 2016 and October 2015, respectively, which concluded that the dams did not meet current NRCS standards for high hazard potential dams. The performance of the dams was not evaluated against TCEQ criteria in these assessments.

# 2.0 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

The scope is the range of actions, alternatives, and impacts to be considered in this Plan-EA.

## 2.1 Scoping

On June 8, 2020, a Public Scoping Meeting was held at the Bronte Recreation Center, in Coke County, to identify issues of economic, environmental, cultural, and social importance in the watershed. Input was provided by representatives from the Coke County Soil and Water Conservation District, Coke County Kickapoo Creek WCID #1, the City of Bronte, Coke County, the Texas NRCS, and the Texas State and Soil Water Conservation Board (TSSWCB). Factors that would affect soil, water, air, plant, animals, and human resources were identified by an interdisciplinary planning team composed of the following areas: engineering, biology, economics, resource conservation, water resources, archeology, and geology.

Local citizens expressed similar concerns at the first Public Scoping Meeting.

The scoping process identified (1) the objectives, needs, and primary concerns for the Sponsors, (2) the relevant issues associated with each FRS, and (3) the environmental concerns associated with the Project.

## 2.2 Resource Concerns Identified Through Scoping

Based on the results of the initial scoping process, issues relevant in defining the problems and formulating and evaluating alternative solutions were identified for further assessment in this Plan-EA. **Table 2-1** indicates which resources of concern are present in the watershed analysis area, are relevant to the Proposed Action, and are further analyzed in this document. Resources that are not present or not relevant are eliminated from further analysis.

**Table 2-1. Resource Concerns Considered and Identified Through Scoping**

| ITEM/CONCERN | Relevant to the Proposed Action? | | RATIONALE |
|---|---|---|---|
| | YES | NO | |
| **SOILS** | | | |
| Prime and Unique Farmland | X | | There are areas of Prime Farmland downstream of both FRSs that are potentially at risk of flooding from Middle Kickapoo Creek should the FRSs be removed. There are also areas of Prime Farmland within and immediately adjacent to the floodpool for FRS No. 4 that could be impacted by modifications to the FRS. Potential impacts to these areas resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |

| ITEM/CONCERN | Relevant to the Proposed Action? YES | NO | RATIONALE |
|---|---|---|---|
| Erosion and Sediment | X | | The impact of sediment accumulation in FRS No. 4 and FRS No. 5 is relevant to the existing and future service life of the FRSs. In addition, downstream erosion and sedimentation could be impacted by modifications to the FRSs. Potential erosion and sedimentation impacts resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |
| **WATER** | | | |
| Floodplain Management | X | | FRS No. 4 and FRS No. 5 are located in areas that are not covered by mapped regulatory floodplains. Bronte, TX, located downstream of FRS No. 5, does have a mapped regulatory floodplain. Modifications to FRS No. 4 and FRS No. 5 could impact the effective floodplain and the regulatory floodplain (where mapped) and these impacts will be considered. |
| Coastal Zone Management Plans | | X | The project is not located in an area subject to Coastal Zone Management Act requirements, so this item is not considered to be relevant to the proposed action. |
| Potable Water Supply/Regional Water Management Plans/Water Resources | | X | These dams are not used for water supply, so this is not considered relevant to the proposed action. |
| Sewer Utilities | | X | There are no known sewer utilities in the project area, so this item is not considered to be relevant to the proposed action. |
| Sole Source Aquifers | | X | The project is not located in a contributing or recharge zone for a sole source aquifer, so this item is not considered to be relevant to the proposed action. |
| Streams, Lakes, and Wetlands/Waters of the U.S | X | | Middle Kickapoo Creek, an ephemeral tributary to Kickapoo Creek, flows through FRS No. 4 and FRS No. 5. Wetland areas have been identified within the reservoir area and downstream of FRS No. 5. Potential impacts to the wetland plant communities and functional values resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |
| Water Quality | X | | Construction activities and the resulting modifications could have impacts to downstream water quality. Potential impacts to water quality resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |
| Wild and Scenic Rivers | | X | No designated Wild and Scenic Rivers were identified in the project area. Nationwide Rivers Inventory listed segments are also protected by the Wild and Scenic Rivers act. The closest Nationwide Rivers Inventory-listed segments of the Colorado River (from US67 bridge at Ballinger to US 283 bridge south of Rockwood) are outside of the area of effects of the proposed action. This item is not considered to be relevant to the proposed action. |

| ITEM/CONCERN | Relevant to the Proposed Action? YES | NO | RATIONALE |
|---|---|---|---|
| **AIR** | | | |
| Air Quality / Clean Air Act | | X | The project is located in an attainment/unclassifiable county (Coke) for National Ambient Air Quality Standards, so this item is not considered to be relevant to the proposed action. There could be some temporary effects during construction (dust and exhaust) if the dam is modified. |
| **PLANTS** | | | |
| Threatened and Endangered Species | X | | Federally and/or state-listed threatened or endangered plant species have the potential to occur within the project area, so this item is considered to be relevant to the proposed action. |
| Woodland Vegetation/Forest Resources | X | | Woodland vegetation is present in the project area. Potential impacts resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |
| Invasive Species | X | | Invasive plant species have the potential to occur within the project area and could be transported into or out of the project area or could be spread within the project area by construction activities. Potential impacts resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. . |
| Natural Areas | | X | The project is not located within a designated Natural Area, so this item is not considered to be relevant to the proposed action. |
| Riparian Areas | X | | Riparian areas were identified along Middle Kickapoo Creek at FRS No. 5. Potential impacts to riparian areas resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |
| **ANIMALS** | | | |
| Coral Reefs | | X | No coral reefs were identified within or near the project area, so this item is not considered to be relevant to the proposed action |
| Ecologically Critical Areas | | X | The project is not located within or near a designated Ecologically Critical Area, so this item is not considered to be relevant to the proposed action. |
| Threatened and Endangered Species | X | | Federally-listed threatened or endangered species have the potential to occur within the project area.<br><br>State-listed threatened or endangered species have the potential to occur within the project area.<br><br>Potential impacts resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |
| Essential Fish Habitat | | X | No essential fish habitats have been identified within the project area, so this item is not considered to be relevant to the proposed action. |
| Fish and Wildlife | X | | It is unlikely that FRS No. 4 provides habitat for fish as the dam does not impound water consistently throughout the year, but it does provide habitat for other wildlife. FRS No. 5 could potentially provide habitat for fish and provides habitat for other wildlife. Potential impacts to fish and wildlife resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |

| ITEM/CONCERN | Relevant to the Proposed Action? YES | NO | RATIONALE |
|---|---|---|---|
| Invasive Species | | X | With the use of appropriate BMPs, modifications to FRS No. 4 and FRS No. 5 would not result in the spread of invasive animal species that could potentially be found at the site, so this item is not considered to be relevant to the proposed action. |
| Migratory Birds/Bald and Golden Eagles | X | | Migratory bird pathways, stopover habitats, wintering areas, and breeding areas occur within and/or adjacent to the project area and may be associated with wetlands, ponds, riparian corridors, fallow fields, grasslands, and woodlands.<br><br>Bald Eagles/Golden Eagles were not observed in the project area during a site visit. However, Bald Eagles occur throughout the state and therefore have the potential to utilize the site for hunting and/or stopover.<br><br>Potential impacts to Migratory Birds/Bald and Golden Eagles resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |
| **HUMANS** | | | |
| Costs/Public Benefits | X | | Per PR&G, Public Benefits relative to costs will be considered in the evaluation of potential modifications to FRS No. 4 and FRS No. 5. |
| Cultural Resources | X | | Cultural resources have the potential to occur within the area of potential effect (APE) for the dams and could be impacted by modifications to them. Consultation with the Texas State Historic Preservation Office (SHPO) and relevant Tribes has been completed, see **Appendix A**. As a result of consultation and historic and prehistoric identification studies, NRCS has determined there will be no effect to historic properties as planned. |
| Drought | | X | FRS No. 4 does not impound water consistently throughout the year and neither FRS No. 4 nor FRS No. 5 were designed to provide water supply benefits, so this item is not considered to be relevant to the proposed action. |
| Environmental Justice and Civil Rights | X | | After comparing U.S. Census and EJScreen data to that of Coke County and the State of Texas as a whole, there is the potential for impacts to high minority populations and EJ concerns should be a consideration when evaluating the proposed action. |
| Land Use | X | | There is a residence located adjacent to the floodpool for FRS No. 4 and access to the residence is through the auxiliary spillway of FRS No. 4. Potential impacts to the residence, access to the residence, and private property could result from modifications to FRS No. 4. Potential impacts to land use adjacent to and downstream of FRS No. 4 and FRS No. 5 resulting from modifications to the structures will be considered. |

| ITEM/CONCERN | Relevant to the Proposed Action? YES | NO | RATIONALE |
|---|---|---|---|
| Local and Regional Economy | | X | The population of Bronte (downstream of FRS No. 5 has decreased between the years of 2000 to 2010 (-7%) and 2010 to 2020 (-7%), but there is no indication that this population decrease is related to the condition of the upstream dams in any way. No adverse impacts are anticipated to the local and regional economy as a result of modifications to FRS No. 4 and FRS No. 5, so this item is not considered to be relevant to the proposed action. |
| Park Lands, Scenic Areas | | X | FRS No. 4 and FRS No. 5 are not located within designated park lands or designated scenic areas, so this item is not considered to be relevant to the proposed action. |
| Public Health and Safety | X | | FRS No. 4 and FRS No. 5 are classified as high hazard potential dams and in their existing condition are a risk to the public. Potential impacts to Public Health and Safety resulting from modifications to FRS No. 4 and FRS No. 5 will be considered. |
| Public Recreation | | X | There have been no public recreation opportunities identified within the project area, so this item is not considered to be relevant to the proposed action. |
| Scenic Beauty | | X | FRS No. 4 and FRS No. 5 are not located within an area that has been identified as an area of scenic beauty. While FRS No. 4 is visible from a private residence and both FRS No. 4 and FRS No. 5 are visible from public access locations, it is not anticipated that potential modifications would degrade scenic beauty of the general landscape or viewsheds, and modifications to the dams may protect and/or contribute to them, so this item is not considered to be relevant to the proposed action. |
| Scientific Resources | | X | No scientific resources/studies have been identified within the project area, so this item is not considered to be relevant to the proposed action. |
| Community Cohesion | X | | Potential impacts to community cohesion could result from modifications to FRS No. 4 and FRS No. 5 and will be considered. |

## 2.3 Ecosystem Services

According to DM9500-13 (USDA Natural Resources and Environment, 2017), in 2005, the Millennium Ecosystem Assessment (MEA) organized benefits into four service categories:

- Provisioning services are tangible goods provided for direct human use and consumption, such as food, fiber, water, timber or biomass.
- Regulating services maintain a world in which it is possible for people to live, providing critical benefits that buffer against environmental catastrophe – examples include flood and disease control, water filtration, climate stabilization, or crop pollination.
- Supporting services refer to the underlying processes maintaining conditions for life on Earth, including nutrient cycling, soil formation, and primary production.
- Cultural services make the world a place in which people want to live – recreational use, spiritual, aesthetic viewsheds, or tribal values.

Ecosystem services that are likely to meaningfully change as a result of the project are:

- Urban flood damage reduction; this Regulating Service is considered through the analyses of floodplain management and public health and safety.

# 3.0 AFFECTED ENVIRONMENT

The affected environment includes ecological, cultural, social, aesthetic, and economic resources that could potentially be affected by proposed alternatives. The purpose of describing the affected environment is to define the context in which the potential impacts could occur. Additional information regarding the affected environment of the Kickapoo Creek Watershed can be found in the Kickapoo Creek Watershed Work Plan (USDA-SCS,1960). Existing conditions that are specific to FRS No. 4 and FRS No. 5 are described in the following sections.

## 3.1 Planning Activities

The following hydrologic and hydraulic analysis planning activities were considered when defining the affected environment for FRS No. 4 and FRS No. 5:

- Development of watershed boundaries and hydraulic model topography from current LiDAR;
- Sediment and bathymetric survey of FRS No. 5;
- Development of structure (culvert, bridge, and dam) critical dimensions from currently available information and site visits;
- Development of watershed hydrologic models for each dam and the aggregate watershed above the confluence of Kickapoo Creek and the West Kickapoo Creek, for 8 statistical storms: 100% AEP through the 0.2% AEP;
- Development of a HECRAS 1-D model for Middle Kickapoo Creek, from the Dam 4 outlet to the backwater of Dam 5, and below Dam 5 to the confluence with Kickapoo Creek, and for Kickapoo Creek from the confluence with Middle Kickapoo Creek to the confluence with West Kickapoo Creek;
- Development of Water Resources Site Analysis Program (SITES) models for each dam, to include development of NRCS design floods per TR-210-60 (USDA NRCS, 2019);
- Development of a HEC-FDA model for economic analysis.
- Use of the above tools to evaluate existing conditions and to develop and evaluate potential alternatives.

Other planning activities considered when defining the affected environment included land use inventory, geologic analyses, natural resources inventories, cultural resources inventories, wetland assessments, and the identification of threatened and endangered species.

## 3.2 Physical Features

### 3.2.1 Project Location

FRS No. 4 and FRS No. 5 (downstream of FRS No. 4) are located, in series, in Coke County, Texas on Middle Kickapoo Creek, a tributary to Kickapoo Creek, a tributary to the Colorado River, and are located approximately 8 and 5 miles north, respectively, of Bronte, Texas. The project location is depicted in **Appendix B**, on **Figure B - 1**.

### 3.2.2 Topography

The area of interest is located in northeastern Coke County, Texas, within the Blackwell and Bronte Quadrangles from the United States Geological Survey (USGS) 7.5-minute topographic map series. The elevations in the Quadrangles range from approximately 1,705 to 2,243 feet above mean sea level and the topography ranges from nearly level to strongly sloping.

### 3.2.3 Soils

According to the *Soil Survey of Coke County, Texas* (Barnhill, 1974), the region exhibits nearly level to gently sloping soils on broad terraces and adjoining uplands and gently sloping to strongly sloping soils over sandstone. The predominant soil associations within the area of the dam sites according to this reference, and updated according to the more recent NRCS Websoil Survey, are summarized below. See maps in **Appendix C**.

Cobb Series
Cobb fine sandy loam, 1 to 3 percent slopes (CfB): Moderately deep, well drained, moderately permeable, reddish brown and pink sandy to clayey loam soil and, in some areas, yellow sandstone. This association is on uplands with convex to plane slopes.

Oben and Cobb soils, 1 to 3 percent slopes (CnB): Shallow to moderately deep, well drained, moderately to highly permeable, reddish-brown loamy residuum weathered from sandstone. These soils are on uplands. Composition includes about 55 percent Oben and similar soils, 25 percent Cobb and similar soils, and 20 percent minor components.

Westola Series
Westola very fine sandy loam (Ya): Deep, well drained, nearly level, calcareous, loamy soils. These soils are on the floodplain of rivers and streams. Typically, reddish-brown to reddish-yellow sandy loam, moderately permeable. (Note this unit is referred to as "Yahola very fine sandy loam" in Barnhill, 1974).

Miles Series
Miles fine sandy loam, 0 to 1 percent slopes (MmA): Deep, well drained, generally non-calcareous, loamy, and sandy soils. Moderately permeable includes zones that are similar to

Miles soils but are calcareous throughout the profile. This association is present on terraces along streams and rivers.

Sagerton Series
Sagerton clay loam, 0 to 1 percent slopes (OcA): Deep, well drained, nearly level to gently sloping, reddish-brown to pink clay loam. With moderately low permeability, these soils formed in loamy outwash materials under a grass cover and are presently located on uplands and old terraces. (Note this association is referred to as "Olton clay loam" in Barnhill, 1974).

Oplin-Rock outcrop
Oplin-Rock outcrop (SS): Miscellaneous land type that consists of steep to very steep hills that have a shallow covering of soil over limestone, chalky marl, sandstone, or marine clays. Slopes range from 20 percent to nearly vertical but are predominantly between 30 to 60 percent with slopes of 20 to 30 percent on hill tops. (Note this association is referred to as "Stony Steep Land" in Barnhill, 1974.)

### 3.2.4 Regional Geology

According to the Physiographic Map of Texas (Wermund, 1996), the eastern portion of Coke County is located within the North-Central Plains physiographic province of Texas. The North-Central Plains consist of an erosion surface that formed on upper Paleozoic formations. The province includes a vast expanse of flat to very gently rolling terrain with elevations generally below 2,000 feet above mean sea level. Shale bedrock is predominant in the vicinity of rivers, while more resistant bedrock such as sandstones and limestones are observed in areas of hills and rolling plains. Soils and rocks in the western region of this physiographic province have distinctive red and gray color resulting from oxidation of gypsum minerals, while most soils in the eastern region (such as those underlying FRS No. 4 and FRS No. 5) are generally of tannish hues.

The dams sites are located in northeast Coke County, which is generally underlain by Permian bedrock of the San Angelo Formation, Quaternary fluviatile terrace deposits, and recent alluvium associated with the Kickapoo Creek (and its three tributaries) which flows into the Colorado River approximately three miles south of Bronte, Texas. Descriptions of the relevant geologic units are provided below.

Quaternary
Holocene age alluvium is generally located near the floodplain level, primarily along streams, and is comprised of gravel, sand, silt, and clay. The thickness of these deposits is variable. Somewhat older Pleistocene terrace deposits are comprised of sand, silt, and gravel in various proportions, with gravel more predominant in older, higher terrace deposits. Locally, these deposits may be indurated with calcium carbonate (caliche) and commonly contain pebbles and cobbles of chert and quartzite in terraces along streams (Eifler et al., 1976).

Permian
The Kickapoo Creek Watershed is primarily underlain by Permian deposits of the San Angelo Formation (Psa). This formation is generally consists of sandstone, shale, and conglomerate.

The sandstone of the San Angelo Formation is described by Eifler et al. (1976) as thinly to massively bedded, friable, cross-bedded, and generally ranges from red to yellowish brown in color. Characteristic conglomerate beds of this formation including dolomite and siliceous pebbles ("chert") are generally associated with sandstone intervals. The shale is generally described as sandy and indistinctly bedded varying from red to bluish-green in color. Locally, the San Angelo formation reaches thicknesses of 125 to 200 feet.

Near the confluence with the Colorado River, in the outer edges of Bronte, Texas, the Clear Fork Group (Pcf) is mapped. This formation is primarily composed of shale and less predominantly dolomites. The formation includes sandy intervals and alternates in color from red to blueish green. The dolomites, when observed, are thinly to massively bedded. The formation thickness is approximately 750 feet (Eifler, et al., 1976).

Occurrence of Groundwater

The *Aquifers of Texas* Report No. 380 (George et al., 2011) developed by the Texas Water Development Board describes the Edwards-Trinity (Plateau) Aquifer as a major aquifer extending across much of the southwestern portion of the state of Texas. Outcrops of this aquifer are observed in the southwestern region of Coke County, as well as near the northeastern reach of the County near the area of interest for this project, but outside the area that would be impacted by potential project alternatives. The aquifer is predominantly composed by limestone and dolomite of the Edwards Group along with sands of the Trinity Group. The Edwards Group is a porous, karstic formation with several solution features (e.g. caves, conduits, caverns) resulting from dissolution of the limestone. As such, large amounts of water can be transmitted quickly through the aquifer. Recharge generally occurs through precipitation on the land surface and is estimated to be in the order of 0.1 inch or less annually in Permian zones (Wilson, 1973). Bedrock underlying the aquifer is generally significantly less permeable than the Edwards Group, which restricts downward groundwater flow. Groundwater is primarily unconfined in the shallow parts of the aquifer, and primarily confined at deeper depths.

While the maximum saturated thickness of the aquifer is greater than 800 feet, freshwater saturated thickness averages 433 feet (George et al., 2011). Groundwater present at shallow depths in the Permian rocks is useable for domestic supply, livestock, and irrigation (which represents more than two-thirds of all groundwater pumped from the aquifer) as water quality ranges from fresh to slightly saline and the water is characterized as hard. Total dissolved solids concentration ranges from 100 to 3,000 milligrams per liter (George et al., 2011). The fresh to moderately saline water found at shallow depths occurs under both water-table and artesian conditions. At deeper depths, groundwater becomes highly mineralized with artesian conditions identified in most deep wells tapping into the Permian (Wilson, 1973).

It should be noted that the Trinity Aquifer is not designated as a Sole Source Aquifer by the United States Environmental Protection Agency (USEPA).

### 3.2.5 Local Geology

Mapped Geology at FRS No. 4

According to published geologic maps from the United States Geological Survey (USGS), the FRS No. 4 site is underlain by Quaternary Alluvium deposits (Qal) and bedrock of the San Angelo Formation (Psa). Alluvium deposits typically consist of gravel, sand, silt, and clay in varying proportions that coarsen with depth. Bedrock of the San Angelo Formation includes mudstone, sandstone, siltstone, shale, conglomerate, and gypsum. The formation consists mostly of brownish-red to light gray mudstone and siltstone containing thin lenses of satin spar gypsum and alabaster gypsum nodules. The USGS karst hazard map of the United States (Weary and Doctor, 2014) indicates the location of Kickapoo 4 as located within a hazard zone for potential karst conditions. Karst conditions are formed by dissolution of bedrock due to subsurface water flow and/or surface water infiltration, and can contain features including voids, caves, and sinkholes. The specific hazard zone is classified as "evaporite rocks at or near the land surface in a dry climate", which is associated with the San Angelo formation underlying the dam site and much of the surrounding areas. Evaporites are generally defined as non-clastic sedimentary rocks composed primarily of water-soluble salts or minerals that were deposited from evaporation of a body of water. Evaporite karst hazards principally occur in deposits of gypsum, anhydrite, and halite. Dissolution of gypsum can produce karst conditions relatively rapidly (i.e., over a period of months to years or less) as compared to the rate of dissolution of carbonate rocks such as limestone and dolomite (i.e., over geologic time).

Previous Geologic Investigations at FRS No. 4

*Original Geologic Investigation (USCS-SCS, 1961a)*

The original boring logs were not available for review as part of this project but stick logs on the geologic profiles and descriptive text included in the original partial GIR (USDA-SCS, 1961a) were used to develop understanding of subsurface conditions. The embankment is underlain by overburden soils described in the field as silty sand (SM), clayey sand (SC), and sandy lean clay (CL) which vary abruptly both laterally and vertically. The results of laboratory testing on select samples recovered from the borings yielded similar classifications, including silty sand (SM), lean clay (CL), and silty clay (CL-ML). Overburden thickness in the lower creek valley ranges from as little as 5 feet towards the left abutment to more than 30 feet right of the spillway, with an average thickness of about 25 feet. Depth to bedrock in the lower creek valley was generally less than 13 feet to the left of the original creek channel but ranged from 23 to more than 30 feet to the right of the original creek channel (i.e., bedrock not encountered in borings drilled between embankment centerline STA. 14+00 and STA. 23+00). The overburden soils were noted to contain trace gravel that becomes more concentrated immediately above the underlying bedrock.

According to the original GIR (USDA-SCS, 1961a), the entire site is underlain by bedrock of the San Angelo formation of Permian age. The San Angelo formation was described as predominately alternating shale and sandstone beds. A chert conglomerate bed, also a member of the San Angelo formation, is reported to cap the hills on either abutment; however, it is well above the top elevation of the embankment and auxiliary spillway channel invert. Underlying the

embankment, the shale was generally described as compact and slightly silty, and the sandstone was generally described as massive and moderately hard to very hard with occasional calcareous intervals. An observation of a "few gypsum streaks" was noted within a sandstone bed at a depth of about 9 feet (El. 1968) in boring 304, but gypsum was not noted as a concern in either the original GIR or SMR. Surface outcrops of sandstone bedrock were encountered at the left abutment (present-day auxiliary spillway) above the top elevation of the embankment and spillway channel. The sandstone outcrops were described as medium-bedded to massive, weathered, and fractured with legacy SCS hardness rating Hd3 (moderately soft) to Hd4 (moderately hard). Bedding strike was reported as north-south (i.e., oblique to the embankment centerline alignment) with slight dip. Jointing, bedding, and fractures were not well characterized.

The original geologic investigation data indicate several outcrops of sandstone bedrock within the present-day existing auxiliary spillway channel, particularly in the area near and just upstream of the control section. A surficial layer of slightly calcareous silty to clayey sand (SC, SM, SM-SC) ranging in thickness from less than 1 foot up to 7 feet was encountered overlying the sandstone in most other areas of the spillway. The thickness of the surficial soil layer was greater in the upstream forebay entrance (nearly 10 feet thick) and spillway exit area at the valley bottom (15 feet thick or greater).

Two upstream borrow areas, designated as Zone A and Zone B, located within the present-day reservoir and separated by the original creek channel were investigated as potential borrow sources during the original investigation. The borrow areas studied indicated the presence of lean clay (CL) with thin sand lenses and trace gravel in zone A between 0 and 13 feet below the ground surface. Some shale was also identified in Zone A. In Zone B, silty to clayey sands (SM, SC) were identified in the upper 5 feet and were followed by approximately 8 feet of lean clay with sand lenses (CL, SC-CL).

Limited groundwater information from previous borings at the project site was available to for review as part of this project. The original pre-construction GIR for Kickapoo 4 (USDA-SCS 1961a) stated that no groundwater table was encountered in the borings. The dam currently operates without a normal pool, although historically the dam operated with low pool below the principal spillway riser crest and about 4 feet above the valley floor at the inlet (USDA-SCS, 1967a). Based on the historically dry conditions of the reservoir at Kickapoo 4, shallow groundwater is not expected.

*Embankment Cracking Investigation (NRCS, 2013-2014)*

An investigation of the embankment cracking was performed by NRCS geologists in 2013. Findings and conclusions were documented in a trip report (NRCS, 2013) and a geophysical survey report (NRCS, 2014). The investigation consisted of a visual reconnaissance, single hand auger boring on the embankment crest to a depth of 16 feet and laboratory testing on recovered soil samples, and four (4) lines of surface-based geophysical survey (electrical resistivity method) on the embankment (longitudinal and transverse directions). Visual observations were similar to previous documentation, with cracking appearing as discontinuous holes along the upstream crest with typical depths of 3 to 7 feet and up to 16 feet in one area. Many of the cracks

were described as having a "jug-like" shape below the ground surface, indicative of sidewall erosion and possibly dispersive soils in the embankment. Solutioning and re-deposition of soluble salts from the matrix of foundation materials was postulated as a potential source of settlement and/or soil migration contributing to the observed cracking.

The geophysical survey was performed on the embankment for both existing conditions and after pumping about 16,000 gallons of water into the cracks. During the geophysical testing, seepage was not observed to exit anywhere on the slopes or abutments. However, embankment soils became more wet in the depth interval of 9 to 19 feet below top of dam following pumping, suggesting the cracks/holes extend deeper than indicated by measurements taken at the ground surface and/or there is a zone of permeable soils in the embankment. For reference, the dam embankment is about 30 feet tall.

Laboratory testing on the recovered hand auger boring samples collected at 1-foot intervals indicated mostly silty clay (CL-ML) in the upper 4 feet underlain by lean clay (CL) to the borehole termination depth. On the basis of crumb and double-hydrometer tests, the embankment soils were generally classified as non-dispersive. The testing did not indicate any instances of elevated soluble salts in the embankment (all test results <0.5%). Although no laboratory collapse testing was performed, collapsible soils were suspected as potential contributor to cracking based on the semi-arid climate of the site and observed geologic features.

*Cracking Investigation (NRCS-Angelo State University, 2017)*

A follow-up investigation of the cracking was performed in joint study by NRCS and Angelo State University (ASU) in 2017. The results of the study were documented in a laboratory Soil Mechanics Report (NRCS, 2017), and a student presentation poster and accompanying report by ASU students presented at the Geological Society of America (GSA) Annual Meeting in Seattle, Washington (ASU, 2017). The investigation included three (3) test pit trenches at the downstream toe of the dam, collection of both disturbed and relatively undisturbed samples and associated laboratory testing, and seven (7) lines of surface-based geophysical survey (electrical resistivity method).

Advances in electrical resistivity survey methods since the prior 2014 survey allowed for deeper penetration into the core materials and higher data resolution for the 2017 survey. Results of the electrical resistivity survey identified discrete near-vertical anomalies with high resistivity near the embankment surface (upper 5 to 15± feet) interpreted as cracking. Underlying near-vertical anomalies with lower resistivity located in generally the same horizontal position as the interpreted cracking were believed to be potential subsurface flow paths within the embankment, and generally terminated near the top of the bedrock surface. Discontinuous pockets of high resistivity materials within the dam foundation were interpreted as paleo-channel fill.

Results of the laboratory index testing indicate classifications of the foundation materials include silty sand (SM), lean clay (CL), silty clay (CL-ML), and silty clayey sand (SC-SM). On the basis of crumb and double-hydrometer tests and pinhole tests, the foundation soils were generally classified as non-dispersive to possibly dispersive. The testing did not indicate any instances of elevated soluble salts in the foundation materials (all test results <0.5%). The results of three (3)

one-dimensional swell/collapse tests on undisturbed samples ranged from 0.1 to 2.9% collapse, suggesting the presence of collapsible soils. Based on the results of the investigation, collapsible soils were suspected as the primary source of cracking.

Supplemental Preliminary Geologic Investigation at FRS No. 4

Supplemental preliminary geologic investigation and soil mechanics laboratory testing were conducted as part of this project. The purpose of the preliminary investigation was to further assess the potential source(s) of observed embankment cracking/holes and dam foundation conditions that could materially affect the cost and/or geologic feasibility of various rehabilitation and/or decommission alternatives presented in this Plan-EA.

The field investigation was conducted in December 2021. The general scope of the field investigation included:

- Visual reconnaissance and limited mapping of geologic outcroppings;
- Two (2) geotechnical test borings (001-21 and 002-21) on the embankment crest within the area of existing cracking/holes;
- One (1) geotechnical test boring (701-21) at the upstream toe of the dam in line with boring 002-21; and
- One (1) geotechnical test boring (601-21) at the downstream toe of the dam in line with boring 002-21.

The purpose of including borings at both the upstream and downstream toes was to evaluate whether there was a difference in collapse potential between the two locations. It was hypothesized that because the upstream location had been previously inundated (and possibly saturated) by the reservoir pool shortly after original construction, the upstream soils may have already experienced collapse and thus may have lower collapse potential. Likewise, because the soils in the downstream location had likely not been inundated previously, it was hypothesized that the downstream soils were less likely to have already experienced collapse and thus may have a higher collapse potential for future loading.

Based on the potential for gypsum beds within the San Angelo formation, a particular focus of the field investigation was to identify potential beds of soluble gypsum bedrock under the dam that had experienced solutioning (i.e., karst conditions) and/or were of sufficient thickness such that future solutioning could produce appreciable additional settlement. Additionally, visual classification and laboratory testing of recovered samples was focused on identifying potential elevated concentrations of soluble salts (i.e., gypsum and chlorides) and/or dispersive clays which may be contributing to ongoing growth of the holes/cracking on the embankment.

Both disturbed (Standard Penetration Test [SPT], ASTM D1586) and relatively undisturbed (Shelby tube, ASTM D1587) soil samples were collected in each of the borings. Continuous rock coring was performed in 5-foot runs (ASTM D2113) upon reaching bedrock in the embankment crest borings. Laboratory geotechnical testing was performed on select soil and rock samples recovered from the borings. The laboratory testing program included:

- Index testing for classification purposes (i.e., moisture content, dry unit weight, Atterberg limits, sieve analysis);
- Limited strength testing on soil and rock (i.e., unconfined compression);
- Analytical testing (i.e., soluble sulfates, soluble chlorides, pH)
- Dispersive soil testing (i.e., crumb and double-hydrometer);
- One-dimensional swell/collapse to evaluate presence of collapsible soils.

The two crest borings encountered embankment fill described in the field as silty lean clay and lean clay (CL) with some silt (ML). The alluvial foundation materials under and upstream/downstream of the dam embankment were generally described as lean clay (CL), silty sand (SM), poorly-graded sand (SP), and clayey silt (CL-ML). Bedrock included sandstone and claystone of the San Angelo Formation. Foundation materials were observed to contain "pinholes" in a number of Shelby tube samples (a common characteristic of collapsible soils), and laboratory swell/collapse testing was prioritized for these samples.

Seven (7) swell/collapse tests were performed on samples of foundation materials from upstream, downstream, and under the existing embankment. Samples were tested at the estimated existing effective overburden pressure, and produced collapse in four samples ranging from 0.4 to 6.2% (2.2% average). Tests on three samples produced swell of 0.8 to 2.9%, two of which were located at the downstream toe of the dam. The results of laboratory swell/collapse are in general agreement with previous lab results (NRCS, 2017), and support the conclusions of prior studies which suggested differential settlement of collapsible foundation materials as a likely source of observed embankment cracking/holes. It is noted that soil samples from the upstream boring tested in laboratory swell/collapse experienced relatively large collapse values, suggesting that prior inundation by the reservoir pool may not have saturated and initiated full collapse in these materials. Thus, it appears the potential still exists for significant additional settlements in the upstream foundation materials. Differences in collapse potential for foundation materials under, upstream, and downstream of the embankment will be further evaluated in a future revision of this report upon receipt of the laboratory test results.

No evidence of gypsum or related karst foundation conditions (voids, etc.) was encountered in the borings. However, secondary mineralization of gypsum was observed within fractures in the claystone at a bedrock outcrop located on the east side of the site near the left abutment and above the auxiliary spillway channel. This observation suggests that solutioning and redeposition of soluble materials within the natural foundation materials may be occurring.

Results of soil dispersion testing (crumb, double hydrometer) indicated the soils are generally non-dispersive. Prior testing (NRCS 2017) on foundation materials indicated elevated double-hydrometer test results in some foundations samples, but these were generally coarse-grained and/or low-plasticity soils for which dispersive classifications generally do not apply. Results of soluble salts (chlorides and sulfates) testing in both embankment and foundation materials from current and prior studies did not indicate elevated soluble salt content, suggesting that highly-soluble soils may not be present near the dam embankments.

Estimates of Geologic Input Parameters for SITES Evaluations of FRS No. 4

Hydraulic analysis and design of vegetated earthen spillways for dams are typically performed using the Water Resources Site Analysis computer program (SITES) developed by NRCS. SITES is used to evaluate erosional stability and head-cutting potential for auxiliary spillway channels subjected to flows associated with the design flood event. Development of recommended geologic input parameters for SITES analysis was performed according to published NRCS guidance (NRCS 2001, NRCS 2011) and other publications (McCook, 2005).

A geologic investigation of the auxiliary spillway was not included in the scope of work performed for FRS No. 4, as the components included in the field investigation needed to be prioritized and obtaining additional information on the auxiliary spillway was not expected to impact the selection of the preferred alternative. The original Geologic Investigation Report, original Soil Mechanics Report, and additional limited existing geologic information from the as-built drawings, published literature, engineering judgement, and experience in the general project area were relied upon to develop estimates of geologic input parameters for SITES evaluations.

To account for inherent variability in the geologic units and parameter uncertainty, the headcut erodibility index (Kh) and other geologic input parameters were estimated considering both "favorable" and "unfavorable" soil properties and bedrock characteristics. While there were not adequate data to perform an actual statistical analysis for this project, the unfavorable values could generally be considered a "low average" and the favorable could be considered a "high average" based on engineering judgment. It should be noted that the selected values are heavily reliant on judgement and experience with similar soils and geologic units in the general project area.

The SITES parameters recommended for the concept design analysis are presented in **Table 3-1**. Detailed discussion of the analysis assumptions, methodology, and results is provided in **Appendix E**. Based on limitations of the existing geologic data as discussed above, a supplemental geologic investigation is recommended to confirm the preliminary estimates of site stratigraphy and material properties herein if the project includes use or modification of the existing auxiliary spillway. The recommended supplemental investigation would include a detailed geologic reconnaissance with surface mapping, geotechnical test borings, and soil mechanics laboratory testing. Note that results of the supplemental investigation may warrant revision of the stratigraphy and/or material parameters presented below.

**Table 3-1. Recommended Material Properties for FRS No. 4 SITES Concept Design Analysis**

| Stratum Description | Post-Grading Thickness (ft) | USCS | Bounding Case | Dry Unit Weight (pcf) | PI | Clay Fraction (%) | D75 (mm) | Kh |
|---|---|---|---|---|---|---|---|---|
| SC-SM | 0 - 7 | SC-SM | Unfavorable Values | 110 d | NP c | 29 c | 0.06 c | 0.03 |
| | | | Favorable Values | 115 d | NP c | 6 c | 0.84 c | 0.04 |

| Stratum Description | Post-Grading Thickness (ft) | USCS | Bounding Case | Dry Unit Weight (pcf) | PI | Clay Fraction (%) | D75 (mm) | Kh |
|---|---|---|---|---|---|---|---|---|
| Sandstone | > 25 | Sandstone | Unfavorable Values | 97 b | --- a | --- a | --- a | 88 |
| | | | Favorable Values | 106 b | --- a | --- a | --- a | 215 |

[a] "---" input parameter not applicable to material type.
[b] Historical test results reported for Sandstone cores in the original Soil Mechanics Report (SCS, 1961b).
[c] Historical test results for SC-SM soils reported in the Plan and Profiles for Geologic Investigation (SCS, 1961a). Soils were sampled in the auxiliary spillway, borrow area, principal spillway, and dam embankment and were assumed to be representative of the soil properties in the auxiliary spillway. This assumption must be validated through field investigation and laboratory testing.
[d] Estimated based on typical properties of SM-SC soils per NAVFAC Design Manual 7.02 dated 1 September 1986.

Mapped Geology at FRS No. 5

The site geology at FRS No. 5 is mapped as Fluviatile terrace deposits (Qt), and bedrock of the San Angelo Formation (Psa) from the Double Mountain group. Fluviatile terrace deposits typically consist of gravel, sand, silt, and clay in varying proportions that coarsen with depth. Bedrock of the San Angelo Formation includes mudstone, sandstone, siltstone, shale, conglomerate, and gypsum. The formation consists mostly of brownish-red to light-gray mudstone and siltstone containing thin lenses of satin spar gypsum and alabaster gypsum nodules.

The USGS karst hazard map of the United States (Weary and Doctor, 2014) indicates the location of Kickapoo 5 as located within a hazard zone for potential karst conditions. Karst conditions are formed by dissolution of bedrock due to subsurface water flow and/or surface water infiltration, and can contain features including voids, caves, and sinkholes. The specific hazard zone is classified as "evaporite rocks at or near the land surface in a dry climate", which is associated with the San Angelo formation underlying the dam site and much of the surrounding areas. Evaporites are generally defined as non-clastic sedimentary rocks composed primarily of water-soluble salts or minerals that were deposited from evaporation of a body of water. Evaporite karst hazards principally occur in deposits of gypsum, anhydrite, and halite. Dissolution of gypsum can produce karst conditions relatively rapidly (i.e., over a period of months to years or less) as compared to the rate of dissolution of carbonate rocks such as limestone and dolomite (i.e., over geologic time).

Previous Geologic Investigations at FRS No. 5

The original boring logs were not available for review as part of this project, but stick logs on the geologic profiles and descriptive text included in original GIR (USDA-SCS, 1961b) were used to develop understanding of subsurface conditions. The embankment is underlain by overburden soils described in the field as lean clay (CL) and clayey sand (SC) with silty sand (SM) and gravel zones near the stream channel. The results of laboratory testing on select samples recovered from the borings yielded similar classifications, including silty sand (SM), lean clay (CL), silty clay (CL-ML), clayey to silty sand (SC-SM), and poorly graded sand with silt (SP-SM). The thickness of overburden materials and depth to bedrock generally ranged from about 4

to 13 feet, with locally deeper zones on the right bank of the original creek centerline (20 to 26 feet in borings 303 and 302, respectively) and in a low area towards the left abutment (26 feet in boring 54).

According to the original GIR (USDA-SCS, 1961b), the entire site is reported to be underlain by the Permian San Angelo formation of the Double Mountain group. The underlying bedrock was described as predominantly sandstone with interbedded shale, although the contact between the shale and sandstone was not always distinguishable due to gradational changes. The sandstone was generally described as medium bedded, fairly well cemented, and moderately hard (Hd4). Poorly to well cemented conglomerate layers and lenses were also identified within the sandstone. Slight gypsum of "insignificant" amount was noted in boring 54 (near STA. 37+00) but was judged to not be detrimental according to the original GIR. The report noted slight gypsum occurrences (in crystalline and disseminated form) and local concentrations of calcium carbonate-cemented gravel can be expected within the bedrock units at the site.

Investigations completed in the auxiliary spillway included a number of borings and test pits upstream of the control section (between about STA. 3+00 and STA. 8+00), and three other borings drilled near the discharge end of the auxiliary spillway between about STA. 24+00 and 25+00. However, the original investigation did not include investigation between these locations, resulting in an approximately 1,600-foot "gap" between existing borings. The borings and test pits completed near the auxiliary spillway control section (201 through 208, 251 through 258, 2201 through 2211, and 3201) encountered overburden soils described as clayey sand (SC), silty sand (SM), and lean clay (CL) and generally ranging from 0 to 8 feet thick, as surficial rock outcrops were present at and between the locations of some borings. The bedrock encountered at the right abutment and present-day auxiliary spillway was described primarily as massive, poorly-cemented sandstone ranging from soft and shaley to moderately hard. The interbedded shale was described as compact and locally very sandy. The GIR noted abrupt lateral changes from sandstone to shale, and the rock hardness is extremely variable over relatively short distances. Bedding strike was reported as north-south (i.e., approximately perpendicular to the embankment centerline) with dip to the west. Jointing, bedding, and fracture orientations and characteristics are not well characterized. In contrast, the borings completed near the auxiliary spillway discharge (259 through 261) drilled to depths of about 15 feet encountered overburden soils consisting of lean clay (CL), clayey sand (SC), and silty sand (SM), but did not encounter bedrock within the investigated depths.

Three upstream areas (Zones A, B, and C) within the present-day reservoir were investigated as potential borrow sources. The investigation at Zone A encountered lean clay (CL) and clayey sand (SC) underlain by shale or sandstone with conglomerate at depths ranging from 5 to more than 12 feet below the ground surface. The Zone B investigations encountered lean clays (CL) with disseminated gypsum inclusions underlain by shale at about 5.5 to 7 feet below grade. Investigations in Zone C encountered lean clays (CL) and pockets of clayey sand (SC) underlain by sandstone at an average depth of about 12 feet below the ground surface.

Limited groundwater information from previous borings at the project site was available to for review as part of this project. The original pre-construction GIR for Kickapoo 5 (USDA-SCS

1961b) stated that no groundwater table was encountered in the borings. While a permanent normal pool is now present at Kickapoo 5, the ground surface elevation of proposed borings in the auxiliary spillway and potential upstream borrow area is generally above the normal pool, and shallow groundwater is not expected at these locations. However, groundwater levels may vary over time, and may have a significant impact on borrow area operations and proposed auxiliary spillway modifications.

Supplemental Preliminary Geologic Investigation of FRS No. 5

Supplemental preliminary geologic investigation and soil mechanics laboratory testing were conducted as part of this project. The purpose of the preliminary investigation was to further assess geologic conditions that could materially affect the cost and/or geologic feasibility of various rehabilitation and/or decommission alternatives presented in this Plan-EA. Specifically, the investigation focused on the following two areas that have significant cost implications for the alternatives:

1. Borrow source: The availability of on-site borrow sources for potential rehabilitation alternatives was found to have a significant effect on estimated construction cost during preliminary evaluations for this project. Therefore, a borrow source investigation was needed to confirm availability of suitable borrow material on-site to aid in refining the construction cost estimates. Accordingly, the supplemental geologic investigation included borings and associated laboratory testing in one potential borrow source located on the right bank of the reservoir upstream of the existing auxiliary spillway channel. Project constraints stipulates that the elevation of potential borrow sources must be below the proposed auxiliary spillway crest elevation (i.e., within the flood pool). Although several borings were advanced in this general area during the original 1961 GI, the area does not appear to have been developed as the primary borrow source for the original construction due to the similarity of pre-construction and current (2018) LIDAR topographic contours. In addition, the boring stick logs in the as-built drawings had limited usefulness in borrow source characterization, and have only vague descriptions delineating soluble salts (e.g., gypsum) content and concentration.

2. Auxiliary spillway stability and integrity: As part of the preliminary analysis, a parametric assessment of the auxiliary spillway stability and integrity was performed using SITES software and a range of estimated geotechnical input parameters (i.e., “favorable” and “unfavorable”) developed based on available data and engineering experience in the region. Results of the SITES analysis indicated excessive headcutting with breach (integrity issues) and erodibility (stability) of the auxiliary spillway channel for the unfavorable set of parameters. Consequently, construction cost estimates for the various alternatives in which the auxiliary spillway remains in service were developed assuming an additional RCC overtopping spillway would be added or the existing spillway would be widened to address integrity issues, and articulated concrete block (ACB) armoring would be required to mitigate stability issues. Due to the significant construction cost implications associated with these components and the uncertainties in geotechnical parameters used in the analysis, a geologic investigation was needed to refine the geologic input parameters for the SITES analysis with the intent to reduce conservatism and confirm whether these components was

needed. Accordingly, supplemental geologic investigation included borings and associated laboratory testing within the existing auxiliary spillway channel.

The field investigation was conducted in December 2021. The general scope of the field investigation included:

- Visual reconnaissance and limited mapping of geologic outcroppings;
- Four (4) geotechnical test boring (101-21 through 104-21) plus two (2) offset borings (104-21B and 104-21C) within the proposed borrow area; and
- Four (4) geotechnical test borings (201-21 through 204-21) plus one (1) offset boring (201-21B) within the existing auxiliary spillway channel.

Both disturbed (Standard Penetration Test [SPT], ASTM D1586) and relatively undisturbed (Shelby tube, ASTM D1587) soil samples were collected in each of the borings. Continuous rock coring was performed in 5-foot runs (ASTM D2113) upon reaching competent bedrock in the auxiliary spillway borings only. Bulk samples were collected from the auger cuttings in the borrow area for the purpose of performing laboratory index and strength testing on remolded samples. Laboratory geotechnical testing was performed on select soil and rock samples recovered from the borings. The laboratory testing program included:

- Index testing for classification purposes (i.e., moisture content, dry unit weight, Atterberg limits, sieve analysis, hydrometer);
- Analytical testing (i.e., soluble sulfates, soluble chlorides, pH)
- Dispersive soil testing (i.e., crumb and pinhole);
- Unconfined compression on soil and rock;
- Standard Proctor compaction on bulk samples from borrow area;
- Unconsolidated-undrained (UU) triaxial compression on remolded borrow sample; and
- Consolidated-undrained triaxial compression with pore pressure measurement (CU-bar) on remolded borrow samples.

The borrow area borings encountered natural alluvial materials described in the field as predominantly lean clay (CL) and clayey sand (SC) with one instance of silty clayey sand (SC-SM). The measured fines content generally ranged from about 32 to 83 percent, and the Plasticity Index (PI) generally ranged from about 6 to 26 (excluding one outlier with 15 percent fines at a depth of about 10 feet in boring 104-21). These results indicate that these materials have generally low permeability, which is desirable for proposed embankment fill materials. Measured concentrations of soluble salts (i.e., chlorides and gypsum) were found to be in a range generally suitable for embankment fill (72 to 5,440 ppm, i.e., about 0.5% or less). Crumb and pinhole tests indicate the borrow area materials are non-dispersive. Total and effective stress shear strengths on remolded samples were within typical ranges for CL and SC soils. Consequently, that the soils encountered in the on-site borrow area are estimated suitable for embankment fill.

The borings drilled in the lower portion of the auxiliary spillway (203-21 and 204-21) encountered about 6.5 to 8.5 feet of alluvial soils consisting of very stiff to hard lean clay (CL). A thin layer of existing fill materials classifying as lean clay (CL) was encountered in boring

202-21, located on the steepest portion of the auxiliary spillway channel immediately downstream of the crest. According to as-built drawings, the existing fill materials comprise much of the auxiliary spillway crest section and steepest portion immediately downstream of the crest. Underlying the alluvium, fractured bedrock of the San Angelo formation was encountered to depths of about 20 feet in borings 203-21 and 204-21. Fractured bedrock was also encountered at the ground surface in upstream boring 201-21 to termination depth of 20 feet, and immediately beneath existing fill materials in boring 202-21 to a depth of about 15 feet. The fractured bedrock consisted primarily of moderately strong to strong sandstone, with some intervals of very stiff claystone and very weak to very strong conglomerate, but very poor rock core recovery and rock quality designation (RQD) was encountered in this zone. The underlying bedrock encountered at depths ranging from 15 to 20 feet had significantly higher rock core recovery and RQD, and consisted of mostly moderately weak to strong sandstone with some intervals of stiff to very stiff claystone and strong to very strong conglomerate. In general, the soils encountered in the 2021 auxiliary spillway borings were more fine-grained, more plastic, and stiffer/denser than assumed in the preliminary SITES analyses performed for this project on the basis of both field strength testing (SPT $N_{60}$ and pocket penetrometer) and laboratory unconfined compressive strength testing. Consequently, the data allowed for revised SITES geologic input parameters that generally have higher Kh values and more favorable index properties (dry density, PI, etc.), thereby improving the erosion resistance of the materials in the auxiliary spillway.

No evidence of gypsum bedrock or related karst foundation conditions (voids, etc.) was encountered in the auxiliary spillway or borrow borings. The alluvium and claystone in the auxiliary spillway was found to be potentially dispersive based on the results of three crumb tests (i.e., Grades 3 and 4), but confirmatory pinhole tests on two of these samples were non-dispersive (ND2) to only slightly dispersive (ND3). Additional dispersion testing is recommended for future rehabilitation designs to confirm dispersive classifications and to determine whether any surface treatments are needed to provide additional erosion resistance.

It is noted that some relatively undisturbed samples of natural alluvium and bedrock materials in both the borrow area and auxiliary spillway were observed to contain “pinholes”. As discussed previously, pinholes are a common characteristic of collapsible soils. Although the existing embankment at FRS No. 5 has not experienced adverse performance to date due to collapsible soils, it is possible that potentially collapsible soils may be present in the vicinity of the embankment. Future geologic investigations should be performed as part of rehabilitation design (if a rehabilitation alternative is selected) to investigate the potential for collapsible soils at the downstream toe of the dam to determine if foundation treatment (e.g., overexcavation/replacement, prewetting/preloading, etc.) is needed rehabilitation alternative.

Estimates of Geologic Input Parameters for SITES Evaluations of FRS No. 5

Hydraulic analysis and design of vegetated earthen spillways for dams are typically performed using the Water Resources Site Analysis computer program (SITES) developed by NRCS. SITES is used to evaluate erosional stability and head-cutting potential for auxiliary spillway channels subjected to flows associated with the design flood event. Development of recommended geologic input parameters for SITES analysis was performed according to published NRCS guidance (NRCS 2001, NRCS 2011) and other publications (McCook, 2005).

Development soil stratigraphy and geologic input parameters for existing materials within the auxiliary spillway for SITES analysis were based on the results of the 2021 geologic investigation, as well as limited existing geologic information from the as-built drawings, published literature, engineering judgement, and our experience in the general project area.

To account for inherent variability in the geologic units and parameter uncertainty, the headcut erodibility index (Kh) and other geologic input parameters were estimated considering both "favorable" and "unfavorable" soil properties and bedrock characteristics. While there were not adequate data to perform an actual statistical analysis for this project, the unfavorable values could generally be considered a "low average" and the favorable could be considered a "high average" based on data scatter and engineering judgment.

The SITES parameters recommended for the concept design analysis are presented in **Table 3-2**. Detailed discussion of the analysis assumptions, methodology, and results is provided in **Appendix E**.

**Table 3-2. Recommended Material Properties for FRS No. 5 SITES Concept Design Analysis**

| Stratum Description | USCS | Bounding Case [b] | Dry Unit Weight (pcf) | PI | Clay Fraction (%) | $D_{75}$ (mm) | $D_{50}$ (mm) | $K_h$ |
|---|---|---|---|---|---|---|---|---|
| Existing Fill | SC, CL | Unfavorable Values | 110 | 20 | 20 | 0.100 | --- [a] | 0.06 |
| | | Favorable Values | 115 | 25 | 30 | 0.200 | --- [a] | 0.09 |
| Alluvium | CL, SC | Unfavorable Values | 107 | 18 | 35 | 0.040 | --- [a] | 0.09 |
| | | Favorable Values | 112 | 23 | 45 | 0.050 | --- [a] | 0.13 |
| Fractured Bedrock ("rock-like") | Sandstone, Claystone, Conglom-erate | Unfavorable Values | 120 | --- [a] | --- [a] | --- [a] | 0.070 | 0.20 |
| | | Favorable Values | 125 | --- [a] | --- [a] | --- [a] | 0.100 | 1.68 |
| Fractured Bedrock ("soil-like") | Sandstone, Claystone, Conglom-erate | Unfavorable Values | 120 | 4 | 18 | 0.080 | --- [a] | 0.30 |
| | | Favorable Values | 125 | 12 | 25 | 0.200 | --- [a] | 0.43 |
| Bedrock | Sandstone, Claystone, Conglom-erate | Unfavorable Values | 120 | --- [a] | --- [a] | --- [a] | 50.8 | 10.1 |
| | | Favorable Values | 130 | --- [a] | --- [a] | --- [a] | 101.6 | 134.0 |
| Proposed New Fill [c] | CL, SC | Unfavorable Values | 108 | 10 | 20 | 0.005 | --- [a] | 0.09 |
| | | Favorable Values | 115 | 20 | 30 | 0.010 | --- [a] | 0.10 |

[a] "---" indicates values are not applicable for this material type.

[b] Unfavorable values correspond to roughly 33rd percentile of available data, whereas favorable values correspond to roughly average to 67th percentile of available data.

[c] Values based on results of 2021 borrow area borings (101-21 through 104-21 and 104-21B/C) drilled on the upstream right bank of the reservoir and associated laboratory testing.

### 3.2.6 Climate

According to Bronte, Texas Monthly Weather at The Weather Channel, accessed December 4, 2020, the average annual precipitation at Bronte is about 22.8 inches. The wettest month of the year is June, averaging 3.11 inches. The driest month of the year is January, averaging 0.88 inch. The coolest month is January with temperatures ranging from 29ºF to 59ºF. The warmest month is August with temperatures ranging from 70ºF to 97°F. Historical extreme (record) temperatures range from -2°F to 114°F.

## 3.3 Land Use

The total drainage area above FRS No. 4 and FRS No. 5 is 2,525.4 acres and 5,552.4 acres, respectively. These drainage areas were derived using ArcMap 10.8 (ESRI, 2020), the Arc Hydro tool, and LiDAR topography (USGS, 2018). Automatic ArcMap delineations were checked and edited as necessary against the LiDAR topography. The land use/land cover data were extracted from the 2019 National Land Cover Dataset (NLCD) and then hand edited to reflect recent and/or missing development within the study area. **Table 3-3** lists the land uses in the uncontrolled watershed area upstream of both dams as well as in the breach inundation zone below FRS No. 5. Located approximately 60 miles from Abilene, TX, land use in the watersheds has remained relatively unchanged since the dams were constructed, but there has been a small amount of low-density residential development, including in the vicinity of and downstream of both dams. **Appendix C** contains land use maps (**Figures C-1 and C-2**) of the upstream contributing watershed and the downstream sunny day breach zone.

**Table 3-3. Existing Land Use**

| Land Cover Type | Drainage Area Above FRS No. 4 | | Drainage Area Above FRS No. 5 (acres) - not including area controlled by FRS No. 4 | | Breach Inundation Zone below FRS No. 5 [a] | |
|---|---|---|---|---|---|---|
| | (acres) | (%) | (acres) | (%) | (acres) | (%) |
| Open Water | 0.2 | 0.0% | 24.9 | 0.4% | 1.0 | 0.1% |
| Developed, Open Space | 20.0 | 0.8% | 110.5 | 2.0% | 177.9 | 9.4% |
| Developed, Low Intensity | 0.7 | 0.0% | 4.7 | 0.1% | 7.5 | 0.4% |
| Developed, Medium Intensity | -- | -- | 0.7 | 0.0% | 2.0 | 0.1% |
| Developed, High Intensity | -- | -- | 0.2 | 0.0% | 0.2 | 0.0% |
| Deciduous Forest | 242.5 | 9.6% | 319.7 | 5.8% | 7.2 | 0.4% |
| Evergreen Forest | 179.2 | 7.1% | 151.2 | 2.7% | 2.4 | 0.1% |
| Mixed Forest | 5.3 | 0.2% | 6.4 | 0.1% | 0.9 | 0.0% |
| Shrub/Scrub | 1977.1 | 78.4% | 4754.8 | 85.6% | 1287.6 | 68.2% |
| Grassland/Herbaceous | 2.4 | 0.1% | 2.2 | 0.0% | 35.3 | 1.9% |

| Land Cover Type | Drainage Area Above FRS No. 4 | | Drainage Area Above FRS No. 5 (acres) - not including area controlled by FRS No. 4 | | Breach Inundation Zone below FRS No. 5 [a] | |
|---|---|---|---|---|---|---|
| Cultivated Crops | 95.1 | 3.8% | 175.4 | 3.2% | 365.1 | 19.3% |
| **Total** | **2525.5** | **100.0%** | **5550.7** | **100.0%** | **1887.1** | **100.0%** |

[a] Acreages were estimated below FRS No. 5 from the structure to the downstream limit of the top of dam sunny day breach zone as depicted on **Figure C-2.**

## 3.4 Prime and Unique Farmland

According to the U.S. Department of Agriculture soil data access website, Prime Farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. The soil quality, growing season, and moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management and acceptable farming methods are applied. Unique farmland is land other than prime farmland that is used for the production of specific high-value food and fiber crops, such as citrus, tree nuts, olives, cranberries, and other fruits and vegetables. It has the special combination of soil quality, growing season, moisture supply, temperature, humidity, air drainage, elevation, and aspect needed for the soil to economically produce sustainable high yields of these crops when properly managed. In some areas, land that does not meet the criteria for prime or unique farmland is considered to be farmland of statewide importance for the production of food, feed, fiber, forage, and oilseed crops. The criteria for defining and delineating farmland of statewide importance are determined by the appropriate State agencies.

Based on the NRCS Soil Survey, there are areas surrounding both FRS No. 4 and FRS No. 5 that have been identified as prime farmland or farmland of statewide importance. Based on a review of aerial imagery for the project area, it does not appear that most of these areas are currently being actively farmed. There are approximately 40 acres of prime farmland within or immediately adjacent to the flood pool for FRS No. 4 that appear to be actively being farmed. There are also areas downstream of both FRS No. 4 and FRS No. 5, along Middle Kickapoo Creek, that have been identified as prime farmland or farmland of statewide importance that appear to be actively being farmed. A map of farmland designations is provided as **Figure C-3** in **Appendix C**.

## 3.5 Woodland Vegetation/Forest Resources

Woodland vegetation is present surrounding both the FRS No. 4 and FRS No. 5 sites. Dominant species present surrounding the FRS No. 4 site includes honey mesquite (*Prosopis glandulosa*), sugarberry (*Celtis laevigata*), and eastern red cedar (*Juniperus virginiana*). Dominant species surrounding the FRS No. 5 site includes honey mesquite, eastern red cedar, sugarberry, and southern live oak (*Quercus virginiana*).

## 3.6 Invasive Species

Invasive plant species have the potential to occur throughout Texas and have can establish themselves and then spread aggressively, threating the existing biodiversity of native plants.

According to the Texas Invasives website (Texas Invasives, 2022), the following invasive plant species have been identified as being particularly worrisome within the Rolling Plains Ecoregion, in which FRS No. 4 and FRS No. 5 are located:

- Chinese tallow tree (*Triadica sebifera)*
- Japanese privet (*Ligustrum japonicum)*
- Salt cedar (*Tamarix ramosissima)*
- Johnson grass (*Sorghum halepense)*
- Japanese honeysuckle (*Lonicera japonica)*
- King Ranch bluestem (*Bothriochloa ischaemum var. songarica)*
- Giant reed (*Arundo donax)*
- Nutgrass (*Cyperus rotundus)*
- Dallisgrass (*Paspalum dilatatum)*
- Bermudagrass (*Cynodon dactylon)*
- Russian thistle (*Salsola tragus)*
- Siberian elm (*Ulmus pumila)*

According to the Texas Invasives website (Texas Invasives, 2022), the following are common invasive wildlife species that have the potential to occur within the project area or in the surrounding watershed include:

- Asian clam (*Corbicula fluminea*)
- Zebra Mussel (*Dreissena Polymorpha*)
- European Starling (*Sturnus vulgaris*)
- Red imported fire ants (*Solenopsis invicta*)
- Feral pig (*Sus scrofa*)
- Nutria (*Myocastor coypus*)

## 3.7 Threatened and Endangered Species

A desktop analysis was performed to determine the presence or absence of any threatened or endangered species within the FRS No. 4 and FRS No. 5 sites. Information was obtained from Texas Parks and Wildlife Department's (TPWD) Texas Natural Diversity Database (TXNDD) (TPWD, 2020) and U.S. Fish and Wildlife Services' (USFWS) Information for Planning and Consultation (IPaC) database (USFWS, 2020) concerning the occurrence and location of state and federally listed wildlife and plant species in and surrounding the sites.

According to TPWD and USFWS, there are 13 federal and/or state listed wildlife/plant species/ subspecies that have the potential to, or have historically occurred within Coke County. Federally listed species include the following:

- Black rail (*Laterallus jamaicensis*), Federal Proposed Threatened/State Threatened;
- Piping plover (*Charadrius melodus*), Federal Threatened/State Threatened;
- Red knot (*Calidris canutus rufa*); Federal Threatened/State Threatened;
- Sharpnose shiner (*Notropis oxyrhynchus*), Federal Endangered/State Endangered;

- Monarch butterfly (*Danaus plexippus*), Federal Candidate;
- Tricolored bat (*Perimyotis subflavus*), Federal Proposed Endangered;
- Texas fatmucket (*Lampsilis bracteata*), Federal Proposed Endangered/State Threatened;
- Texas pimpleback (*Cyclonaias petrina*), Federal Proposed Endangered/State Threatened; and
- Texas Poppy-mallow (*Callirhoe scabriuscula*) Federal Endangered/State Endangered.

State listed threatened species include the following:

- White-faced ibis (*Plegadis chihi*);
- Red River pupfish (*Cyprinodon rubrofluviatilis*);
- Texas fatmucket (*Lampsilis bracteata*);
- Texas pimpleback (*Cyclonaias petrina*);
- Brazos water snake (*Nerodia harteri*); and
- Texas horned lizard (*Phrynosoma cornutum*).

Based on TxNDD data received on July 19, 2023, no element of occurrence records (EORs) were recorded within five miles of FRS No. 4 or FRS No. 5 (TPWD, 2023).

Field investigations occurred on July 12, 2023, to assess the potential for habitat at each dam site. Based on the field investigations, it was determined that suitable habitat is present for the monarch butterfly (federal candidate), tricolored bat (federal proposed endangered), and the Texas horned lizard (state threatened) at both FRS No. 4 and FRS No. 5.

No suitable habitat was determined to be present for any additional federal or state listed species.

Tricolored Bat

The tricolored bat is currently proposed for listing as an endangered species by USFWS and does not yet have federal protection. However, habitat was assessed as a matter of due diligence. Based on a 12-month finding on a petition to list the tricolored bat, USFWS found that listing the species is warranted and on September 14, 2022, USFWS proposed a rule to list the tricolored bat as endangered. USFWS will make a final determination no more than 18 months from the proposed rule. This wide-ranging bat was once common across the eastern and central U.S. However, the species currently faces extinction due to white-nose syndrome, a deadly fungal disease affecting cave-dwelling bats across North America. Caves and abandoned mines are considered very important to this species for roosting in the winter months. Tricolored bats can also roost in man-made structures such as culverts and buildings. Tricolored bats use woodlands and forested areas for roosting during the spring, summer, and fall. They typically roost in the leaves of live or recently dead deciduous hardwood trees, as well as Spanish moss and pine trees. Woodlands and forested areas, especially along riparian corridors, could provide suitable roosting and foraging habitat for this species within the survey area in the Spring, Summer, and Fall. No known caves or hibernacula are present within the survey area.

Monarch Butterfly

The monarch butterfly is currently considered a candidate species for listing by USFWS and does not yet have federal protection; however, habitat was assessed as a matter of due diligence. Monarch butterflies are habitat generalists but require milkweed species as larval hosts and a nectar source for adults. The presence of milkweed indicates suitable monarch butterfly habitat. In Texas, monarch butterflies and their eggs and larvae are present from March-June and September-October. Milkweeds and nectar plants are known to occur along roadsides and in other disturbed and open areas. One species, green milkweed, was observed in the southern portion of the survey area. Therefore, suitable habitat for the monarch butterfly may be present throughout the survey area where milkweed and nectar plants are present.

Texas Horned Lizard

Suitable habitat for the state threatened Texas horned lizard were identified within survey area. This species prefers open habitats with sparse vegetation including; grass, prairie, cactus, scattered brush or scrubby trees, soil varying from sandy to rocky, and harvester ants as a food source. Harvester ant mounds and suitable vegetation and soil types were observed within the survey area. Therefore, the survey area could provide suitable habitat for the Texas horned lizard.

## 3.8 Cultural Resources, Natural and Scenic Areas, and Visual Resources

Section 106 of the National Historic Preservation Act (NHPA) of 1966 required Federal Agencies to consider the impacts of their actions on historic properties. NRCS consultation with the State Historic Preservation Office (SHPO), Tribal Historic Preservation Offices (THPO), and federally recognized Tribes, as appropriate, as well as other interested parties, has been documented in **Appendix A**.

### 3.8.1 Section 106 of the National Historic Preservation Act

NRCS determined the Area of Potential Effect (APE) through identification studies and consultation and includes the areas of potential ground disturbance (using the maximum possible extent of ground disturbance). The indirect APE is the viewshed from any identified historic resource to the proposed undertaking (using the maximum possible extent of ground disturbance). The APE considers areas that would be directly or indirectly affected by the proposed undertaking in addition to the viewshed of historic properties that would be affected by the project. The viewshed includes all of the visible area in the line of sight of the project and excludes areas obstructed by terrain or other features.

A cultural resources desktop review was performed by AECOM on behalf on NRCS in February 2021. The desktop review included a search of archeological records available on the Texas Archeological Sites Atlas maintained by the Texas Historical Commission (THC), which acts as the State Historic Preservation Office (SHPO) in Texas, to determine if any previously recorded cultural resources sites, including archeological sites, historic properties, cemeteries, or State Antiquities Landmarks (SALs), were located within one kilometer of the APE at FRS No. 4 and FRS No. 5. The desktop review revealed no previous cultural resources sites occur inside either APE. However, the desktop review indicated that each area has potential to contain unrecorded archeological resources.

AECOM conducted the cultural resources survey of the APE on behalf of NRCS on April 8, 2021, through April 13, 2021, under Texas Antiquities Permit No. 30086. The survey resulted in the identification of three previously unrecorded prehistoric archeological sites and four prehistoric isolated finds. In addition, three historic-age resources were identified and recorded, including the FRS No. 4 and FRS No. 5 dam structures, and a livestock shelter/corral complex.

Consultation with the Texas SHPO has been completed, (see **Appendix A**). As a result of consultation and historic and prehistoric identification studies, NRCS has determined there will be no effect to historic properties as planned. SHPO concurrence was received on July 12, 2021 that no historic properties are present, and the proposed project would have no effect on historic properties (see **Appendix A**).

The following tribes have a stated interest in ancestral lands and might attach religious or cultural significance to historic properties or have claims to land areas within Coke County, Texas: Comanche Nation of Oklahoma; Kiowa Indian Tribe of Oklahoma; the Apache Tribe of Oklahoma; the Tonkawa Tribe of Indians of Oklahoma; and the Wichita and Affiliated Tribes (Wichita, Keechi, Waco, and Tawakonie) of Oklahoma. NRCS initiated consultation July 15, 2022 with listed Tribes by certified mail inviting them to participate in the consultation process and help identify previously unknown resources in and around the APE. A determination letter was emailed on May 5, 2024, but NRCS has received no replies from Tribal Nations to date.

Kickapoo FRS No. 4 and 5 were constructed in 1962 and 1963, respectively, and therefore, are old enough for National Register consideration due to their age (50+ years old). A property must be at least 50 years of age and must have cultural significance to be considered a historic place and be eligible for listing in the National Register (National Park Service, 1997). Although the resources retain integrity, their association with flood control development or agriculture in the Kickapoo Creek watershed is not sufficient for NRHP-listing as there are other examples of these types of resources in Coke County, with similar historical context. NRCS has determined that the dams do not meet the NRHP criteria of eligibility and are therefore recommended as Not Eligible for listing in the NRHP or for designation as a SAL.

In accordance with the Prototype Programmatic Agreement (PPA) among NRCS and the Texas SHPO, and the National Programmatic Agreement among NRCS, the National Conference of State Historic Preservation Officers, the Advisory Council of Historic Preservation (ACHP), and according to NRCS General Manual 420, Part 401 guidance, NRCS will consult with the Texas SHPO during the design phase to determine what (if any) additional cultural resource investigations must be undertaken, should a decommission or rehabilitation alternative be selected.

### 3.8.2 National Historic Landmarks Program

The National Parks Services (NPS) National Historic Landmarks Program identifies nationally significant historic places or properties designated by the Secretary of the Interior and listed in the NRHP. These places or properties possess a high degree of historic integrity, which can be

defined as the ability of a place or property to convey its historical associations or attributes (NPS, 2021).

Per the NPS's National Historic Landmarks Program website, there are no National Historic Landmarks listed in Coke County, Texas. Therefore, the National Historic Landmarks Program is not applicable to the project's affected environment and will not be carried forward for impact analysis in the Environmental Consequences section.

## 3.9 Water Quality

The 2020 305(b)/303(d) Integrated Water Quality Assessment and Impaired Waters Report (TCEQ, 2020) did not identify any impaired streams within the FRS No. 4 or FRS No. 5 sites.

## 3.10 Streams, Lakes, and Wetlands/Waters of the U.S.

Based on review of U.S. Geological Survey (USGS) topographic map, one stream, Middle Kickapoo Creek, flows through FRS No. 4. During the field investigation, this stream was determined to not exhibit a discernible bed and bank and no visible indications of an ordinary high-water mark from stream flow events; therefore, was determined to not be present within the survey area. At the time of the survey, the reservoir at FRS No. 4 did not contain any water. A review of historic aerials photographs indicated that FRS No. 4 reservoir has not held water in approximately 25 years. No wetlands were observed within the survey area of FRS No. 4.

Based on a review of USGS topographic map, two streams, Dry Creek and Middle Kickapoo Creek, flow into FRS No. 5. Middle Kickapoo Creek leaves the reservoir and flows into the Colorado River. During the field investigation, these streams were determined to be intermittent in nature within the survey area. Dry Creek spans approximately 900 linear feet (0.25 acres in aerial extent) within the survey area with an average ordinary high-water mark of 12 feet. Middle Kickapoo Creek spans approximately 1,923 linear feet (0.48 acre in aerial extent) within the survey area with an average ordinary high-water mark of 26 feet. In addition to the intermittent streams, the FRS No. 5 Reservoir was delineated within the survey area. The reservoir is approximately 27 acres within the survey area and was determined to be perennial in nature.

## 3.11 Riparian Areas

Riparian areas were not present at the normal pool/sediment pool area for FRS No. 4 or downstream along Middle Kickapoo Creek. It is assumed that this is due to the absence of water within the stream and reservoir. A riparian area was noted along Middle Kickapoo Creek at FRS No. 5 and was dominated by trees and shrubs with various grasses, sedges, cattails, and rushes comprising the understory. Wildlife species within the sites are those typically found in urban and modified settings. These species can include migratory birds and native wildlife.

## 3.12 Migratory Birds

The migratory bird pathways, stopover habitats, wintering areas, and breeding areas may occur within and/or adjacent to disturbed area and may be associated with wetlands, ponds, riparian

corridors, fallow fields, grasslands, and woodlands. If construction or clearing would take place during migratory bird season (March 1 to August 31), a qualified wildlife biologist will conduct nest presence/absence surveys to identify any active nests within the site to ensure compliance with the Migratory Bird Treaty Act (MBTA).

## 3.13 Social and Economic Conditions

The following presents the social and economic conditions of the Project study area. The Project's study area was delineated using U.S. Census-defined geographic boundaries. The Project study area for social and economic analyses is delineated by Census Tract 9501 (hereafter, affected census tract), the census tract the Project is located within (**Figure C-4** in **Appendix C**). County-level and state-level data on social and economic conditions were compiled for comparative purposes and socioeconomic conditions of the Project area are presented for Census Tract 9501 Block Group 1, Census Tract 9501 Block Group 2, Census Tract 9501, Coke County, and the state of Texas. For the following social and economic information block group information is presented when available for all items within the tables, otherwise Census tract information is presented.

With an approximate population of 3,300, Coke County is rural and not part of a metropolitan statistical area (U.S. Census Bureau). **Table 3-4** provides relevant information regarding the Project beneficiary profile for Census Tract 9501, Coke County, and Texas.

**Table 3-4. Project Beneficiary Profile**

| Beneficiary | Census Tract 9501 | County Coke | State Texas |
|---|---|---|---|
| Population | 1,584 | 3,298 | 28,635,442 |
| Median Age | 43.3 | 47.9 | 34.8 |
| Total Number of Households | 759 | 1,625 | 9,906,070 |
| Median Value of Owner-Occupied Housing Units | $82,100 | $74,100 | $187,200 |
| Median Household Income | $47,708 | $45,072 | $63,826 |
| Poverty Rate (all people) | 7.4% | 12.5% | 14.2% |
| Unemployment Rate | 1.1% | 2.3% | 5.3% |

Source: 2016-2020 American Community Survey 5-Year Estimates

### 3.13.1 Agriculture Statistics

According to the USDA's 2017 Census of Agriculture, harvested cropland in Coke County was dominated by winter wheat (for grain) and oats (for grain) and the top Ag. products by value are cattle (70%), then sheep, cotton, wheat. Much of the former cropland has moved to forage production, lessening potential erosion. **Table 3-5** lists 2017 statistical data on agricultural land and products for Coke County that were obtained from the USDA 2017 Census of Agriculture.

**Table 3-5. Land and Product Statistics for Coke County**

| **Statistic** | **2017** |
|---|---|
| Number of farms | 449 |
| Land in farms | 469,303 acres |
| Average size of farm | 1045 acres |
| Market value of products sold | $7,840,000 |
| Average per farm | $17,460 |
| Percentage of producers that are white/non-Hispanic | 95% |

Source: USDA 2017 Census of Agriculture

### 3.13.2 Population

**Table 3-6** shows the break-down of age and gender characteristics of Census Tract 9501, Coke County, and Texas. The percentage that each population characteristic represents of the total population evaluated in the table column are provided in parenthesis.

**Table 3-6. Population Characteristics**

| **Socioeconomic Criteria** | | **Census Tract 9501** | **County Coke** | **State Texas** |
|---|---|---|---|---|
| Total Population | | 1,584 | 3,298 | 28,635,442 |
| Gender | Male | 794 (50.1%) | 1,591 (48.2%) | 14,221,720 (49.7%) |
| | Female | 790 (49.9%) | 1,707 (51.8%) | 14,413,722 (50.3%) |
| Age | Under 18 | 371 (23.4%%) | 706 (21.4%) | 7,381,482 (25.8%) |
| | 18 & over | 1,213 (76.6%) | 2,592 (78.6%) | 21,253,960 (74.2%) |
| | 20-24 | 47 (3.0%) | 91 (2.8%) | 2,000,883 (7.0%) |
| | 25-34 | 256 (16.2%) | 309 (9.4%) | 4,210,488 (14.7%) |
| | 35-44 | 125 (7.9%) | 386 (11.7%) | 3,888,044 (13.6%) |
| | 45-54 | 152 (9.6%) | 438 (13.3%) | 3,542,967 (12.4%) |
| | 55-59 | 101 (6.4%) | 208 (6.3%) | 1,702,570 (5.9%) |
| | 60-64 | 99 (6.3%) | 219 (6.6%) | 1,512,413 (5.3%) |
| | 65 & over | 417 (26.3%) | 919 (27.9%) | 3,593,369 (12.5%) |

Source: 2016-2020 American Community Survey 5-Year Estimates

### 3.13.3 Race and Ethnicity

Race and ethnicity characteristics for Census Tract 9501, Census Tract 9501 Block Group 1, Census Tract 9501 Block Group 2, Coke County, and Texas are provided in **Table 3-7** and **Table 3-8**. The shares of selected population characteristics as a percent of the populations in the study area are provided in parenthesis. As shown in Table 3-7, Hispanic or Latino populations make up a smaller percentage of the populations in Census Tract 9501 and Coke County than of Texas at large. As shown in Table 3-8, Census Tract 9501 Block Group 1, Census Tract 9501 Block Group 2, and Coke County have a higher percentage of white and a lower percentage of all other races (combined) than Texas does at large.

**Table 3-7. Population by Ethnicity**

| Ethnicity | Census Tract 9501 | County Coke | State Texas |
|---|---|---|---|
| Hispanic or Latino | 354 (22.3%) | 727 (22.0%) | 11,294,257 (39.4%) |
| Not Hispanic or Latino | 1,230 (77.7%) | 2,571 (78.0%) | 17,341,185 (60.6%) |

Source: 2016-2020 American Community Survey 5-Year Estimates

**Table 3-8. Population by Race**

| Race | Census Tract Block Group 1 | Census Tract Block Group 2 | County Coke | State Texas |
|---|---|---|---|---|
| White | 514 (96.3%) | 875 (83.3%) | 2,963 (89.8%) | 19,805,623 (69.2%) |
| African American | 0 (0.0%) | 34 (3.2%) | 37 (1.1%) | 3,464,424 (12.1%) |
| American Indian and Alaska Native | 4 (0.7%) | 0 (0.0%) | 45 (1.4%) | 137,921 (0.5%) |
| Asian | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 1,415,664 (4.9%) |
| Native Hawaiian and other Pacific Islander | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 25,328 (0.1%) |
| Some other race | 16 (3.0%) | 109 (10.4%) | 207 (6.3%) | 1,788,398 (6.2%) |
| Two or more races | 0 (0.0%) | 32 (3.0%) | 28 (0.8%) | 703,620 (2.5%) |

Source: 2016-2020 American Community Survey 5-Year Estimates

### 3.13.4 Employment and Income

**Table 3-9** summarizes labor force characteristics of Census Tract 9501 Block Group 1, Census Tract 9501 Block Group 2, Coke County, and Texas. Census Tract 9501 Block Group 1, Census Tract 9501 Block Group 2, and Coke County have lower unemployment than Texas at large.

**Table 3-9. Labor Force**

| Characteristic | Census Tract 9501 Block Group 1 | Census Tract 9501 Block Group 2 | County Coke | State Texas |
|---|---|---|---|---|
| Population 16 years and older | 481 | 771 | 2,688 | 22,078,090 |

| Characteristic | Census Tract 9501 Block Group 1 | Census Tract 9501 Block Group 2 | County Coke | State Texas |
|---|---|---|---|---|
| Civilian labor force | 229 | 489 | 1,483 | 14,214,242 |
| Civilian labor force participation rate | 47.6% | 63.4% | 55.2% | 64.4% |
| Employed | 222 | 488 | 1,449 | 13,461,358 |
| % Employed | 96.9% | 99.8% | 97.7% | 94.7% |
| Unemployed | 7 | 1 | 34 | 752,884 |
| % Unemployed | 3.1% | 0.2% | 2.3% | 5.3% |

Source: 2016-2020 American Community Survey 5-Year Estimates

The distribution of employment by industry is provided in **Table 3-10**. The top three employment industries in Census Tract 9501 are as follows: educational services, and health care and social assistance; transportation and warehousing, and utilities; and construction.

**Table 3-10. Employment by Industry**

| Industry Sector | Census Tract 9501 | County Coke | State Texas |
|---|---|---|---|
| Agriculture, forestry, fishing and hunting, and mining | 48 | 89 | 382,157 |
| Construction | 76 | 97 | 1,162,805 |
| Manufacturing | 27 | 58 | 1,136,354 |
| Wholesale trade | 45 | 46 | 376,139 |
| Retail trade | 52 | 139 | 1,511,963 |
| Transportation and warehousing, and utilities | 95 | 171 | 808,075 |
| Information | 0 | 4 | 227,404 |
| Finance and insurance, and real estate and rental leasing | 28 | 152 | 911,531 |
| Professional, scientific, and management, and administrative and waste management services | 20 | 112 | 1,576,600 |
| Educational services, and health care and social assistance | 214 | 398 | 2,932,061 |
| Arts, entertainment, and recreation, and accommodation and food services | 10 | 62 | 1,212,944 |
| Other services, except public administration | 73 | 98 | 680,503 |
| Public administration | 22 | 23 | 542,822 |

Source: 2016-2020 American Community Survey 5-Year Estimates

Income statistics for Census Tract 9501, Coke County, and Texas are provided in Table 3-11. As shown in **Table 3-11**, median household income, mean household income, and per capita household incomes in Census Tract 9501 and Coke County are lower than those of Texas at large.

**Table 3-11. Income (in 2020 Inflation-Adjusted Dollars)**

| Characteristic | Census Tract 9501 | County Coke | State Texas |
|---|---|---|---|
| Median Household Income | $47,708 | $45,072 | $63,826 |
| Mean Household Income | $58,043 | $60,146 | $89,506 |
| Per Capita Income | $24,799 | $27,033 | $32,177 |

Source: 2016-2020 American Community Survey 5-Year Estimates

### 3.13.5 Poverty

Poverty statistics are provided in **Table 3-12**. Census Tract 9501 has lower poverty rates than Coke County and Texas at large. Coke County has a higher percentage of senior residents (aged 65 and over) living below the poverty level than Texas but a lower percentage of all people, people between ages 18-64, and families living below the poverty level.

**Table 3-12. Poverty Rates**

| Characteristic | Census Tract 9501 | County Coke | State Texas |
|---|---|---|---|
| Percent all people living below poverty level | 7.4% | 12.5% | 14.2% |
| Percent people living below poverty level (between 18-64) | 5.5% | 9.6% | 12.5% |
| Percent people living below poverty level (65 and over) | 9.7% | 17.1% | 10.7% |
| Percent families living below poverty level | 4.1% | 5.5% | 10.9% |

Source: 2016-2020 American Community Survey 5-Year Estimates

### 3.13.6 Environmental Justice

Executive Order 12898 – Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations directs federal agencies to identify and address the disproportionally high and adverse human health or environmental effects of their actions on minority and low-income populations.

Following a review of social and economic conditions, it is unlikely the Project will disproportionately affect minority populations as Census Tract 9501 Block Group 1 and 2 have a higher share of white residents and lower share of all other races compared to the entire state of Texas. Similarly, Census Tract 9501 has a smaller share of residents identifying as Hispanic or Latino compared to the entire state of Texas. However, EJScreen, EPA's Environmental Justice Screening and Mapping Tool, Block 480819501002, representing Census Tract 9501 Block Group 2, show 36% people of color. EJScreen also reports that Block 480819501001,

representing Census Tract 9501 Block Group 1, has 4% people of color (comparable to ACS findings). EJScreen suggests Block Group 2 may contain a more racially diverse population than Census estimates capture.

It is also possible the Project will not disproportionately impact low-income populations as Census Tract 9501 has a lower share of all people living below the poverty level, residents aged 18-65 living below the poverty level, and families living below the poverty level than Texas does at large (USEPA, 2020). However, American Community Survey data measures the poverty level by percentage of families and people whose income in the past 12 months is below the poverty level. This is not a perfect method of capturing poverty, and it does not account for low-income people and families who live just above the poverty level and are vulnerable to shocks. According to  EJScreen shows Block 480819501002 is 38% low-income, while Block 480819501001is 29% low-income, suggesting that approximately one-third of the population impacted by the Project are low-income.

## 3.14 Description of Existing Dams

### 3.14.1 Current Condition of FRS No. 4

The below record of the existing conditions of FRS No. 4 was summarized from the *Dam Assessment Report* (NRCS, 2016), The 2018 NRCS Inspection Report (NRCS, 2019a), a NRCS internal memo to the State Conservation Engineer from the Dam Safety Engineer (NRCS, 2013), an Electronic Resistivity Investigation (ERI) (NRCS, 2014), in addition to observations made during site visits associated with this Supplemental Watershed Plan effort.

Current Condition of the Dam
FRS No. 4 is located approximately 8 miles North of Bronte in Coke County, Texas and outflows to Middle Kickapoo Creek, through FRS No. 5, then to Kickapoo Creek, and then to the Colorado River. FRS No. 4 is a typical NRCS earthen embankment dam with storage allocated for sediment storage and flood control. According to the 2018 Dam Safety Inspection Report for FRS No. 4 (NRCS, 2019a) FRS No. 4 is in unsatisfactory condition (A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution). Observations from the 2018 Dam Safety Inspection Report for FRS No. 4 (NRCS, 2019a) are included below:

- The embankment was in poor condition from poor vegetative cover. Most topsoil had eroded off of slopes and had collected at the toes. Woody brush had been chemically treated and was primarily all dead;
- The visible portion of the concrete inlet riser and principal spillway conduit outlet were in good condition. The conduit had good alignment near the outlet. The steel plates originally placed across the weir crest were still in place. Woody vegetation and trees had been removed from the area around the conduit outlet; and
- The auxiliary spillway appeared to be in good dimension condition at all three sections, but all sections had woody brush on them. Good vegetative cover existed on the exit slope.

The Sponsors are aware of the items noted above. These observations are not impacting the performance of the dam and are not the cause of the needed dam rehabilitation. It should be noted that rehabilitation assistance may not be used to perform operation and maintenance activities specified in the agreement for the covered water resource project entered into between the Secretary and the Sponsor responsible for the works of improvement. Other items of concern noted that contribute to the need for rehabilitation of FRS No. 4 include:

- A private gravel road travels through the auxiliary spillway channel and over the control section. According to the easement documentation for FRS No. 4, the intent was that the Grantee of the easement (Coke County WCID #1) was to, following construction of the FRS, construct a new driveway outside of the auxiliary spillway. It does not appear that this new driveway was ever constructed. The cost of replacing the driveway will be the responsibility of the Sponsors; and
- Longitudinal cracking and resulting holes and lessened cross-sectional area were observed along the dam crest. Additional information on the longitudinal cracking and potential caused is provided below in the description of the embankment.

Potential Dam Safety Deficiencies

FRS No. 4 was designed in 1961 and constructed in 1962 to be a single purpose, significant hazard potential dam. Because there is a potential for loss of life downstream due to residential development and multiple roads should the dam breach, the structure is now classified as a high hazard potential dam by NRCS. However, the dam does not have the auxiliary spillway capacity to safely pass the Freeboard Hydrograph (FBH) for a high hazard potential dam without overtopping the embankment. The dam meets the 10-day drawdown requirement during the Principal Spillway Hydrograph (PSH) event.

As-Built Dam Specifications

The dam was constructed in 1962 and "As-Built" drawings (USDA-SCS, 1962) were available for review from the NRCS Texas State Office . The original as-built elevations were based on NGVD29 vertical datum, but have been adjusted to NAVD88 vertical datum for this Plan using an adjustment factor of +0.597 foot. The embankment is single zone, compacted earthfill dam with rockfill blankets/berms at the upstream and downstream toes. The drawings specified earthfill consisting of silt (ML), silty clay (CL-ML), lean clay (CL), and silty to clayey sand (SC-SM) according to the Unified Soil Classification System (USCS). Selective placement of the lean clay (CL) borrow source was specified for the embankment cutoff trench, central section, and upstream section of the embankment although it is unclear whether or not this was performed. A transition zone layer of gravel and spalls was included at the interface between earthfill and rockfill.

A 12-foot-wide core trench with 1:1 side slopes was constructed under the centerline of the dam. The core trench has nominal depth of about 6 to 13 feet below original ground surface with the purpose of seepage control. The core trench terminates within shale or sandstone bedrock near the left and right abutments, but over most of the length of the dam, the core trench terminates in soil overburden materials ranging from sandy lean clay (CL) to clayey sand (SC).

The dam is approximately 28 feet tall and 2,200 feet long. The upstream and downstream slopes of the embankment have a slope of approximately 2.5:1 (horizontal:vertical). The top width of the structure is approximately 14 feet. **Table 3-15** summarizes as-built structural data for FRS No. 4.

Principal Spillway

The principal spillway inlet structure is a drop inlet (30 inches x 100 inches x 12 feet, 1 inch tall) with a steel debris guard and a crest of 1985.3 feet. There is one low-level port on two sides of the riser (two ports total - each 8 inches tall x 12 inches wide) at elevation 1983.0 feet. The conduit is 220 feet of 30-inch-diameter prestressed, concrete lined, steel cylinder pipe with five anti-seep collars. The spillway riser is generally in good condition. Minor corrosion on the debris guard should be monitored and repaired as needed. The outlet conduit is in good condition. According to local reports from the Sponsors, the water level was above the principal spillway crest during a storm that occurred around August 2007. This is the only documented instance of the water level being above the principal spillway crest, although there are anecdotal reports that it may have also happened on a number of occasions during the first ten years after the dam was constructed. Photographs of the existing principal spillway system are provided in **Figure 3-1**.

Inlet structure (10/2020)

Outlet pipe and plunge pool (10/2020)

**Figure 3-1. FRS No. 4 Principal Spillway Inlet and Outlet-**

Auxiliary Spillway

A 230-foot-wide, grass-lined auxiliary spillway was excavated at the left abutment. The auxiliary spillway has never experienced flows. The as-built drawings show a grassed inlet section sloping at a mild 0.5% up to the control section, a 50-foot-long control section, and an exit section at a 8.0% slope for a distance of about 190 feet before transitioning to a slope of 2.86% for about 790 feet before transitioning back to the original ground. According to the 2018 Dam Safety Inspection Report for FRS No. 4 (NRCS, 2019a) and observations made during the site visit performed for this plan, there is woody vegetation in all sections of the auxiliary spillway. All 3 sections of the auxiliary spillway appear to be in good dimensional condition and good vegetative cover exists in the exit slope. There is a private gravel driveway that travels through

the auxiliary spillway and through the control section. Photographs of the existing auxiliary spillway system are provided in **Figure 3-2**.

Auxiliary spillway control section (10/2020)

Auxiliary spillway exit section (10/2020)

**Figure 3-2. FRS No. 4 Auxiliary Spillway Condition**

Embankment

Based on observations noted in the 2018 Dam Safety Inspection Report for FRS No. 4 (NRCS, 2019a) and observations made during the site visit performed for this Plan, the embankment is in poor condition. The front and back slopes were sparsely vegetated and rill erosion was observed on the front slope. Most topsoil has eroded off of the slopes and has collected at the toes due to poor vegetative cover, and the surface of the upstream slope is visually irregular.

Significant longitudinal cracking and large holes were observed along the dam crest during a site visit on October 16, 2020. The cracking/holes are concentrated within approximately the middle 2/3 of the embankment alignment, extending both left and right of the PSW conduit by several hundred feet. Approximately 80 individual holes were observed during a site visit on October 16, 2020. The holes range from about 2 inches in diameter to 3 feet wide at the ground surface, with measured depths ranging from approximately 4 feet to 10 feet deep. No transverse cracking has been observed to date, and no lateral cracking that would outlet to either slope has been observed. However, trenching has not been performed to confirm the absence of transverse cracks.

A deficiency report prepared in 1967 (USDA-SCS, 1967a) indicates the first crack was noticed in 1965, and subsequent inspections noted the crack was becoming more extensive with crack depths up to about 20 feet below surface. Survey measurements taken in 1966 indicated the centerline of the embankment in the area of cracking had settled about 0.8 feet. The 1967 report suggested the most plausible source of embankment cracking was differential settlement at the interface between the upstream shell and central core zones of the embankment due to hydro-collapsible foundations soils. Specifically, the 1967 report postulated that the sandy foundation materials under the upstream shell experienced collapse settlement after wetting due to initial reservoir filling, whereas the central zone experienced little settlement due to the excavation of the core through most of the upper collapsible soils, thereby producing cracking through the

brittle embankment material in response to the differential settlement. A subsequent embankment repair report (USDA-SCS, 1967b) documented filling of the cracks that took place October 30 through November 3, 1967. According to the report, the cracks were filled to within 1.5 to 2 feet of the embankment crest using a slurry of soil and water mixed at the surface and poured into the crack, and the upper 2 feet was filled with soil and compacted by passes of a tractor wheel and/or dual wheel truck. However, recurrence of cracking has occurred in the years since the original 1967 repair.

The cracking and holes and were the subject of a 2013 NRCS internal memo to the State Conservation Engineer (NRCS, 2013) and a 2014 Electrical Resistivity Investigation (NRCS, 2014) that were provided by NRCS for review. The 2013 NRCS internal memo was dated September 18, 2013 and was from Dam Safety Engineer Todd Marek to State Conservation Engineer John Mueller. The memo was based on a site visit performed during the period of August 26 through August 30, 2013, when the Electrical Resistivity Investigation was being performed. In the memo, Todd Marek documents his interactions with the project sponsors, his observations, and his thoughts on repairs. In the memo, Todd Marek states that he observed cracking along the top of the dam starting at approximately the station 7+00 centerline and continuing sporadically to station 24+00. The size of the openings was observed to be approximately 1.5 feet to 3 feet across and most had depths of approximately 3 feet to 7 feet, with one opening having a depth of approximately 16 feet. No transverse cracking was observed and no lateral cracking that would outlet to either slope was observed.

The 2014 Electrical Resistivity Investigation report was prepared by Bryan Moffatt, PG, GSU Geologist for NRCS. The report describes the equipment used to perform the investigation, the methods utilized for the investigation, and the conclusions from the investigation. The ERI report indicates that based on the results of the investigation it is suspected that the cracking has been caused by wet/dry cycles that allow intermittent settlement within the underlying collapsible/compressible soils that act as the foundation for the embankment. The report also indicates that it is suspected longitudinal cracking has not occurred on the downstream portion of the embankment as a result of the core trench. The 2014 NRCS study also suggested that cracking/holes may be a manifestation of collapsible soils and/or internal erosion of dispersive clays, erodible silts/sands, and/or soluble (i.e., gypsum-rich) soils in the embankment and/or foundation. Available documentation suggests the presence of soils which may have limited resistance to internal erosion in the embankment and foundation zones.

Supplemental investigation of cracking and potential sources of cracking was performed in a joint study by NRCS and Angelo State University in 2017. The investigation included electrical resistivity geophysical surveying, test pit trenches, and geotechnical laboratory testing. The study concluded that settlement within collapsible foundation soils was the likely source of observed cracking.

The supplemental geologic investigation performed in November through December 2021 and subsequent soil mechanics testing under the current project found similar poor conditions of the embankment with erosion, poor vegetative cover, embankment cracking/holes, and evidence of possible upstream slope sloughing. The findings of the investigation and testing generally

support prior assessments that collapsible foundation materials are the likely source of observed cracking/holes, and that continued episodic collapse settlement is likely during heavy rainfall.

Photos of the embankment and some areas of longitudinal cracking are provided in **Figure 3-3**.

Crown of dam and embankments (10/2020)

Upstream slope (10/2020)

Large hole resulting from longitudinal cracking. (10/2020)

Large hole resulting from longitudinal cracking. (10/2020)

**Figure 3-3. FRS No. 4 Embankment Condition**

Topographic Data

No topographical survey was performed in support of plan development. A topographical survey will be required as part of a future final design phase. Light Detection and Ranging (LiDAR) data were the basis for critical elevations and the design of rehabilitative measures. The following data source provided coverage for the analysis:

- United States Geological Survey (USGS). 70 cm resolution Light Detection and Ranging (LiDAR) data for 70 counties across west Texas and northern central Texas. Data

collected by Dewberry from February 1, 2018, thru May 27, 2018 with reflights collected on November 5, 2018.

The Mosaic tool within ArcGIS was used to combine the 70 cm tiles into a single Digital Elevation Model (DEM) at 1-meter resolution. The DEM was re-projected from UTM to Texas State Plane Zone 3 coordinate system and elevations were converted from meters to feet. The re-projected DEM was used to verify as-built elevations (adjusted from NGVD29 to NAVD88) and to develop 1-foot interval contours for use in the analysis. The LiDAR DEM was also used to develop the elevation-storage relationship presented in **Table 3-13**.

There was no apparent water present in the reservoir at the time the LiDAR was flown.

Sedimentation and Reservoir Storage

FRS No. 4 was designed for a service life of 50 years with a sediment pool of 197 acre-feet (submerged sediment) below the low level ports in the principal spillway riser, per **Table 3-13**. Presuming this dam would maintain a normal pool, these ports set the normal pool surface area at 42 acres. The total sediment storage was set at 409 acre-feet, including 308 acre-feet of submerged sediment storage below the principal spillway crest at elevation 1985.3 feet (NAVD 88 adjusted), and an additional 101 acre-feet of flood pool (aerated) sediment storage below elevation 1986.8 feet (NAVD 88 adjusted). The surface area at the principal spillway riser crest was planned at 55 acres.

A comparison was performed between the sediment pool and principal spillway volumes reported in the as-builts for FRS No. 4 and the volumes calculated from the LiDAR data at the same elevation to estimate the annual sediment yield to the structure (**Table 3-13**). Note at the time of LiDAR data collection, the reservoir was dry, thus no sediment or bathymetric survey was necessary for FRS No. 4. The comparison shows that at the sediment pool elevation, there is currently 263.0 acre-feet storage available, compared to the 197.0 acre-feet estimated at the time of construction. The comparison also shows that at the principal spillway crest elevation, there is currently 387.3 acre-feet of storage available, compared to the 308.0 acre-feet estimated at the time of construction. As it is estimated that this reservoir currently has more submerged sediment storage than planned at the principal spillway crest, it is reasonable to conclude there has been little sediment accumulation in this reservoir. As a result, it was determined that this comparison could not be used to estimate the historic sediment yield to the structure. Based on the limited amount of sediment accumulation in FRS No. 4, it appears that using the planned deposition rate of 5.53 acre feet per year (1.4 acre-feet/per square mile of watershed area/year) estimated in the watershed work plan for the structure would significantly overestimate the volume needed for sediment storage. Data from the sediment survey of FRS No. 5 (described in **Section 3.13.2** below) was utilized to determine the future sediment capacity required. As the watershed contributing to FRS No. 4 has similar landuse to the watershed contributing to FRS No. 5 and both watersheds have remained relatively undeveloped, it was estimated that past sediment accumulation was a reasonable indicator of future sediment accumulation. The observed sediment deposition rate at FRS No. 5 was 0.017 acre-feet per year per square mile of contributing watershed. Using this same rate at FRS No 4, the minimum storage required for 100 years of future sediment storage is 6.7 acre-feet. The current available sediment storage of 263.0 acre-feet below the sediment pool elevation is sufficient for this sediment load.

**Table 3-13. As-Built and Existing Storage for FRS No. 4**

| Notes | Elevation (ft NGVD 29) | Elevation (ft NAVD 88) | Storage As-Built (ac-ft) | Storage Current (ac-ft) |
|---|---|---|---|---|
| | 1972.0 | 1972.6 | 2.0 | 30.8 |
| | 1976.0 | 1976.6 | 29.0 | 77.7 |
| | 1980.0 | 1980.6 | 112.0 | 171.5 |
| Sediment Storage (Submerged Sed) | 1982.4 | 1983.0 | 197.0 | 263.0 |
| | 1984.0 | 1984.6 | 271.0 | 345.0 |
| PS Crest | 1984.7 | 1985.3 | 308.0 | 387.3 |
| Flood Pool Sediment (Total Sed) | 1986.2 a | 1986.8 | 409.0 | 491.6 |
| | 1988.0 | 1988.6 | 527.0 | 635.8 |
| | 1992.0 | 1992.6 | 903.0 | 1045.2 |
| AS Crest | 1995.8 | 1996.4 | 1432.0 | 1577.0 |
| | 1996.0 | 1996.6 | 1466.0 | 1609.4 |
| | 2000.0 | 2000.6 | 2236.0 | 2368.1 |
| | 2000.8 | 2001.4 | 2410.0 | 2546.2 |
| DC Effective | 2001.1 b | 2001.7 | 2475.2 | 2615.4 |

[a] Interpolated point.
[b] Extrapolated point.

### 3.14.2 Current Condition of FRS No. 5

The below record of the existing conditions of FRS No. 5 is summarized from the *Dam Assessment Report* (NRCS, 2015), the 2018 Dam Safety Inspection Report for FRS No. 5 (NRCS, 2019b) in addition to observations made during site visits associated with this Supplemental Watershed Plan effort.

Current Condition of the Dam

FRS No. 5 is located approximately 5 miles north of Bronte in Coke County, Texas and outflows to Middle Kickapoo Creek, then to Kickapoo Creek, and then to the Colorado River. FRS No. 5 is a typical NRCS earthen embankment dam with storage allocated for sediment storage and flood control. According to the 2018 Dam Safety Inspection Report for FRS No. 5 (NRCS, 2019b), FRS No. 5 is in overall fair condition. Observations from the 2018 Dam Safety Inspection Report for FRS No. 5 (NRCS, 2019b) are included below:

- The embankment was in overall fair condition with fair vegetative cover. Erosion had lessened the cross-sectional area of the dam. In many locations most of the topsoil had eroded away from the top of dam and slopes of the embankment and was collecting at the toes. Woody brush had been chemically treated and was primarily dead, except for the far right and left abutments and along and outside the fence across the slope.
- The visible portions of the concrete inlet riser and principal spillway conduit outlet were in good condition. Woody vegetation and trees had been removed from the area around

the conduit outlet. Willow trees were beginning to encroach into the area of the principal spillway riser.

- The auxiliary spillway appeared to be in good dimensional condition at all three sections. Fair to good vegetative cover existed on all sections.

One item of concern not noted in the 2018 Dam Safety Inspection Report for FRS No. 5 (NRCS, 2019b), but noted in the Dam Assessment Report (NRCS, 2015) and observed during site visits associated with this Supplemental Watershed Plan effort is:

- The left berm of auxiliary spillway has eroded and the right cut slope from natural ground has severe erosion gullies.

The Sponsors are aware of the items noted above. These observations are not impacting the performance of the dam and are not the cause of the needed dam rehabilitation. It should be noted that rehabilitation assistance may not be used to perform operation and maintenance activities specified in the agreement for the covered water resource project entered into between the Secretary and the Sponsor responsible for the works of improvement.

Potential Dam Safety Deficiencies

FRS No. 5 was designed in 1961 and constructed in 1963 to be a single purpose, significant hazard potential dam. The structure is now classified as a high hazard potential dam and does not have the auxiliary spillway capacity to safely pass the FBH for a high hazard potential dam without overtopping the embankment. In addition, the dam does not meet the 10-day drawdown requirement during the PSH event.

As-Built Dam Specifications

The dam was constructed in 1963 and "As-Built" drawings (USDA-SCS, 1963) were available for review from the NRCS Texas State Office. The original as-built elevations were based on NGVD29 vertical datum. The dam is a zoned earthen embankment with rockfill blankets/berms at the upstream and downstream toe. The original SMR (USDA-SCS, 1961) indicated that the downstream rock blanket at the toe would provide internal drainage function, and recommended a two-stage coarse filter at the earthfill/rockfill interface for filter compatibility. From the as-built drawings, however, it is not clear whether a filter/transition zone was included at the interface between earthfill and rockfill.

A 12-foot-wide core trench with 1:1 side slopes was constructed at the centerline of the dam. The as-built profile of the embankment cutoff trench suggests that the cutoff trench was extended to the underlying shale/sandstone bedrock for seepage control.

The as-built drawings specified that the central and upstream zones of the embankment ("Section No. 2") be constructed from on-site borrow sources classifying as lean clay (CL). Permissible classifications for earthfill in the upper and lower downstream shell zones of the embankment ("Section No. 3" and "Section No. 4", respectively) included lean clay (CL), silty sand (SM), and silty to clayey sand (SC-SM) obtained from on-site borrow areas and excavations for the auxiliary spillway. The typical embankment section included a cutoff trench zone ("Section No.

1") under the embankment centerline, with permissible classifications for earthfill including lean clay (CL) and silty sand (SM) obtained from the cutoff trench excavation.

The dam is approximately 32 feet tall and 8,096 feet long. The upstream and downstream slopes of the embankment have a slope of approximately 2.5:1 (horizontal:vertical), with a 12-foot wide berm on the upstream slope and a 17-foot wide berm on the downstream slope. The top width of the structure is approximately 16 feet. **Table 3-15** summarizes as-built structural data for FRS No. 5.

Principal Spillway

The principal spillway inlet structure is a drop inlet (30 inches x 100 inches x 17 feet, 11 inches tall) with a steel debris guard and crest of 1899.0 feet. There are two low-level ports on two sides of the riser (four ports total - each 8 inches tall x 10 inches wide) at elevation 1894.5 feet. The as-built conduit is 220 feet of 30-inch-diameter prestressed, concrete lined, steel cylinder pipe with five anti-seep collars. The spillway is generally in good condition. Willow growth was observed around the principal spillway inlet and should be monitored until it can be removed. Minor corrosion was noted on the debris guard and should be monitored and repaired as needed. Some concrete deterioration was observed at the end of the outfall conduit. The conduit was partially submerged and was also blocked by vegetation. Photographs of the existing principal spillway system are provided in **Figure 3-4**.

Inlet structure Outlet pipe.

**Figure 3-4. FRS No. 5 Principal Spillway Inlet and Outlet**

Auxiliary Spillway

A 400-foot-wide, grass-lined auxiliary spillway is located at the right abutment. The auxiliary spillway is not known to have experienced flows. The as-built drawings show a grassed inlet section sloping at 10% up to the control section, 65-foot-long control section and an exit section at a 5% slope for a distance of about 300 feet before transitioning to a slope of 0.5% for 1,123 feet and then transitioning to a slope of 10% for 144 feet before transitioning back to the original ground. The as-built drawings show that compacted fil materials were placed in the spillway channel to construct the auxiliary spillway crest and steepest portion of the exit section, comprising a channel length of about 200 feet.

The left berm of auxiliary spillway (adjacent to the right end of dam embankment) has eroded with possible damage by feral hogs, which is shown in **Figure 3-5**. Additionally, the right cut slope from natural ground upstream of the auxiliary spillway crest has severe erosion gullies, which is shown in **Figure 3-6**. The spillway channel currently has a fair to good protective grass cover and is in fair condition with no visible erosion.

At right end of embankment, looking downstream | At right end of embankment, looking upstream

**Figure 3-5. FRS No. 5 Auxiliary Spillway Erosion at Left Training Berm**

About 50 ft upstream of crest | About 200 ft upstream of crest

**Figure 3-6. FRS No. 5 Auxiliary Spillway Erosion at Right Cut Slope**

Embankment

The embankment is generally in fair condition and has fair vegetative cover. Embankment erosion has lessened the cross-sectional area of the dam and in many locations most of the topsoil has eroded off the top of dam and slopes and is accumulating at the toes. Woody brush is growing at the left and right abutments and also along the fence on the front slope of the embankment. Photos of the embankment are provided in **Figure 3-7**.

Crest and embankments

Crest and upstream embankment

**Figure 3-7. FRS No. 5 Embankment Condition**

Topographic Data

No topographical survey was performed in support of plan development. A topographical survey will be required as part of a future final design phase. Light Detection and Ranging (LiDAR) data were the basis for critical elevations and the design of rehabilitative measures. The following data source provided coverage for the analysis:

- United States Geological Survey (USGS). 70 cm resolution Light Detection and Ranging (LiDAR) data for 70 counties across west Texas and northern central Texas. Data collected by Dewberry from February 1, 2018, thru May 27, 2018 with reflights collected on November 5, 2018.

The Mosaic tool within ArcGIS was used to combine the 70 cm tiles into a single Digital Elevation Model (DEM) at 1-meter resolution. The DEM was re-projected from UTM to Texas State Plane Zone 3 coordinate system and elevations were converted from meters to feet. The re-projected DEM was used to verify as-built elevations (adjusted from NGVD29 to NAVD88) and to develop 1-foot interval contours for use in the analysis. The LiDAR DEM was also used to develop the elevation-storage relationship presented in **Table 3-14.**

For the purpose of developing a storage curve, the Mosaic tool within ArcGIS was also used to combine the bathymetric data from the sediment survey (described below) into the DEM using the rule that the lowest elevation between the two datasets governed.

Sedimentation and Reservoir Storage

FRS No. 5 was designed for a service life of 50 years with a sediment pool of 200 acre-feet (submerged sediment) below the low level ports in the principal spillway riser, per **Table 3-14**. These low level ports set the normal pool surface area at 55 acres. The sediment storage was set at 711 acre-feet, including 546 acre-feet of submerged sediment storage below the principal spillway crest at elevation 1899.0 feet (NAVD 88 adjusted), and an additional 165 acre-feet of flood pool (aerated) sediment storage below elevation 1900.3 feet (NAVD 88 adjusted). The surface area at the principal spillway riser crest was planned at 102 acres.

**Table 3-14. As-Built and Existing Storage for FRS No. 5**

| Notes | Elevation (ft NGVD 29) | Elevation (ft NAVD 88) | Storage As-Built (ac-ft) | Storage Current b (ac-ft) |
|---|---|---|---|---|
| | 1882.0 | 1882.6 | 0.0 | 0.3 |
| | 1886.0 | 1886.6 | 9 | 15.7 |
| Elevation of Water LiDAR | 1886.6 a | 1887.2 | 12.4 a | 24.6 |
| | 1890.0 | 1890.6 | 52 | 95.9 |
| Sediment Pool (Submerged Sed) | 1893.9 | 1894.5 | 200.0 | 228.7 |
| | 1894.0 | 1894.6 | 201.0 | 233.3 |
| | 1898.0 | 1898.6 | 509.0 | 480.0 |
| PS Crest | 1898.4 | 1899.0 | 546.0 | 513.4 |
| Sediment Storage (Total Sed) | 1899.7 a | 1900.3 a | 711.0 | 637.9 a |
| | 1902.0 | 1902.6 | 998.0 | 911.4 |
| | 1906.0 | 1906.6 | 1708.0 | 1604.3 |
| AS Crest | 1909.0 | 1909.6 | 2399.0 | 2295.4 |
| | 1910.0 | 1910.6 | 2686.0 | 2558.9 |
| | 1914.0 | 1914.6 | 3916.0 | 3778.2 |
| | 1914.7 | 1915.3 | 4138.0 | 4021.9 |
| DC Effective | 1915.3 | 1915.9 a | 4360.5 a | 4238.1 a |
| | 1918.0 | 1918.6 | 5362.0 | 5309.4 |

[a] Interpolated point.
[b] Storage includes bathymetric data from sediment survey.

Review of the LiDAR data indicated that the reservoir was not dry at the time that the data were collected, thus a bathymetric survey was necessary for FRS No. 5 to estimate sediment deposition. Specialty Devices Inc. (SDI) performed a bathymetric and sediment survey of FRS No. 5 (SDI, 2021) on March 05, 2021. The acoustic bathymetric survey indicated that FRS No. 5 had a water depth varying from 0.81 to 7.78 feet with an average water depth of 2.34 feet during the survey. The acoustic sub-bottom survey indicated that FRS No. 5 had a sediment thickness ranging from 0.1 to 4.13 feet, with an average sediment thickness of 0.65 feet at the time of the survey. With the water level at an elevation of 1887.74 feet at the time of the sediment survey, the accumulated sediment volume below the water surface at the time of the survey was estimated to be 8.54 acre-feet. The Sediment Isopach map of FRS No. 5 that was developed as part of the bathymetric and sediment survey is shown in **Figure 3-8**.

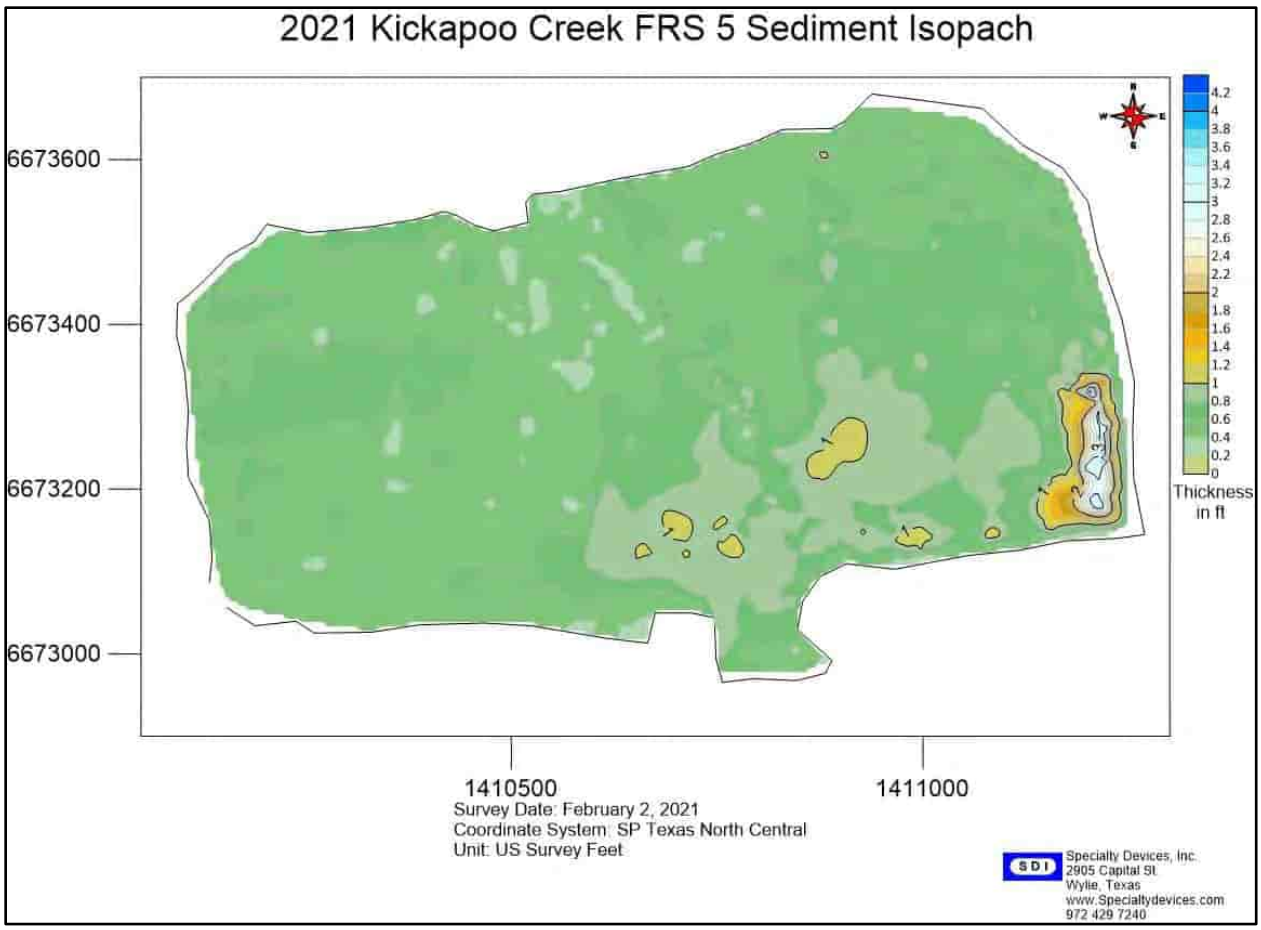


**Figure 38. FRS No. 5 Sediment Isopach Map**

The sediment survey (SDI, 2021) indicates 8.54 acre-feet of submerged sediment accumulation over the 58-year operation (1963 to 2021), yielding a historical submerged sediment deposition rate of 0.15 acre-feet/year (0.017 acre-feet/year per square mile of contributing area). The observed submerged deposition rate is significantly less than the planned rate of 12.04 acre-feet/year (1.4 acre-feet/year per square mile of contributing area). The current estimated available sediment storage of 228.7 acre-feet at the sediment pool elevation (1894.5 feet) and the 513.4 acre-feet at the as-built principal spillway crest elevation (1899.0 feet) both provide more than the minimum storage required for 100 years of future sediment storage using the observed sediment at FRS No. 5 plus the observed deposition rate of 0.15 acre-feet/year projected forward 100 years (23.3 acre-feet required). The estimated existing available sediment storage provided at the sediment pool elevation and principal spillway crest is sufficient for 100 years of sediment storage.

**Table 3-15. As-Built and Existing Structural Data for FRS No. 4 and No. 5**

| Item | FRS No. 4 | | FRS No. 5 | |
|---|---|---|---|---|
| | As-Built | Existing[1] | As-Built | Existing[1] |
| Local Name | NA | | NA | |

| Item | FRS No. 4 | | FRS No. 5 | |
|---|---|---|---|---|
| | **As-Built** | **Existing[1]** | **As-Built** | **Existing[1]** |
| Latitude / Longitude | 32.0030° / -100.2964° | | 31.9590° / -100.2984° | |
| Site Number | TX03515 | | TX03524 | |
| Year Completed | 1962 | | 1963 | |
| Purpose | Flood Control | | Flood Control | |
| Drainage Area ($mi^2$) | 4.17 | 3.95 | 8.6 | 8.68 |
| Dam Height (ft) | 35 | | 32 | |
| Dam Type | Earthfill | | Earthfill | |
| Dam Volume ($yds^3$) | 203,220 | | 390,460 | |
| Dam Crest Length (ft) | 2,200 | 2,200 | 8,096 | 8,096 |
| Total Capacity (ac-ft) | | | | |
| Sediment Submerged (ac-ft) | 308.0 | 387.3 | 546.0 | 513.4 |
| Sediment Aerated (ac-ft) | 101.0 | 104.3 | 165.0 | 124.5 |
| Floodwater Retarding (ac-ft) | 1,023.0 | 1151.8 | 1688.0 | 1657.5 |
| Surface Area (ac) | | | | |
| Sediment Pool (ac) | 42.0 | 62.8 | 55.0 | 86.5 |
| Flood Pool (ac) | 168.0 | 160.8 | 262.0 | 255.4 |
| Principal Spillway | | | | |
| Type | Drop Inlet, Two Stage | | Drop Inlet, Two Stage | |
| Riser Height (ft) | 12.08 | | 17.92 | |
| Conduit Size (in) | 30 | | 30 | |
| Low Level Port Elevation (ft) | 1983.0 | 1983.0 | 1894.5 | 1894.5 |
| Riser Crest Elevation (ft) | 1985.3 | 1985.3 | 1899.0 | 1899.0 |
| Capacity at Aux Crest (cfs) | | | | |
| Energy Dissipater | Plunge Pool | Plunge Pool | Plunge Pool | Plunge Pool |
| Auxiliary Spillway | | | | |
| Type | Earthen channel with protective vegetative cover | | Earthen channel with protective vegetative cover | |
| Width (ft) | 230 | | 400 | |
| Normal Pool Elevation (ft) | 1983.0 | 1983.0 | 1894.5 | 1894.5 |
| Flood Pool Elevation (ft) | 1996.4 | 1996.4 | 1909.6 | 1909.6 |
| Top of Dam Elevation (ft) | 2002.7 | 2002.7 | 1915.9 | 1915.9 |
| Datum [(2)] | NAVD88 | | | |

[1] No site topographic survey was performed as part of this plan. Any updates to existing conditions are based on LiDAR data.
[2] As-built elevations are referenced to NGVD29 and were updated to NAVD88 datum for this plan using conversions factors for FRS No. 4 and FRS No. 5 of +0.597 ft and +0.587 feet, respectively.

## 3.15 Status of Operations and Maintenance

Operation and Maintenance (O&M) of both structures is performed by Coke County SWCD. Inspections are done annually by representatives of the Coke County SWCD and NRCS. Formal inspections have occurred on an approximate 6-year interval, with recent inspections having been performed in 2012 and 2018 by NRCS. Routine brush management and repairs are conducted as needed. Based on inspection reports and site visits to FRS No. 4 and FRS No. 5,

there are a number of O&M items that need to be addressed, but O&M for the sites is improving. Adequate O&M for FRS No. 4 and FRS No. 5 must be performed by the Sponsors and associated O&M costs cannot be included as construction costs for this project.

## 3.16 Floodplain Management

Coke County and incorporated areas participate in the National Flood Insurance Program (NFIP). The current effective FEMA flood hazard delineation is shown as being published on February 21, 2001. The FEMA Map Service Center website indicates that there is no countywide Flood Insurance Study (FIS) for Coke County and no Digital Flood Insurance Rate Map (DFIRM) or Letters of Map Revision (LOMRs) for the unincorporated areas within Coke County, this includes the area between FRS No. 4 and FRS No.5 and the area immediately downstream of FRS No.5. The City of Bronte, located downstream of FRS No. 5) is shown as being mapped as Zone A, indicating that no base flood elevations were determined. The effective date of the flood maps for the City of Bronte is March 04, 1986. There are no LOMRs shown for the City of Bronte.

There are 4 habitable structures within the area classified as Zone A within the City of Bronte, downstream of FRS No. 5. According to the existing condition modeling performed for this plan, there is only one structure at risk for flooding above the First Floor Elevation (FFE) within the same upstream and downstream extents as the current effective floodplain during the 1% AEP flood downstream of FRS No. 5. The regulatory floodplain for these extents was compared to the modeled floodplain for the same extents in order to highlight differences in the modeled floodplains.

## 3.17 Breach Analysis and Hazard Potential Classification

Breach analyses were performed for a sunny day scenario with the water level at the existing top of dam elevation using the methods provided in Technical Release No. 60 (TR-210-60) *Earth Dams and Reservoirs* (USDA NRCS, 2019) and Technical Release No. 66 *Simplified Dam-Breach Routing Procedure* (NRCS SCS, 1985) to confirm the high hazard potential classification and estimate the downstream inundation zones. Impacts to downstream properties and road crossings were assessed. Breach maps depicting the results of the breach analyses for FRS No. 4 and FRS No. 5 are provided in **Appendix C**.

A sunny day breach of FRS No. 4 is predicted to impact 4 homes and 2 road crossings downstream of the dam. The breach analysis for FRS No. 4 was terminated at FRS No. 5.

A sunny day, top of dam breach of FRS No. 5 is predicted to impact 9 homes and 5 road crossings downstream of the dam. The breach analysis for FRS No. 5 was terminated at the confluence with West Kickapoo Creek, approximately 11.1 miles downstream of FRS No. 5. This is the location where the breach inundation boundary was fully contained within the modeled 0.1% AEP floodplain. The number and types of structures that would be impacted by a sunny day, top of dam breach of either of the FRSs confirms the re-classification of the FRSs from significant hazard potential to high hazard potential dams.

Revised breach analyses will be performed during the design phase of the FRS No. 4 and FRS No. 5 rehabilitation and the updated inundation data will be provided to the Sponsors for use in an Emergency Action Plan (EAP) update.

## 3.18 Evaluation of Potential Failure Modes

### 3.18.1 FRS No. 4

Sedimentation

The major land uses in the watershed above FRS No. 4 are provided in **Table 3-1** and include 78.4% shrub/scrub, 9.6% deciduous forest, 7.1% evergreen forest, 3.8% cultivated crops, 0.8% developed- open space, 0.2% mixed forest, 0.1% grassland/herbaceous, and <0.0% developed – low intensity. These uses are not expected to change significantly or be adjusted to land uses that would increase sediment yield. The future sediment accumulation rate is therefore planned to be similar to the historic rate for the previous 56 elapsed years (from dam construction until the 2018 LiDAR data were collected). Based upon the minimal sediment deposition rate and the available 387.3 acre-feet of sediment storage at the principal spillway crest, the remaining sediment storage life of FRS No. 4 is at least 100 years. Therefore, the potential for failure due to inadequate sediment storage capacity is low.

Hydrologic Capacity

Hydrologic failure of a dam occurs when the auxiliary spillway is breached or when the dam is overtopped and fails. FRS No. 4 was originally designed with a total floodwater storage of 1,023 acre-feet. It was designed as a significant-hazard potential dam and is currently performing as intended. However, due to downstream development since dam construction, it has been reclassified as a high hazard potential dam and currently does not meet dam safety criteria as required by the NRCS to prevent overtopping or breaching of the auxiliary spillway and/or embankment during a probable maximum precipitation event as required for a high hazard potential dam. The water in the reservoir would flow over the top of the embankment during the PMF and could cause it to erode and collapse. Therefore, FRS No. 4 is categorized as having high potential to fail due to deficient hydrologic capacity.

Embankment Seepage

Historical and present day longitudinal cracking has been documented on the upstream side of the embankment crest. This cracking has resulted in many holes ranging from about 2 inches in diameter to 1.5 by 3 feet wide at the ground surface, with measured depths ranging from 3 to 7 feet (2015 Dam Assessment) and 1 to 10 feet (October 2020 AECOM measurements). A 1967 deficiency report by USDA-SCS indicated that crack depths up to 20 feet were measured in 1966 prior to an embankment repair project in 1967 that filled the cracks with a slurry mixture of clay and water. Recurrence of cracking has occurred in the years since the repair. Geophysical testing was conducted by NRCS in 2013 for both existing conditions and after pumping about 16,000 gallons of water into the cracks. During the testing, seepage was not observed to exit anywhere on the slopes or abutments. However, embankment soils became more wet in the depth interval of 9 to 19 feet below top of dam following pumping, suggesting either the cracks/holes extend deeper than indicated by measurements taken at the ground surface and/or there is a zone of permeable soils in the embankment. Follow-up geophysical testing by NRCS-ASU in 2017

identified potential near-vertical subsurface flow paths within the embankment located under inferred near-surface cracks, but the inferred flow paths did not extend into the dam foundations. The dam embankment is about 30 feet tall.

No transverse cracking has been identified to date, but trenching has not been performed to confirm the absence of transverse cracks. Surficial rill erosion has been noted on the crest and upstream embankment slopes, but is believed to be associated with poor vegetative cover. No evidence of seepage, depressions, cracking, or slope instability have been documented for the downstream slope.

The observed embankment cracking and holes have been attributed to one or more potential mechanisms by prior studies. The 1967 deficiency report identified differential settlement of collapsible foundation soils as the most probable source of the embankment cracking. The 2015 Dam Assessment (NRCS, 2016) suggested that wet/dry cycles may have caused intermittent settlement within the underlying collapsible/compressible foundation soils. The 2014 NRCS study suggested that cracking/holes may be a manifestation of collapsible soils, as well as possibly internal erosion of dispersive clays, erodible silts/sands, and/or soluble (i.e., gypsum-rich) soils comprising the embankment and/or foundation materials. Additional geophysical and geologic investigation, sampling, and laboratory testing was performed by NRCS-ASU (2017) identified collapsible soils as the most probable source of cracking. Results from the supplemental geologic investigation (performed in support of this project) have also identified collapsible foundation materials through visual examination and laboratory swell/collapse testing. Soil dispersion and soluble salts laboratory testing did not indicate evidence of dispersive soils or highly-soluble soils, and suggests that these type of erosion are not a primary contributor to observed holes/cracking. The hypothesis regarding ongoing embankment crack/hole growth is that the surficial openings may be allowing precipitation to infiltrate directly to the collapsible foundation soils, causing incremental collapse settlement under the dam. Lateral growth of the cracks/holes may be caused by alternating wetting (due to infiltration) and drying of the embankment soils forming the near-vertical sidewalls of the cracks/holes, likely resulting in sloughing of the sidewalls due to the relatively brittle and low-plasticity materials comprising the embankment fill.

The reservoir generally remains dry, even during moderate rainfall events. Based on interviews with local residents/maintenance staff, the principal spillway conduit has anecdotally flowed only 1-3 times in the 60-year history of the dam. Available rain gauge data at the nearby Oak Creek reservoir suggests the observed spillway flows probably correspond to the highest single-day rainfall total of 7.65 inches on August 7, 2007. The next highest single-day rainfall total was 5.27 inches in 1966. Available information suggests lesser rainfall events have left the reservoir by infiltration into the subsurface soils and/or possibly through fractures in the bedrock. The absence of a permanent reservoir pool (and lack of a reservoir pool during most storm events) limits the frequency by which seepage conditions and related effects can develop. Although no piezometer data is available, it is unlikely that a phreatic surface is present through the dam embankment most of the time. However, the dam reportedly operated with a low normal pool shortly after construction (USDA-SCS, 1967), and it is unclear what caused the dam to being operating as a “dry” dam without a normal pool.

Based on the lack of a permanent pool at this site, there is a limited opportunity for problematic seepage conditions to develop at this dam during dry weather. However, in the event that a flood pool does develop as a result of infrequent heavy rainfall events, seepage conditions and related effects could develop. The presence of deep longitudinal cracking/voids on the upstream crest of the dam, which are believed to extend the full embankment height to collapsible foundation materials below based on 2017 geophysical survey results, represent a potential risk for adverse seepage conditions and related internal erosion (piping). Available documentation suggests the presence of soils which may have limited resistance to internal erosion in the embankment and foundation zones. Additionally, the as-built typical section indicates a transition layer between riprap and embankment fill, but it is unclear whether these materials are filter compatible and whether they are capable of restricting the development of piping erosion. The presence of concrete anti-seep collars around the principal spillway conduit also represent an increased risk of internal erosion. While no observed seepage has been reported in the documents available for review, the embankment has rarely been "tested" due to the historically dry nature of the reservoir and there is very little historic data regarding seepage performance.

In summary, the dry nature of the reservoir (i.e., lack of permanent pool or even flood pool during most rainfall events over the last 60+ years) precludes the development of seepage in most cases. However, adverse characteristics present within the embankment (e.g., near-vertical cracks and flow paths extending nearly the full height of the dam) and/or foundation (e.g., collapsible soils) increase the risk of seepage-related distress during the infrequent condition of a reservoir pool caused by heavy rainfall event(s). Completed laboratory testing suggests the dry, brittle, low-plasticity soils may erode during times of concentrated seepage through existing defects, and may be susceptible to piping erosion. However, dispersive soils and/or high concentrations of soluble salts are likely not present within the embankment and/or foundation materials. Based on the foregoing, the risk of dam failure due to under-seepage and/or through-seepage is estimated to be moderate.

Embankment Stability

Slope stability analyses were conducted in the original Soil Mechanics Report (SMR) for this project (USDA-SCS, 1961). The reported factors of safety were 1.67 for the downstream slope (steady state), and between 1.68 and 2.6 for the upstream slope (drawdown). Note that one drawdown trial analysis produced a factor of safety of 0.98, but this assumed shear strength parameters for the embankment fill corresponding to a lower degree of relative compaction than that specified for the project, and thus was not considered representative. The analyses procedures appear to be consistent with standard practice of that era, but current industry practice and NRCS design criteria have evolved in the years since. It is possible that factors of safety for embankment stability may be higher or lower than that reported in the 1961 SMR, and may or may not meet current minimum design criteria by NRCS and/or the Texas Commission on Environmental Quality (TCEQ). Estimating the factor of safety for embankment stability is outside the scope of this project.

Based on available LiDAR data, the downstream slope matches the as-built cross-section slope inclination of 2.5H:1V. However, LIDAR indicates the upstream slope inclination is closer to 3H:1V, which differs from the 2.5H:1V shown in the as-builts. It is unclear whether the difference in upstream slope is attributed to inaccuracy in the as-builts, or some post-construction

phenomenon such as slope erosion, shallow sloughing, and/or accumulation of sedimentation. The upstream slope is visually very irregular (AECOM October 2020 observations), supporting the possibility of post-construction phenomena. The presence of holes/cracking on the upstream slope provide a conduit for water, which could increase pore pressures in the embankment and reduce slope stability. The cracking/holes also represent a defect across which the soil shear resistance has been reduced. Further, the presence of collapsible foundation materials and potential for ongoing collapse settlement, cracking, and hole enlargement represent a threat to embankment stability. However, observed distress to date has been limited to the upstream slope and upstream crest of the dam, with no documented distress on the downstream slope and crest or downstream toe of the dam. The anticipated lack of a phreatic surface in the embankment due to historically dry reservoir conditions reduces the likelihood of embankment stability problems in most cases. However, adverse characteristics present within the embankment and/or foundation increase the risk of embankment instability during the infrequent condition of a reservoir pool caused by heavy rainfall event(s).

Based on the foregoing, the risk of dam failure due to embankment instability is estimated to be moderate.

Spillway Integrity

The auxiliary spillway is in good condition according to the most recent NRCS Dam Safety Inspection (NRCS, 2019a), although all sections have woody brush that needs to be removed. SITES integrity analysis for the existing spillway using the unfavorable soil parameters (i.e. more likely to erode) from the geotechnical analysis at Site No. 5 per **Table 3-1** indicates that significant headcutting during the FBH will occur including breach through the control section, causing the dam to fail. The risk of dam failure due to integrity is judged to be high.

Seismic

FRS No. 4 is located in an area of low potential seismic activity per the USGS National Seismic Hazard Maps (2018) and its risk of failure due to a seismic event is judged to be low.

Material Deterioration

The materials used in the principal spillway system are subject to weathering and chemical reactions due to natural elements within the soil, water, and atmosphere. Concrete risers and conduits can deteriorate and crack, metal components can rust and corrode, and leaks can develop. Embankment failure can occur from internal erosion caused by these leaks. To date, a camera survey of the principal spillway conduit has not been performed. Based on visual inspection of the site, the principal spillway and outlet conduit appear to be in overall good condition. Therefore, the risk of failure due to material deterioration is judged to be low to moderate.

Conclusions

Currently, hydrologic failure and spillway integrity failure are the most likely failure modes for FRS No. 4. The other potential modes of failure present low to moderate risk.

### 3.18.2 FRS No. 5

Sedimentation

The major land uses in the watershed above FRS No. 5 are provided in **Table 3-1** and include 85.6% shrub/scrub, 5.8% deciduous forest, 3.2% cultivated crops, 2.7% evergreen forest, 2.0% developed- open space, 0.4% open water, 0.1% mixed forest, and 0.1% developed – low intensity. These uses are not expected to change significantly or be adjusted to land uses that would increase sediment yield. The future sediment accumulation rate is therefore planned to be similar to the historic rate for the 58 elapsed years (from dam construction until the 2021 sediment survey). Based upon the minimal sediment deposition rate and the available 513.4 acre-feet of sediment storage at the principal spillway crest, the remaining sediment storage life of FRS No. 5 is at least 100 years. Therefore, the potential for failure due to inadequate sediment storage capacity is low.

Hydrologic Capacity

Hydrologic failure of a dam occurs when the auxiliary spillway is breached or when the dam is overtopped and fails. FRS No. 5 was originally designed with a total floodwater storage of 1,688 acre-feet. It was designed as a significant-hazard potential dam and is currently performing as intended. However, due to downstream development since dam construction, it has been reclassified as a high hazard potential dam and currently does not meet dam safety criteria as required by the NRCS to prevent overtopping or breaching of the auxiliary spillway and/or embankment during a probable maximum precipitation event as required for a high hazard potential dam. The water in the reservoir would flow over the top of the embankment during the PMF and could cause it to erode and collapse. Therefore, FRS No. 5 is categorized as having high potential to fail due to deficient hydrologic capacity.

Embankment Seepage

Embankment and foundation seepage can contribute to failure of an embankment by removing (piping) soil material from the embankment and/or foundation. As the soil material is removed (i.e., internal erosion), the resulting void allows more water flow through the embankment or foundation. Progressive internal erosion, if unchecked, can lead to breaching and/or collapse of the dam. Two general types of seepage can develop in earthen embankment dams: under-seepage and through-seepage. Under-seepage occurs when differential hydrostatic head causes excessive flow gradients to develop in relatively pervious dam foundation materials, producing upward vertical flow at the downstream toe of the dam which may result in the formation of seeps, sand boils, and/or piping under the dam. Through-seepage develops when differential hydrostatic head causes the phreatic surface through the embankment to daylight on the downstream slope face, which can produce seeps and/or piping through the dam embankment.

Based on review of the as-built drawings and original Soil Mechanics Report (SMR) both dated 1961, the embankment is a zoned earthfill dam with rockfill blankets/berms at the upstream and downstream toes. An embankment cutoff trench extending to the underlying shale/sandstone bedrock was constructed under the centerline of the dam for seepage control. The cutoff trench backfill materials were specified as a lean clay (CL) borrow source. The upstream/central portion of the earthfill was specified as predominantly lean clay (CL) borrow sources with some clayey

silty sand (SC-SM). A downstream transition zone of silty sand (SM) was included adjacent to the rockfill blanket.

The SMR (USDA-SCS, 1961) indicated that the downstream rock toe would provide internal drainage function and recommended a two-stage coarse filter at the earthfill/rockfill interface for filter compatibility. However, the as-builts do not show any filter layers. Thus, it is unclear whether the rockfill materials are filter compatible with the adjacent earthfill materials. If an existing phreatic surface is present or will develop as a result of through-seepage within the dam, internal erosion (piping) of the embankment soils into pore-space in the rockfill could develop. Further, the presence of rockfill covering on the downstream slopes would likely conceal visual evidence of ongoing piping erosion until a significant void has developed. The existing concrete anti-seep collars around the PSW pipe exacerbate the risk of piping due to potential defects resulting from inadequate compaction of the surrounding backfill during construction.

No evidence of historic under-seepage or through-seepage has been reported at this site. The embankment appears to be performing adequately to date from the standpoint of seepage control. While some defensive measures against seepage were included in the original design to address potential through-seepage and under-seepage (e.g., impervious core and cutoff trench), the concrete anti-seep collars and potential filter incompatibilities may increase the risk of through-seepage and related piping erosion.

Based on the foregoing, the risk of dam failure due to under-seepage is estimated to be low. The risk of dam failure due to through-seepage is estimated to be low to moderate.

Embankment Stability

Slope stability analyses were conducted in the original SMR for this project (USDA-SCS, 1961). The reported factors of safety ranged from 1.40 to 1.56 for the downstream slope (steady-state), and from 1.43 to 1.54 for the upstream slope (drawdown). Note that two other steady-state trial analyses produced lower factors of safety (1.28 and 1.33), but these analyses are not representative because they assumed no toe berm or foundation drain would be included. The as-built drawings confirm that a downstream toe berm consisting of rockfill was included in construction. The analyses procedures appear to be consistent with standard practice of that era, but current industry practice and NRCS design criteria have evolved in the years since. It is possible that factors of safety for embankment stability may be higher or lower than that reported in the 1961 SMR, and may or may not meet current minimum design criteria by NRCS and/or the Texas Commission on Environmental Quality (TCEQ). Estimating the factor of safety for embankment stability is outside the scope of this project.

According to the 2015 Dam Assessment Report (NRCS, 2015), the downstream slope and crest of the embankment have poor vegetative cover. Significant erosion and low spots were noted on the embankment crest. The downstream slope also exhibited evidence of prior surface slides. The 2019 inspection report by NRCS noted fair vegetative cover and lessened embankment erosion compared to prior inspections, but most of the topsoil has eroded form the dam and collected at the toes of the slopes. No evidence of seepage, depressions, cracking, or deep-seated slope instability have been documented at this site.

In summary, surficial erosion and/or minor shallow slides have been documented on the embankment. However, there has been no reported evidence of deep-seated and/or extensive dam instability (e.g., crest deformation, cracking, toe bulges, depressions, etc.). Further, no adverse seepage conditions have been reported at this site.

The supplemental investigation for this project did not included borings on or near the dam embankment. However, borings drilled in the auxiliary spillway and borrow area identified "pinhole" structures within some samples of the natural foundation materials, which are characteristic of collapsible soils. While there are no historical reports or visual evidence of adverse effects on the embankment related to collapsible soils, collapsible soils may be present under the upstream/downstream dam slopes of the embankment (i.e., where not removed by the core trench) and/or near the toes of the embankment. Final design investigations associated with potential rehabilitation alternatives should specifically investigate the potential for collapsible soils and identify whether mitigation measures are required (e.g., overexcavation/replacement, pre-wetting/preloading, etc.).

If rehabilitation alternatives including an embankment raise are required for FRS No. 5, the geotechnical properties of the fill materials and the geometry of the fill will also affect slope stability of the rehabilitated dam. Based on the results of the supplemental geologic investigation, available on-site borrow materials generally classify as lean clay (CL) and clayey sand (SC) and have properties typical of embankment fill for earthen dams. Therefore, it is likely that standard dam embankment slope angles (e.g., 3H:1V) will likely meet minimum stability criteria, but this will need to be confirmed as part of the rehabilitation design.

Based on the foregoing, the risk of dam failure due to embankment instability is estimated to be low.

Spillway Integrity and Stability

The auxiliary spillway is in good condition according to the most recent NRCS Dam Safety Inspection (NRCS, 2019b).

Preliminary SITES integrity analysis for the existing spillway using the unfavorable soil parameters (i.e. more likely to erode) per **Table 3-1** indicates that significant headcutting during the FBH will occur including breach through the control section, causing the dam to fail. The risk of dam failure due to integrity is judged to be high.

The supplemental geologic investigation for this project included laboratory testing for dispersive soils. While less accurate screening-level tests (crumb tests) indicate the presence of dispersive soils, the more accurate confirmatory pinhole tests indicate non-dispersive to slightly dispersive soils. Dispersive soils are more easily eroded than normal soils, and future geologic investigations for final rehabilitation design should include additional dispersive soils testing to confirm that surface treatments of this spillway will not be required. Based on results of pinhole tests and lack of characteristic erosional features of dispersive soils ("jugholes", etc.) observed during the visual reconnaissance, it is believed the risk of dispersive soils within the spillway channel is relatively low.

Preliminary SITES stability analysis for the existing spillway using the favorable and unfavorable soil parameters per **Table 3-1** indicates that stresses on the upper 355 feet of the existing spillway immediately downstream of the control section exceed allowable stresses per USDA-NRCS TR-60, 2nd edition stability analysis for earthen/vegetated spillways. Armoring would be required to maintain stability of surface materials in this section, but risk of breach of the dam due to lack of surface stability under existing conditions is estimated to be moderately low.

Extensive gullies are observed on the right cut slope (outer edge of spillway) located upstream of the control section will need to be repaired and protected from future erosion. However, these are not estimated to pose a risk to the integrity of the spillway, and no significant erosion was observed within the spillway channel itself, so risk of dam failure due to existing erosion is estimated to be low.

Seismic

FRS No. 5 is located in an area of low potential seismic activity per the USGS National Seismic Hazard Maps (2018) and its risk of failure due to a seismic event is judged to be low.

Material Deterioration

The materials used in the principal spillway system are subject to weathering and chemical reactions due to natural elements within the soil, water, and atmosphere. Concrete risers and conduits can deteriorate and crack, metal components can rust and corrode, and leaks can develop. Embankment failure can occur from internal erosion caused by these leaks. To date, a camera survey of the principal spillway conduit has not been performed. Based on visual inspection of the site, the principal spillway and outlet conduit appear to be in overall good condition. Therefore, the risk of failure due to material deterioration is judged to be low to moderate.

Conclusions

Currently, hydrologic failure and spillway integrity failure are the most likely failure modes for FRS No. 5. The other potential modes of failure present low to moderate risk.

## 3.19 Consequences of Dam Failure

Inundation due to dam failure potentially has the following consequences at each structure.

### 3.19.1 FRS No. 4

Both the population-at-risk (PAR) estimate (**Appendix E**) and breach zone analyses (**Appendix C**) estimate depths of inundation based upon LiDAR natural ground elevations at a structure. A structure was considered to be at risk for the PAR estimate when the depth of floodwater exceeded one foot above natural ground. For the breach maps located in **Appendix C (Figures C-5 and C-6)**, structures inundated above the first floor elevation (FFE) by any depth are included in the breach zone.

Loss of Life
The breach inundation study indicates that a dam failure may result in inundation of residential structures and transportation infrastructure. Details regarding the breach inundation studies can be found in **Section 3.17**.

To estimate the PAR from a sunny day, top of dam breach scenario, the following infrastructure was taken into consideration: the lives of people in four residences and motorists on McDonald Rd and Nipple Peak Rd would be at-risk in the event of a breach. Using an average of three people per residence would result in 12 people at risk from a breach. Due to the estimated depth combined with the velocity of the breach floodwaters, there could be many other people at risk of serious injuries. The analysis indicates that McDonald Rd and Nipple Peak Rd would be severely damaged as a result of a breach due to being overtopped by approximately 8.24 feet and 6.42 feet, respectively. It was estimated that two vehicles would be in harm's way on these two crossings. Considering an average of two occupants per vehicle, four motorists would be exposed to risk. Given the number of properties and vehicles located within the breach zone, it is estimated that at a minimum the number of people at risk due to a breach of FRS No. 4 would be 16.

Release of Harmful Materials
The minimal volume of sediment stored in the reservoir and eroded embankment material released to Middle Kickapoo Creek would harm water quality, degrade aquatic habitat, and reduce downstream channel capacity.

Infrastructure Destruction
Residential dwellings, fences, roads, bridges, and public utilities may be damaged or destroyed.

### 3.19.2 FRS No. 5

Loss of Life
The breach inundation study indicates that a dam failure may result in inundation of residential structures and transportation facilities. Details regarding the breach inundation studies can be found in **Section 3.17**.

To estimate the PAR from a sunny day, top of dam breach scenario, the following infrastructure was taken into consideration: the lives of people in nine residences and motorists on Main St, Oliver Ave., and Railroad Rd (at three locations), would be at-risk in the event of a breach. Using an average of three people per residence would result in 27 people at risk from a breach. Due to the estimated depth combined with the velocity of the breach floodwaters, there could be many other people at risk of serious injuries. The analysis indicates that the three Railroad Rd. crossings could be damaged as a result of a breach due to being overtopped by approximately 5.28 feet, 3.5 feet, 2.42 feet of floodwaters, respectively. The analysis indicates that the Main St. and Oliver Ave. stream crossings could be damaged as a result of a breach due to being overtopped by approximately 5.27 feet and 3.09 feet of floodwaters, respectively. It was estimated that one vehicle would be in harm's way at each crossing. Considering an average of two occupants per vehicle, ten motorists would be exposed to risk. Given the number of properties and vehicles located within the breach zone, it is estimated that the number of people at risk due to a breach of FRS No. 5 would be 37.

Release of Harmful Materials

The minimal volume of sediment stored in the reservoir and eroded embankment material released to Middle Kickapoo Creek would harm water quality, degrade aquatic habitat, and reduce downstream channel capacity. Furthermore, the inundation area includes agricultural lands uses that may contain hazardous materials.

Agricultural Damage

Flood damage and sediment transport may cause reduced productivity of agricultural land downstream from FRS No. 5.

Infrastructure Destruction

Residential dwellings, fences, roads, bridges, public utilities, and farm equipment may be damaged or destroyed.

# 4.0 ALTERNATIVE FORMULATION AND COMPARISON

The alternatives for FRS No. 4 and FRS No. 5 were developed with the stated objectives in mind: 1) Address safety concerns associated with the FRS No. 4 embankment, 2) to continue to provide downstream flood prevention, and 3) meet current NRCS and/or TCEQ safety and performance standards. These objectives can be achieved by installing dam rehabilitation measures at one or both dams, by decommissioning one or both dams and mitigating downstream flooding risks, performing non-structural measures that would remove the population at risk below the dams and prevent future development within the breach inundation area, or a combination of the above measures. These alternatives would reduce the risks to life and property from a potential catastrophic dam failure.

All cost estimates provided in this report shall be considered as preliminary in-nature, as they are based on conceptual designs for the alternatives. All material quantities should be updated with those developed during the design phase and unit costs should be updated at the time of design. All cost estimates are based on 2023 dollars.

## 4.1 Formulation Process

Formulation of the alternative rehabilitation plan for Kickapoo Creek Watershed FRS No. 4 and FRS No. 5 followed procedures outlined in the NRCS *National Watershed Program Manual* (USDA-NRCS 2015) and the NRCS *National Watershed Program Handbook* (USDA-NRCS, 2014). Other guidance incorporated into the formulation process included the *Principles and Requirements for Federal Investments in Water Resources* (U.S. Council on Environmental Quality (CEQ), 2013) and *Interagency Guidelines for Principles and Requirements for Federal Investments in Water Resources* (U.S. CEQ, 2014) (documents are collectively referred to as PR&G), Departmental Regulation 9500-013 (USDA 2017), Departmental Manual 9500-013 (USDA 2017), and other NRCS watershed planning policies.

The formulation process began with discussions between the Sponsors, NRCS, and the Texas State Soil and Water Conservation Board (TSSWCB). Alternative plans of action were developed based on NRCS planning requirements and the ability of the alternatives to bring both FRS No. 4 and FRS No. 5 up to date with current safety and design criteria and performance standards, resolve existing safety deficiencies, and address the Sponsors' concerns, as neither dam currently meets NRCS design criteria for High Hazard Potential classification.

The alternatives that were considered for both FRS No. 4 and FRS No. 5 in the development and identification of the selected alternative were:

- No Action;
- Decommission with Federal Assistance (Future with Federal Investment [FWFI]);
- Significant Hazard Potential Rehabilitation (FWFI) - rehabilitate dam to meet current significant hazard potential criteria and perform non-structural measures to reduce risk in the breach zone, i.e. relocating structures;

- High Hazard Potential Rehabilitation (FWFI) - rehabilitate and upgrade dam to meet current high hazard potential criteria; and
- Decommission to TCEQ Standards (SLO Sponsored)
- High Hazard Rehabilitation to TCEQ Standards (SLO Sponsored)

As FRS No. 4 and FRS No. 5 are located in series along Middle Kickapoo Creek (FRS No. 4 is upstream of FRS No. 5), proposed modifications to one structure had to be considered in the context of the proposed modifications to the other structure. From this point forward in the Plan-EA an "alternative" will refer to a combination of a "choice" of a modification type for each FRS No. 4 and FRS No. 5 (i.e. "alternative" 3 includes a dam removal "choice" for FRS No. 4 and a high hazard potential rehabilitation "choice" for FRS No. 5). Each "choice" may consist of one or more "options" for how to achieve that modification type (i.e. in "alternative" 3, the high hazard potential rehabilitation "choice" for FRS No. 5 may be achieved through the "option" of raising the embankment or through the "option" of constructing a new spillway. **Table 4-1** shows the different combinations of "choices" that were considered for each "alternative". Details on the different "options" considered for each "choice" are discussed in subsequent tables.

**Table 4-1. FRS No. 4 and FRS No. 5 Alternatives Considered**

| | FRS No. 4 | | FRS No. 5 | |
|---|---|---|---|---|
| **Alternative** | **Choice No.** | **Choice Description** | **Choice No.** | **Choice Description** |
| No Action | 0 | Maintain Dam Until Failure | 0 | Maintain Dam Until Failure |
| 1 | 1 | Dam Removal (federal) | 1 | Dam Removal (federal) |
| 2 | 1 | Dam Removal (federal) | 2 | Significant Hazard Potential Rehabilitation |
| 3 | 1 | Dam Removal (federal) | 3 | High Hazard Potential Rehabilitation |
| 4 | 2 | Significant Hazard Potential Rehabilitation | 1 | Dam Removal (federal) |
| 5 | 2 | Significant Hazard Potential Rehabilitation | 2 | Significant Hazard Potential Rehabilitation |
| 6 | 2 | Significant Hazard Potential Rehabilitation | 3 | High Hazard Potential Rehabilitation |
| 7 | 3 | High Hazard Potential Rehabilitation | 1 | Dam Removal (federal) |
| 8 | 3 | High Hazard Potential Rehabilitation | 2 | Significant Hazard Potential Rehabilitation |
| 9 | 3 | High Hazard Potential Rehabilitation | 3 | High Hazard Potential Rehabilitation |
| 10 | 1 | Dam Removal (federal) | 5 | High Hazard Potential Rehabilitation to TCEQ Standards (SLO Sponsored) |

| Alternative | FRS No. 4 | | FRS No. 5 | |
|---|---|---|---|---|
| | **Choice No.** | **Choice Description** | **Choice No.** | **Choice Description** |
| 11 | 4 | Dam Removal (SLO Sponsored) | 5 | High Hazard Potential Rehabilitation to TCEQ Standards (SLO Sponsored) |

## 4.2 Alternatives Considered but Eliminated from Detailed Study

Some of the alternatives considered in the planning process were eliminated from detailed consideration because these alternatives were unreasonable due to cost or they were logistically impractical to implement. These alternatives are shown in **Table 4-2**.

**Table 4-2. Alternatives Considered but Eliminated from Detailed Study**

| Alternative | FRS No. 4 | | | | FRS No. 5 | | | |
|---|---|---|---|---|---|---|---|---|
| | **Choice** | **Option** | **Name** | **Option Description** | **Choice** | **Option** | **Name** | **Option Description** |
| 1 | 1 | B | Decommission w/ Fed Assistance | Dam removal to NRCS standards | 1 | A | Decommission w/ Fed Assistance | NA |
| 2 | 1 | B | Decommission w/ Fed Assistance | Dam removal to NRCS standards | 2 | A | Significant Hazard Potential Rehabilitation | NA |
| 4 | 2 | A | Significant Hazard Potential Rehabilitation | Existing Spillway Alignment | 1 | A | Decommission w/ Fed Assistance | NA |
| | | B | | Adjusted Spillway Alignment | | | | |
| 5 | 2 | A | Significant Hazard Potential Rehabilitation | Existing Spillway Alignment | 2 | A | Significant Hazard Potential Rehabilitation | NA |
| | | B | | Adjusted Spillway Alignment | | | | |
| 6 | 2 | A | Significant Hazard Potential Rehabilitation | Existing Spillway Alignment | 3 | A | High Hazard Potential Rehabilitation | NA |
| | | B | | Adjusted Spillway Alignment | | | | |
| 7 | 3 | A | High Hazard Potential Rehabilitation | Existing Spillway Alignment | 1 | A | Dam Removal | NA |
| | | B | | Adjusted Spillway Alignment | | | | |
| 8 | 3 | A | High Hazard Potential Rehabilitation | Existing Spillway Alignment | 2 | A | Significant Hazard Potential Rehabilitation | NA |
| | | B | | Adjusted Spillway Alignment | | | | |

| Alternative | FRS No. 4 | | | | FRS No. 5 | | | |
|---|---|---|---|---|---|---|---|---|
| | **Choice** | **Option** | **Name** | **Option Description** | **Choice** | **Option** | **Name** | **Option Description** |
| 11 | 1 | A | Decommission (SLO Sponsored) | Decommission to TCEQ Standards | 5 | A | TCEQ High Hazard Rehab (SLO Sponsored) | Perform regrading of dam crest to raise effective crest. |

### 4.2.1 Alternative 1 - Decommissioning of FRS No. 4 and FRS No. 5

Decommission of FRS No. 4

Decommissioning consists of removing the storage function of the dam and reconnecting, restoring, and stabilizing the stream and floodplain functions. Although complete removal of the embankment is sometimes required for decommissioning, only partial removal of the embankment was evaluated in this alternative. It includes excavating a breach in the dam with a bottom width of 84 feet to safely pass the 1% AEP flood through the dam. This breach would be a minimum size opening in the dam from top of dam to the valley floor which would eliminate the structure's ability to store water. To not impede flows through the breached embankment and to reduce certain safety and health factors, the principal spillway components would also be removed.

The excavated material (about 23,000 cubic yards) would be placed in the present easement area and the remaining portion of the embankment and all exposed areas would be vegetated as needed for erosion control (approximately 8 acres). Channel work would be performed to reconnect the stream channel through the sediment pool. Riparian vegetation would be established along the stream channel (approximately 1.4 acres). A grade stabilization structure would be installed to stabilize sediment and prevent stream headcutting. Construction activities would require that a Storm Water Pollution Prevention Plan (SWPPP) be in effect.

Existing and proposed floodplains were mapped approximately 14,800 feet downstream of FRS No. 4, ending upstream of the normal pool of FRS No. 5. The 1% AEP floodplain downstream would be enlarged. Since the 1% AEP floodplain downstream would be enlarged, future downstream development would need to be restricted by development restrictions to prevent an increased risk to public safety. Floodwaters from a 1% AEP storm event would overtop the McDonald Rd crossing of Middle Kickapoo Creek by 5.7 feet (versus 0.4 feet in existing conditions) and the Nipple Peak Rd crossing of Middle Kickapoo Creek by 2.9 feet (versus 1.6 feet in existing conditions). These road crossings would be subject to greater flood depths during the 1% AEP storm event and would also be subject to more frequent flooding (i.e. they would be impacted at more frequent storm event). In addition, NW Railroad Road, which runs parallel to Middle Kickapoo Creek would be subject to more extensive and more frequent flooding with this alternative than it would be under current conditions. To continue to provide downstream flood protection as required to meet the Purpose and Need for the project, mitigation for additional flood impacts at these roads would be included in this alternative. This alternative assumes that these impacted roads would have barricades with flood warning lights installed at both sides of the modeled flood extents to prevent an unsafe and potentially deadly situation that could occur as a result of the dam removal. The estimated cost to decommission the dam is $1,652,000. Additional roadway mitigation costs are estimated to be at least $360,000, for an estimated cost of $2,012,000 for FRS No. 4.

Decommission of FRS No. 5

Decommissioning consists of removing the storage function of the dam and reconnecting, restoring, and stabilizing the stream and floodplain functions. Although complete removal of the

embankment is sometimes required for decommissioning, only partial removal of the embankment was evaluated in this alternative. This would consist of excavating a breach in the dam with a 93 foot bottom width to safely pass the 1% AEP flood through the dam. This breach would be a minimum size opening in the dam from top of dam to the valley floor which would eliminate the structure's ability to store water. To not impede flows through the breached embankment and to reduce certain safety and health factors, the principal spillway components would also be removed.

The excavated material (approximately 42,300 cubic yards) would be placed in the sediment and detention pool areas and all exposed areas would be vegetated as needed for erosion control (approximately 38 acres). Channel work would be performed to reconnect the stream channel through the sediment pool. Riparian vegetation would be established along the stream channel (approximately 2.8 acres). A grade stabilization structure would be installed to stabilize sediment and prevent stream headcutting. Construction activities will require that a SWPPP be in effect.

Existing and proposed floodplains were mapped approximately 10.8 miles downstream of FRS No. 5, ending at the confluence of Middle Kickapoo Creek and West Kickapoo Creek. The 1% AEP floodplain downstream would be enlarged. Four houses already in the 1% AEP floodplain would experience an increase in the frequency and depth of flood damages above the FFE, and six additional houses would be added to the 1% AEP floodplain for this alternative but would not be impacted above the FFE. To continue to provide downstream flood protection as required to meet the Purpose and Need for the project, mitigation (structure acquisition) for additional flood impacts at these houses would be included in this alternative. The stream crossings on E. Main Street and E. Oliver Street would experience an increase in the depth and frequency of overtopping. To continue to provide downstream flood protection as required to meet the Purpose and Need for the project, mitigation (enlarging the structures) for additional flood impacts at these roads would be included in this alternative. The structures would only be enlarged to a size that would prevent the 0.1% AEP flood depths occurring in the existing condition from increasing with this alternative. Two segments of US 277 (approximately 4,800 feet total) and a segment of NW Railroad Rd (approximately 12,400 feet), that run parallel to Middle Kickapoo Creek would be inundated in this alternative. To continue to provide downstream flood protection as required to meet the Purpose and Need for the project, mitigation (elevating the roads to prevent an increase in flooding over the existing condition) for additional flood impacts at these locations would be included in this alternative. The estimated cost to decommission the dam is $2,327,000. Additional roadway/habitable structure mitigation costs are estimated to be at least $15,280,000, for an estimated cost of $17,607,000 for FRS No. 5.

<u>Justification for Elimination of Alternative from Detailed Study</u>

This alternative meets the Purpose and Need of the Project but is not considered reasonable due to the high cost of implementation, potential disruption of community cohesion due to major roadway modifications and 4 home acquisitions, and potential logistics issues associated with significant road raises. Preliminary cost estimates indicate that the cost of this alternative would be approximately $20,000,000, with a large portion of that cost being roadway improvements to prevent induced (increased) flooding on US 277 and NW Railroad Rd from the decommissioning of FRS No. 5. The length and height of the road raises required could cause logistical challenges.

This alternative is also expected to cause a potential disruption to community cohesion as a result of road raises and habitable structure buyouts, and a risk to loss of life would remain with this alternative as the roadway modifications would only prevent an increase in flooding over the 1% AEP existing condition. This alternative was therefore eliminated from further evaluation.

### 4.2.2 Alternative 2 – Decommission of FRS No. 4 with Significant Hazard Potential Classification with Nonstructural Measures for FRS No. 5

Decommission of FRS No. 4

See description of Decommission of FRS No. 4 in Section 4.2.1.

Significant Hazard Potential Classification with Nonstructural Measures for FRS No. 5

Reclassification of FRS No. 5 to a significant hazard potential dam considers the purchase of deed restrictions of all areas within the breach zone where an easement does not already exist, acquisition of 9 residences below FRS No. 5 within the breach area, and modification of 5 roadway crossing locations and 2 parallel roadways downstream to ensure traffic would not be at risk from a catastrophic breach. The purpose of the removal of the PAR within the breach zone is to reduce the potential for loss of life in the event of catastrophic breach and allow the dam to be reclassified to a Significant Hazard Potential dam.

Due to surface erosion observed on the embankment, this alternative would also require over-excavation of the downstream slope of the embankment to a depth of approximately 3 feet and replacement of new fill material with the top of dam graded to the as-built elevation. It would also require the downstream embankment to be flattened to a 3:1 (Horizontal:Vertical) slope. No other structural modifications to FRS No. 5 would be required. The estimated construction cost of the required modifications to FRS No. 5 is over $3,244,000. This would be in addition to the structural and non-structural measures that would be required to remove the downstream PAR and allow the dam to be reclassified as a Significant Hazard Potential Dam, which are estimated to be cost approximately $28,672,000 for a cost of $31,916,000 for FRS No. 5.

Justification for Elimination of Alternative from Detailed Study

This alternative meets the Purpose and Need of the Project but is not considered reasonable due to the high cost of implementation, the potential disruption of community cohesion due to the 9 home acquisitions and the significant roadway modifications downstream of FRS No. 5, and potential logistics issues associated with significant road raises that would be required to reduce the potential for loss of life in the event of catastrophic breach of FRS No. 5. Preliminary cost estimates indicate that the cost of this alternative would be approximately $34,000,000, with a large portion of that being roadway modifications downstream of FRS No. 5 that would be required to allow FRS No. 5 to be reclassified to significant hazard potential. It is also expected that the logistics of the significant modifications to the 5 road crossings and 2 road segments that would be required for this alternative would result in the alternative being unreasonable. These measures would be required for the dam to be reclassified as a Significant Hazard Potential Dam. This alternative was therefore eliminated from further evaluation.

### 4.2.3 Alternative 4 - Significant Hazard Potential Classification with Nonstructural Measures for FRS No. 4 and Decommission of FRS No. 5

Significant Hazard Potential Classification with Nonstructural Measures for FRS No. 4

Reclassification of FRS No. 4 to a significant hazard potential dam considers the purchase of deed restrictions of all land within the breach area downstream of FRS No. 4 and FRS No. 5, acquisition of four residences between FRS No. 4 and FRS No. 5 and nine residences downstream of FRS No. 5 that are located within the breach area, modification of the roadways downstream of FRS No. 4 and FRS No. 5 to ensure traffic would not be at risk from a breach, and upgrades to the dam to meet TR-210-60 significant hazard potential criteria. Upgrades would also include repair of embankment material to address geotechnical issues. Selecting this alternative would cause the dam to be reclassified as a significant hazard potential dam, requiring removal of the PAR within the breach zone to reduce the potential for loss of life in the event of catastrophic breach. This alternative consists of the following components at FRS No. 4 to address geotechnical concerns related to observed cracking:

- Excavate all existing rock blanket and a minimum 5-feet of existing embankment material,
- Construct a new chimney filter/toe drain at a 2:1 slope on the downstream embankment,
- Add new embankment fill on the upstream and downstream embankment at a 3:1 slope with minimum 5 feet cover over filter, and
- Add rock riprap over geotextile over new fill on the upstream slope.

This alternative assumes that the existing principal spillway riser, conduit, and impact basin remain in place. Exterior inspection of the riser and impact basin showed these structures to be in good condition, but an inspection of the conduit would be recommended before any action associated with this alternative is undertaken.

The estimated cost of the rehabilitation of FRS No. 4 is $13,302,000. This would be in addition to the structural and non-structural measures that would be required to remove the downstream PAR and allow the dam to be reclassified as a significant hazard potential dam, which are estimated to be cost approximately $39,556,000 for a cost of $52,858,000 for FRS No. 4.

Decommission of FRS No. 5

See description of Decommission of FRS No. 5 in Section 4.2.1. The estimated cost of the decommission of FRS No. 5 is $2,327,000. Note that roadway/habitable structure mitigation costs for the roads downstream of FRS No. 5 are included in the cost estimate for FRS No. 4 above.

Justification for Elimination of Alternative from Detailed Study

This alternative meets the Purpose and Need of the Project but is not considered reasonable due to the high cost of implementation, the potential disruption of community cohesion due to the 13

home acquisitions and the significant roadway modifications downstream of FRS No. 4, and potential logistics issues associated with significant road raises that would be required to allow FRS No. 4 to be reclassified to significant hazard potential. Preliminary cost estimates indicate that the cost of this alternative would be approximately $55,200,000, with a large portion of that being roadway modifications downstream of FRS No. 4 that would be required to allow FRS No. 4 to be reclassified to significant hazard potential. It is also expected that the logistics of the significant modifications to the 7 road crossings and 3 road segments that would be required for this alternative would result in the alternative being unreasonable. These measures would be required for the dam to be reclassified as a significant hazard potential dam. This alternative was therefore eliminated from further evaluation.

### 4.2.4 Alternative 5 – Significant Hazard Potential Classification with Nonstructural Measures for FRS No. 4 with Significant Hazard Potential Classification with Nonstructural Measures for FRS No. 5

Significant Hazard Potential Classification with Nonstructural Measures for FRS No. 4

See description of Significant Hazard Potential Classification with Nonstructural Measures for FRS No. 4 in Section 4.2.3.

Significant Hazard Potential Classification with Nonstructural Measures for FRS No. 5

See description of Significant Hazard Potential Classification with Nonstructural Measures for FRS No. 5 in Section 4.2.2.

Justification for Elimination of Alternative from Detailed Study

This alternative meets the purpose and need of the Project but is not considered reasonable due to the high cost of implementation, the potential disruption of community cohesion due to the 13 home acquisitions and the significant roadway modifications downstream of FRS No. 4, and potential logistics issues associated with significant road raises that would be required to allow FRS No. 4 and FRS No. 5 to be reclassified to significant hazard potential dams. Preliminary cost estimates indicate that the cost of this alternative would be approximately $56,100,000, with a large portion of that being roadway modifications downstream of FRS No. 4 and FRS No. 5 that would be required to allow the dams to be reclassified to significant hazard potential. It is also expected that the logistics of the significant modifications to the 7 road crossings and 3 road segments that would be required for this alternative would result in the alternative being unreasonable. These measures would be required for the dams to be reclassified as significant hazard potential dams. This alternative was therefore eliminated from further evaluation

### 4.2.5 Alternative 6 – Significant Hazard Potential Classification with Nonstructural Measures for FRS No. 4 with High Hazard Potential Rehabilitation of FRS No. 5

Justification for Elimination of Alternative from Detailed Study

Per TR-210-60 (USDA NRCS, 2019):

> The hydrologic criteria and procedures for the design of an upper dam in a system of dams in series must be the same as, or more conservative than, those for dams downstream if failure of the upper dam could contribute to failure of the lower dam.

Therefore, this alternative was eliminated for detailed study.

### 4.2.6 Alternative 7 – High Hazard Rehabilitation of FRS No. 4 with Decommission of FRS No. 5

High Hazard Potential Rehabilitation of FRS No. 4

The high hazard potential rehabilitation option for FRS No. 4 consists of the following components which provides 100 years of future sediment storage and addresses geotechnical concerns related to observed cracking:

- Regrade the inlet and outlet channels of the auxiliary spillway and lower the crest to elevation 1994.1 feet (2.3 feet lower than as-built);
- Excavate all existing rock blanket and a minimum 5-feet of existing embankment material,
- Construct a new chimney filter/toe drain at a 2:1 slope on the downstream embankment,
- Add new embankment fill on the upstream and downstream embankment at a 3:1 slope with minimum 5 feet cover over filter, and
- Add rock riprap over geotextile over new fill on the upstream slope.

Construct 340-foot wide RCC overtopping spillway at elevation of 1994.3 feet. This alternative assumes that the existing principal spillway riser, conduit, and impact basin remain in place. Exterior inspection of the riser and impact basin showed these structures to be in good condition, but an inspection of the conduit would be recommended before any action associated with this alternative is undertaken.

During construction, best management practices will be utilized to avoid and minimize any potential adverse impacts. Construction activities will require that a SWPPP be in effect. All disturbed areas will be revegetated using adapted and/or non-invasive native species. Planting equipment will be cleaned and certified seed will be used as measures to prevent the spread of invasive species. No compensatory mitigation will be required as a result of implementing this alternative. All work of disturbance, including stockpiling, equipment staging, and ingress/egress, will occur on the embankment, the auxiliary spillway, and previously disturbed areas.
The estimated cost of the rehabilitation of FRS No. 4 is $23,824,000. Additional roadway mitigation costs (including roads downstream of FRS No. 5) are estimated to be at least $7,000,000, for a total estimated cost of $30,824,000 for FRS No. 4.

Decommission of FRS No. 5

See description of Decommission of FRS No. 5 in Section 4.2.3. The estimated cost of the decommission of FRS No. 5 is $2,327,000. Note that roadway/habitable structure mitigation costs for the roads downstream of FRS No. 5 are included in the cost estimate for FRS No. 4 above.

Justification for Elimination of Alternative from Detailed Study

While the High Hazard Potential Rehabilitation of FRS No. 4 is considered a viable alternative, the high cost of implementation, the potential for disruption of community cohesion, and the logistics associated with the significant road raises required to not cause induced (increased) flooding from the decommission of FRS No. 5 make this Alternative unreasonable. Preliminary cost estimates indicate that the cost of this alternative would be approximately $33,200,000, with a large portion of that cost being roadway improvements to prevent induced (increased) flooding on US 277 and NW Railroad Rd from the decommissioning of FRS No. 5. It is expected that the logistics of the significant modifications to the road crossings and road segments that would be required for this alternative would result in the alternative being unreasonable. This alternative is also expected to cause a potential disruption to community cohesion as a result of road raises and habitable structure buyouts, and a risk to loss of life would remain with this alternative as the roadway modifications would only prevent an increase in flooding over the 1% AEP existing condition. This alternative was therefore eliminated from further evaluation.

### 4.2.7 Alternative 8 – High Hazard Rehabilitation of FRS No. 4 with Significant Hazard Potential Classification with Nonstructural Measures for FRS No. 5

High Hazard Potential Rehabilitation of FRS No. 4

See description of High Hazard Potential Rehabilitation of FRS No. 4 in Section 4.2.6.

Significant Hazard Potential Classification with Nonstructural Measures for FRS No. 5

See description of Significant Hazard Potential Classification with Nonstructural Measures for FRS No. 5 in Section 4.2.4.

Justification for Elimination of Alternative from Detailed Study

This alternative meets the purpose and need of the Project but is not considered reasonable due to the high cost of implementation, the potential disruption of community cohesion due to the 9 home acquisitions, the significant roadway modifications downstream of FRS No. 5, and potential logistics issues associated with significant road raises that would be required to allow FRS No. 5 to be reclassified to significant hazard potential dam. Preliminary cost estimates indicate that the cost of this alternative would be approximately $54,800,000, with a large portion of that being roadway modifications downstream of FRS No. 5 that would be required to

allow FRS No. 5 to be reclassified to significant hazard potential. It is also expected that the logistics of the significant modifications to the 5 road crossings and 2 road segments that would be required for this alternative would result in the alternative being unreasonable. These measures would be required for the dam to be reclassified as a significant hazard potential dam. This alternative was therefore eliminated from further evaluation.

### 4.2.8 Alternative 11 – SLO Sponsored Decommission of FRS No. 4 and SLO Sponsored Rehab of FRS No. 5 to TCEQ Standards

SLO Sponsored Decommission of FRS No. 4

The SLO Sponsored Decommission of FRS No. 4 would not include any federal investment and would consist of excavating a breach in the dam of sufficient size to safely pass the 1% AEP, 24-hour flood event. This breach would be a minimum size opening in the dam from top of dam to the valley floor which would eliminate the structure's ability to store water. To not impede flows through the breached embankment and to reduce certain safety and health factors, the principal spillway components would also be removed. The excavated material (about 23,000 cubic yards) would be placed in the present easement area. All exposed areas would have vegetation established for erosion control (approximately 13 acres). Construction activities would require that a Storm Water Pollution Prevention Plan (SWP3) be in effect.

Following the SLO Sponsored Decommissioning, downstream flooding conditions would be similar to those that existed prior to the construction of the dam. The 1% AEP floodplain downstream would be enlarged. Since the 1% AEP floodplain downstream would be enlarged due to the absence of flood protection, future downstream development would be restricted by floodplain zoning. Floodwaters from a 1% AEP storm event would overtop McDonald Rd by 5.7 feet (versus 0.4 feet in existing conditions) and Nipple Peak Rd by 2.9 feet (versus 1.6 feet in existing conditions). These road crossings would be subject to greater flood depths during the 1% AEP storm event and would also be subject to more frequent flooding (i.e. they would be impacted at more frequent storm event). In addition, NW Railroad Road, which runs parallel to Middle Kickapoo Creek would be subject to more extensive and more frequent flooding with this alternative than it would be under current conditions. To continue to provide downstream flood protection as required to meet the Purpose and Need for the project, mitigation for additional flood impacts at these roads would be included in this alternative. This alternative assumes that these impacted roads would have barricades with flood warning lights installed at both sides of the modeled flood extents to prevent an unsafe and potentially deadly situation that could occur as a result of the dam removal. The estimated cost for the Sponsor to decommission the dam is $758,000, with an additional $360,000 in costs associated with the flood barricades and flood warning lights, for a total of $1,118,000.

SLO Sponsored Rehab of FRS No. 5 to TCEQ Standards

Without FRS No. 4 in place, minor modifications to FRS No. 5 would be required for the dam to meet TCEQ standards for an intermediate size high hazard dam. The crest of FRS No. 5 would need to be re-graded to fill in depressions and raise the effective dam crest by 0.29 foot to an

elevation of 1916.19 feet. The raise would be to an elevation below the as-built top-of-dam elevation (1916.79). It should be noted that although the auxiliary spillway would not experience integrity issues (headcutting) in the TCEQ design storm it would experience stability (erosion) issues, if engaged. Although not required to meet TCEQ hydrologic criteria, the sponsor may want to make modifications to the auxiliary spillway to protect it against erosion. The estimated cost for the Sponsor to regrade the dam crest and raise the effective crest 0.29 foot is $147,000. A conceptual figure is included as **Appendix C-14**.

Justification for Elimination of Alternative from Detailed Study

This alternative meets the purpose and need of the Project but is not considered reasonable due to the lack of state-level funding sources available to the Sponsors for funding the project. The SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ standards would be eligible for funding through the State of Texas, as the dam has exceeded its service life, but the SLO Sponsored Decommissioning of FRS No. 4 would not be eligible for state-level funding. An alternative considering the Federal Decommissioning of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ standards would have the similar impacts and benefits, but would be eligible for State funding, (the State could provide funding to support a federal project, even if it includes decommissioning of a dam), so such an alternative has been included as Alternative 10 and this Alternative 11 was eliminated from further evaluation.

## 4.3 Description of Alternatives Considered

The alternatives that meet the Project Purpose and Need and were considered reasonable were carried through analysis. In addition, the No Action/ Future without Federal Investment Alternative was also considered. These alternatives for are shown in **Table 4-3**.

**Table 4-3. Alternatives Considered**

| | **FRS No. 4** | | **FRS No. 5** | |
|---|---|---|---|---|
| **Alternative** | **Name** | **Description** | **Name** | **Description** |
| **No Action** | **No Action** | **Maintain dam until failure.** | **No Action** | **Maintain dam until failure.** |
| 3 | Decommission w/ Federal Assistance | Dam removal to NRCS criteria | High Hazard Potential Rehabilitation | Option A – Lower PS crest, replace PS conduit, raise AS crest, add ACB to AS, raise dam, and add RCC spillway. |
| | | | | Option B – Lower PS crest, replace PS conduit, raise and widen AS crest, add ACB to AS, and raise dam. |

| | **FRS No. 4** | | **FRS No. 5** | |
|---|---|---|---|---|
| 9 | High Hazard Potential Rehabilitation | Option A - Lower AS crest and add RCC spillway. | High Hazard Potential Rehabilitation | Option C – Lower PS crest, lower AS crest, add ACB to AS, and raise dam. |
| | | Option B - Lower AS crest, add ACB to AS, and add RCC spillway. | | Option C – Lower PS crest, lower and widen AS crest, add ACB to AS, and raise dam. |
| 10 | Decommission w/ Federal Assistance | NRCS criteria | TCEQ High Hazard Rehab (SLO Sponsored) | Perform regrading of dam crest to raise effective crest. |

### 4.3.1 No Action Alternative

The No Action alternative documents baseline conditions against which all other alternatives are analyzed. It does not involve federal action or federal investment and assumes that the existing dams would remain in place without any action that would improve the dams from their original designs or correct safety deficiencies beyond maintenance or replacements performed in accordance with operations and maintenance plans for the dams. There would be no new operation and maintenance (O&M) agreement between the Sponsors and NRCS and any future NRCS involvement in FRS No. 4 and FRS No. 5 would be limited to that which would be available in the future. It is assumed that the dams will catastrophically fail (from the highest probability failure mode) in the future and not be subsequently rebuilt or rehabilitated.

No Action Alternative for FRS No. 4

The most likely failure modes for FRS No. 4 are hydrologic failure (overtopping) and spillway integrity failure (breach of the auxiliary spillway). The probability of failure of these events was estimated by reducing the Probable Maximum Precipitation (PMP) values until they were at the minimum values that would cause each type of failure. Frequency rainfall events were plotted and a power function trendline equation was used to estimate the return interval for the rainfall events that would result in each failure type. Hydrologic failure is estimated to occur as a result of the 94% PMP event, which is estimated to have a return interval of 25,295-years. Integrity failure is estimated to occur as a result of the 52% PMP event, which is estimated to have a return interval of 2,136-years.

Catastrophic failure of the dam could result in damages to four residences, two downstream road crossings and multiple road segments, other infrastructure, and small areas of agricultural lands. Both catastrophic failures scenarios would pose a significant risk of loss of life.

Following catastrophic failure of the dam, downstream flooding conditions would be similar to those that existed prior to the construction of the dam. Existing and proposed floodplains were mapped approximately 14,800 feet downstream of FRS No. 4, ending upstream of the normal

pool of FRS No. 5. The 1% AEP floodplain downstream would be enlarged. Since the 1% AEP floodplain downstream would be enlarged due to the absence of flood protection, future downstream development would be restricted by floodplain zoning. Floodwaters from a 1% AEP storm event would overtop McDonald Rd by 5.7 feet (versus 0.4 feet in existing conditions) and Nipple Peak Rd by 2.9 feet (versus 1.6 feet in existing conditions).

No Action Alternative for FRS No. 5

The most likely failure modes for FRS No. 5 are hydrologic failure (overtopping) and spillway integrity failure (breach of the auxiliary spillway). The probability of failure of these events was estimated by reducing the Probable Maximum Precipitation values until they were at the minimum values that would cause each type of failure. Frequency rainfall evented were plotted and a power function trendline equation was used to estimate the return interval for the rainfall events that would result in each failure type. Hydrologic failure is estimated to occur as a result of the 80% PMP event, which is estimated to have a return interval of 12,118-years. Integrity failure would not occur until the 90% PMP event and the dam would have overtopped at the 80% PMP event, so integrity failure was not included in the No Action alternative for FRS No. 5.

Catastrophic failure of the dam could result in damages to ten residences, five downstream road crossings and multiple road segments, other infrastructure, and agricultural lands. The catastrophic failure scenario would pose a significant risk of loss of life.

Following catastrophic breach, downstream flooding conditions would be similar to those that existed prior to the construction of the dam. Existing and proposed floodplains were mapped approximately 10.8 miles downstream of FRS No. 5, ending at the confluence of Middle Kickapoo Creek and West Kickapoo Creek. The four houses already in the 1% AEP floodplain would experience an increase in the frequency and depth of flood damages, and additional houses would be added to the 1% AEP floodplain. The stream crossings on E. Main Street and E. Oliver Street would experience an increase in the depth and frequency of overtopping. Railroad Road at three crossing locations would be overtopped in the 1% AEP event due to this alternative. Two segments of US 277 and a segment of NW Railroad Rd that run parallel to Middle Kickapoo Creek would be inundated in this alternative. Since the 1% AEP floodplain downstream would be enlarged due to the absence of flood protection, future downstream development would be restricted by floodplain zoning.

### 4.3.2 Alternative 3 – Decommissioning of FRS No. 4 and High Hazard Rehabilitation of FRS No. 5

Decommission of FRS No 4

Decommissioning consists of removing the storage function of the dam and reconnecting, restoring, and stabilizing the stream and floodplain functions. Although complete removal of the embankment is sometimes required for decommissioning, only partial removal of the embankment was evaluated in this alternative. It includes excavating a breach in the dam of sufficient size to safely pass the 1% AEP flood through the dam. This breach would be a minimum size opening in the dam from top of dam to the valley floor which would eliminate the

structure's ability to store water and would have a bottom width of approximately 84 feet. To not impede flows through the breached embankment and to reduce certain safety and health factors, the principal spillway components would also be removed.

The excavated material (about 23,000 cubic yards) would be placed in the present easement area and the remaining portion of the embankment and all exposed areas would be vegetated as needed for erosion control (approximately 8 acres). Channel work would be performed to reconnect the stream channel through the sediment pool. Riparian vegetation would be established along the stream channel (approximately 1.4 acres). A grade stabilization structure would be installed to stabilize sediment and prevent stream headcutting. Construction activities would require that a Storm Water Pollution Prevention Plan (SWPPP) be in effect.

Downstream flooding conditions from a 1% AEP, 24-hour storm would be similar to those that existed prior to the dam being construction. In order to continue to provide downstream flood protection as required to meet the Purpose and Need of the project, mitigation for additional flood impacts would be included in this alternative. Existing and proposed floodplains were mapped approximately 14,800 feet downstream of FRS No. 4, ending upstream of the normal pool of FRS No. 5. The 1% AEP floodplain downstream would be enlarged. Since the 1% AEP floodplain downstream would be enlarged due to the absence of flood protection, future downstream development would be restricted by floodplain zoning. Floodwaters from a 1% AEP storm event would overtop McDonald Rd by 5.7 feet (versus 0.4 feet in existing conditions) and Nipple Peak Rd by 2.9 feet (versus 1.6 feet in existing conditions). These road crossings would be subject to greater flood depths during the 1% AEP storm event and would also be subject to more frequent flooding (i.e. they would be impacted at more frequent storm event). In addition, NW Railroad Road, which runs parallel to Middle Kickapoo Creek would be subject to more extensive and more frequent flooding with this alternative than it would be under current conditions. To continue to provide downstream flood protection as required to meet the Purpose and Need for the project, mitigation for additional flood impacts at these roads would be included in this alternative. This alternative assumes that these impacted roads would have barricades with flood warning lights installed at both sides of the modeled flood extents to prevent an unsafe and potentially deadly situation that could occur as a result of the dam removal. The estimated cost to decommission the dam is $1,652,000. Additional roadway mitigation costs are estimated to be at least $360,000, for a total estimated cost of $2,012,000. A conceptual figure is included as **Appendix C-9**.

<u>High Hazard Potential Rehabilitation of FRS No 5</u>

Two high hazard potential rehabilitation options were considered for FRS No. 5 for Alternative 3 as presented in **Table 4-4**, and are briefly described as follows:

- Option A: Raise the top of dam, raise the auxiliary spillway crest and add a 100-ft wide RCC overtopping spillway at the elevation of the raised auxiliary spillway crest, and raise the principal spillway crest; and
- Option B: Raise the top of dam, raise the auxiliary spillway crest and widen by 100-ft, and raise the principal spillway crest.

Variations in these options include principal spillway conduit size (either 30-inch- or 48-inch-diameter). The principal spillway conduit size was selected based upon the need to: a) safely pass the PSH; b) achieve a drawdown period less than 10 days; and c) allow sufficient riser height needed for proper hydraulic design given a principal spillway conduit diameter. Both of these high hazard potential rehabilitation options require over-excavation of the downstream slope of the embankment to a depth of approximately 3 feet and replacement of new fill material as well as flattening the upstream and downstream embankments to 3:1 slopes.

**Table 4-4. FRS No. 5 High Hazard Potential Rehabilitation Options Considered**

| **Option A** | **Option B** |
|---|---|
| Replace principal spillway riser with new crest at 1894.5 feet (4.5 feet lower than existing crest at 1899.0 feet and at same elevation of existing low-level ports);<br>Install a 48-inch-diameter RCP conduit;<br>Regrade auxiliary spillway crest to 1909.7 feet (0.1 foot raise);<br>Line upper 355 feet of existing auxiliary spillway slope with articulated concrete blocks;<br>Install 100 foot wide RCC step overtopping spillway at elevation on 1909.7; and<br>Raise the top of dam crest from the as-built elevation of 1915.9 feet to 1918.7 feet (2.8 feet raise).<br><br>**Cost: $23,690,000** | Replace principal spillway riser with new crest at 1894.5 feet (4.5 feet lower than existing crest at 1899.0 feet and at same elevation of existing low-level ports);<br>Install a 48-inch-diameter RCP conduit;<br>Regrade auxiliary spillway crest to 1909.7 feet (0.1 foot raise);<br>Widen auxiliary spillway to approximately 500 feet (100 foot increase)<br>Line upper 355 feet of existing auxiliary spillway slope with articulated concrete blocks; and<br>Raise the top of dam crest from the as-built elevation of 1915.9 feet to 1918.7 feet (2.8 feet raise).<br><br>**Cost: $21,719,000** |

For both rehabilitation configurations, best management practices during construction will be utilized to avoid and minimize any potential adverse impacts. Construction activities will require that a SWPPP be in effect. All disturbed areas will be revegetated using adapted and/or non-invasive native species. Planting equipment will be cleaned and certified seed will be used as measures to prevent the spread of invasive species. No compensatory mitigation will be required as a result of implementing this alternative. All work of disturbance, including stockpiling, equipment staging, and ingress/egress, will occur on the embankment, the auxiliary spillway, and previously disturbed areas.

Option A is considered the most optimal option and was carried forward for Alternative 3 because of logistics. It was determined that Option B would require the addition of a splitter dike to the auxiliary spillway since the auxiliary spillway currently exceeds 200 feet wide and would be widened under this alternative, which would increase the cost and would also require the spillway to be widened to accommodate the width of the splitter dike. The increase in cost is expected to exceed $2,000,000 and the additional widening of the auxiliary spillway (approximately 50 feet, in addition to the proposed 100-foot widening) would impact a habitable structure located adjacent to the spillway. The cost of Option A is $23,690,000. A conceptual figure is included as **Appendix C-10**.

### 4.3.3 Alternative 9 – High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5

High Hazard Potential Rehabilitation of FRS No. 4

Two high hazard potential rehabilitation options were considered for FRS No.4 for Alternative 9 as presented in **Table 4-5**, and are briefly described as follows:

- Option A: Construct 340-foot wide RCC overtopping spillway at elevation of 1994.3; and
- Option B: Construct 200-foot wide RCC overtopping spillway at elevation of 1994.3 feet and line upper 270 feet of existing vegetated auxiliary spillway slope with articulated concrete blocks (ACB).

Both of these high hazard potential rehabilitation options require the following components to meet current NRCS hydrologic and hydraulic criteria, provide 100 years of future sediment storage, and address geotechnical concerns related to observed cracking:

- Regrade the inlet and outlet channels of the auxiliary spillway and lower the crest to elevation 1994.3 feet (2.1 feet lower than as-built);
- Excavate all existing rock blanket and a minimum 5-feet of existing embankment material,
- Construct a new chimney filter/toe drain at a 2:1 slope on the downstream embankment,
- Add new embankment fill on the upstream and downstream embankment at a 3:1 slope with minimum 5 feet cover over filter, and
- Add rock riprap over geotextile over new fill on the upstream slope.

**Table 4-5. FRS No. 4 High Hazard Potential Rehabilitation Options Considered**

| **Option A** | **Option B** |
|---|---|
| Lower crest elevation of vegetated auxiliary spillway to 1994.3 feet (2.1 feet lower than as-built);<br>Construct 340-foot wide RCC overtopping spillway at elevation of 1994.3;<br>Excavate all existing rock blanket and a minimum 5-feet of existing embankment material,<br>Construct a new chimney filter/toe drain at a 2:1 slope on the downstream embankment,<br>Add new embankment fill on the upstream and downstream embankment at a 3:1 slope with minimum 5 feet cover over filter, and<br>Add rock riprap over geotextile over new fill on the upstream slope.<br><br>**Cost: $23,824,000** | Lower crest elevation of vegetated auxiliary spillway to 1994.3 feet (2.1 feet lower than as-built);<br>Line upper section of existing auxiliary spillway slope with articulated concrete blocks;<br>Construct 200-foot wide RCC overtopping spillway at elevation of 1994.3;<br>Excavate all existing rock blanket and a minimum 5-feet of existing embankment material,<br>Construct a new chimney filter/toe drain at a 2:1 slope on the downstream embankment,<br>Add new embankment fill on the upstream and downstream embankment at a 3:1 slope with minimum 5 feet cover over filter, and<br>Add rock riprap over geotextile over new fill on the upstream slope.<br><br>**Cost: $22,897,000** |

This alternative assumes that the existing principal spillway riser, conduit, and impact basin remain in place. Exterior inspection of the riser and impact basin showed these structures to be in good condition, but an inspection of the conduit would be recommended before any action associated with this alternative is undertaken.

During construction, best management practices will be utilized to avoid and minimize any potential adverse impacts. Construction activities will require that a SWPPP be in effect. All disturbed areas will be revegetated using adapted and/or non-invasive native species. Planting equipment will be cleaned and certified seed will be used as measures to prevent the spread of invasive species. No compensatory mitigation will be required as a result of implementing this alternative. All work of disturbance, including stockpiling, equipment staging, and ingress/egress, will occur on the embankment, the auxiliary spillway, and previously disturbed areas.

Because of the cost, Option B is considered the most optimal option and was carried forward for Alternative 9. A conceptual figure is included as **Appendix C-11**.

High Hazard Potential Rehabilitation of FRS No. 5

Two high hazard potential rehabilitation options were considered for FRS No. 5 for Alternative 9 as presented in **Table 4-6**, and are briefly described as follows:

- Option C: Raise the top of dam and construct RCC overtopping spillway; and
- Option D: Raise top of dam and widen existing vegetated auxiliary spillway.

Variations in these options include principal spillway conduit size (either 30-inch- or 48-inch-diameter. The principal spillway conduit size was selected based upon the need to: a) safely pass the PSH; b) achieve a drawdown period less than 10 days; and c) allow sufficient riser height needed for proper hydraulic design given a principal spillway conduit diameter. Both of these high hazard potential rehabilitation options require over-excavation of the downstream slope of the embankment to a depth of approximately 3 feet and replacement of new fill material as well as flattening the upstream and downstream embankments to 3:1 slopes.

**Table 4-6. FRS No. 5 High Hazard Potential Rehabilitation Options Considered**

| **Option C** | **Option D** |
|---|---|
| Replace principal spillway riser with new crest at 1894.5 feet (4.5 feet lower than existing crest at 1899.0 feet and at same elevation of existing low-level ports);<br>Lower crest elevation of vegetated auxiliary spillway to 1908.4 feet (1.2 feet lower than as-built);<br>Line upper 350 feet of existing auxiliary spillway slope with articulated concrete blocks; and<br>Raise the top of dam crest from the as-built elevation of 1915.9 feet to 1916.9 feet (1.0 foot raise).<br><br>**Cost: $15,708,000** | Replace principal spillway riser with new crest at 1894.5 feet (4.5 feet lower than existing crest at 1899.0 feet and at same elevation of existing low-level ports);<br>Lower crest elevation of vegetated auxiliary spillway to 1908.4 feet (1.2 feet lower than as-built);<br>Widen vegetated auxiliary spillway from 400-feet to 500-feet width;<br>Line upper section of existing auxiliary spillway slope with articulated concrete blocks; and<br>Raise the top of dam crest from the as-built elevation of 1915.9 feet to 1916.8 feet (0.9 foot raise).<br><br>**Cost: $20,046,000** |

For both rehabilitation configurations, best management practices during construction will be utilized to avoid and minimize any potential adverse impacts. Construction activities will require that a SWPPP be in effect. All disturbed areas will be revegetated using adapted and/or non-invasive native species. Planting equipment will be cleaned and certified seed will be used as measures to prevent the spread of invasive species. No compensatory mitigation will be required as a result of implementing this alternative. All work of disturbance, including stockpiling, equipment staging, and ingress/egress, will occur on the embankment, the auxiliary spillway, and previously disturbed areas. No major change in reservoir or downstream operation will result from this alternative.

It was determined that Option D would require the addition of a splitter dike to the auxiliary spillway since the auxiliary spillway currently exceeds 200 feet wide and would be widened under this alternative, which would increase the cost and would also require the spillway to be widened to accommodate the width of the splitter dike. The increase in cost is expected to exceed $2,000,000 and the additional widening of the auxiliary spillway (approximately 50 feet, in addition to the proposed 100-foot widening) would impact a habitable structure located adjacent to the spillway. Because of cost, Option C is considered the most optimal option and was carried forward for Alternative 9. The cost of this choice is $15,708,000. A conceptual figure is included as **Appendix C-12**.

### 4.3.4 Alternative 10 –Decommission of FRS No. 4 and SLO Sponsored Rehab of FRS No. 5 to TCEQ Standards

Decommission of FRS No 4

Decommissioning consists of removing the storage function of the dam and reconnecting, restoring, and stabilizing the stream and floodplain functions. Although complete removal of the embankment is sometimes required for decommissioning, only partial removal of the embankment was evaluated in this alternative. It includes excavating a breach in the dam of sufficient size to safely pass the 1% AEP flood through the dam. This breach would be a minimum size opening in the dam from top of dam to the valley floor which would eliminate the structure's ability to store water and would have a bottom width of approximately 84 feet. To not impede flows through the breached embankment and to reduce certain safety and health factors, the principal spillway components would also be removed.

The excavated material (about 23,000 cubic yards) would be placed in the present easement area and the remaining portion of the embankment and all exposed areas would be vegetated as needed for erosion control (approximately 8 acres). Channel work would be performed to reconnect the stream channel through the sediment pool. Riparian vegetation would be established along the stream channel (approximately 1.4 acres). A grade stabilization structure would be installed to stabilize sediment and prevent stream headcutting. Construction activities would require that a Storm Water Pollution Prevention Plan (SWPPP) be in effect.

Downstream flooding conditions from a 1% AEP, 24-hour storm would be similar to those that existed prior to the dam being construction. In order to continue to provide downstream flood

protection as required to meet the Purpose and Need of the project, mitigation for additional flood impacts would be included in this alternative. Existing and proposed floodplains were mapped approximately 14,800 feet downstream of FRS No. 4, ending upstream of the normal pool of FRS No. 5. The 1% AEP floodplain downstream would be enlarged. Since the 1% AEP floodplain downstream would be enlarged due to the absence of flood protection, future downstream development would be restricted by floodplain zoning. Floodwaters from a 1% AEP storm event would overtop McDonald Rd by 5.7 feet (versus 0.4 feet in existing conditions) and Nipple Peak Rd by 2.9 feet (versus 1.6 feet in existing conditions). These road crossings would be subject to greater flood depths during the 1% AEP storm event and would also be subject to more frequent flooding (i.e. they would be impacted at more frequent storm event). In addition, NW Railroad Road, which runs parallel to Middle Kickapoo Creek would be subject to more extensive and more frequent flooding with this alternative than it would be under current conditions. To continue to provide downstream flood protection as required to meet the Purpose and Need for the project, mitigation for additional flood impacts at these roads would be included in this alternative. This alternative assumes that these impacted roads would have barricades with flood warning lights installed at both sides of the modeled flood extents to prevent an unsafe and potentially deadly situation that could occur as a result of the dam removal. The estimated cost to decommission the dam is $1,652,000. Additional roadway mitigation costs are estimated to be at least $360,000, for a total estimated cost of $2,012,000. A conceptual figure is included as **Appendix C-13**.

SLO Sponsored Rehab of FRS No. 5 to TCEQ Standards

Without FRS No. 4 in place, minor modifications to FRS No. 5 would be required for the dam to meet TCEQ standards for an intermediate size high hazard dam. The crest of FRS No. 5 would need to be re-graded to fill in depressions and raise the effective dam crest by 0.29 foot to an elevation of 1916.19 feet. The raise would be to an elevation below the as-built top-of-dam elevation (1916.79). It should be noted that although the auxiliary spillway would not experience integrity issues (headcutting) in the TCEQ design storm it would experience stability (erosion) issues, if engaged. Although not required to meet TCEQ hydrologic criteria, the sponsor may want to make modifications to the auxiliary spillway to protect it against erosion. The estimated cost for the Sponsor to regrade the dam crest and raise the effective crest 0.29 foot is $147,000. A conceptual figure is included as **Appendix C-14**.

## 4.4 Comparison of Alternatives

**Table 4-7** provides a summary of the social, environmental, and economic impacts and benefits of each of the considered alternatives. **Table 4-8** provides a summary of the impacts and benefits of the considered alternatives in the context of the Guiding Principles from the PR&G.

### 4.4.1 Environmentally Preferred Alternative

Alternative 9 and Alternative 3 would have the largest temporary construction impacts of the considered alternatives but Alternative 9 would result in the fewest changes to the existing environmental conditions downstream of FRS No. 4, of the alternatives considered. Alternatives 3 and 10 would have similar impacts to the downstream existing environmental conditions

(natural flow/sediment regime restored downstream of FRS No. 4, minimal changes downstream of FRS No. 5), but Alternative 10 would have fewer temporary construction impacts than Alternative 3 and slightly fewer downstream impacts. Alternative 10 would restore the historic flow/sediment regime downstream of FRS No. 4 but would result in similar downstream environmental conditions for FRS No. 5 when compared to the existing condition and would have the fewest construction impacts at FRS No. 5. While there is not an obvious choice for the Environmentally preferred alternative, Alternative 10 has the potential to result in some long term positive environmental benefits downstream of FRS No. 4 by restoring the natural flow and sediment regime, while resulting in few negative temporary and long term impacts at and downstream of FRS No. 5, so it is considered the Environmentally preferred alternative.

### 4.4.2 Socially Preferred Alternative

Alternative 9 would provide the highest level of flood protection downstream of FRS No. 4 and FRS No. 5, of the alternatives considered with the fewest impacts to the local residents resulting from infrastructure modifications, as it would not require flood warning systems with barricades on roadways or roadway improvements. Both Alternative 3 and Alternative 10 would continue to provide flood protection downstream of FRS No. 5 (Alternative 3 would provide a higher level of protection) but would result in impacts to residents downstream of FRS No. 4 or those traveling through that area during storm events due to increased and more frequent roadway flooding and flood warning systems with barricades that may be engaged and block their route. Therefore, Alternative 9 is considered the Socially preferred alternative. It should be noted that there could be significant social impacts, in the form of increased taxes or fees, resulting from Alternative 9, depending upon how the Sponsors would fund the alternative.

### 4.4.3 Locally Preferred Alternative

Representatives from the Coke County SWCD and Coke County Kickapoo Creek WCID #1, have expressed their support for Alternative 3. This alternative would address their concerns about the FRS No. 4 embankment and would continue to provide flood protection downstream of FRS No. 5 at a much lower cost than Alternative 9. They have also expressed support for Alternative 10. Therefore, Alternative 3 is considered the Locally Preferred alternative.

### 4.4.4 Economically Preferred Alternative

Finally, the economic analysis shows that Alternative 10 results in the least negative net benefits when compared to the other alternatives. This is due to the relatively low construction cost of the alternative and the similar (to the other considered alternatives) level of flood protection benefits that it would provide downstream of FRS No. 5 for higher probability storm events. While there would be no federal cost share available for the rehabilitation component of this alternative because the rehabilitation of FRS No. 5 would not be to NRCS standards, the cost of the alternative would still be less than the cost share amount required of the Sponsors for the fully federally assisted alternatives. Alternative 10 is considered the Economically Preferred alternative.

### 4.4.5 Recommended Alternative

Alternative 10 has been identified as the recommended plan. The plan reasonably meets the following four criteria: completeness, effectiveness, efficiency, and acceptability. NRCS and the Sponsors are in agreement on the recommended plan.

## Table 4-7. Summary and Comparison of Alternative Plans

| Item | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
|---|---|---|---|---|
| **Optimizing Criteria** | | | | |
| Locally Preferred | | ✓ | | |
| Environmentally Preferred | | | | ✓ |
| Economically Preferred | | | | ✓ |
| Socially Preferred | | | ✓ | |
| **Guiding Principles** | | | | |
| Healthy and Resilient Ecosystems | | ✓ | ✓ | ✓ |
| Sustainable Economic Development | | ✓ | ✓ | ✓ |
| Floodplains | | ✓ | ✓ | ✓ |
| Public Safety | | ✓ | ✓ | ✓ |
| Environmental Justice | | ✓ | ✓ | ✓ |
| Watershed Approach | | ✓ | ✓ | ✓ |
| **Evaluation Framework (Ecosystem Services)** | | | | |
| Provisioning Services - Tangible goods provided for direct human use (e.g., timber, food, fiber, water) | | | | |
| Prime and Unique Farmlands | FRS No. 4:<br>No changes prior to failure. Sudden catastrophic breach would cause damage to downstream prime farmlands. Loss of flood storage would eliminate flood protection for downstream prime farmlands currently provided by FRS No 4.<br><br>FRS No. 5: | FRS No. 4<br>Removal of flood storage would eliminate flood protection for downstream prime farmlands currently provided by FRS No. 4. Impacted farmland within modeled 1% AEP floodplain would be increased from 146 to 184 acres for prime farmland, and from 71 to 149 acres for farmland of statewide importance, if | FRS No. 4:<br>Would continue to provide similar level of flood protection for prime farmlands as existing conditions.<br><br>FRS No. 5:<br>Would continue to provide similar level of flood protection for prime and unique farmlands as existing conditions. Dam raise and | FRS No. 4<br>Same impacts as Alternative 3.<br><br>FRS No. 5:<br>Would continue to provide similar level of flood protection for prime farmlands as existing conditions. |

| Item | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
|---|---|---|---|---|
| | No changes prior to failure. Sudden catastrophic breach would cause damage to downstream prime farmlands. Loss of flood storage would eliminate flood protection for downstream prime farmlands currently provided by FRS No.5. | irrigated. The decommission would also remove risk of flooding farmlands (32 acres of prime farmland and 14 acres of statewide importance, if irrigated) currently within top of dam backwater elevation.<br><br><u>FRS No. 5:</u><br>Dam raise would impact areas designated as prime farmlands and areas designated as farmland of statewide importance, if irrigated within the backwater and the LOD for FRS No. 5. Currently, these areas do not appear to be actively being farmed. Impacted farmland within modeled 1% AEP floodplain would be increased from 478 to 495 acres for prime farmland, from 3 to 3 acres for prime farmland, if irrigated and from 36 to 40 acres for farmland of statewide importance, if irrigated. Raise of dam crest and construction activities would impact an additional 31.5 acres of prime farmland and 22.9 acres of farmland of statewide importance, if | construction would impact areas designated as prime farmlands (16.5 additional acres impacted) and areas designated as farmland of statewide importance, if irrigated (17.9 additional acres impacted) within the backwater and the LOD for FRS No. 5. These areas do not appear to be actively being farmed. | |

| Item | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
|---|---|---|---|---|
| | | irrigated, although these areas do not appear to be actively farmed. | | |
| Streams, Lakes, and Wetlands/Waters of the U.S. | FRS No. 4:<br>No changes prior to failure. Sudden catastrophic breach would result in discharge of fill/sediment into potentially jurisdictional waters of U.S. Loss of flood storage would result in downstream streams and wetlands being subject to more frequent flooding. Natural flow regime would be restored over time following catastrophic breach of dam.<br><br>FRS No. 5:<br>No changes prior to failure. Sudden catastrophic breach would result in discharge of fill into potentially jurisdictional waters of U.S. Loss of flood storage would result in downstream streams and wetlands being subject to more frequent flooding and there would be loss of upstream aquatic habitat, hydrology, and fringe wetlands. Natural flow regime would be restored | FRS No. 4:<br>Would result in discharge of fill into potentially jurisdictional waters of U.S. during decommissioning and would result in more frequent flooding of downstream streams and wetlands. Natural flow regime would be restored over time following decommission of dam.<br><br>FRS No. 5:<br>Would result in discharge of fill into potentially jurisdictional waters of U.S during construction. Would maintain upstream wetlands and continue to provide protection for downstream streams and wetlands. | FRS No. 4:<br>Would result in discharge of fill into potentially jurisdictional waters of U.S during construction. Would continue to provide protection for downstream streams and wetlands.<br><br>FRS No. 5:<br>Would result in discharge of fill into potentially jurisdictional waters of U.S during construction. Would maintain upstream wetlands and continue to provide protection for downstream streams and wetlands. | FRS No. 4:<br>Same impacts as Alternative 3.<br><br>FRS No. 5:<br>Would maintain upstream wetlands and continue to provide protection for downstream streams and wetlands. |

| Item | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
|---|---|---|---|---|
| | over time following catastrophic breach of dam. | | | |
| Water Quality | FRS No. 4:<br>No changes prior to failure. Sudden catastrophic breach would cause impacts due to discharge of fill and sediment. Loss of sediment storage function would allow sediment to move downstream, decreasing the water quality. Natural sediment regime would be restored over time following catastrophic breach of dam.<br><br>FRS No. 5:<br>No changes prior to failure. Sudden catastrophic breach would cause impacts due to discharge of fill and sediment. Loss of sediment storage function would allow sediment to move downstream, decreasing the water quality. Natural sediment regime would be restored over time following catastrophic breach of dam. | FRS No. 4:<br>Removal of storage function would allow sediment to move downstream decreasing the water quality. Minor, temporary impacts to water quality during construction. Natural sediment regime would be restored over time following decommission of dam.<br><br>FRS No. 5:<br>Minor, temporary impacts to water quality during construction. | FRS No. 4:<br>Minor, temporary impacts to water quality during construction.<br><br>FRS No. 5:<br>Same impacts as Alternative 3. | FRS No. 4:<br>Same impacts as Alternative 3.<br><br>FRS No. 5:<br>No impacts. |
| Regulating Services - Maintains the world we live in and is regulated (e.g., flood control, erosion, water quality, crop pollination) | | | | |
| Erosion and Sediment | FRS No. 4:<br>No changes prior to failure. Sudden catastrophic breach | FRS No. 4:<br>Would eliminate the current function of the dam to collect | FRS No. 4:<br>Would continue to allow the dam to collect and retain | FRS No. 4:<br>Same impacts as Alternative 3. |

| Item | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
|---|---|---|---|---|
| | would result in excessive streambank erosion and sedimentation downstream. Breach would eliminate the current function of the dam to collect and retain sediment and would increase the potential for downstream erosion and sedimentation from large storm events. Natural sediment regime would be restored over time following catastrophic breach of dam.<br><br>FRS No. 5:<br>No changes prior to failure. Sudden catastrophic breach would result in excessive streambank erosion and sedimentation downstream. Breach would eliminate the current function of the dam to collect and retain sediment and would increase the potential for downstream erosion and sedimentation from large storm events. Natural sediment regime would be restored over time following catastrophic breach of dam. | and retain sediment and would increase the potential for downstream erosion and sedimentation from large storm events. Natural sediment regime would be restored over time following decommission of dam.<br><br>FRS No. 5:<br>Would continue to allow the dam to collect/retain sediment and would provide 100-yrs of sediment capacity. Would reduce the downstream erosion potential by safely passing controlled storm flows through the new PS conduit. | sediment, would provide 100-yrs of sediment capacity, and would reduce the downstream erosion potential by safely passing controlled storm flows through the new conduit.<br><br>FRS No. 5:<br>Same impacts as Alternative 3. | FRS No. 5:<br>Would continue to allow the dam to collect/retain sediment. Would reduce the downstream erosion potential by safely passing controlled storm flows through existing PS conduit. |
| Floodplain Management | FRS No. 4: | FRS No. 4: | FRS No. 4: | FRS No. 4: |

| Item | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
|---|---|---|---|---|
| | No changes prior to failure. Loss of storage function following catastrophic breach would result in expansion of the 1% AEP floodplain. No regulatory floodplain exists for the reach segment between FRS No. 4 and FRS No. 5.<br><br>FRS No. 5:<br>No changes prior to failure. Loss of storage function following catastrophic breach would result in expansion of the 1% AEP the floodplain. Existing regulatory floodplain in Bronte would need to be updated through a CLOMR. | No regulatory floodplain exists for the reach segment between FRS No. 4 and FRS No. 5. Removal of storage function would result in expansion of the 1% AEP floodplain. Modeled 1% AEP floodplain would be increased from 467 to 680 acres with decommission of FRS No. 4, but no additional habitable structures would be added to it.<br><br>FRS No. 5:<br>Existing regulatory floodplain in Bronte would need to be updated through a CLOMR. The existing downstream 1% AEP floodplain would be expanded from 915 to 952 acres, but no additional structures would be added to it. Would continue to provide flood protection benefits. | No regulatory floodplain exists for the reach segment between FRS No. 4 and FRS No. 5.<br>Modeled 1% AEP floodplain would be decreased from 467 to 463 acres. Would continue to provide flood protection benefits.<br><br>FRS No. 5:<br>Existing regulatory floodplain would need to be updated through a CLOMR. The existing downstream 1% AEP floodplain would be reduced from 915 to 914 acres. Would continue to provide flood protection benefits. | Same impacts as Alternative 3.<br><br>FRS No. 5:<br>Existing regulatory floodplain in Bronte would need to be updated through a CLOMR. The existing downstream 1% AEP floodplain would be expanded from 915 to 939 acres, but no additional structures would be added to it. Would continue to provide flood protection benefits. |
| Plants - Threatened and Endangered Species | FRS No. 4<br>No changes prior to failure. Sudden catastrophic breach could cause impacts to potential downstream T&E species due to sudden release of flows and sediment. | FRS No. 4<br>No impacts.<br><br>FRS No. 5<br>No impacts. | FRS No. 4<br>No impacts.<br><br>FRS No. 5<br>No impacts. | FRS No. 4<br>No impacts.<br><br>FRS No. 5<br>No impacts. |

| Item | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
|---|---|---|---|---|
| | FRS No. 5<br>No changes prior to failure. Sudden catastrophic breach could cause impacts to downstream T&E species due to sudden release of flows and sediment. | | | |
| Woodland Vegetation/Forest Resources | FRS No.4<br>No changes prior to failure. Sudden catastrophic breach would result in loss of forest resources due to embankment failure and sudden release of flows.<br><br>FRS No. 5<br>No changes prior to failure. Sudden catastrophic breach would result in loss of forest resources due to embankment failure and sudden release of flows. | FRS No. 4<br>Would result in the removal of approximately 7.5 acres of vegetation including trees. In addition, forest resources downstream would be subject to more frequent flooding.<br><br>FRS No. 5<br>Would result in the removal of approximately 16.8 acres of vegetation including trees. | FRS No. 4<br>Would result in the removal of approximately 13.4 acres of vegetation including trees.<br><br>FRS No. 5<br>Same impacts as Alternative 3. | FRS No. 4<br>Same impacts as Alternative 3.<br><br>FRS No. 5<br>No impacts |
| Invasive Species – Plants | FRS No.4<br>No changes prior to failure. Sudden catastrophic breach could spread invasive species potentially found at site to downstream areas. Potential for introduction/spread of invasive species during routine O&M unless all tools, equipment, and vehicles are cleaned before entering and leaving the site. | FRS No.4<br>During construction, efforts will be made to ensure invasive species are not introduced. All disturbed areas will be revegetated using adapted and/or non-invasive native species. All tools, equipment, and vehicles will be cleaned before transporting materials and before entering and | FRS No. 4<br>Same impacts as Alternative 3.<br><br>FRS No. 5<br>Same impacts as Alternative 3. | FRS No.4<br>Same impacts as Alternative 3.<br><br>FRS No.5<br>During regrading of dam crest, efforts will be made to ensure invasive species are not introduced. All disturbed areas will be revegetated using adapted and/or non-invasive native species. All |

| Item | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
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| | FRS No. 5<br>No changes prior to failure. Sudden catastrophic breach could spread invasive species potentially found at sites to downstream areas. Potential for introduction/spread of invasive species during routine O&M unless all tools, equipment, and vehicles are cleaned before entering and leaving the site. | leaving the worksite to prevent the introduction and spread of invasive plant species.<br><br>FRS No.5<br>During construction, efforts will be made to ensure invasive species are not introduced. All disturbed areas will be revegetated using adapted and/or non-invasive native species. All tools, equipment, and vehicles will be cleaned before transporting materials and before entering and leaving the worksite to prevent the introduction and spread of invasive plant species. | | tools, equipment, and vehicles will be cleaned before entering and leaving the worksite to prevent the introduction and spread of invasive plant species. |
| Fish and Wildlife | FRS No. 4<br>No changes prior to failure. Sudden catastrophic breach would cause impacts to downstream fish and wildlife habitat due to sudden release of flows and sediment. Loss of storage function would eliminate habitat provided by flood pool and would remove downstream protection from flooding, which would result in impacts to downstream | FRS No. 4<br>Removal of storage function would eliminate downstream protection from flooding which would result in impacts to downstream aquatic and terrestrial wildlife and their habitat due to flooding events. Natural flow regime and historic riparian habitat areas would be restored over time | FRS No. 4<br>Would maintain the existing terrestrial wildlife and their habitat in the long term. Downstream aquatic and terrestrial wildlife and habitat would continue to be maintained and protected by controlling the stream flow and flood protection. Minor, temporary impacts to terrestrial habitat may occur during construction. Less- | FRS No. 4<br>Same impacts as Alternative 3.<br><br>FRS No. 5<br>Would maintain the existing terrestrial wildlife and their habitat in the long term. Downstream aquatic and terrestrial wildlife and habitat would continue to be maintained and protected by controlling the stream flow |

| Item | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
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| | aquatic and terrestrial wildlife and their habitat due to flooding events. Natural flow regime and historic riparian habitat areas would be restored over time following catastrophic breach of dam.<br><br>FRS No. 5<br>No changes prior to failure. Sudden catastrophic breach would cause impacts to downstream fish and wildlife habitat due to sudden release of flows and sediment. Loss of storage function would eliminate habitat provided by flood pool and would remove downstream protection from flooding which would result in impacts to downstream aquatic and terrestrial wildlife and their habitat due to flooding events. Natural flow regime and historic riparian habitat areas would be restored over time following catastrophic breach of dam. | following decommission of dam.<br><br>FRS No. 5<br>Would maintain the existing terrestrial wildlife and their habitat in the long term. Downstream aquatic and terrestrial wildlife and habitat would continue to be maintained and protected by controlling the stream flow and flood protection. Minor, temporary impacts to terrestrial habitat may occur during construction. Less-mobile species may be lost due to equipment during construction. | mobile species may be lost due to equipment during construction.<br><br>FRS No. 5<br>Would result in a slight reduction in flood pool habitat area by lowering the normal pool. Otherwise, same impacts as Alternative 3. | and flood protection. Minor, temporary impacts to terrestrial habitat may occur during regrading. Less-mobile species may be lost due to equipment during construction. |
| Riparian Areas | FRS No. 4:<br>No changes prior to failure. The loss of flood storage | FRS No. 4:<br>The removal of flood storage would restore the | FRS No. 4:<br>No impacts. | FRS No. 4:<br>Same impacts as Alternative 3. |

| Item | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
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| | would restore the downstream flow regime to pre-impoundment conditions, which could result in the establishment of riparian areas.<br><br>FRS No. 5:<br>No changes prior to failure. Sudden catastrophic breach would result in large discharge of flows that could impact downstream riparian areas. Loss of flood storage would result in impacts to riparian areas surrounding the normal pool and would result in uncontrolled flows that may impact downstream riparian areas during large storm events. The loss of flood storage would also restore the downstream flow regime to pre-impoundment conditions. | downstream flow regime to pre-impoundment conditions, which could result in the establishment of riparian areas.<br><br>FRS No. 5:<br>Would result in minor temporary impacts during construction. Riparian areas would establish surrounding the normal pool/sediment pool area following construction activities. | FRS No. 5:<br>Would result in minor temporary impacts during construction. Riparian areas would establish surrounding the normal pool/sediment pool area following construction activities. | FRS No. 5:<br>Would result in minor temporary impacts during construction. Riparian areas would establish surrounding the normal pool/sediment pool area following construction activities. |
| Animals - Threatened and Endangered Species | FRS No. 4<br>No changes prior to failure. Sudden catastrophic breach could impact downstream threatened and endangered species due to sudden release of flows and fill.<br><br>FRS No. 5 | FRS No. 4<br>BMPs would be implemented to avoid harming state-listed species.<br><br>FRS No. 5<br>BMPs would be implemented to avoid harming state-listed species. | FRS No. 4<br>Same impacts as Alternative 3.<br><br>FRS No. 5<br>Same impacts as Alternative 3. | FRS No. 4<br>Same impacts as Alternative 3.<br><br>FRS No. 5<br>Same impacts as Alternative 3. |

| Item | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
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| | No changes prior to failure. Sudden catastrophic breach could impact downstream threatened and endangered species due to sudden release of flows and fill. | | | |
| Migratory Birds/Bald Eagle | FRS No. 4<br>No changes prior to failure. Sudden catastrophic breach could have effects on migratory birds as result of tree damage due to sudden release of flows. Natural flow regime and historic riparian habitat areas would be restored over time following catastrophic breach of dam.<br><br>FRS No. 5<br>No changes prior to failure. Sudden catastrophic breach could have effects on migratory birds as result of tree damage due to sudden release of flows. Natural flow regime and historic riparian habitat areas would be restored over time following catastrophic breach of dam. | FRS No. 4<br>May temporarily affect migratory birds if construction activities occur between March 1 and August 31. Appropriate measures will be implemented in accordance with the MBTA. Natural flow regime and historic riparian habitat areas would be restored over time following decommission of dam.<br><br>FRS No. 5<br>May temporarily affect migratory birds if construction activities occur between March 1 and August 31. Appropriate measures will be implemented in accordance with the MBTA. | FRS No. 4<br>May temporarily affect migratory birds if construction activities occur between March 1 and August 31. Appropriate measures will be implemented in accordance with the MBTA.<br><br>FRS No. 5<br>Same impacts as Alternative 3. | FRS No. 4<br>Same impacts as Alternative 3.<br><br>FRS No. 5<br>Same impacts as Alternative 3. |
| Cultural Services – Makes the world a place people want to live (e.g., recreation, spiritual, aesthetics) | | | | |

| Item | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
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| Land Use | FRS No. 4<br>No changes prior to failure. Sudden catastrophic breach would result in significant impacts to downstream land use as a result of sudden discharge of flows and fill. Floodplain will be expanded as a result of loss of flood protection, resulting in land use changes due to more frequent flooding and development restrictions.<br><br>FRS No. 5<br>No changes prior to failure. Sudden catastrophic breach would result in significant impacts to downstream land use as a result of sudden discharge of flows and fill. Floodplain will be expanded as a result of loss of flood protection, resulting in land use changes due to more frequent flooding and development restrictions. | FRS No. 4<br>Modeled 1% AEP floodplain would be increased from 467 to 680 acres, resulting in land use changes due to more frequent flooding and development restrictions.<br><br>FRS No. 5<br>Modeled 1% AEP floodplain would be increased from 915 to 952 acres, resulting in land use changes due to more frequent flooding and development restrictions. Would result in minimal changes to land use and vegetation cover due to dam raise. | FRS No. 4<br>No anticipated impacts.<br><br>FRS No. 5<br>Would result in minimal changes to land use and vegetation cover due to dam raise. | FRS No. 4<br>Same impacts as Alternative 3.<br><br>FRS No. 5<br>Modeled 1% AEP floodplain would be increased from 915 to 939 acres, resulting in land use changes due to more frequent flooding and development restrictions. Would result in minimal changes to land use and vegetation cover due to dam raise. |
| Public Health and Safety | FRS No. 4<br>No changes prior to failure. Unsatisfactory condition and risk of catastrophic breach would remain. Sudden catastrophic breach would | FRS No. 4<br>Would remove the risk associated with the potential for dam failure, after the dam has been removed. The modeled 1% AEP floodplain | FRS No. 4<br>Would maintain the current flood protection benefits for 100 years. Upstream of the dam, no homes will be at risk as a result of the dam raise. | FRS No. 4<br>Same impacts as Alternative 3.<br><br>FRS No. 5 |

| Item | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
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| | cause significant impacts to public health and safety due to sudden release of flows and fill. The 1% AEP floodplain would be expanded, and increased development restrictions would need to be implemented to protect public health and safety within the enlarged floodplain area.<br><br>FRS No. 5<br>No changes prior to failure. Risk of catastrophic breach would remain. Sudden catastrophic breach would cause significant impacts to public health and safety due to sudden release of flows and fill. The 1% AEP floodplain would be expanded, and increased development restrictions would need to be implemented to protect public health and safety within the enlarged floodplain area. | would be increased from 467 to 680 acres, and increased development restrictions would need to be implemented to protect public health and safety within the enlarged floodplain area. Flood depths and frequency would increase at two road crossings and a road segment and flood warning systems would be installed. Modifications to FRS No. 5 would be performed prior to decommission of FRS No. 4.<br><br>FRS No. 5<br>Upstream of the dam, no homes will be at risk as a result of the dam raise. Modeled downstream 1% AEP floodplain would be increased from 915 to 952 acres. Minor increase in flood depth and frequency at two road crossings. The threat to loss of life from failure of the dam would be greatly reduced in relation to existing conditions. | The downstream water surface elevation during the 1% AEP 24-hour storm event will be similar to the current condition. The threat to loss of life from failure of the dam would be greatly reduced in relation to existing conditions.<br><br>FRS No. 5<br>Would maintain the current flood protection benefits for 100 years. Upstream of the dam, no homes will be at risk as a result of the dam raise. The downstream water surface elevation during the 1% AEP 24-hour storm event will be similar to the current condition. The threat to loss of life from failure of the dam would be greatly reduced in relation to existing conditions. | Upstream of the dam, no homes will be at risk as a result of the dam raise. Modeled downstream 1% AEP floodplain would be increased from 915 to 939 acres. Minor increase in flood depth and frequency at two road crossings. The threat to loss of life from failure of the dam would be greatly reduced in relation to existing conditions. |
| Community Cohesion | FRS No. 4<br>No changes prior to failure. Sudden catastrophic breach would result in loss of | FRS No. 4<br>Could result in loss of community cohesion due to flooding on three roads | FRS No. 4<br>Impacts to community cohesion could result from | FRS No. 4<br>Same impacts as Alternative 3. |

| Item | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
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| | community cohesion due to downstream flood damage to some structures while sparing others. Loss of flood protection could cause loss of community cohesion due to development restrictions.<br><br>FRS No. 5<br>No changes prior to failure. Sudden catastrophic breach would result in loss of community cohesion due to downstream flood damage to some structures while sparing others. Loss of flood protection could cause loss of community cohesion due to more frequent flood impacts to some structures and development restrictions. | (flood warning systems with barricades would be installed) and development restrictions that may be imposed following decommission of dam.<br><br>FRS No. 5<br>Impacts to community cohesion could result from additional taxation required to fund rehabilitation. | additional taxation required to fund rehabilitation.<br><br>FRS No. 5<br>Same impacts as Alternative 3. | FRS No. 5<br>No impacts. |
| **Economic Analysis** | | | | |
| **Costs** | | | | |
| ***Project Investment*** | | | | |
| Federal PL-83-566 | $0 | $18,405,000 | $27,710,000 | $1,401,000 |
| Other Federal | $0 | $0 | $0 | $0 |
| Matching | $0 | $7,297,000 | $10,895,000 | $758,000 |
| Total | $0 | $25,702,000 | $38,605,000 | $2,159,000 |

| Item | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
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| ***Annual O&M Costs*** | | | | |
| Federal PL-83-566 | $0 | $0 | $0 | $0 |
| Other Federal | $0 | $0 | $0 | $0 |
| Matching | $10,000 | -$2,000 | $0 | -$2,000 |
| Total | $10,000 | -$2,000 | $0 | -$2,000 |
| **Total Discounted Annual Costs** | $10,000 | $786,000 | $1,184,000 | $64,000 |
| **Benefits** | | | | |
| Residential and Non-Residential Structures | $0 (Baseline) | -$3,000 | $0 | -$2,000 |
| Roads and Bridges | $0 (Baseline) | -$13,000 | $2,000 | -$13,000 |
| | | | | |
| **Total Annual Benefits** | $0 (Baseline) | -$16,000 | $2,000 | -$15,000 |
| **Evaluation** | | | | |
| Benefit-to-Cost Ratio | N/A | 0.0:1.0 | 0.0:1.0 | -0.2:1.0 |
| Net Benefit | -$10,000 | -$802,000 | -$1,182,000 | -$77,000 |
| Annual Remaining Flood Damage | $48,000 | $64,000 | $46,000 | $63,000 |
| **Regional Economic Benefits (Texas)** | | | | |
| Job-Years of Employment Created by Construction | 0 | 163 | 245 | 14 |
| Value Added to Texas Economy During Construction (One-time benefits) | $0 (Baseline) | $42,448,000 | $63,758,000 | $3,566,000 |
| Total Benefits (Including annualized Value Added from construction) to Texas Economy | $-10,000 | $438,000 | $686,000 | $16,000 |

Notes: 2023 price level; 2.75% discount rate; annualized over the 100-year evaluation period; Total Discounted Annual Costs includes interest during construction; O&M costs for the with-project alternatives are shown in relation to the No Action Alternative (i.e., difference between existing O&M and the with-project alternative); monetary values rounded to the nearest $1,000; sums may not match due to rounding

## Table 4-7. Consideration of PR&G Guiding Principles

| PR&G GUIDING PRINCIPLES | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
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| **Healthy and Resilient Ecosystems** | FRS No. 4 and FRS No. 5<br>Would maintain current ecological function of both impoundment areas and protection for downstream habitat prior to failure. Sudden catastrophic breach would cause damage to downstream habitat. Loss of flood storage would return stream's ecological function to pre-impoundment conditions. | FRS No. 4<br>Removal of storage function would return stream's ecological function to pre-impoundment condition.<br><br>FRS No. 5<br>Maintain current ecological function of impoundment area for fish and wildlife habitat | FRS No. 4 and FRS No. 5<br>Maintain current ecological function of impoundment areas for fish and wildlife habitat | FRS No. 4<br>Removal of storage function would return stream's ecological function to pre-impoundment condition.<br><br>FRS No. 5<br>Maintain current ecological function of impoundment area for fish and wildlife habitat |
| **Sustainable Economic Development** | FRS No. 4 and FRS No. 5<br>Would maintain current flood control function of both dams while still subjecting downstream areas to risk of breach, prior to failure. Sudden catastrophic breach would cause damage to downstream residences and businesses. | FRS No. 4<br>Complies with sustainable use and management of water resources through return to natural conditions.<br><br>FRS No. 5<br>Complies with sustainable use and management of water resources through maintaining flood protection. | FRS No. 4 and FRS No. 5<br>Complies with sustainable use and management of water resources through maintaining flood protection. | FRS No. 4<br>Complies with sustainable use and management of water resources through return to natural conditions.<br><br>FRS No. 5<br>Complies with sustainable use and management of water resources through maintaining flood protection. |

| PR&G GUIDING PRINCIPLES | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
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| **Floodplains** | FRS No. 4 and FRS No. 5<br>Would maintain current flood protection from both dams while still subjecting downstream areas to risk of breach, prior to failure. Sudden catastrophic breach would cause damage to downstream residences and businesses. Following catastrophic breach, loss of flood would remove flood protection benefits from dams and increase 1% AEP floodplain. | FRS No. 4<br>Modeled 1% AEP floodplain would increase from 467 to 680 acres.<br><br>FRS No. 5<br>Modeled 1% AEP floodplain would increase from 915 to 952 acres. | FRS No. 4<br>Modeled 1% AEP floodplain would decrease from 467 to 463 acres.<br><br>FRS No. 5<br>Modeled 1% AEP floodplain would decrease from 915 to 914 acres. | FRS No. 4<br>Modeled 1% AEP floodplain would increase from 467 to 680 acres.<br><br>FRS No. 5<br>Modeled 1% AEP floodplain would increase from 915 to 939 acres. |
| **Public Safety** | FRS No. 4 and FRS No. 5<br>Would maintain current level of public safety from both dams while still subjecting downstream areas to risk of breach prior to failure. Sudden catastrophic breach would cause temporary impacts to public safety. Following catastrophic breach, loss of flood storage would remove risk of breach, but would also remove flood protection benefits from dams and increase | FRS No. 4<br>Remove risk of breach, remove public safety benefits from dam, and increase 1% AEP floodplain from 467 to 680 acres. Flood warning systems to be installed on 2 road crossings and one road segment to address increased risk to public safety.<br><br>FRS No. 5<br>Public safety benefits would remain, floodplain would increase from 915 to | FRS No. 4<br>Public safety benefits would remain and risk of breach would be reduced.<br><br>FRS No. 5<br>Public safety benefits would remain and risk of breach would be reduced. | FRS No. 4<br>Remove risk of breach, remove public safety benefits from dam, and increase 1% AEP floodplain from 467 to 680 acres. Flood warning systems to be installed on 2 road crossings and one road segment to address increased risk to public safety.<br><br>FRS No. 5<br>Public safety benefits would remain, floodplain |

| PR&G GUIDING PRINCIPLES | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
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| | frequency and extent of flooding. | 952 acres, and risk of breach would be reduced. | | would increase from 915 to 939 acres. |
| **Environmental Justice** | FRS No. 4 and FRS No. 5<br>Affected populations downstream will continue to be at risk of a catastrophic dam breach prior to breach. Following catastrophic breach, there will be a loss of flood protection for affected population below dams. | FRS No. 4<br>Loss of flood protection for affected population below dam. Risk of breach to affected population removed. Modeled 1% AEP floodplain expanded. No additional habitable structures added to 1% AEP floodplain.<br><br>FRS No. 5<br>Flood protection maintained with minimal change to existing condition and risk of dam breach reduced for affected population. Modeled 1% AEP floodplain expanded. No additional habitable structures added to 1% AEP floodplain. | FRS No. 4 and FRS No. 5<br>Flood protection maintained with minimal change to existing condition and risk of catastrophic dam breach reduced for affected population. | FRS No. 4<br>Loss of flood protection for affected population below dam. Risk of breach to affected population removed. Modeled 1% AEP floodplain expanded. No additional habitable structures added to 1% AEP floodplain.<br><br>FRS No. 5<br>Flood protection maintained with no change to existing condition. Modeled 1% AEP floodplain expanded. No additional habitable structures added to 1% AEP floodplain. |
| **Watershed Approach** | FRS No. 4 and FRS No. 5<br>Would maintain ecological function of Kickapoo Creek and contribution to ecological function of Colorado River System, | FRS No. 4<br>Removal of flood storage could improve ecological function of Kickapoo Creek and contribution to ecological function of | FRS No. 4 and FRS No. 5<br>Maintain ecological function of Kickapoo Creek and contribution to ecological function of Colorado River System | FRS No. 4<br>Removal of flood storage could improve ecological function of Kickapoo Creek and contribution to ecological function of |

| PR&G GUIDING PRINCIPLES | No Action – FRS No. 4 and FRS No. 5 | Alternative 3 Decommission with Federal Assistance of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 9 High Hazard Potential Rehabilitation of FRS No. 4 and High Hazard Potential Rehabilitation of FRS No. 5 | Alternative 10 Decommission of FRS No. 4 and SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards |
|---|---|---|---|---|
| | prior to failure. Sudden catastrophic breach would result in temporary impacts to ecologic function. Loss of flood protection could improve ecological function of System by returning it to pre impoundment conditions. | Colorado River System by returning it to pre-impoundment conditions<br><br><u>FRS No. 5</u><br>Maintain ecological function of Kickapoo Creek and contribution to ecological function of Colorado River System | | Colorado River System by returning it to pre-impoundment conditions<br><br><u>FRS No. 5</u><br>Maintain ecological function of Kickapoo Creek and contribution to ecological function of Colorado River System |

# 5.0 ENVIRONMENTAL CONSEQUENCES

Alternative plans of action can result in a multitude of effects on resources upstream and downstream of FRS No. 4 and FRS No. 5. This section describes anticipated effects on resource concerns identified by the Sponsors, the public, and agency personnel in the Scoping meeting and the public meetings.

For the purpose of the following discussions, project areas within the affected environment are defined below.

- Project footprint – The area within the footprint of the proposed rehabilitated structure and expanded auxiliary spillway.
- Limit of disturbance (LOD) – The maximum extent that could potentially be temporarily disturbed during construction to accommodate for borrow areas, equipment staging, and camp site.
- Normal pool/sediment pool area – This term refers to the acreage of the normal pool (also known as the sediment pool) area directly upstream from FRS No. 4 and FRS No. 5.
- Breach inundation area – This refers to the area downstream from the dam within the study reach that would be directly impacted by sudden dam failure.

FRS No. 4 and FRS No. 5 were constructed in series, so any alterations/modifications considered for one FRS must also consider the impacts on and impacts from alterations/modifications to the other FRS. As a result, it was necessary to combine corresponding alteration/modification Choices for the two FRSs into single Alternatives for the two-FRS system. The individual Choices for the alterations/modification and the combination of them into Alternatives are described in detail in Section 4. The environmental consequences for the Alternatives are described by individual FRS. It is important to note that the consequences for each Alternative for FRS No. 4 are described for the backwater area upstream of FRS No. 4 and the area downstream of FRS No. 4 to the backwater of FRS No. 5 and the consequences for each Alternative for FRS No. 5 are described for the backwater area of FRS No. 5 and the area downstream of FRS No. 5. The consequences for each FRS are only valid when considering the corresponding modification for Alternative.

## 5.1 Environmental Evaluation Worksheet (NRCS-CPA-52)

An Environmental Evaluation Worksheet, NRCS-CPA-52 form, was completed for the FRS No. 4 and FRS No. 5 rehabilitation projects individually but considering that corresponding Options would be combined into Alternatives. The NRCS-CPA-52 provides information on the effects of the various alternatives on the individual resource concerns in the watershed. As portions of the preferred alternatives at FRS No. 4 and FRS No. 5 will be outside the limits of NRCS categorical exclusions (NWPM Part 501.38(A)), an Environmental Assessment was considered appropriate for this Supplemental Watershed Plan effort.

## 5.2 Environmental Concerns Excluded from Environmental Consequences Evaluation

The following environmental concerns identified through the scoping process were determined to not be relevant to the proposed action:

- Coastal Zone Management Plans
- Sewer Utilities
- Sole Source Aquifers
- Wild and Scenic Rivers
- Air Quality/Clean Air Act
- Natural Areas
- Coral Reefs
- Ecologically Critical Areas
- Essential Fish Habitat
- Invasive Species - Animals
- Cultural Resources
- Drought
- Local and Regional Economy
- Park Lands, Scenic Areas
- Public Recreation
- Scenic Beauty
- Scientific Resources

## 5.3 Comparative Environmental Effects of Options – FRS No. 4

### 5.3.1 Prime and Unique Farmland

Existing Conditions

Prime and unique farmland is land that has the soil quality, growing season, and moisture supply necessary for producing crops and is available for these uses. In addition, the land is not excessively eroded or saturated with water for a long period of time and is either protected from flooding or does not flood frequently. In some areas, land that does not meet the criteria for prime or unique farmland is considered to be farmland of statewide importance for the production of food, feed, fiber, forage, and oilseed crops.

Based on the NRCS Soil Survey, there are approximately 32 acres of prime farmland and approximately 14 acres of farmland of statewide importance, if irrigated below the TOD elevation, upstream of FRS No. 4, although only 14 acres of the areas designated as prime farmland appear to be being actively farmed. There are approximately 146 acres of area designated as prime farmland and 71 acres of area designated as farmland of statewide importance, if irrigated within the 1% AEP floodplain, downstream of FRS No. 4 and upstream of FRS No. 5. Of those areas, very little, if any of the acreage appears to be being actively farmed.

No Action

The No Action Alternative would have no effect on the existing conditions of prime and unique farmland while the dam remains in place, prior to failure. Sudden catastrophic breach of the dam has the potential to cause significant impacts to the downstream areas of prime farmland and farmland of statewide importance as a result of the sudden discharge of large flows, embankment fill, and sediment. Following catastrophic breach of the dam, the elimination of the existing flood protection would subject the downstream areas of prime farmland and farmland of statewide importance to more frequent and severe flooding. These areas may no longer be considered prime farmland or farmland of statewide importance if they are subject to more frequent and severe flooding in the future. With the loss of flood storage, areas that currently have the potential to be inundated by the backwater of FRS 4 would no longer be inundated.

Decommission (FWFI) – Alternative 3

The Decommission Alternative would subject the areas of prime farmland and farmland of statewide importance downstream to more frequent and severe flooding. The number of acres of prime farmland within the modeled 1% AEP floodplain would increase from 146 to 184 acres and the acres of farmland of statewide importance would increase from 71 acres to 149. Due to the potential for more frequent flooding if flood protection is removed, these areas may no longer be considered prime farmlands or farmlands of statewide importance if FRS No. 4 is decommissioned. With the removal of flood storage, areas that currently have the potential to be inundated by the backwater of FRS 4 would no longer be inundated.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9

The High Hazard Potential Rehabilitation Alternative would maintain the flood protection downstream of the dam resulting in inundation of prime farmland within the backwater of the dam for short periods of time. The existing areas below the TOD elevation and upstream of the dam would be subject to the same potential for inundation as in the existing condition. As no dam raise would be required for this alternative, no additional impacts to prime and unique farmlands from the backwater of FRS No. 4 are anticipated. There is less than 1 acre of farmland of statewide importance, if irrigated within the FRS No. 4 projected maximum LOD that would potentially be impacted during construction, although this area does not appear to be being actively farmed.

Decommission (FWFI) – Alternative 10

Same as Decommission - Alternative 3.

Cumulative Impacts

Construction activities associated with any of the alternatives would contribute to temporary impacts to prime farmland and farmland of statewide importance within the LOD, but it is expected that the construction impacts would be considered minor and temporary and would not be incremental to any other impacts within the LOD. Potential long-term impacts to downstream prime farmland and farmland of statewide importance would occur if the storage function of the dam is removed either through catastrophic breach or decommissioning. These long-term effects would be incremental to other regional impacts to prime and unique farmland resulting from future development, conversion of agricultural lands to other land uses, and rehabilitation, decommission, or breach of other flood retarding structures within the watershed.

### 5.3.2 Erosion and Sediment

Existing Conditions

Soils and Erosion – Based on the NRCS Web Soil Survey, the predominant soil groups in the FRS No. 4 LOD include Cobb fine sandy loam, Westola very fine sandy loam, Oben and Cobb soils, and Miles fine sandy loam. Current conditions indicate that some areas of erosion are present on the embankment.

Sedimentation – FRS No. 4 is currently functioning to collect and retain sediment, albeit minimal, from the watershed.

No Action

The No Action Alternative would have no effect on the existing conditions of erosion and sedimentation while the dam remains in place, prior to failure. Sudden catastrophic breach of the dam has the potential to cause significant impacts to erosion and sedimentation downstream as a result of the sudden discharge of large flows, embankment fill, and sediment. Following catastrophic breach, the current function of the dam to collect and retain sediment would be eliminated and the removal of flood protection would increase the potential for downstream erosion and sedimentation to private properties, roads, and utilities as a result of uncontrolled flows. The natural sediment regime would be restored over time following catastrophic breach of the dam.

Decommission (FWFI) – Alternative 3

The excavated material (about 23,000 cubic yards) would be placed in the present easement area and the remaining portion of the embankment and all exposed areas would be vegetated as needed for erosion control (approximately 8 acres). The Decommission Alternative includes a controlled breach of the dam and would eliminate the current function of the dam to collect and retain sediment. This Alternative would eliminate the current function of the dam to control flows and would increase the potential for downstream erosion and sedimentation to private properties, roads, and utilities as a result of uncontrolled flows. The natural sediment regime would be restored over time following decommission of the dam.

Temporary impacts to erosion and sedimentation may occur during construction; however, these impacts would be reduced through the use of water quality BMPs identified in the SWPPP.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9

The High Hazard Potential Rehabilitation Alternative would rehabilitate the dam to meet NRCS High Hazard Potential Class dam criteria. This Alternative would continue to allow the dam to collect and retain sediment as well as continue to reduce the downstream erosion potential by safely passing controlled storm flows through the new conduit. The flood protection to downstream properties, roads, and utilities would be maintained through the proposed modifications.

Temporary impacts to erosion and sedimentation may occur during construction; however, these impacts would be reduced through the use of water quality BMPs identified in the SWPPP.

Decommission (FWFI) – Alternative 10
Same as Decommission - Alternative 3.

Cumulative Impacts
Temporary impacts to erosion and sedimentation would occur during construction associated with decommissioning or rehabilitation; however, these impacts would be reduced through the use of water quality BMPs identified in the SWPPP. Temporary, but significant impacts to erosion and sediment would occur in the event of catastrophic breach. Long-term positive and negative impacts to downstream erosion and sedimentation would occur if the sediment and flood storage function of the dam is removed either through catastrophic breach or decommissioning. These long-term effects would be incremental to other regional impacts to erosion and sedimentation resulting from future development, conversion of agricultural lands to other land uses, and rehabilitation, decommissioning, or breaching of other flood retarding structures within the watershed.

### 5.3.3 Floodplain Management

Existing Conditions
FRS No. 4 is not within a Federal Emergency Management Agency (FEMA)-regulated 1% AEP floodplain. The existing impoundment provides flood damage reduction benefits by reducing the peak flow and duration of storm events within the watershed. The existing condition 1% AEP floodplain was modeled from downstream of FRS No. 4 to the FRS No. 5 impoundment. The modeled 1% AEP floodplain boundary encompasses 467 acres.

No Action
The No Action Alternative would have no effect on the existing conditions of floodplain management while the dam remains in place, prior to failure. The extent of the breach inundation area from the AS integrity and overtopping failures would be 1,176 acres and 1,267 acres, respectively. Following catastrophic breach of the dam, the current flood protection benefits would be lost, as the structure would no longer be able to store floodwater, store sediment, and retard peak flows. The downstream floodplain extent would increase from the existing condition.

Decommission (FWFI) – Alternative 3
The Decommission Alternative would remove the flood protection benefits, as the structure would no longer be able to store floodwater, store sediment, and retard peak flows. The downstream modeled 1% AEP floodplain extent would increase from 467 to 680 acres, but no critical structures will be impacted, and no residential structures will be added to the 1% AEP floodplain.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
The High Hazard Potential Rehabilitation Alternative would maintain the existing level of flood protection. The downstream modeled 1% AEP floodplain extent would decrease from 467 to 463 acres.

Decommission (FWFI) – Alternative 10

Same as Decommission - Alternative 3.

Cumulative Impacts
Temporary impacts to the downstream floodplain would occur in the event of catastrophic breach of the dam. Potential long-term impacts to the downstream floodplain would occur if the flood storage function of the dam is removed either through catastrophic breach or decommissioning. These long-term effects would be incremental to other regional impacts to floodplain management resulting from future development, conversion of agricultural lands to other land uses, and rehabilitation, decommission, or breach of other flood retarding structures within the Kickapoo Creek Watershed.

### 5.3.4 Streams, Lakes, and Wetlands/Waters of the U.S.

Existing Conditions
Based on a preliminary site visit, FRS No. 4 did not exhibit a normal pool/sediment area or any potentially jurisdictional waters of the U.S. under the Clean Water Act.

No Action
The No Action Alternative would have no effect on the downstream streams and wetlands while the dam remains in place, prior to failure. Sudden catastrophic breach has the potential to cause significant discharge of fill material into downstream potentially jurisdictional waters of the U.S.. Following catastrophic breach of the dam, the potential for the discharge of fill material into potentially jurisdictional waters of the U.S would remain. The loss of flood storage would also increase the potential for flooding downstream of FRS No. 4 affecting the upstream area of FRS No. 5.

Decommission (FWFI) – Alternative 3
The Decommission Alternative would result in a discharge of fill material into potentially jurisdictional waters of the U.S during and after the controlled breach. This would be managed through the implementation of a SWPPP. The controlled breach of the dam would increase the potential for flooding that would likely impact streams, lakes, and wetlands downstream of FRS No. 4.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
The High Hazard Potential Rehabilitation Alternative could result in a discharge of fill material into potential jurisdictional waters of the U.S. during construction. This would be managed through the implementation of a SWPPP. BMPs would be identified in the SWPPP. Rehabilitation of the dam would maintain downstream flood protection.

Decommission (FWFI) – Alternative 10
Same as Decommission - Alternative 3.

Cumulative Impacts
Temporary impacts to downstream streams and wetlands would occur in the event of catastrophic breach, decommissioning, or rehabilitation of the dam. Potential negative long-term

impacts to the downstream streams and wetlands due to uncontrolled flows and discharged fill could occur if the dam is removed either through catastrophic breach or decommissioning. Potential positive long-term impacts to streams and wetlands could occur through dam removal and the conversion of still water back to the free-flowing streams that existed prior to the dam being constructed. These potential long-term effects would be incremental to other regional impacts to streams and wetlands resulting from future rehabilitation, decommission, or breach of other flood retarding structures within the watershed.

### 5.3.5 Water Quality

Existing Conditions
The 2020 305(b)/303(d) Integrated Water Quality Assessment and Impaired Waters Report (TCEQ, 2020) did not identify Middle Kickapoo Creek or Kickapoo Creek as impaired streams.

No Action
The No Action Alternative would have no effect on the existing conditions of water quality while the dam remains in place, prior to failure. Sudden catastrophic breach of the dam has the potential to cause significant downstream water quality impacts as a result of discharge of fill material and impounded sediment. Following the catastrophic breach, the loss of flood storage would allow sediment from upstream erosion to move downstream. The natural sediment regime would be restored over time following catastrophic breach of dam.

Decommission (FWFI) – Alternative 3
The Decommission Alternative would allow impounded sediment and sediment from upstream erosion to move downstream, potentially impacting water quality. Minor, temporary impacts to water quality would occur as a result of erosion and sedimentation during construction. Sedimentation and erosion would be managed through the implementation of a SWPPP. BMPs would be identified in the SWPPP.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
The High Hazard Potential Rehabilitation Alternative would result in temporary impacts to water quality during construction. Sedimentation and erosion would be managed through the implementation of a SWPPP. BMPs would be identified in the SWPPP.

Decommission (FWFI) – Alternative 10
Same as Decommission - Alternative 3.

Cumulative Impacts
Temporary impacts to water quality would occur during construction associated with decommissioning or rehabilitation; however, these impacts would be reduced through the use of water quality BMPs identified in the SWPPP. Temporary, but significant impacts to water quality would occur in the event of catastrophic breach. Negative long-term impacts to the downstream water quality would result from uncontrolled sediment being discharged into downstream water bodies if the is dam removed either through catastrophic breach or decommissioning. Potential positive long-term impacts to water quality could occur through dam removal and the conversion of still water back to the free-flowing stream that existed prior to the

dam being constructed. These potential long-term effects would be incremental to other regional impacts to water quality resulting from future rehabilitation, decommission, or breach of other flood retarding structures within the watershed.

### 5.3.6 Woodland Vegetation/Forest Resources

Existing Conditions
There are approximately 13.4 acres with trees within the LOD consisting primarily of eastern red cedar (*Juniperus virginiana*), honey mesquite (*Prosopis glandulosa*), and hackberry (*Celtis laevigata*).

No Action
The No Action Alternative would have no effect on the existing conditions of woodland vegetation/forest resources while the dam remains in place, prior to failure. Sudden catastrophic breach of the dam has the potential to cause significant impacts to woodland vegetation/forest resources as a result of breach of the embankment and the sudden discharge of large flows downstream.

Decommission (FWFI) – Alternative 3
The Decommission Alternative would result in the removal of approximately 7.5 acres of vegetation including trees.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
The High Hazard Potential Rehabilitation Alternative would result in the removal of approximately 13.4 acres of vegetation including trees within the LOD.

Decommission (FWFI) – Alternative 10
Same as Decommission - Alternative 3.

Cumulative Impacts
Construction activities associated with any of the alternatives would result in impacts to woodland vegetation/forest resources within the LOD. Temporary, but significant impacts to woodland vegetation/forest would occur in the event of catastrophic breach. Potential long-term impacts to downstream woodland vegetation/forest resources would occur if the storage function of the dam is removed either through catastrophic breach or decommissioning. These long-term effects would be incremental to other regional impacts to woodland vegetation/forest resource resulting from future development and rehabilitation, decommission, or breach of other flood retarding structures within the watershed.

### 5.3.7 Invasive Species

Existing Conditions
According to the Texas Invasives website (Texas Invasives, 2022), the following invasive plant species have been identified as being particularly worrisome within the Rolling Plains Ecoregion, in which FRS No. 4 is located:

- Chinese tallow tree (*Triadica sebifera)*
- Japanese privet (*Ligustrum japonicum)*
- Salt cedar (*Tamarix ramosissima)*
- Johnson grass (*Sorghum halepense)*
- Japanese honeysuckle (*Lonicera japonica)*
- King Ranch bluestem (*Bothriochloa ischaemum var. songarica)*
- Giant reed (*Arundo donax)*
- Nutgrass (*Cyperus rotundus)*
- Dallisgrass (*Paspalum dilatatum)*
- Bermudagrass (*Cynodon dactylon)*
- Russian thistle (*Salsola tragus)*
- Siberian elm (*Ulmus pumila)*

No Action

The No Action Alternative would initially result in no change to the existing condition of invasive species at the site, prior to failure. There is potential for the introduction and/or spread of invasive species during routine O&M unless all tools, equipment, and vehicles are cleaned before entering and leaving the site. Sudden catastrophic breach of the dam could result in the spread of invasive plant and animal species through transportation to downstream areas following the breach.

Decommission (FWFI) – Alternative 3

The Decommission Alternative could result in the introduction of new invasive species by construction equipment or spreading of existing invasive species during construction if preventative measures are not taken. All disturbed areas would be revegetated using adapted and/or non-invasive native species. All tools, equipment, and vehicles will be cleaned before transporting materials and before entering and leaving the worksites to prevent the introduction and spread of invasive species.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9

The High Hazard Potential Rehabilitation Alternative could result in the introduction of new invasive species by construction equipment or spreading of existing invasive species during construction if preventative measures are not taken. All disturbed areas would be revegetated using adapted and/or non-invasive native species. All tools, equipment, and vehicles will be cleaned before transporting materials and before entering and leaving the worksites to prevent the introduction and spread of invasive species.

Decommission (FWFI) – Alternative 10

Same as Decommission - Alternative 3.

Cumulative Impacts

Long term impacts to invasive species could occur if new invasive species are introduced to the site during construction or O&M activities. These potential long-term effects would be incremental to other regional impacts to invasive species resulting from future development in the watershed and rehabilitation, decommission or O&M of other flood retarding structures within the watershed.

### 5.3.8 Riparian Areas

Existing Conditions
The site does not support riparian areas and no riparian areas were identified downstream of FRS No. 4 along Middle Kickapoo Creek, upstream of FRS No.5. The vegetation on site consists of native upland vegetation.

No Action
The No Action Alternative would have no effect on the existing conditions of riparian areas while the dam remains in place, prior to failure. Following catastrophic breach, the loss of flood storage would also restore the downstream flow regime to pre-impoundment conditions and could result in the establishment of riparian vegetation.

Decommission (FWFI) – Alternative 3
The Decommissioning Alternative may result in the establishment of downstream riparian areas, as the removal of flood storage would restore the downstream flow regime to pre-impoundment conditions.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
The High Hazard Potential Rehabilitation Alternative would not result in impacts to riparian areas.

Decommission (FWFI) – Alternative 10
Same as Decommission - Alternative 3.

Cumulative Impacts
Potential positive long-term impacts to riparian areas could occur through dam removal and the conversion of still water back to the free-flowing stream that existed prior to the dam being constructed. These potential long-term effects would be incremental to other regional impacts to riparian area resulting from future rehabilitation or breach of other flood retarding structures within the watershed.

### 5.3.9 Threatened and Endangered Species

Existing Conditions
Based on the USFWS IPaC report, federal species with the potential to occur in Coke County include:

- Black rail (*Laterallus jamaicensis*), Federal Proposed Threatened/State Threatened;
- Piping plover (*Charadrius melodus*), Federal Threatened/State Threatened;
- Red knot (*Calidris canutus rufa*); Federal Threatened/State Threatened;
- Sharpnose shiner (*Notropis oxyrhynchus*), Federal Endangered/State Endangered;
- Monarch butterfly (*Danaus plexippus*), Federal Candidate;
- Tricolored bat (*Perimyotis subflavus*), Federal Proposed Endangered;
- Texas fatmucket (*Lampsilis bracteata*), Federal Proposed Endangered/State Threatened;

- Texas pimpleback (*Cyclonaias petrina*), Federal Proposed Endangered/State Threatened; and
- Texas Poppy-mallow (*Callirhoe scabriuscula*) Federal Endangered/State Endangered.

A site reconnaissance visit was conducted and identified potentially suitable habitat for the monarch butterfly and tricolored bat. No potentially suitable habitat was identified for any additional federally listed species.

Based on the TPWD Rare, Threatened, and Endangered Species list, last modified on January 4, 2023, one state-listed species with the potential to occur and was determined to have potentially suitable habitat within FRS No. 4, the Texas horned lizard ( *Phrynosoma cornutum*).

No federally-designated critical habitat is present in the survey area.

No Action
The No Action Alternative would have no effect on the existing conditions of Threatened and Endangered species while the dam remains in place, prior failure. Sudden catastrophic breach of the dam has the potential to cause significant impacts to downstream threatened and endangered species as a result of the sudden discharge of fill/sediment and large flows.

Decommission (FWFI) – Alternative 3
The Decommission Alternative could impact the monarch butterfly and tricolored bat during construction. However, these species are not currently afforded protection under the federal Endangered Species Act. Coordination with the USFWS may be required if these species become listed prior to construction. BMPs would be implemented to avoid harming state-listed species during construction. Information on agency consultation can be found in Section 6.3.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
Same as Decommission - Alternative 3.

Decommission (FWFI) – Alternative 10
Same as Decommission - Alternative 3.

Cumulative Effects
No impacts to threatened and endangered species are anticipated, so no cumulative effects have been identified.

### 5.3.10 Fish and Wildlife

Existing Conditions
The FRS No. 4 LOD and surrounding area is generally consistent with previously disturbed lands associated with the dam and undeveloped woodland and cropland. As a result, the fish and wildlife resources include primarily native plants and animals and their habitats.

Habitat within and surrounding the LOD consists of upland woodland areas and cropland.

No Action
The No Action Alternative would have no effect on the existing conditions of fish and wildlife while the dam remains in place, prior to failure. Sudden catastrophic breach has the potential to cause significant impacts to downstream fish and wildlife and associated habitat as a result of the sudden discharge of fill/sediment and large flows. Following catastrophic breach, flood storage would be lost, which would restore the downstream flow regime to pre-impoundment conditions.

Decommission (FWFI) – Alternative 3
The Decommission Alternative would eliminate downstream protection from flooding and would restore the downstream flow regime to pre-impoundment conditions.

Minor, temporary impacts to terrestrial habitat may occur during construction. Highly-mobile species would be expected to leave the area; however, less-mobile species may be lost due to equipment during construction. It is expected that wildlife would return to the area post construction and all habitat areas would be re-established.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
The High Hazard Potential Rehabilitation Alternative would maintain the existing wildlife and their habitat. In addition, downstream aquatic and terrestrial wildlife and their habitat would continue to be maintained and protected by controlling the stream flow and flood protection.

Minor, temporary impacts to terrestrial habitat may occur during construction. Highly-mobile species would be expected to leave the area; however, less-mobile species may be lost due to equipment during construction. It is expected that wildlife would return to the area post construction and all habitat areas would be re-established.

Decommission (FWFI) – Alternative 10
Same as Decommission - Alternative 3.

Cumulative Effects
Temporary impacts to fish and wildlife would occur during construction associated with decommissioning or rehabilitation. Temporary, but significant impacts to fish and wildlife would occur in the event of catastrophic breach. Potential negative long-term impacts to downstream fish and wildlife could result from uncontrolled flows being discharged into downstream fish and wildlife habitat if the is dam removed either through catastrophic breach or decommissioning. Potential positive long-term impacts to fish and wildlife could occur through dam removal and the conversion of still water back to the free-flowing streams that existed prior to the dam being constructed. These potential long-term effects would be incremental to other regional impacts to fish and wildlife habitat resulting from future rehabilitation or breach of other flood retarding structures and development within the watershed.

### 5.3.11 Migratory Birds

Existing Conditions
Texas lies within the Central Flyway Migration Route. Many of the birds that migrate through North America rely on the Central Flyway for its diverse habitats. Migratory birds including,

song birds, raptors, and waterfowl that may occur in the FRS No. 4 LOD are protected by the MBTA. During the site reconnaissance, no bald eagles or nests were observed.

No Action
The No Action Alternative would have no effect on the existing conditions of migratory birds while the dam remains in place, prior to failure. Sudden catastrophic breach has the potential to cause significant impacts to migratory birds as a result of tree damage from the sudden discharge of large flows.

Decommission (FWFI) – Alternative 3
Decommissioning may temporarily affect migratory birds if activities occur between March 1 and August 31. In accordance with the MBTA the following measures will be implemented:

- Construction activities and vegetation clearing should be conducted outside peak-nesting seasons (March-August) to avoid any adverse effects to the migratory birds and their habitat.
- Should construction and vegetation clearing occur from March through August, active bird nest surveys during vegetation clearing will be conducted daily by a biologist before clearing begins. During construction active bird nest surveys will be conducted by a biologist no more than 5 days prior to planned construction.
- Ground-nesting species such as Killdeer have the potential to be found on-site. Construction personnel should be made aware of these species, their habits, and regulatory status, and biological monitors clearing areas for construction should take these species into account.
- In the event that migratory birds or their nests are present prior to or during construction, actions should be implemented to ensure migratory birds, their nests, eggs, and young will not be harmed. This can be achieved by establishing buffer distances from the nests in which clearing and construction should not occur until the nests are no longer active. These distances will be determined on a case-by-case basis as different birds require varying buffer distances (i.e., raptor or passerine). Consultation with a qualified biologist will be necessary to determine these buffer distances.

Migratory birds and their nests may be permanently affected in areas where tree removal is necessary.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
Same as Decommission - Alternative 3.

Decommission (FWFI) – Alternative 10
Same as Decommission - Alternative 3.

Cumulative Effects
Temporary impacts to migratory birds have the potential to occur during construction associated with decommissioning or rehabilitation unless the required measured are taken. Temporary, but significant impacts to migratory birds would occur in the event of catastrophic breach. Potential

negative long-term impacts to migratory birds could result from minor loss of habitat if the is dam removed either through catastrophic breach or decommissioning. These potential long-term effects would be incremental to other regional impacts to migratory birds resulting from future rehabilitation or breach of other flood retarding structures and development within the watershed.

### 5.3.12 Cultural Resources

Existing Conditions

A cultural resources survey of the APE for FRS No. 4 was performed on April 9, 2021 through April 11, 2021, under Texas Antiquities Permit No. 30086. The survey resulted in the identification of two previously unrecorded prehistoric archeological sites and one prehistoric isolated find. In addition, FRS No. 4 was identified and recorded as a historic-age resource.

Consultation with the Texas SHPO has been completed, (see **Appendix A**). As a result of consultation and historic and prehistoric identification studies, NRCS has determined there will be no effect to historic properties as planned. SHPO concurrence was received on July 12, 2021 that no historic properties are present, and the proposed project would have no effect on historic properties (see **Appendix A**).

The following tribes have a stated interest in ancestral lands and might attach religious or cultural significance to historic properties or have claims to land areas within Coke County, Texas: Comanche Nation of Oklahoma; Kiowa Indian Tribe of Oklahoma; the Apache Tribe of Oklahoma; the Tonkawa Tribe of Indians of Oklahoma; and the Wichita and Affiliated Tribes (Wichita, Keechi, Waco, and Tawakonie) of Oklahoma. NRCS initiated consultation July 15, 2022 with listed Tribes by certified mail inviting them to participate in the consultation process and help identify previously unknown resources in and around the APE. A determination letter was emailed on May 5, 2024, but NRCS has received no replies from Tribal Nations to date.

Kickapoo FRS No. 4 was constructed in 1962, and therefore, is old enough for National Register consideration due to its age (50+ years old). Although the resource retains integrity, its association with flood control development or agriculture in the Kickapoo Creek watershed is not sufficient for NRHP-listing as there are other examples of these types of resources in Coke County, with similar historical context. NRCS has determined that FRS No. 4 does not meet the NRHP criteria of eligibility and is therefore recommended as Not Eligible for listing in the NRHP or for designation as a SAL.

Per the NPS's National Historic Landmarks Program website, there are no National Historic Landmarks listed in Coke County, Texas. Therefore, the National Historic Landmarks Program is not applicable to the project's affected environment and will not be carried forward for impact analysis in the Environmental Consequences section.

No Action

The No Action Alternative would have no effect on the existing conditions of cultural resources.

Decommission (FWFI) – Alternative 3

The Decommission Alternative would have no effect on the existing conditions of cultural resources within the surveyed APE. The investigated area encompassed portions of McDonald, Nipple Peak, and NW Railroad Roads, the roads that would have flood warning systems installed on them under this alternative., and assessed potential direct and indirect (visual, noise, and vibration) effects the Project could have on historic properties (NRHP-eligible or NRHP-listed).

If, during final design, it is determined that there are areas outside of the previously surveyed APE that would be impacted, a cultural resources survey may be required for these areas. If any unmarked prehistoric or historic human remains or burials are encountered at any point during the project, the area of the remains is considered a cemetery under current Texas law and all construction activities must cease immediately to avoid impacting the remains. The THC must be notified immediately by contacting the Archeology Division at (512) 463-6096. All cemeteries are protected under State law and cannot be disturbed. Further protection is provided in Section 28.03(f) of the Texas Penal Code, which provides that intentional damage or destruction inflicted on a human burial site is a state jail felony.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
The High Hazard Rehabilitation Alternative would have no effect on the existing conditions of cultural resources within the surveyed APE.

If, during final design, it is determined that there are areas outside of the previously surveyed APE that would be impacted, a cultural resources survey may be required for these areas. If any unmarked prehistoric or historic human remains or burials are encountered at any point during the project, the area of the remains is considered a cemetery under current Texas law and all construction activities must cease immediately to avoid impacting the remains. The THC must be notified immediately by contacting the Archeology Division at (512) 463-6096. All cemeteries are protected under State law and cannot be disturbed. Further protection is provided in Section 28.03(f) of the Texas Penal Code, which provides that intentional damage or destruction inflicted on a human burial site is a state jail felony.

Decommission (FWFI) – Alternative 10
Same as Decommission - Alternative 3.

Cumulative Impacts
No impacts to cultural resources within the surveyed APE are anticipated, so no cumulative effects have been identified.

### 5.3.13 Land Use

Existing Conditions
The land use in the upstream watershed has remained relatively consistent (78.4% shrub/scrub, 9.6% deciduous forest, 7.1% evergreen forest, 3.8% cultivated crops) for the life of the dam but has experienced limited residential development (0.8%). The upstream drainage area consists of approximately 2,526 acres. The existing area at the dam is a floodwater retarding structure with an impounded normal pool/sediment pool area that remains dry. The area downstream of the dam (and upstream of FRS No. 5) receiving flood damage reduction benefits has also

experienced minor residential development since installation of the existing dam. The modeled existing condition 1% AEP floodplain from downstream of FRS No. 4 to the FRS No. 5 impoundment encompasses 467 acres.

No Action
The No Action Alternative would have no effect on the existing conditions of land use while the dam remains in place, prior to failure. Sudden catastrophic breach of the dam has the potential to cause impacts to 4 habitable structures, 2 road crossings, multiple road segments, and downstream agricultural lands as a result of the sudden discharge of fill/sediment and large flows. Following catastrophic breach, the loss of flood storage would result in in downstream agricultural, residential, and road crossings no longer being protected from flooding. Development restrictions would be required to prevent development in the expanded 1% AEP floodplain.

Decommission (FWFI) – Alternative 3
The Decommission Alternative would affect current and future land use. Impacts to land use would result in downstream agricultural, residential, and road crossings no longer being protected from flooding. The modeled 1% AEP floodplain from downstream of FRS No. 4 to the FRS No. 5 impoundment would be expanded from 467 to 680 acres, but no critical structures would be impacted, and no residential structures would be added to the 1% AEP floodplain.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
The High Hazard Rehabilitation alternative would provide increased protection against breach and continued flood to properties downstream of the dam and would provide continued flood protection.

Decommission (FWFI) – Alternative 10
Same as Decommission - Alternative 3.

Cumulative Impacts
Temporary impacts to the downstream land use would occur in the event of catastrophic breach of the dam. Potential long-term impacts to the downstream land use would occur if the flood storage function of the dam is removed either through catastrophic breach or decommissioning. These long-term effects would be incremental to other regional impacts to land use resulting from future development, conversion of agricultural lands to other land uses, and rehabilitation, decommission, or breach of other flood retarding structures within the Kickapoo Creek Watershed.

### 5.3.14 Public Health and Safety

Existing Conditions
FRS No. 4 has provided flood protection benefits to downstream areas since it was constructed in 1962, but there are currently safety concerns associated with the FRS, and it does not meet NRCS criteria for a high hazard dam. The existing vegetated earth auxiliary spillway does not have the capacity necessary to safely pass the PMP event. Overtopping the dam or an integrity failure of the auxiliary spillway could cause the dam to erode and collapse, resulting in a release

of the water and sediment stored behind the dam. In addition, there are concerns associated with the stability of the embankment and the condition is currently listed as "unsatisfactory". Approximately 16 people are at risk for loss of life. There are 4 homes within the breach inundation zone of this dam and 2 roads that would be inundated by over 1 foot in the event of a catastrophic breach. The modeled existing condition 1% AEP floodplain from downstream of FRS No. 4 to the FRS No. 5 impoundment encompasses 467 acres and no habitable structures are located within it. During the 1% AEP event, McDonald Road would be overtopped by 0.4 feet and Nipple Peak Road would be overtopped 1.6 feet, putting vehicles at risk.

No Action

The No Action Alternative would have no effect on the existing conditions of public health and safety while the dam remains in place, prior to failure. The safety concerns associated with the dam embankment and the risk of dam breach would remain and if a sudden catastrophic breach does occur, it has the potential to kill or injure people. The population at risk in the event of catastrophic breach is 16 people. Following catastrophic breach, the loss of flood storage would result in the 1% AEP floodplain being expanded and downstream areas would be subject to more frequent flooding. Additionally, the depth and frequency in which downstream roads would be overtopped would increase. Increased development restrictions would be necessary to protect public health and safety within the enlarged floodplain area.

Decommission (FWFI) – Alternative 3

The Decommission Alternative would remove the risk associated with the potential for dam failure. Flows resulting from the 1% AEP storm event would safely pass the constricted breach, but the modeled 1% AEP floodplain would be expanded from 467 to 680 acres, but no critical structures or habitable structures would be added to the 1% AEP floodplain. Additionally, McDonald Road would be overtopped by 5.7 feet in the 1% AEP event, Nipple Peak Road would be overtopped by 3.1 feet, and portions of NW Railroad Road would be flooded, so flood warning systems with barricades and warning lights would be included in the alternative to address the increased risk to public safety and meet the Purpose and Need of the project. All of these roads would be subject to increased depth and frequency of flooding. Increased development restrictions would be necessary to protect public health and safety within the enlarged floodplain area. FRS No. 5 would be modified prior to decommissioning of FRS No. 4 to prevent increased threat to human life during construction.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9

Under the High Hazard Potential Rehabilitation Alternative, the dam would be rehabilitated using current NRCS design and safety criteria and performance standards to provide flood protection for 100 years. Upstream of the dam, the 1% AEP flood pool for the NRCS design storm will not increase for the existing condition, and no upstream homes will be at risk. McDonald Road would be overtopped by 0.9 feet in the 1% AEP event and Nipple Peak Road would be overtopped by 1.5 feet

Decommission (FWFI) – Alternative 10

Same as Decommission - Alternative 3.

Cumulative Impacts

There is the potential for downstream injury and death in the event of a sudden catastrophic breach of the dam. The downstream population at risk is estimated to be 16 people. Potential long-term impacts to public safety would occur if the flood storage function of the dam is removed either through catastrophic breach or decommissioning. These long-term effects would be incremental to other regional impacts to public health and safety resulting from rehabilitation or breach of other flood retarding structures within the Kickapoo Creek Watershed.

### 5.3.15 Social Issues/Community Cohesion

Existing Conditions
FRS No. 4 has provided value to the community since 1962 by providing flood protection benefits that enhance the quality of life for downstream residents.

No Action
The No Action Alternative would have no effect on the existing conditions of social issues/community cohesion while the dam remains in place, prior to failure. Sudden catastrophic breach has the potential to cause injury and death to those living within the 4 residences located within the FRS No. 4 Breach Inundation Area. Although the census tract in which these residences are within is not considered impoverished, when compared to the State, these residences appear to be dilapidated and it is unlikely that the residents would have the resources to rebuild. The injury, death, and property damage that would likely result from catastrophic breach of the FRS has the potential to cause significant impacts to downstream social issues and community. Following catastrophic breach, the loss of flood storage would remove the flood protection benefits and would necessitate development restrictions downstream which could negatively impact social issues and community cohesion.

Decommission (FWFI) – Alternative 3
The Decommission Alternative would remove the flood protection benefits and increase development restrictions downstream due to the expanded 1% AEP floodplain. To prevent increased loss of life to downstream motorists, flood warning systems would be installed on McDonald Road, Nipple Peak Road, and NW Railroad Road. All of these roads would be subject to increased depth and frequency of flooding

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
The High Hazard Potential Rehabilitation Alterative will allow flood protection benefits to continue for 100 years and would avoid residential relocation and increased development restrictions downstream. Could result in increased taxes/fees to fund rehabilitation.

Decommission (FWFI) – Alternative 10
Same as Decommission - Alternative 3.

Cumulative Impacts
Potential long-term impacts to social issues and community cohesion would occur in the event of a catastrophic breach. It is also anticipated that minor long-term impacts to community cohesion could occur if the flood storage function of the dam is removed through decommissioning. These long-term effects would be incremental to other regional impacts to social issues and community

cohesion resulting from rehabilitation of other flood retarding structures within the Kickapoo Creek Watershed.

## 5.4 Comparative Environmental Effects of Alternatives – FRS No. 5

### 5.4.1 Prime and Unique Farmland

Prime and unique farmland is land that has the soil quality, growing season, and moisture supply necessary for producing crops and is available for these uses. In addition, the land is not excessively eroded or saturated with water for a long period of time and is either protected from flooding or does not flood frequently. In some areas, land that does not meet the criteria for prime or unique farmland is considered to be farmland of statewide importance for the production of food, feed, fiber, forage, and oilseed crops.

Based on the NRCS Soil Survey, there are approximately 125 acres of prime farmland and approximately 35 acres of farmland of statewide importance, if irrigated below the existing TOD elevation, upstream of FRS No. 5, although none of these areas appear to be being actively farmed. There are approximately 478 acres of area designated as prime farmland, 3 acres of area designated as prime farmland, if irrigated, and 36 acres of area designated as farmland of statewide importance, if irrigated within the 1% AEP floodplain, downstream of FRS No. 5 within the modeling extents. Of those areas, it appears that approximately 165 acres of prime farmland and 15 acres of farmland of statewide importance, if irrigated are being actively farmed.

No Action

The No Action Alternative would have no effect on the existing conditions of prime and unique farmland while the dam remains in place, prior to failure. Sudden catastrophic breach of the dam has the potential to cause significant impacts to the downstream areas of prime farmland and farmland of statewide importance as a result of the sudden discharge of large flows, embankment fill, and sediment. Following catastrophic breach of the dam, the elimination of the existing flood protection would subject the downstream areas of prime farmland and farmland of statewide importance to more frequent and severe flooding. These areas may no longer be considered prime farmland or farmland of statewide importance if they are subject to more frequent and severe flooding in the future. With the loss of flood storage, areas that currently have the potential to be inundated by the backwater of FRS 5 would no longer be inundated.

High Hazard Potential Rehabilitation (FWFI) – Alternative 3

The High Hazard Potential Rehabilitation Alternative would maintain the flood protection downstream of the dam resulting in inundation of prime farmlands within the backwater of the dam for short periods of time. A 2.8-foot dam raise would be required for this alternative, which would cause approximately 20 additional acres of prime farmland and 7 additional acres of farmland of statewide importance, if irrigated to be inundated by the backwater of FRS No. 5 at the TOD elevation, although these areas do not appear to be being actively farmed. There are approximately 11.5 acres designated as prime farmland and approximately 15.9 acres designated as farmland of statewide importance, if irrigated within the FRS No. 5 projected maximum LOD that would potentially be impacted during construction, although these areas do not appear to be being actively farmed. The modeled downstream 1% AEP would increase and there would be

approximately 495 acres of area designated as prime farmland, 3 acres of area designated as prime farmland, if irrigated, and 40 acres of area designated as farmland of statewide importance, if irrigated within the 1% AEP floodplain, downstream of FRS No. 5 within the modeling extents.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9

The High Hazard Potential Rehabilitation Alternative would maintain the flood protection downstream of the dam resulting in inundation of prime farmlands within the backwater of the dam for short periods of time. A 1.0-foot dam raise would be required for this alternative, which would cause approximately 5 additional acres of prime farmland and 2 additional acres of farmland of statewide importance, if irrigated to be inundated by the backwater of FRS No. 5 at the TOD elevation, although these areas do not appear to be being actively farmed. There are approximately 11.5 acres designated as prime farmland and approximately 15.9 acres designated as farmland of statewide importance, if irrigated within the FRS No. 5 projected maximum LOD that would potentially be impacted during construction, although these areas do not appear to be being actively farmed.

SLO Sponsored Rehab to State Standards – Alternative 10

The SLO Sponsored Rehab to State Standards Alternative would maintain the flood protection downstream of the dam resulting in inundation of prime farmlands within the backwater of the dam for short periods of time. The modeled downstream 1% AEP would increase and there would be approximately 482 acres of area designated as prime farmland, 3 acres of area designated as prime farmland, if irrigated, and 36 acres of area designated as farmland of statewide importance, if irrigated within the 1% AEP floodplain, downstream of FRS No. 5 within the modeling extents.

Cumulative Impacts

Construction activities associated with any of the alternatives would contribute to temporary impacts to prime farmland and farmland of statewide importance within the LOD, but it is expected that the construction impacts would be considered minor and temporary and would not be incremental to any other impacts within the LOD. Potential long-term impacts to downstream prime farmland and farmland of statewide importance would occur if the storage function of the dam is removed. Potential positive long-term impacts to prime farmland and farmland of statewide importance below the TOD would occur if the dam is rehabilitated. These long term effects would be incremental to other regional impacts to prime and unique farmland resulting from future development, conversion of agricultural lands to other land uses, and rehabilitation or breach of other flood retarding structures within the watershed.

### 5.4.2 Erosion and Sediment

Existing Conditions

Soils and Erosion – Based on the NRCS Web Soil Survey, the predominant soil groups in the FRS No. 5 LOD include Oben and Cobb soils, Miles fine sandy loam, Colorado loam, Bronte fine sandy loam, and Canton fine sandy loam. Current conditions indicate that the left berm of auxiliary spillway has eroded and the right cut slope from natural ground has severe erosion gullies.

Sedimentation – FRS No. 5 is currently functioning to collect and retain sediment from the watershed.

No Action

The No Action Alternative would have no effect on the existing conditions of erosion and sedimentation while the dam remains in place, prior to failure. Sudden catastrophic breach of the dam has the potential to cause significant impacts to erosion and sedimentation downstream as a result of the sudden discharge of large flows, embankment fill, and sediment. Following catastrophic breach, the current function of the dam to collect and retain sediment would be eliminated and the removal of flood protection would increase the potential for downstream erosion and sedimentation to private properties, roads, and utilities as a result of uncontrolled flows. The natural sediment regime would be restored over time following catastrophic breach of the dam.

High Hazard Potential Rehabilitation (FWFI) – Alternative 3

The High Hazard Potential Rehabilitation Alternative would rehabilitate the dam to meet NRCS High Hazard Potential Class dam criteria. This Alternative would continue to allow the dam to collect and retain sediment for 100 years as well as further reduce the downstream erosion potential by safely passing controlled storm flows through the new principal spillway conduit. The increased conduit size and larger flows have the potential to increase downstream erosion. The flood protection to downstream properties, roads, and utilities would be maintained through the proposed modifications.

Temporary impacts to erosion and sedimentation may occur during construction; however, these impacts would be reduced through the use of water quality BMPs identified in the SWPPP.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9

Same as the High Hazard Potential Rehabilitation (FWFI) – Alternative 3

SLO Sponsored Rehab to State Standards – Alternative 10

SLO Sponsored Rehab to State Standards Alternative would rehabilitate the dam to meet TCEQ criteria for an intermediate size, high hazard dam. This Alternative would continue to allow the dam to collect and retain sediment as well as further reduce the downstream erosion potential by safely passing controlled storm flows through the existing principal spillway conduit. The flood protection to downstream properties, roads, and utilities would be maintained through the proposed modifications.

Temporary impacts to erosion and sedimentation may occur during construction; however, these impacts would be reduced through the use of water quality BMPs.

Cumulative Impacts

Temporary impacts to erosion and sedimentation would occur during construction associated with rehabilitation; however, these impacts would be reduced through the use of water quality BMPs identified in the SWPPP. Temporary, but significant impacts to erosion and sediment would occur in the event of catastrophic breach. Long-term impacts to downstream erosion and

sedimentation would occur if the sediment and flood storage function of the dam is removed. These long-term effects would be incremental to other regional impacts to erosion and sedimentation resulting from future development, conversion of agricultural lands to other land uses, and rehabilitation or breaching of other flood retarding structures within the watershed.

### 5.4.3 Floodplain Management

Existing Conditions
FRS No. 5 is not within a Federal Emergency Management Agency (FEMA)-regulated 1% AEP floodplain. There is an area in Bronte (downstream of FRS No. 5) that is within a Federal Emergency Management Agency (FEMA)-regulated 1% AEP floodplain. The existing impoundment provides flood damage reduction benefits by reducing the peak flow and duration of storm events within the watershed. The existing condition 1% AEP floodplain was modeled from downstream of FRS No. 5 to the confluence of West Kickapoo Creek and Kickapoo Creek. The modeled 1% AEP floodplain boundary encompasses 915 acres.

No Action
The No Action Alternative would have no effect on the existing conditions of floodplain management while the dam remains in place, prior to failure. The extent of the breach from overtopping failure would be 2,223 acres and would damage habitable structures not currently within the modeled 1% AEP floodplain boundary. Following catastrophic breach of the dam, the current flood protection benefits would be lost, as the structure would no longer be able to store floodwater, store sediment, and retard peak flows. The downstream floodplain extent would increase from the existing condition.

High Hazard Potential Rehabilitation (FWFI) – Alternative 3
The High Hazard Potential Rehabilitation Alternative would continue to provide downstream flood protection. The modeled 1% AEP floodplain would be increased from approximately 915 to approximately 952 acres, but no critical structures would be impacted, and no residential structures will be added to the 1% AEP floodplain. The drawdown time in the dam backwater would be less than 10 days.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
The High Hazard Potential Rehabilitation Alternative would maintain the existing level of flood protection. The 1% AEP floodplain would be decrease from approximately 915 to approximately 914 acres. The drawdown time in the dam backwater would be less than 10 days.

SLO Sponsored Rehab to State Standards – Alternative 10
The SLO Sponsored Rehab to State Standards Alternative would continue to provide downstream flood protection. The modeled 1% AEP floodplain would be increased from approximately 915 to approximately 939 acres, but no critical structures would be impacted and no residential structures will be added to the 1% AEP floodplain.

Cumulative Impacts
Temporary impacts to the downstream floodplain would occur in the event of catastrophic breach of the dam. Potential long-term impacts to the downstream floodplain would occur if the flood storage function of the dam is lost due to catastrophic breach. These long-term effects

would be incremental to other regional impacts to floodplain management resulting from future development, conversion of agricultural lands to other land uses, and rehabilitation or breach of other flood retarding structures within the Kickapoo Creek Watershed.

### 5.4.4 Streams, Lakes, and Wetlands

Existing Conditions
The normal pool/sediment pool area associated with FRS No. 5 as well as the streams flowing into and out of the normal pool/sediment pool area would be considered potentially jurisdictional waters of the U.S under the Clean Water Act. During the site visit conducted July 12, 2023, Middle Kickapoo Creek, Dry Creek, and FRS No. 5 reservoir were determined to be present within the survey area.

No Action
The No Action Alternative would have no effect on the downstream streams and wetlands while the dam remains in place, prior to failure. Sudden catastrophic breach has the potential to cause significant discharge of fill material into downstream potentially jurisdictional waters of the U.S.. Following catastrophic breach of the dam, the potential for the discharge of fill material into potentially jurisdictional waters of the U.S would remain. The loss of flood storage would also increase the potential for flooding downstream that would likely impact streams and wetlands downstream of FRS No. 5. The loss of flood storage would eliminate the normal pool/sediment pool area and likely decrease the surface water upstream resulting in the loss of aquatic habitat and hydrology.

High Hazard Potential Rehabilitation (FWFI) – Alternative 3
The High Hazard Potential Rehabilitation Alternative would result in a discharge of fill material into potential jurisdictional waters of the U.S. during construction. Aquatic habitat upstream and within the normal pool/sediment pool area would be maintained. In addition, the vegetation would be maintained; however, temporary impacts would likely occur during construction.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
Same as the High Hazard Potential Rehabilitation (FWFI) – Alternative 3

SLO Sponsored Rehab to State Standards – Alternative 10
The SLO Sponsored Rehab to State Standards Alternative would result in Aquatic habitat upstream and within the normal pool/sediment pool area being maintained. In addition, the vegetation would be maintained; however, temporary impacts would likely occur during construction.

Cumulative Impacts
Temporary impacts to streams and wetlands would occur in the event of catastrophic breach or rehabilitation of the dam. Potential negative long-term impacts to the downstream streams and wetlands due to uncontrolled flows and discharged fill could occur in the event of catastrophic breach. Potential positive long-term impacts to streams, lakes, and wetlands could occur through the loss of flood storage and the conversion of still water back to the free-flowing streams that existed prior to the dam being constructed. These potential long-term effects would be

incremental to other regional impacts to streams and wetlands resulting from future rehabilitation or breach of other flood retarding structures within the watershed.

### 5.4.5 Water Quality

Existing Conditions
The 2020 305(b)/303(d) Integrated Water Quality Assessment and Impaired Waters Report (TCEQ, 2020) did not identify Middle Kickapoo Creek or Kickapoo Creek as impaired streams.

No Action
The No Action Alternative would have no effect on the existing conditions of water quality while the dam remains in place, prior to failure. Sudden catastrophic breach of the dam has the potential to cause significant downstream water quality impacts as a result of discharge of fill material and impounded sediment. Following the catastrophic breach, the loss of flood storage would allow sediment from upstream erosion to move downstream. The natural sediment regime would be restored over time following catastrophic breach of dam.

High Hazard Potential Rehabilitation (FWFI) – Alternative 3
The High Hazard Potential Rehabilitation Alternative would result in temporary impacts to water quality during construction. Sedimentation and erosion would be managed through the implementation of a SWPPP. BMPs would be identified in the SWPPP.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
Same as High Hazard Potential Rehabilitation (FWFI) – Alternative 3

SLO Sponsored Rehab to State Standards – Alternative 10
The SLO Sponsored Rehab to Sate Standards Alternative would result in temporary impacts to water quality during construction. As the disturbed area for Alternative 10 is expected to be less than 5 acres (disturbed area would be ~3 acres), no SWPPP would be required.

Cumulative Impacts
Temporary impacts to water quality would occur during construction associated with rehabilitation; however, these impacts would be reduced through the use of water quality BMPs identified in the SWPPP. Temporary, but significant impacts to water quality would occur in the event of catastrophic breach. Negative long-term impacts to the downstream water quality could result from uncontrolled sediment being discharged into downstream water bodies in the event of catastrophic breach. Potential positive long-term impacts to water quality could occur through dam removal and the conversion of still water back to the free-flowing stream that existed prior to the dam being constructed. These potential long-term effects would be incremental to other regional impacts to water quality resulting from future rehabilitation or breach of other flood retarding structures within the watershed.

### 5.4.6 Woodland Vegetation/Forest Resources

Existing Conditions
There are approximately 16.8 acres with trees within the LOD consisting primarily of

eastern red cedar, southern live oak (*Quercus virginiana*), honey mesquite, and hackberry.

No Action
The No Action Alternative would have no effect on the existing conditions of woodland vegetation/forest resources while the dam remains in place, prior to failure. Sudden catastrophic breach of the dam has the potential to cause significant impacts to woodland vegetation/forest resources as a result of breach of the embankment and the sudden discharge of large flows downstream.

High Hazard Potential Rehabilitation (FWFI) – Alternative 3
The High Hazard Potential Rehabilitation Alternative would result in the removal of approximately 16.8 acres of vegetation including trees.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
Same as the High Hazard Potential Rehabilitation (FWFI) – Alternative 3

SLO Sponsored Rehab to State Standards – Alternative 10
The SLO Sponsored Rehab to State Standards Alternative would have no impacts on woodland vegetation.

Cumulative Impacts
Construction activities associated with the rehabilitation alternatives would result in impacts to woodland vegetation/forest resources within the LOD. Temporary, but significant impacts to woodland vegetation/forest would occur in the event of catastrophic breach. Potential long-term impacts to downstream woodland vegetation/forest resources would occur if the storage function of the dam is removed through catastrophic breach. These long-term effects would be incremental to other regional impacts to woodland vegetation/forest resource resulting from future development and rehabilitation or breach of other flood retarding structures within the watershed.

### 5.4.7 Invasive Species

Existing Conditions
According to the Texas Invasives website (Texas Invasives, 2022), the following invasive plant species have been identified as being particularly worrisome within the Rolling Plains Ecoregion, in which FRS No. 5 is located:

- Chinese tallow tree (*Triadica sebifera)*
- Japanese privet (*Ligustrum japonicum)*
- Salt cedar (*Tamarix ramosissima)*
- Johnson grass (*Sorghum halepense)*
- Japanese honeysuckle (*Lonicera japonica)*
- King Ranch bluestem (*Bothriochloa ischaemum var. songarica)*
- Giant reed (*Arundo donax)*
- Nutgrass (*Cyperus rotundus)*
- Dallisgrass (*Paspalum dilatatum)*

- Bermudagrass (*Cynodon dactylon)*
- Russian thistle (*Salsola tragus)*
- Siberian elm (*Ulmus pumila)*

No Action
The No Action Alternative would initially result in no change to the existing condition of invasive species at the site, prior to failure. There is potential for the introduction and/or spread of invasive species during routine O&M unless all tools, equipment, and vehicles are cleaned before entering and leaving the site. Sudden catastrophic breach of the dam could result in the spread of invasive plant and animal species through transportation to downstream areas following the breach.

High Hazard Potential Rehabilitation (FWFI) – Alternative 3
The High Hazard Potential Rehabilitation Alternative could result in the introduction of new invasive species by construction equipment or spreading of existing invasive species during construction if preventative measures are not taken. All disturbed areas would be revegetated using adapted and/or non-invasive native species. All tools, equipment, and vehicles will be cleaned before transporting materials and before entering and leaving the worksites to prevent the introduction and spread of invasive species.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
Same as High Hazard Potential Rehabilitation (FWFI) – Alternative 3

SLO Sponsored Rehab to State Standards – Alternative 10
Same as High Hazard Potential Rehabilitation (FWFI) – Alternative 3

Cumulative Impacts
Long term impacts to invasive species could occur if new invasive species are introduced to the site during construction or O&M activities. These potential long-term effects would be incremental to other regional impacts to invasive species resulting from future development in the watershed and rehabilitation or O&M of other flood retarding structures within the watershed.

### 5.4.8 Riparian Areas

Existing Conditions
Riparian areas are present in a narrow band surrounding the approximately 86.5-acre normal pool/sediment pool area as well as downstream along Middle Kickapoo Creek. These areas are comprised of various grasses and trees/shrubs, sedges, and rushes. The vegetation outside of these areas is comprised of upland species.

No Action
The No Action Alternative would have no effect on the existing conditions of riparian areas while the dam remains in place, prior to failure. Sudden catastrophic breach of the dam has the potential to cause significant impacts to riparian areas surrounding the normal pool and downstream riparian areas as a result of breach of the embankment and the sudden discharge of

large flows downstream. Following catastrophic breach, the loss of flood storage would result in uncontrolled flows that may impact downstream riparian areas during large storm events. The loss of flood storage would also restore the downstream flow regime to pre-impoundment conditions. Riparian areas along Middle Kickapoo Creek and downstream would likely increase with removal of the dam.

High Hazard Potential Rehabilitation (FWFI) – Alternative 3
The High Hazard Potential Rehabilitation Alternative would result in minor temporary impacts during construction. The riparian areas would establish surrounding the normal pool/sediment pool area consistent with pre-construction conditions following rehabilitation activities. The normal pool/sediment pool area will remain the same with this alternative, so the amount of riparian area should not be impacted.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
The High Hazard Potential Rehabilitation Alternative would result in minor temporary impacts during construction. The riparian areas would establish surrounding the normal pool/sediment pool area consistent with pre-construction conditions following rehabilitation activities. The normal pool/sediment pool area will be reduced to approximately 63.5 acres with this alternative, so the amount of riparian area will be reduced.

SLO Sponsored Rehab to State Standards – Alternative 10
The normal pool/sediment pool area will remain the same with this alternative, so the amount of riparian area should not be impacted.

Cumulative Impacts
Temporary impacts to downstream riparian areas would occur in the event of catastrophic breach. Negative long-term impacts to the downstream riparian areas would result from uncontrolled flows being discharged into downstream riparian areas if there is a loss of flood storage as a result of catastrophic breach. Potential positive long-term impacts to riparian areas could occur through dam removal and the conversion of still water back to the free-flowing stream that existed prior to the dam being constructed. In addition, riparian areas along Middle Kickapoo Creek and downstream would likely increase with removal of the dam. These potential long-term effects would be incremental to other regional impacts to riparian resulting from future rehabilitation or breach of other flood retarding structures within the watershed.

### 5.4.9 Threatened and Endangered Species

Existing Conditions
Based on the USFWS IPaC report, federal species with the potential to occur in Coke County include:

- Black rail (*Laterallus jamaicensis*), Federal Proposed Threatened/State Threatened;
- Piping plover (*Charadrius melodus*), Federal Threatened/State Threatened;
- Red knot (*Calidris canutus rufa*); Federal Threatened/State Threatened;
- Sharpnose shiner (*Notropis oxyrhynchus*), Federal Endangered/State Endangered;
- Monarch butterfly (*Danaus plexippus*), Federal Candidate;

- Tricolored bat (*Perimyotis subflavus*), Federal Proposed Endangered;
- Texas fatmucket (*Lampsilis bracteata*), Federal Proposed Endangered/State Threatened;
- Texas pimpleback (*Cyclonaias petrina*), Federal Proposed Endangered/State Threatened; and
- Texas Poppy-mallow (*Callirhoe scabriuscula*) Federal Endangered/State Endangered.

A site reconnaissance visit was conducted and identified potentially suitable habitat for the monarch butterfly and tricolored bat. No potentially suitable habitat was identified for any additional federally listed species.

Based on the TPWD Rare, Threatened, and Endangered Species list, last modified on January 4, 2023, one state-listed species with the potential to occur and was determined to have potentially suitable habitat within FRS No. 4, the Texas horned lizard ( *Phrynosoma cornutum*).

No federally-designated critical habitat is present in the survey area.

No Action
The No Action Alternative would have no effect on the existing conditions of Threatened and Endangered species while the dam remains in place, prior failure. Sudden catastrophic breach of the dam has the potential to cause significant impacts to downstream threatened and endangered species as a result of the sudden discharge of fill/sediment and large flows.

High Hazard Potential Rehabilitation (FWFI) – Alternative 3
The High Hazard Potential Rehabilitation Alternative could impact the monarch butterfly and tricolored bat. However, these species are not currently afforded protection under the federal Endangered Species Act. Coordination with the USFWS may be required if these species become listed prior to construction. BMPs would be implemented to avoid harming state-listed species during construction. Information on agency consultation can be found in Section 6.3.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
Same as High Hazard Potential Rehabilitation (FWFI) – Alternative 3

SLO Sponsored Rehab to State Standards – Alternative 10
Same as High Hazard Potential Rehabilitation (FWFI) – Alternative 3

Cumulative Effects
No impacts to threatened and endangered species are anticipated, so no cumulative effects have been identified.

### 5.4.10 Fish and Wildlife

Existing Conditions
The FRS No. 5 LOD and surrounding area is generally consistent with previously disturbed lands associated with the dam and roadways; and undeveloped woodland. As a result, the fish and wildlife resources include primarily native plants and animals and their habitats.

Habitat within and surrounding the LOD consists of the upland grazed grasses, woodland areas, and narrow riparian areas. Aquatic habitats are present in the normal pool/sediment pool area and stream channels within the LOD and downstream of the dam.

The sediment pool is approximately 86.5 acres and provides habitat for fish, waterfowl, and general wildlife. Habitat is also present within the flood pool area and stream channels upstream of the dam.

No Action

The No Action Alternative would have no effect on the existing conditions of fish and wildlife while the dam remains in place, prior to failure. Sudden catastrophic breach has the potential to cause significant impacts to downstream fish and wildlife and associated habitat as a result of the sudden discharge of fill/sediment and large flows. Following catastrophic breach, flood storage would be lost, which would restore the downstream flow regime to pre-impoundment conditions. The loss of flood storage would eliminate approximately 86.5 acres of shallow and deep water habitat by converting it to unimproved riparian habitat, floodplain, or upland. The stream flow would no longer be controlled which would result in impacts to downstream aquatic and terrestrial wildlife and their habitat through the both the lack of water as well as during flooding events.

High Hazard Potential Rehabilitation (FWFI) – Alternative 3

The High Hazard Potential Rehabilitation Alternative would maintain the existing aquatic and terrestrial wildlife and their habitat. In addition, downstream aquatic and terrestrial wildlife and their habitat would continue to be maintained and protected by controlling the stream flow and flood protection.

Minor, temporary impacts to aquatic and terrestrial habitat may occur during construction. Highly-mobile species would be expected to leave the area; however, less-mobile species may be lost due to equipment during construction. It is expected that wildlife would return to the area post construction and all habitat areas would be re-established.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9

The sediment pool would be reduced to approximately 63.5 acres. Other than the reduction in area, the High Hazard Potential Rehabilitation Alternative would maintain the existing aquatic and terrestrial wildlife and their habitat. In addition, downstream aquatic and terrestrial wildlife and their habitat would continue to be maintained and protected by controlling the stream flow and flood protection.

Minor, temporary impacts to aquatic and terrestrial habitat may occur during construction. Highly-mobile species would be expected to leave the area; however, less-mobile species may be lost due to equipment during construction. It is expected that wildlife would return to the area post construction and all habitat areas would be re-established.

SLO Sponsored Rehab to State Standards – Alternative 10

Same as High Hazard Potential Rehabilitation (FWFI) – Alternative 3

Cumulative Effects
Temporary impacts to fish and wildlife would occur during construction associated with decommissioning or rehabilitation. Temporary, but significant impacts to fish and wildlife would occur in the event of catastrophic breach. Negative long-term impacts to downstream fish and wildlife would result from uncontrolled flows being discharged into downstream fish and wildlife habitat if there is a loss of flood storage as a result of catastrophic breach. Negative long-term impacts to upstream habitat would result from dam removal. Potential positive long-term impacts to fish and wildlife could occur through dam removal and the conversion of still water back to the free-flowing stream that existed prior to the dam being constructed. These potential long-term effects would be incremental to other regional impacts to fish and wildlife habitat resulting from future rehabilitation or breach of other flood retarding structures and development within the watershed.

### 5.4.11 Migratory Birds

Existing Conditions
Texas lies within the Central Flyway Migration Route. Many of the birds that migrate through North America rely on the Central Flyway for its diverse habitats. Migratory birds including, song birds, raptors, and waterfowl that may occur in the FRS No. 5 LOD are protected by the MBTA. During the site reconnaissance, no bald eagles or nests were observed.

No Action
The No Action Alternative would have no effect on the existing conditions of migratory birds while the dam remains in place, prior to failure. Sudden catastrophic breach has the potential to cause significant impacts to migratory birds as a result of tree damage from the sudden discharge of large flows.

High Hazard Potential Rehabilitation (FWFI) – Alternative 3
Rehabilitation may temporarily affect migratory birds if activities occur between March 1 and August 31. In accordance with the MBTA the following measures will be implemented:

- Construction activities and vegetation clearing should be conducted outside peak-nesting seasons (March-August) to avoid any adverse effects to the migratory birds and their habitat.
- Should construction and vegetation clearing occur from March through August, active bird nest surveys during vegetation clearing will be conducted daily by a biologist before clearing begins. During construction active bird nest surveys will be conducted by a biologist no more than 5 days prior to planned construction.
- Ground-nesting species such as Killdeer have the potential to be found on-site. Construction personnel should be made aware of these species, their habits, and regulatory status, and biological monitors clearing areas for construction should take these species into account.
- In the event that migratory birds or their nests are present prior to or during construction, actions should be implemented to ensure migratory birds, their nests, eggs, and young will not be harmed. This can be achieved by establishing buffer distances from the nests

in which clearing and construction should not occur until the nests are no longer active. These distances will be determined on a case-by-case basis as different birds require varying buffer distances (i.e., raptor or passerine). Consultation with a qualified biologist will be necessary to determine these buffer distances.

All areas would be expected to return to pre-existing conditions following rehabilitation activities.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
Same as High Hazard Potential Rehabilitation (FWFI) – Alternative 3

SLO Sponsored Rehab to State Standards – Alternative 10
Same as High Hazard Potential Rehabilitation (FWFI) – Alternative 3

Cumulative Effects
Temporary impacts to migratory birds have the potential to occur during construction associated with decommissioning or rehabilitation unless the required measured are taken. Temporary, but significant impacts to migratory birds would occur in the event of catastrophic breach. Potential negative long-term impacts to migratory birds could result from minor loss of habitat if the is dam removed through catastrophic breach. These potential long-term effects would be incremental to other regional impacts to migratory birds resulting from future rehabilitation or breach of other flood retarding structures and development within the watershed.

### 5.4.12 Cultural Resources

Existing Conditions
A cultural resources survey of the APE for FRS No. 5 was performed on April 8th, 12th, and 13th 2021, under Texas Antiquities Permit No. 30086. The survey resulted in the identification of one previously unrecorded prehistoric archeological site and three prehistoric isolated finds. In addition, FRS No. 5 and a livestock shelter/corral were identified and recorded as historic-age resources.

Consultation with the Texas SHPO and relevant federally recognized Tribes has been completed, (see **Appendix A**). As a result of consultation and historic and prehistoric identification studies, NRCS has determined there will be no effect to historic properties as planned. SHPO concurrence was received on July 12, 2021 that no historic properties are present, and the proposed project would have no effect on historic properties (see **Appendix A**).

The following tribes have a stated interest in ancestral lands and might attach religious or cultural significance to historic properties or have claims to land areas within Coke County, Texas: Comanche Nation of Oklahoma; Kiowa Indian Tribe of Oklahoma; the Apache Tribe of Oklahoma; the Tonkawa Tribe of Indians of Oklahoma; and the Wichita and Affiliated Tribes (Wichita, Keechi, Waco, and Tawakonie) of Oklahoma. NRCS initiated consultation July 15, 2022 with listed Tribes by certified mail inviting them to participate in the consultation process and help identify previously unknown resources in and around the APE. A determination letter was emailed on May 5, 2024, but NRCS has received no replies from Tribal Nations to date.

Kickapoo FRS No. 5 was constructed in 1963, and therefore, is old enough for National Register consideration due to its age (50+ years old). In addition, the livestock shelter/corral identified in the cultural resources survey are estimated to have been constructed in 1975, and therefore, are also old enough for National Register consideration due to their age. Although the resources retain integrity, their association with flood control development or agriculture in the Kickapoo Creek watershed is not sufficient for NRHP-listing as there are other examples of these types of resources in Coke County, with similar historical context. NRCS has determined that the dams do not meet the NRHP criteria of eligibility and are therefore recommended as Not Eligible for listing in the NRHP or for designation as a SAL.

Per the NPS's National Historic Landmarks Program website, there are no National Historic Landmarks listed in Coke County, Texas. Therefore, the National Historic Landmarks Program is not applicable to the project's affected environment and will not be carried forward for impact analysis in the Environmental Consequences section.

No Action
The No Action Alternative would have no effect on the existing conditions of cultural resources.

High Hazard Potential Rehabilitation (FWFI) – Alternative 3
The High Hazard Potential Rehabilitation Alternative would have no effect on the existing conditions of cultural resources within the surveyed APE. If, during final design, it is determined that there are areas outside of the previously surveyed APE that would be impacted, a cultural resources survey may be required for these areas. If any unmarked prehistoric or historic human remains or burials are encountered at any point during the project, the area of the remains is considered a cemetery under current Texas law and all construction activities must cease immediately to avoid impacting the remains. The THC must be notified immediately by contacting the Archeology Division at (512) 463-6096. All cemeteries are protected under State law and cannot be disturbed. Further protection is provided in Section 28.03(f) of the Texas Penal Code, which provides that intentional damage or destruction inflicted on a human burial site is a state jail felony.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
Same as High Hazard Potential Rehabilitation (FWFI) – Alternative 3

SLO Sponsored Rehab to State Standards – Alternative 10
Same as High Hazard Potential Rehabilitation (FWFI) – Alternative 3

Cumulative Impacts
No impacts to cultural resources within the surveyed APE are anticipated, so no cumulative effects have been identified.

### 5.4.13 Land Use

Existing Conditions
The land use in the upstream watershed (not including the area controlled by FRS No. 4) has remained relatively consistent (85.6% shrub/scrub, 5.8% deciduous forest, 2.7% evergreen forest, 3.2% cultivated crops) for the life of the dam but has experienced limited residential

development (2.1%). The upstream drainage area (not including the area controlled by FRS No. 4) consists of approximately 5,551 acres. The existing area at the dam is a floodwater retarding structure with an impounded normal pool/sediment pool. The area downstream of the dam receiving flood damage reduction benefits has also experienced minor residential development since installation of the existing dam. The modeled existing condition 1% AEP floodplain from downstream of FRS No. 4 to the FRS No. 5 impoundment encompasses 915 acres.

No Action

The No Action Alternative would have no effect on the existing conditions of land use while the dam remains in place, prior to failure. Sudden catastrophic breach of the dam has the potential to cause impacts to 10 habitable structures, 5 road crossings, and downstream agricultural lands as a result of the sudden discharge of fill/sediment and large flows. Following catastrophic breach, the loss of flood storage would result in in downstream agricultural, residential, and road crossings no longer being protected from flooding. Development restrictions would be required to prevent development in the expanded 1% AEP floodplain.

High Hazard Potential Rehabilitation (FWFI) – Alternative 3

The High Hazard Rehabilitation alternative would provide increased protection against breach and continued flood protection to properties downstream of the dam and would provide continued flood protection.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9

Same as High Hazard Potential Rehabilitation (FWFI) – Alternative 3

SLO Sponsored Rehab to State Standards – Alternative 10

The SLO Sponsored Rehab to State Standards would provide continued flood to properties downstream of the dam.

Cumulative Impacts

Temporary impacts to the downstream land use would occur in the event of catastrophic breach of the dam. Potential long-term impacts to the downstream land use would occur if the flood storage function of the dam is removed either through catastrophic breach or decommissioning. These long-term effects would be incremental to other regional impacts to land use resulting from future development, conversion of agricultural lands to other land uses, and rehabilitation or breach of other flood retarding structures within the Kickapoo Creek Watershed.

### 5.4.14 Public Health and Safety

Existing Conditions

FRS No. 5 has provided flood protection benefits to downstream areas since it was constructed in 1963, but currently does not meet NRCS criteria for a high hazard dam. The existing vegetated earth auxiliary spillway does not have the capacity necessary to safely pass the PMP event. Overtopping the dam could cause the dam to erode and collapse, resulting in a release of the water and sediment stored behind the dam. Approximately 37 people are at risk for loss of life in the event of catastrophic breach. There are 9 homes within the breach inundation zone of this dam and 5 roads and multiple road segments that would be inundated by over 1 foot in the event

of a catastrophic breach. The modeled existing condition 1% AEP floodplain from downstream of FRS No. 5 to the confluence of West Kickapoo Creek and Kickapoo Creek encompasses 915 acres and there are 4 habitable structures are located within it. During the 1% AEP event, the 3 Railroad Road crossings downstream of FRS No. 5 are not overtopped, but E. Main Street is overtopped by 2.9 feet and Oliver Street is overtopped by 2.4 feet, putting vehicles at risk.

No Action

The No Action Alternative would have no effect on the existing conditions of public health and safety while the dam remains in place, prior to failure. The risk of dam breach would remain and if a sudden catastrophic breach does occur, it has the potential to kill or injure people. The population at risk in the event of catastrophic breach is 37 people. Following catastrophic breach, the loss of flood storage would result in the 1% AEP floodplain being expanded and downstream areas would be subject to more frequent flooding. Additionally, the depth and frequency in which downstream roads would be overtopped would increase. Increased development restrictions would be necessary to protect public health and safety within the enlarged floodplain area.

High Hazard Potential Rehabilitation (FWFI) – Alternative 3

Under the High Hazard Potential Rehabilitation Alternative, the dam would be rehabilitated using current NRCS design and safety criteria and performance standards to provide flood protection for 100 years. Upstream of the dam, no residences would be impacted by the rehabilitation. During the 1% AEP event, one Railroad Road crossing would overtop by 0.1 foot, E. Main Street would overtop by 2.9 feet and Oliver Street would overtop by 2.5 feet, putting vehicles at risk. The modeled 1% AEP floodplain would be expanded from 915 to 952 acres, but no critical structures or habitable structures would be added to the 1% AEP floodplain.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9

Under the High Hazard Potential Rehabilitation Alternative, the dam would be rehabilitated using current NRCS design and safety criteria and performance standards to provide flood protection for 100 years. Upstream of the dam, no residences would be impacted by the rehabilitation. During the 1% AEP event, E. Main Street would overtop by 0.9 feet and Oliver Street would overtop by 1.5 feet, putting vehicles at risk.

SLO Sponsored Rehab to State Standards – Alternative 10

Under the High Hazard Potential Rehabilitation Alternative, the dam would be rehabilitated using current TCEQ design and safety criteria and performance standards. Upstream of the dam, no residences would be impacted by the rehabilitation. During the 1% AEP event, E. Main Street would overtop by 2.9 feet and Oliver Street would overtop by 3.1 feet, putting vehicles at risk. The modeled 1% AEP floodplain would be expanded from 915 to 939 acres, but no critical structures or habitable structures would be added to the 1% AEP floodplain.

Cumulative Impacts

There is the potential for downstream injury and death in the event of a sudden catastrophic breach of the dam. The downstream population at risk is estimated to be 37 people. Potential long-term impacts to public safety would occur if the flood storage function of the dam is removed through catastrophic breach. These long-term effects would be incremental to other

regional impacts to public health and safety resulting from rehabilitation, decommission, or breach of other flood retarding structures within the Kickapoo Creek Watershed.

### 5.4.15 Social Issues/Community Cohesion

Existing Conditions
FRS No. 5 has provided value to the community since 1963 by providing flood protection benefits that enhance the quality of life for watershed residents.

No Action
The No Action Alternative would have no effect on the existing conditions of social issues/community cohesion while the dam remains in place, prior to failure. Sudden catastrophic breach has the potential to cause injury and death to those living within the 9 residences located within the FRS No. 4 Breach Inundation Area. The injury, death, and property damage that would likely result from catastrophic breach of the FRS has the potential to cause significant impacts to downstream social issues and community cohesion. Following catastrophic breach, the loss of flood storage would remove the flood protection benefits and would necessitate development restrictions downstream which could negatively impact social issues and community cohesion.

High Hazard Potential Rehabilitation (FWFI) – Alternative 3
The High Hazard Potential Rehabilitation Alternative will allow flood protection benefits to continue for 100 years and would avoid residential relocation and increased development downstream. Could result in increased taxes/fees to fund rehabilitation. Could result in loss of community cohesion resulting from increased development restrictions.

High Hazard Potential Rehabilitation (FWFI) – Alternative 9
Same as High Hazard Potential Rehabilitation (FWFI) – Alternative 3

SLO Sponsored Rehab to State Standards – Alternative 10
The High Hazard Potential Rehabilitation Alternative will allow flood protection benefits to continue. Could result in loss of community cohesion resulting from increased development restrictions.

Cumulative Impacts
Potential long-term impacts to social issues and community cohesion would occur in the event of a catastrophic breach. It is also anticipated that long-term impacts to community cohesion would occur if the flood storage function of the dam is lost as a result of catastrophic breach. Long term impacts to residents in the form of increased taxes/fees required to fund rehabilitation could result from rehabilitation alternatives. These long-term effects would be incremental to other regional impacts to social issues and community cohesion resulting from rehabilitation of other flood retarding structures within the Kickapoo Creek Watershed.

## 5.5 Cumulative Effects

NRCS has constructed six flood control dams in the Kickapoo Creek Watershed, all of which are currently classified as high hazard potential dams. Two of the FRSs (FRS No. 1 and FRS No. 2) are located on West Kickapoo Creek, two (FRS No. 4 and FRS No. 5) are located on Middle Kickapoo Creek, one (FRS No. 3) is located on a tributary to Middle Kickapoo Creek and one (FRS No. 6) is located on East Kickapoo Creek. Rehabilitation or decommission of the FRS No. 1, FRS No. 2, FRS No. 3, or FRS No. 6 would not reduce or increase the catastrophic breach risk associated with FRS No. 4 or FRS No. 5, would not impact the concerns associated with the FRS No. 4 embankment, and would not change the flood protection benefits provided to structures located downstream of FRS No. 4 and FRS No. 5 but upstream of the confluence of Middle Kickapoo Creek and the tributaries that these other Kickapoo FRSs contribute to.

Construction of FRS No. 4 and FRS No. 5 has had long-term direct effects on the environment through the excavation of the sites, filling of the structures, and development of permanent impoundments upstream from the dams that now provide flood control, fish and wildlife habitat, and other incidental benefits.

The dams have indirectly affected the natural environment by creating permanent upstream normal pools (only FRS No. 5), by temporarily inundating the floodplain upstream of the dams during rain events, and by trapping sediment that would otherwise move downstream during rain events. The dams have reduced downstream peak flows during storm events, and consequently protect property and people in otherwise flood-prone areas.

FRS No. 4 would be the first dam in the watershed to be decommissioned and FRS No. 5 would be the first dam in this watershed to be rehabilitated. While the decommission of FRS No. 4 would change the hydrology for the segment of Middle Kickapoo Creek between FRS No. 4 and FRS No. 5, the rehabilitation of FRS No. 5 to state standards will account for the absence of FRS No. 4 and thus would not significantly change the hydrology downstream of FRS No. 5 in higher probability storm events. Rehabilitation of FRS No. 5 to TCEQ standards would allow downstream areas within the floodplain to support continued agricultural areas and residential development. The decommission of FRS No. 4 will remove the potential risk of failure for that dam and the rehabilitation of FRS No. 5 will ensure that flood protection benefits for the area downstream of FRS No. 5 remain.

No other sites (FRS Nos. 1,2,3, and 6) within the Kickapoo Creek Watershed are currently scheduled for planning studies, rehabilitation, or decommission. As Site 3 and Site 6 outfall to the study area considered as part of this project, future modifications to these structures could have an effect of the impacts and benefits attributed to this project. It should be noted that the combined as-built capacity of FRS No. 3 (1485 ac-ft) and FRS No. 6 (1478 ac-ft), is approximately 42.4% of the combined capacity of FRS No. 4 (2606 ac-ft) and FRS No. 5 (4386 ac-ft) and only 67.6% of FRS No. 5. In addition, 5 of the 13 potentially impacted structures are located upstream of the confluence of the outfall from FRS No. 3 and Middle Kickapoo Creek and 9 of the 13 potentially impacted structures are located upstream of the confluence of East Kickapoo Creek (the outfall of FRS No. 6) and Middle Kickapoo Creek.

## 5.6 Risk and Uncertainty

Environmental (Wetlands and Fish/Wildlife Habitat)
During the planning process, an evaluation was undertaken to determine what effects or consequences the selected alternatives would have on the environment. NRCS biologists, environmental coordinators and hydrologic/hydraulic engineers conducted multiple field reviews and determined that best professional judgment was appropriate to make fish and wildlife habitat determinations. While technically the Nominal Group method was used, there was no reason to rank the solutions (alternatives) because all planning team members were in agreement on the alternatives, the adverse impacts, and the benefits due to the minor, temporary nature of the impacts.

Climate Change
According to the EPA Region 6 Climate Adaptation Implementation Plan (USEPA, 2022), while projected changes in annual rainfall amounts are uncertain, increases in extreme precipitation events are projected. While the increase in extreme precipitation events has not been quantified, if extreme precipitation events become more frequent, the probability of an event that could cause catastrophic failure of the dams will also increase.

Cultural Resources
Based on the results of the background review, field survey, and assessment, no cultural resources that meet the necessary criteria to be considered eligible for inclusion in the National Register of Historic Places or to merit designation as State Antiquities Landmarks (SALs) have been identified within the APE associated with rehabilitation measures at FRS No. 4 or FRS No. 5. Therefore, the project should have No Effect on historic properties or SALs., Concurrence with a No Effect determination was received from the Texas SHPO on July 12, 2021.

The tribal search indicated that the Comanche Nation of Oklahoma, the Apache Tribe of Oklahoma, the Tonkawa Tribe of Indians of Oklahoma, and the Wichita and Affiliated Tribes (Wichita, Keechi, Waco, and Tawakonie) of Oklahoma have indicated interest in ancestral lands and might attach religious or cultural significance to historic properties or have claims to land areas within Coke County, Texas. NRCS initiated consultation July 15, 2022 with listed Tribes by certified mail inviting them to participate in the consultation process and help identify previously unknown resources in and around the APE. A determination letter was emailed on May 5, 2024, but NRCS has received no replies from Tribal Nations to date.

Economics
Risk and uncertainty were incorporated into the flood damage reduction analysis through Monte Carlo simulation incorporated in HEC-FDA. The uncertainty could be reduced for the economic analysis, but that would require more intensive primary and secondary data collection. Identification of the alternative with the highest net economic benefits (or least negative net economic benefits) was not distorted by the level of uncertainty. Thus, it was determined that increased investment in analysis was not necessary and any reduction in risk and uncertainty would not result in the selection of a different alternative.

In addition, it is unknown what actions may be taken with regard to the other FRSs within the watershed in the future. Currently, no other sites (FRS Nos. 1,2,3, and 6) within the Kickapoo Creek Watershed are currently scheduled for planning studies, rehabilitation, or decommission. As Kickapoo FRS No. 3 and No. 6 outfall to the study area considered as part of this project, future modifications to these structures could have an impact on the study watershed, although the modifications associated with these structures would not impact the current breach risks associated with FRS No. 4 or FRS No. 5 or the concerns associated with the FRS No. 4 embankment.

It should also be noted that the timing of failure of FRS No. 4 and FRS No. 5 in the No Action Alternative is uncertain. The probability of the precipitation events which could cause failure have been estimated for both dams (2,136-year event for integrity failure at FRS No. 4 and 12,118-year event for overtopping failure at FRS No. 5), but there is uncertainty about when these events would occur and if they would cause failure. The probability of failure was applied to the estimated damages for these failure events, so even if the timing of these events changed, the probability of the events would not change. As the No Action alternative serves as the baseline in which all alternatives are compared (the benefits are relative to the No Action alternative), any changes in the timing of these failures would not change the selection of the preferred alternative.

Hydrology and Hydraulics

Areas of risk and uncertainty associated with this project lie in the accuracy of estimating flood flows and flood elevations. The uncertainty of flood flows and water surface elevations has the potential for increased damages as new properties are converted from agricultural to residential or commercial use. It is possible these uncertainties could lead to increased risk to human life in the event of a dam breach. Hydrologic methods and computer modeling used in this analysis are consistent with the standards of practice at this time. However, the tributary is not gauged, and no verification of storm flows is possible. Potential impacts for each alternative are estimated using techniques that relate potential damage to lost opportunity. However, these methods are in part based on professional judgment, and actual experience could be different.

Engineering

Areas of risk and uncertainty associated with this project lie in the accuracy of estimating costs associated with each alternative. Cost estimates were developed from available historic and current data but it should be noted that unit costs have fluctuated dramatically in the recent past and may do so in the future based on many factors. Factors discovered during actual design, notably the bearing capacity of the existing structure and availability of suitable material for construction could affect these estimates. Potential impacts have estimated for each alternative, however, these methods are in part based on professional judgment, and actual experience could be different.

# 6.0 CONSULTATION, COORDINATION, AND PUBLIC PARTICIPATION

## 6.1 Dam Assessments Reports and Assistance Request

NRCS completed Rehabilitation Assessment Reports and estimated risk-based profiles of FRS No. 4 and FRS No. 5 in September 2016 and October 2015, respectively. These evaluations indicated that the dams did not meet NRCS requirements with respect to the current hazard potential classification and recommended modifications to meet current design criteria.

The Sponsors submitted formal requests for assistance to NRCS for both FRS No. 4 and FRS No. 5 on July 10, 2019 and July 12, 2019, respectively. The requests for assistance listed concerns about compliance with current dam safety criteria and the hazard potential classification changes as well as the deteriorating condition of FRS No. 4.

## 6.2 Scoping and Public Meetings

The project sponsors are the Coke County Soil and Water Conservation District (SWCD), Coke County Kickapoo Creek WCID #1, the City of Bronte, and the Coke County Commissioners Court. Multiple meetings were held throughout the project with representatives from the sponsoring local organizations, NRCS, and TSSWCB to provide updates on the planning process and gather input on the development of the Plan-EA. Due to the COVID-19 Pandemic, it was necessary to hold many of these meetings virtually, rather than in-person, as would have been preferred.

The client kickoff meeting for the project was held via Microsoft Teams on May 4, 2020. The overall project scope, personnel, schedule, and public participation plan were reviewed and discussed. Key assumptions were discussed, and additional data were requested by AECOM. Project impacts related to the COVID-19 Pandemic were also discussed. The meeting was attended by representatives AECOM, NRCS, and TSSWCB.

A sponsor kickoff/scoping meeting for the project was held via Microsoft Teams on June 3, 2020. The required sponsor commitment, overall project scope, schedule, and public participation plan were reviewed and discussed. An overview of FRS No. 4 and FRS No. 5 and the contributing watersheds were provided and information on site issues and concerns were provided by the sponsors. The meeting was attended by representatives AECOM, NRCS, TSSWCB, Coke County SWCD, Coke County Kickapoo Creek WCID #1, and the Coke County Commissioners Court.

The first public meeting for FRS No. 4 and FRS No. 5 was held on June 8, 2020, at the Bronte Recreation Center to discuss the Watershed Rehabilitation Program and potential alternative solutions to bring the dam into compliance with current dam safety and design criteria. In addition to providing the public information on the planning process, a primary purpose of the meeting was to discuss resource problems, issues, and concerns of local residents associated with the FRS No. 4 and FRS No. 5 project area. A slide show was presented to help facilitate

discussions. Notice for the public meeting was published in the Coke County Observer/Enterprise. Public comment forms were available at the public meeting.

Additional meetings were held via Microsoft Teams with the project sponsors, NRCS and TSSWCB on March 18, 2021, May 18, 2021, January 4, 2022, March 22, 2022, April 17, 2022, November 14, 2023, and April 22, 2024 to provide updates on the planning process and to gather additional input on the project. Specific input related to key analysis assumptions and potential alternatives, including the No Action Alternative, was gathered during these meetings.

A second public meeting for FRS No. 4 and FRS No. 5 was held on May 6, 2024, at the beginning of the public review and comment period, to discuss the planning process, development of the potential alternatives, evaluation of the alternatives, and selection of the preferred alternatives to bring the dams into compliance with current dam safety and design criteria. Notice for the public meeting was published in the Coke County Observer/Enterprise on April 19, April 26, and May 3, 2024.

The Plan-EA was made available for public review May 6, 2024, the day of the second public meeting. Electronic copies of the document were made available to the public through the Coke County website. Comments will be solicited from the reviewing agencies and from the public during the comment period. After the interagency and public review period, comments received will be incorporated into the Final Plan-EA. Letters of comment received on the Plan-EA and NRCS responses to the comments will be included in **Appendix A**.

## 6.3 Agency Consultation

Consultation with Texas State Historic Preservation Office (SHPO)/Texas Historical Commission (THC) was initiated in March 23, 2021 through the email submission of a Texas Antiquities Permit application to conduct a cultural resources survey of all areas of new disturbance associated with potential rehabilitation measures. Texas Antiquities Permit No. 30086 was issued by the THC on March 26, 2021. AECOM, on behalf of NRCS, completed the pedestrian survey of the Area of Potential Effect (APE) on April 8 through April 13, 2021 on behalf of NRCS. Consultation with the SHPO/THC was completed and concurrence was received on July 12, 2021 that no historic properties are present and that the proposed project would have no effect on historic properties (**Appendix A**) If, during the design phase of this project, it is determined that work will occur outside of the areas previously surveyed for cultural resources, appropriate investigations procedures will be initiated for these areas.

The Comanche Nation of Oklahoma; Kiowa Indian Tribe of Oklahoma; the Apache Tribe of Oklahoma; the Tonkawa Tribe of Indians of Oklahoma; and the Wichita and Affiliated Tribes (Wichita, Keechi, Waco, and Tawakonie) of Oklahoma have a stated interest in ancestral lands and might attach religious or cultural significance to historic properties or have claims to land areas within Coke County, Texas. NRCS invited tribal consultation via certified mail (**Appendix A)** and invited to participate in the consultation via email in July of 2022, but none expressed interest in participating. Likewise, there was no response from Tribal Nations regarding the letter of determination.

The USFWS was contacted early in the planning phase to initiate informal coordination; however, effect determinations were required prior to holding any meetings with the agency. A habitat assessment (**Appendix E)** was performed for the sites in July 2023 and identified potentially suitable habitat for the monarch butterfly and tricolored bat, both of which are Federal Candidate species. No potentially suitable habitat was identified for any additional federally listed species. As Candidate species are not currently afforded protection under the federal Endangered Species Act, no coordination was required. It should be noted that coordination with the USFWS may be required if these species become listed prior to construction.

Pre-application meetings for FRS No. 4 (SWF-2023-00178) and FRS No. 5 (SWF-2023-00180) were held with the USACE on May 4, 2023 and May 2, 2023, respectively. Based on these meetings, it appears coverage under a Section 404 permit may be required for the proposed project at FRS No. 5, however impacts are expected to be minimal. Based on the meetings, it appears that no Section 404 permit would be required for FRS No. 4, as no Waters of The United States have been identified at FRS No. 4.

# 7.0 PREFERRED ALTERNATIVE

Alternative 10, which includes the Decommissioning of FRS No. 4 and SLO Sponsored rehabilitation of FRS No. 5 to TCEQ standards, has been selected as the Preferred Alternative. Alternative 10 meets the Purpose and Need for the project, is the Environmentally and Economically preferred alternative, and while not the Locally Preferred alternative, has support from the Sponsors. Of the alternatives considered, this alternative provides the least negative economic net benefits with few environmental impacts.

## 7.1 Rationale for Preferred Alternative

The preferred alternative is to decommission FRS No. 4 and to rehabilitate FRS No. 5 to meet current state standards for an intermediate size high hazard dam. The preferred alternative meets the identified Purposes and Need for the project and significantly reduces the potential risk to human life. The preferred alternative:

- Addresses the concerns and risk associated with the embankment issues as FRS No. 4.
- Eliminates the threat to loss of life from catastrophic breach of FRS No. 4 to approximately 16 people by decommissioning the dam.
- Ensures continued flood protection downstream of FRS No. 5 for residents, by keeping FRS No. 5 in place and rehabilitating FRS No. 5 to meet state standards, considering the decommission of FRS No. 4.
- Eliminates the Sponsors' liability of operating FRS No. 4 which currently is listed as being in "unsatisfactory condition" (A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution).
- Maintains existing stream habitat downstream of FRS No. 5.
- Retains the existing aquatic and terrestrial habitat in and around FRS No. 5.

Formulation of the alternatives considered four criteria: completeness, effectiveness, efficiency, and acceptability. All action alternatives meet the criteria for completeness, as they were developed in a way to provide and account for all necessary investments or other actions to ensure the realization of the planned effects, including any necessary actions by others. Alternatives 3, 9, and 10 address the "unsatisfactory condition" listing of FRS No. 4 and continue to provide flood protection downstream of FRS No. 5. Therefore, the action alternatives meet the criteria for effectiveness, as they alleviate the specified problems and achieve the specified opportunities. Among the action alternatives, Alternative 10 has the least negative net economic benefits. Alternative 10 meets the criteria for efficiency, as it alleviates the specified problems and realizes the specified opportunities at least cost. While all of the action alternatives have some Environmental and Social impacts, they are considered to be minor in relation to the existing conditions. Alternatives 3, 9, and 10 meet the criteria for acceptability as they have few negative environmental and social impacts when compared to the existing condition and therefore, demonstrates viability and appropriateness from the perspective of the general public and consistency with existing Federal laws, authorities, and public policies. The Preferred Alternative (Alternative 10) addresses the "unsatisfactory condition" listing of FRS No. 4 and ensures FRS No. 5 to meet TCEQ standards while continuing to provide downstream flood protection in a manner that takes into consideration economic, social, and environmental goals.

## 7.2 FRS No. 4 Measures to Be Installed

Measures for the decommission of FRS No. 4 include:

- Excavating a breach in the dam of sufficient size to safely pass the 1% AEP flood;
- Placing the excavated material in the easement area;
- Removal of the principal spillway components;
- Vegetating all exposed areas; and
- Reconnecting the stream channel through the sediment pool;
- Establishing riparian vegetation along the stream channel; and
- Installing a grade stabilization structure
- Installing flood warning systems with barricades and warning lights on portions of McDonald Road, Nipple Peak Road, and NW Railroad Road.

After the implementation of these planned works, the "unsatisfactory condition" listing of FRS No. 4 will no longer be applicable, and the liability associated with the potential failure of FRS No. 4 will be eliminated for the Sponsors.

## 7.3 FRS No. 5 Measures to Be Installed

Measures for the SLO sponsored rehabilitation of FRS No. 5 to TCEQ standards include:

- Re-grading the dam crest to raise the effective crest to elevation 1916.19, a 0.29 foot raise.

After the implementation of these planned works of improvement, FRS No. 5 will meet TCEQ criteria for an intermediate-size high hazard dam. Detailed structural data for the proposed rehabilitated dam can be found in **Table 7-3**.

## 7.4 Emergency Action Plan

Once FRS No. 4 has been decommissioned, an EAP for the FRS will no longer be needed. The Sponsors will provide leadership in updating the existing EAP for FRS No. 5 prior to the commencement of construction and will review and update the EAP annually with local emergency response officials. The breach inundation map of the final design will be the basis for potential areas to be affected and those to be notified. The purpose of the EAP is to identify areas at risk, outline appropriate actions, and to designate parties responsible for those actions in the event of a potential failure of FRS No. 5.

## 7.5 Real Property Rights

### 7.5.1 General

Real Property
The Sponsors will acquire such real property as will be needed in connection with the works of improvement.

### 7.5.2 Easements

The Sponsors are responsible for obtaining any needed land rights, title, and easements associated with the rehabilitation projects and associated works of improvement.

The Sponsors currently hold five easements at FRS No. 4 and seven easements at FRS No. 5, which may cover land required for the construction and/or related construction activities of the preferred alternatives. The 1960 and 1961 easements procured for the watershed prior to FRS construction do not refer to specific elevations upstream of each structure for which a flow easement has been procured. There is general language which provides a broadly worded description of the easement. This broad wording will require greater definition by the Sponsors before the construction of the two dam projects can proceed. Specifically, the new easements should refer to a specific flow easement elevation in the flood pool of each structure.

FRS No. 4
For FRS No. 4, the existing flood pool has a surface area of 160.8 acres. As the preferred alternative for FRS No. 4 is Decommissioning, which will remove the storage function of the dam, it is anticipated that the existing easement will encompass the area required for the preferred alternative, but the extent of the current easements will need to be investigated and verified prior to construction.

FRS No. 5
For FRS No. 5, the existing flood pool has a surface area of 255.6 acres and the flood pool associated with the preferred alternative will be the same.

The recommended easement elevation for the High Hazard Potential Rehabilitation of FRS No. 5 is 1916.19 feet, which is the proposed effective crest. The easement would need to include a prohibition on future construction of inhabitable dwellings below the elevation of the acquired landrights. The existing easements may encompass the area required for the preferred alternative, but the terms and extent of the current easements will need to be investigated and verified prior to construction. The Sponsors will need to investigate the extents of the preferred alternatives within the existing easement areas and evaluate additional acreage required outside of their existing easement prior to or during final design and coordinate with local landowners as needed for obtaining additional easements. No residential or commercial relocations within the backwater of the structures will be necessary as a result of the two projects.

## 7.6 Mitigation

During construction, site mitigation measures will include erosion and sediment control, seeding of disturbed areas, dust control, and other practices identified during the design process. An erosion and sediment control plan will be developed as part of the permitting process. Vegetation will be established immediately following construction on all land disturbed by construction activities. Appropriate plants for erosion control and wildlife habitat will be selected based upon the installation season, soils, surrounding vegetation, and the Sponsors' preference. All tools, equipment, and vehicles will be cleaned before transporting materials and before entering and leaving the worksites to prevent the introduction and spread of invasive plant species.

All needed measures will be taken to mitigate (avoid, minimize, and compensate) any adverse impacts during construction and may include timing of the work, sediment controls such as seeding, mulching and silt fences, and wetting construction areas to reduce dust.

## 7.7 Permits and Compliance

Prior to construction, the Sponsors will be responsible for obtaining and complying with permits required by federal, state, and/or local regulatory agencies.

U.S. Army Corps of Engineers (USACE) guidelines indicate that any discharge of dredged or fill material into "Waters of the United States" require authorization under Section 404 of the Clean Water Act of 1972. Based on previous consultations with USACE, it appears that any discharges into Waters of the U.S. associated with the decommissioning of FRS No. 4 and the SLO Sponsored rehabilitation of FRS No. 5 to state standards may be authorized by a general permit such as Nationwide General Permit No. 3, Maintenance without a Pre-Construction Notification. U.S. Fish and Wildlife Service coordination will be completed by the USACE as part of the permit approval process. Separate U.S. Fish and Wildlife Service coordination is not required for the projects. It will be the responsibility of the Sponsors to comply with the conditions of the general permit during design and construction.

For projects with disturbances equal to or greater than five acres, it is necessary to have a Storm Water Pollution Prevention Plan (SWPPP) in place prior to construction of the proposed project and filing a Notice of Intent with the TCEQ is required. A Notice of Termination (NOT) must be filed once the site has reached final stabilization. Construction activities associated with the decommissioning of FRS No. 4 will require a Stormwater Pollution Prevention Plan, but the SLO Sponsored rehabilitation of FRS No. 5 to state standards is expected to disturb less than five acres.

If, during the design phase of this project, it is determined that work will occur outside of the areas previously surveyed for cultural resources, appropriate investigations procedures will be initiated for these areas. If cultural resources are discovered during installation, work will cease, and the State Historic Preservation Officer will be notified. Appropriate investigations procedures will be initiated.

## 7.8 Costs and Cost Sharing

**Table 7-1** through **Table 7-6**, located at the end of Chapter 7 describe the project costs, project benefits, and structure data for the Preferred Alternative. Estimated installation costs and cost sharing allocations for the Preferred Alternatives are shown in **Table 7-1** and **Table 7-2**. Structure data for the preferred alternatives are provided in **Table 7-3**. Total annualized costs are shown in **Table 7-4**. Costs shown in **Table 7-1**, **Table 7-2**, and **Table 7-4** and throughout the document are based on standard cost accounting practices required of federal watershed planning agencies, such as NRCS. The basis for cost sharing between NRCS and the Sponsors is based on the provisions of the dam rehabilitation amendments of the Watershed Protection and Flood Prevention program. It should be noted that because the SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards does not meet NRCS standards, there will be no federal cost share for that component of the preferred alternative.

**Table 7-5** displays the average annual benefits of the preferred alternatives, and **Table 7-6** provides a comparison of benefits and costs. Costs and benefits are reported in 2023 dollars (2023$) and were evaluated over a 103-year period of analysis (3 years for design and construction and 100-year evaluation period). The costs and benefits were annualized over the 100-year evaluation period using a 2.75 percent discount rate.

## 7.9 Installation and Financing

The project is planned for a phased installation totaling about 36 months including design and construction. The SLO Sponsored rehabilitation of FRS No. 5 to TCEQ standards must occur first (to ensure adequate flood protection is provided for the decommission of FRS No. 4) with an anticipated construction duration of about 12 months. FRS No. 4 will be decommissioned following completion or partial completion of the rehabilitation of FRS No. 5 with an anticipated construction duration of about 12 months. The actual installation period is contingent on the availability of funds for design and installation.

During construction, equipment will not be allowed to operate when conditions are such that soil erosion and water, air, and noise pollution cannot be satisfactorily controlled.

As the SLO Sponsored Rehabilitation of FRS No. 5 to TCEQ Standards is not to NRCS standards, NRCS will not provide any assistance to the Sponsors with the FRS No. 5 rehabilitation component of the project.

NRCS will provide assistance to the Sponsors with the FRS No. 4 Decommissioning component of the project. NRCS will be responsible for the following:

- Execute a new Operation and Maintenance Agreement with the Sponsors that extends the O&M responsibilities for another 100 years following construction for FRS No. 4. This agreement will be based on the NRCS National Operation and Maintenance Manual.
- Provide financial assistance equal to 65% of total eligible project costs, not to exceed 100% of actual construction costs.

- Provide engineering support, technical assistance, and approval during the design and construction of the project.
- Certify completion of all installed measures.

Kickapoo Water Control and Improvement District No. 1 will be responsible for the following:

- Secure all needed environmental permits, easements, and rights for installation, operation and maintenance of the rehabilitated structure and for the decommission of FRS No. 4.
- Update the Emergency Action Plan for FRS No. 5 to the initiation of construction.
- Execute an updated Operation and Maintenance Agreement with NRCS for FRS No. 4. This agreement will be based on the NRCS National Operation and Maintenance Manual.
- Provide engineering services for the design, construction, and certification of the project.
- Provide local administrative and contract services necessary for the installation of the project.
- Provide non-federal funds for cost-sharing of the project at a rate equal to, or greater than, 35% of the total eligible project costs.
- Participate in and comply with applicable Federal floodplain management and flood insurance programs.
- Enforce all associated easements and rights-of-way for the safe operation of the dam.

The NRCS share of installation costs will be provided from funds appropriated under the Watershed Protection and Flood Prevention Act (Public Law 83-566), Watershed Rehabilitation. This is not a fund-obligating document, and federal assistance is subject to the availability of Congressional appropriations. The Sponsors have analyzed their financial requirements for carrying out the plan, including components that are not eligible for federal assistance as part of this plan. The Sponsors will arrange for funds to be available, when needed, from donations, non-federal grants, cash reserves, tax revenues and other non-federal sources. Credit for in-kind contributions will be as specified in the Memorandum of Understanding.

The cost, if any, of all water, mineral, and other resource rights and all required permits are not eligible for federal financial assistance. These costs shall be borne, in full, by the Sponsors. The Sponsors also understands that they will be fully responsible for costs incurred for the operation, maintenance, and replacement of installed measures.

## 7.10 Operation, Maintenance, and Replacement

Measures installed in this plan, and previously installed measures, will be operated and maintained by the Sponsors with technical assistance from federal, state, and local agencies in accordance with their delegated authority. An updated O&M agreement will be developed, including FRS No. 4, utilizing the NRCS-National Operation and Maintenance Manual, and will be executed when the implementation agreements are executed. The term of the new O&M agreement will be for 100 years following the completion of decommission of FRS No. 4. The O&M agreement will specify responsibilities of the Sponsors and include detailed provisions for retention, use, and disposal of property acquired or improved with Public Law 83-566 cost sharing. Provisions will be made for free access of Sponsors, state, and federal representatives to inspect all structural measures and their appurtenances at any time. No new O&M agreement will be developed for FRS No. 5, as O&M will be at the discretion of and the sole responsibility of the Sponsors.

**Table 7-1. Economics Table 1 - Estimated Installation Costs Kickapoo Creek Watershed, TX**

| Cost Item | PL-83-566 Funds[1] | Other Funds[1] | Total |
|---|---|---|---|
| Decommissioning of FRS No. 4 and SLO Sponsored Rehab of FRS No. 5 to State Standards | $1,401,000 | $758,000 | $2,159,000 |

[1] Price base: 2023 Q1
[2] Table prepared 2/2024

**Table 7-2. Economics Table 2 - Estimated Cost Distribution – Structural Measures Kickapoo Creek Watershed, TX**

| Cost Item | Installation Costs: PL-83-566[1] | | | | | Installation Costs: Other Funds[1] | | | | | | | Total Project Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Construction | Engineering | Project Administration | Mitigation | Total PL-83-566 | Construction | Engineering | Real Property | Permits | Project Administration | Mitigation | Total Other Funds | |
| FRS No. 4 and FRS No. 5 | $807,000 | $234,000 | $126,000 | $234,000 | $1,401,000 | $547,000 | $21,000 | $30,000 | $23,000 | $11,000 | $126,000 | $758,000 | $2,159,000 |

[1] Price base: 2023 Q1
[2] Table prepared 2/2024

**Table 7-3. Economics Table 3 - Structural Data – Dams with Planned Storage Capacity Kickapoo Creek Watershed, TX**

| Item | Unit | FRS No. 5 Planned SLO Sponsored Rehabilitation to State Standards |
|---|---|---|
| Class of Structure | | High |
| Seismic Zone | | 0 |
| Uncontrolled Drainage Area | sq-mi | 12.63 |
| Controlled Drainage Area | sq-mi | 0 |
| Total Drainage Area | sq-mi | 12.63 |
| Runoff Curve Number (1-day) (Type III for TCEQ Criteria) | | 85 |
| Time of Concentration ($T_c$) | hrs | 2.57 |
| Elevation Effective Top of Dam[1] | ft | 1916.19 |
| Elevation Crest of Vegetated Auxiliary Spillway | ft | 1909.6 |
| Elevation Crest Principal Spillway – High Stage Inlet | ft | 1899.0 |
| Elevation Crest Principal Spillway – Low Stage Inlet | ft | 1894.5 |
| Auxiliary Spillway Type | | Vegetated |
| Auxiliary Spillway Bottom Width | ft | 400 |
| Auxiliary Exit Slope | % | 5 |
| Maximum Height of Dam | ft | 32.29 |
| Volume of Embankment Fill[2] | $yd^3$ | 390,460 |
| Total Capacity (Auxiliary Spillway Crest)[4] | ac-ft | 2295.4 |
| Sediment Submerged | ac-ft | 513.4 |
| Sediment Aerated | ac-ft | 124.5 |
| Beneficial Use (None) | ac-ft | N/A |
| Floodwater Retarding Capacity | ac-ft | 1657.5 |
| Between High and Low stage | ac-ft | N/A |
| Surface Area | | |
| Sediment Pool | acres | 86.5 |
| Beneficial Use Pool (None) | acres | N/A |
| Floodwater Retarding Pool | acres | 255.4 |
| Principal Spillway Design | | |
| Rainfall Volume (1-day) | in | NA – Designed to TCEQ Criteria |
| Rainfall Volume (10-day) | in | NA – Designed to TCEQ Criteria |
| Runoff Volume (10-day) | in | NA – Designed to TCEQ Criteria |
| Capacity of Low Stage (max) | $ft^3/s$ | 0 – Assumed to be blocked with sediment |
| Capacity of High Stage (max) – At Vegetated AS Crest | $ft^3/s$ | 115 |

| Item | Unit | FRS No. 5 Planned SLO Sponsored Rehabilitation to State Standards |
|---|---|---|
| Dimensions of Conduit | in | 30 |
| Type of Conduit | | RCP |
| Frequency of Operation (Vegetated Auxiliary Spillway) | % chance | ~2.3% |
| Auxiliary Spillway Hydrograph | | |
| Rainfall Volume | in | NA – Designed to TCEQ Criteria |
| Runoff Volume | in | NA – Designed to TCEQ Criteria |
| Storm Duration | hrs | NA – Designed to TCEQ Criteria |
| Velocity of Flow ($V_e$) | ft/s | NA – Designed to TCEQ Criteria |
| Maximum Reservoir Water Surface Elevation | ft | NA – Designed to TCEQ Criteria |
| Freeboard Hydrograph | | |
| Rainfall Volume | in | NA – Designed to TCEQ Criteria |
| Runoff Volume | in | NA – Designed to TCEQ Criteria |
| Storm Duration | | NA – Designed to TCEQ Criteria |
| Maximum Reservoir Water Surface Elevation | | NA – Designed to TCEQ Criteria |
| Capacity Equivalents | | |
| Sediment Volume | in | 0.95 |
| Floodwater Retarding Volume | in | 2.46 |
| Beneficial Volume (None) | in | NA |

1/ All elevations are recorded in North American Vertical Datum 1988 (NAVD88).
2/ Total volume of earthfill in FRS No. 5 = 390,460 CY from As-builts, 1961. It is assumed that dam crest will be re-graded with existing embankment material. ).
3/ Table prepared 12/2023

## Table 7-4. Economics Table 4 - Average Annual Costs Kickapoo Creek Watershed, TX

| Cost Item | Average Annual Construction Cost | Average Annual Operation and Maintenance Cost | Total Average Annual Cost |
|---|---|---|---|
| FRS No. 4 | $60,000 | -$2,000 | $58,000 |
| FRS No. 5 | $4,000 | $0 | $4,000 |
| Total | $64,000 | -$2,000 | $62,000 |

Notes: 2023 price level; 2.75% discount rate; annualized over the 100-year evaluation period; implementation costs included interest during construction; values rounded to the nearest $1,000; sums may not match due to rounding.
Table prepared 2/2024

## Table 7-5. Economics Table 5 - Estimated Average Annual Flood Damage Reduction Benefits Kickapoo Creek Watershed, TX

| Benefit Category | FRS No. 4 | | | FRS No. 5 | | |
|---|---|---|---|---|---|---|
| | Average Annual Damages | | Average Annual Benefits | Average Annual Damages | | Average Annual Benefits |
| | Without Project | With Project | | Without Project | With Project | |
| Structures | $0 | $0 | $0 | $37,000 | $39,000 | -$2,000 |
| Roads and Bridges | $4,000 | $16,000 | -$12,000 | $6,000 | $7,000 | -$1,000 |
| Total | $4,000 | $16,000 | -$12,000 | $43,000 | $46,000 | -$3,000 |

Notes: 2023 price level; 100-year evaluation period
Table prepared 12/2023

## Table 7-6. Economics Table 6 - Comparison of Benefits and Costs Kickapoo Creek Watershed, TX

| Dam | Average Annual Benefits | Average Annual Costs | Net Benefits | Benefit-to-Cost Ratios |
|---|---|---|---|---|
| FRS No. 4 | -$12,000 | $58,000 | -$70,000 | -0.2:1.0 |
| FRS No. 5 | -$3,000 | $4,000 | -$7,000 | -0.7:1.0 |
| Total | **-$15,000** | **$62,000** | **-$77,000** | -0.2:1.0 |

Notes: 2023 price level; 2.75% discount rate; annualized over the 100-year evaluation period; monetary values rounded to the nearest $1,000; sums may not match due to rounding.
Table prepared 2/2024

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# 9.0 LIST OF PREPARERS

**Table 9-1. List of Preparers**

| Name / Title | Current Position (Years) | Education | Total Experience (Years) | Applicable Certifications |
|---|---|---|---|---|
| **NRCS** | | | | |
| Mark Northcut, Natural Resource Manager | 3 | B.S. Ag. Engineering | 34 | |
| David Sullivan, Civil Engineer | 2 | B.S. Civil Engineering | 12 | |
| Rocky Ingram, Soil Conservationist | 5 | B.S. Ag. Education | 12 | |
| Angela Moody, Archeologist | 5 | B.A. Anthropology<br>M.A. Museum Sciences | 17 | |
| David Buland, Economist | 3 | B. S. Economics<br>M.A. Theology<br>M.A. Economics | 40 | |
| **Texas State Soil and Water Conservation Board** | | | | |
| Steve Bednarz, Program Administrator/Engineer | 8 | B.S. Ag. Engineering | 46 | P.E. |
| Allen Nash, Engineer | 2 | B.S. Env. Engineering | 12 | P.E.,CFM |
| **Engineering/Consulting Firm** | | | | |
| Clifton Dorrance, Project Manager, Planning Lead, AECOM | 13 | B.S. Agricultural Engineering | 13 | P.E. |
| Monica Wedo, Alternatives Analysis, AECOM | 20 | B.S. Civil Engineering, M.S. Environmental and Water Resources Engineering | 21 | P.E. |
| Sabin Shrestha, H&H Modeling & Alternatives Analysis, AECOM | 1 | B.S. Civil Engineering, M.S. Civil Engineering | 8 | P.E. |
| Travis Brand, H&H Modeling & Alternatives Analysis, AECOM | 8 | B.S. Civil Engineering | 8 | P.E. |
| Lance Finnefrock, Geotechnical Analysis, AECOM | 13 | B.S. Civil & Environmental Engineering, M.S. Civil (Geotechnical) Engineering | 14 | P.E., G.E. |
| Matthew Engel, Alternative Analysis CADD, Alternative Analysis Cost | 5 | B.S. Civil Engineering | 11 | P.E. |
| Jason Weiss, Economic Analysis, AECOM | 21 | MS, Resource Economics and Policy; BIE, Industrial Engineering, | 25 | |
| Jennifer Oakley, Ecologist, AECOM | 6 | B.S. Biology, B.S. Environmental Science, M.S. Wildlife Ecology | 12 | Wetland Training |
| Joseph Jandle, Ecologist, AECOM | 5 | B.S. Wildlife Biology, M.S. Wildlife Ecology | 6 | Wetland Training |

| Name / Title | Current Position (Years) | Education | Total Experience (Years) | Applicable Certifications |
|---|---|---|---|---|
| Amanda Hargrave, Ecologist, AECOM | 5 | B.S. Wildlife Biology, M.S. Wildlife Ecology | 6 | Wetland Training |
| Steve Ahr, Cultural Resources, AECOM | 12 | B.A. Anthropology | 25 | RPA |
| Beth Reed, Cultural Resources, AECOM | 3.5 | M.A. Anthropology | 20 | |
| Lucy Harrington, Cultural Resources, AECOM | 4 | Ph.D. Geology | 7 | RPA |
| Jonathan Stroik, Cultural Resources, AECOM | 11 | B.A. History, M.S. Architectural Studies | 25 | RPA |

# 10.0 DISTRIBUTION LIST

Comments will be requested on the Draft Supplemental Plan I – EA from the following agencies and organizations.

## 10.1 Federal Agencies

NRCS National Watershed Management Center, Little Rock, Arkansas.

U.S. Fish and Wildlife Service, Austin, TX

USACE District, Fort Worth, Texas

EPA Region 6, Dallas, Texas

## 10.2 Texas State Agencies

Texas State Soil & Water Conservation Board, Temple, Texas

Texas Parks and Wildlife Department, Austin, Texas

Texas Commission on Environmental Quality, Region 13, San Antonio, Texas

Texas Historical Commission, Austin, Texas

## 10.3 Other

Coke County Soil and Water Conservation District

Coke County Kickapoo Water Control and Improvement District No. 1

City of Bronte

Coke County Commissioners Court

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