

**REQUEST FOR QUALIFICATIONS
ENGINEERING SERVICES
RIVERBEND PARK UTILITY BRIDGE
RFQ NO. 25-1026**



catawba county
MAKING. LIVING. BETTER.

Date of Issue: June 24, 2025

Qualifications Statement Due Date: July 21, 2025

Time: 4:00 PM ET

**Issued by:
Catawba County Purchasing Manager
25 Government Drive
Newton, North Carolina 28658
(828) 465-8224**

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Section I Advertisement

Pursuant to NCGS §143-64.31, Catawba County (“County”) is soliciting Statements of Qualifications (SOQs) from Professional Firms interested in providing Engineering services required to design and construct an 8’x40’ pre-fabricated bridge at Riverbend Park.

In September 2024, flooding caused by Hurricane Helene damaged the culvert providing access to the back portion of Riverbend Park. Instead of replacing the destroyed culvert crossing, the County has determined the best course of action is to install an 8’x40’ pre-fabricated steel utility bridge with 42” truss rail (8-ton capacity).

All or part of this procurement may be funded by the Federal Emergency Management Agency (FEMA) and is subject to the Federal procurement standards outlined in 2 C.F.R. §§ 200.317 – 200.326. All Firms must comply with these regulations. In addition, the County must include within the contract applicable provisions described in Appendix II to 2 C.F.R. Part 200, contained in Section IX – Uniform Guidance Addendum of this Request for Qualifications.

Statements of Qualifications will be accepted until **4:00 pm on July 21, 2025** and must be submitted to:

Tina M. Wright
Catawba County Purchasing Manager
PO Box 389 (mailing address)
25 Government Drive (physical address)
Newton, North Carolina 28658

Catawba County reserves the right to reject any/all submittals. The County assumes no contractual obligation as a result of the issuance of this request, the preparation or submission of a qualifications statement by a Firm, the evaluation of statements or final selection. This Request for Qualifications and any Addenda will be posted on the County’s website at www.catawbacountync.gov - County Services – Purchasing – Bid Notices.

Once the submittals have been reviewed, if necessary, the County reserves the right to shortlist Firm(s) and request that the Firm(s) conduct a presentation and be interviewed by the selection committee.

Information regarding requirements and instructions for the preparation of qualifications statements are contained in the following RFQ. Please read the entire document carefully.

Tina M. Wright, NIGP-CPP, CPPO
Catawba County Purchasing Manager

Section II RFQ Schedule and Submission of Qualifications

RFQ Schedule

The table below shows the *intended* schedule for this RFQ. Catawba County will make every effort to adhere to this schedule.

Event	Responsibility	Date and Time
Issue RFQ	County	June 24, 2025
Statement of Qualifications Due	Firms	July 21, 2025 by 4:00 PM
Contract Award	County	TBA
Contract Effective Date	County	Upon Execution

The qualifications statement shall be submitted no later than 4:00 PM ET on July 21, 2025. No submittals will be accepted after the deadline.

Once the submittals have been reviewed, if necessary, the County reserves the right to shortlist Firm(s) and request that the Firm(s) conduct a presentation and be interviewed by the selection committee.

Submission of Qualifications

The qualifications statement must be submitted with one (1) original and one (1) electronic copy on flash drive. In addition, qualifications shall be submitted on 8-1/2 x 11 paper, side bound with Table of Contents and reference tabs for key sections.

When responding to this RFQ, please follow all instructions carefully. Please submit proposal contents according to the outline specified in Section IV: Contents of Qualification Statement. Failure to follow these instructions may be considered a non-responsive submission and may result in immediate elimination from further consideration. The qualifications statement should be sent to the address indicated in the table below.

Mailing address for delivery of RFQ via US Postal Service	Office Address of delivery by any other method (hand delivery, overnight, or any other carrier)
RFQ Number: 25-1026 Catawba County Government Center Attn: Tina Wright, Purchasing Manager Post Office Box 389 Newton, North Carolina 28658	RFQ Number: 25-1026 Catawba County Government Center Attn: Tina Wright, Purchasing Manager 25 Government Drive Newton, North Carolina 28658

IMPORTANT NOTE: All qualifications shall be physically delivered to the office address listed above on or before the submission deadline in order to be considered timely, regardless of the method of delivery. **This is an absolute requirement.** All risk of late arrival due to unanticipated delay—whether delivered by hand, U.S. Postal Service, courier or other delivery service is entirely on the Firm(s). It is the sole responsibility of the Firm to have the qualifications physically in this Office by the specified time and date of opening.

Section III Scope of Work

The selected Firm shall work with County staff in the preparation of design drawings and specifications for the installation of an 8'x40' pre-fabricated steel utility bridge with 42" truss rail (8-ton capacity.)

The services required for this project will include, but are not are limited to:

- a. Engineered design
- b. Geotechnical
- c. Survey

The list of tasks above is not meant to be a full description of the work, but a summary breakdown of the scope in the engineering services required for this project. The County has obtained a Hydrologic and Hydraulic Report that contains a HY-8 Culvert Analysis. The Report has been included as Section X of this RFQ for reference.

Section IV Contents of Qualification Statement

Respondents must carefully read the information in this “Contents of Qualifications Statement” section and submit a complete Qualifications Statement responding to each request for information. Incomplete Qualifications Statements will be considered non-responsive and are subject to rejection.

Qualifications shall be submitted on 8-1/2 x 11 paper, side bound with Table of Contents and reference tabs for key sections.

Qualification Statement shall include the following information:

1. Introduction – Letter of Transmittal

- Summarize in a brief and concise manner the Firm’s understanding of the scope of work relating to this request and make a positive commitment to perform the work in a professional and timely manner.

2. Qualifications of Firm

Please provide:

- General work plan that demonstrates the Firm's complete understanding of the scope of work and approach to the design process.
- Firm's recent history and experience relating to projects of same or similar scope as this project.
- Qualifications of the firm and overall qualifications of project's managers and key personnel.
- Firm's approach and/or method of cost control and project scheduling.
- Firm's approach to quality control and assurance process.
- Firm's experience with FEMA funded projects.
- Hourly billing rates charged by your Firm for each position type.
- Summary of any litigation, claim(s), or contract dispute(s) filed by or against the Firm in the past five (5) years that are related to the services that the Firm provides in the regular course of business. The summary shall state the nature of the litigation, claim, or contract dispute; a brief description of the case; the outcome or projected outcome; and the monetary amount involved. If no litigation claim(s) or contract dispute(s) have been filed by or against the Firm in the past five (5) years, please state.
- List any regulatory or license agency sanctions. If no license sanctions against the Firm, please state that.

3. Project Management and Key Personnel

Please provide:

- Firm staff resumes that show experience in North Carolina for staff assigned to this project.
- State qualifications of the Firm's key personnel who will be assigned to work with the County.
- List of personnel who will work on the project and experience on projects of similar scope.
- Project Management and Key Personnel's approach to and/or method of cost control and project scheduling. List of projects of similar scope detailing if completed on time and within budget.
- List any professional training and experience, especially in relation to the type and magnitude of work required for this particular scope of services.
- List any licenses or certifications related to the scope of work described in this Request for Qualifications.
- List any unique qualifications or work methodology.
- Current work load and percentage of availability of key personnel.

4. References – Past Performance and Existing Contracts

Please provide:

- List of previous and current clients for work similar to this scope of work within the past five years. Include names and location of project, brief description and Firm's key personnel's involvement, name of project manager and telephone number, date and value of project. In addition, please complete Section VII: Reference Disclosure Form and submit with qualifications.

Section V Selection Process and Evaluation Criteria

Catawba County will use the following selection process. This process is designed to ensure that Firms are selected in a fair and uniform manner. In addition, the process is intended to ensure those selected for work are qualified and experienced in the professional services desired, and to ensure that every qualified Firm has the opportunity to be considered for providing professional services to Catawba County.

A Selection Committee will evaluate responses to the Request for Qualifications and determine the most qualified applicants. It is the intention of the County to retain a Firm with demonstrated abilities to meet timelines, budgets and client expectations.

Upon receipt of the Statements of Qualifications from Firms, the Selection Committee will review using a scoring matrix that has been determined by the Committee and detailed below. Past performance will be scored based on responses from the references submitted by the Firm and/or the experience of Catawba County staff with particular Firm's past performance. Only one reviewer will contact any given reference.

The Selection Committee will use the total point scores to rank the prospective Firms. The Selection Committee will determine the most highly qualified Firm based upon the ranking scores. Once the Firm is selected, contract award and authorization will be sought from either the County Manager or the Catawba County Board of Commissioners, whichever is applicable.

Evaluation Criteria

The Content of Qualifications Statement, as referenced above, shall be evaluated as follows:

Description	Total Possible Points
Qualifications of Firm <ul style="list-style-type: none"> • Project Understanding • Project Experience of Similar Scope • Previous/Pending Litigation 	30
Project Management and Key Personnel <ul style="list-style-type: none"> • Experience on Similar Projects • Professional Training/Qualification • Work Load and Availability • Cost Control/Scheduling – Projects on Time and in Budget • Relevant Licenses/Certifications 	60
References – Past Performance and Existing	10
	100 Points

Section VI Insurance Requirements

Firm shall maintain at all times during the term of this Agreement, at the Firm's sole expense the following minimum insurance requirements. Please note, County reserves the right to increase the minimum insurance requirements in a task order if the County determines higher insurance limits are needed based on project value.

A. Commercial General Liability Insurance

Firm shall maintain Commercial General Liability insurance written on an occurrence basis, including coverage for products and completed operations liability, contractual liability, liability from independent contractors, property damage liability, bodily injury liability, and personal injury liability with limits of not less than \$1,000,000 per occurrence and \$1,000,000 annual aggregate. The limits may be satisfied by a combination of primary and excess insurance.

B. Professional Liability Insurance

Firm shall maintain Professional Liability insurance with limits of not less than \$1,000,000 per claim and \$1,000,000 aggregate.

C. Business Automobile Insurance

At all times while the Firm's representatives are conducting on-site work, the Firm shall maintain Automobile Liability insurance for any owned, hired, rented, or borrowed vehicle with a limit of not less than \$1,000,000 per occurrence combined single limit for bodily injury and property damage liability. The limit may be satisfied by a combination of primary and excess insurance.

D. Workers Compensation & Employers Liability Insurance

At all times while the Firm's representatives are conducting on-site work, Firm shall maintain statutory Workers Compensation insurance in accordance with the laws of North Carolina. Firm shall also maintain Employers' Liability insurance with limits of not less than \$500,000 per accident and \$500,000 each employee for injury by disease.

E. General Requirements

1. Catawba County shall be named as an additional insured under Firm's automobile and general liability insurance. In the event of a loss arising out of, or related to the Firm's services performed under this Agreement, Firm's Liability insurance shall be primary (pay first) with respect to any other insurance which may be available to the County, regardless of how the "other insurance" provisions may read.
2. The Workers Compensation insurance must contain a waiver of subrogation in favor of the County.

3. Firm shall be responsible for insuring all of its own personal property, improvements, and betterments.
4. All insurance policies put forth to satisfy the above requirements shall require the insurer to provide a minimum of thirty (30) days' notice to the County of any material change in coverage, cancellation, or non-renewal.
5. All insurance put forth to satisfy the above requirements shall be placed with insurance companies licensed to provide insurance in the state of North Carolina. Any deductibles or self-insured retentions in the required insurance shall be subject to approval by the County.
6. Prior to the execution of written contract, Firm will provide a Certificate of Insurance ("COI") to the County. Firm agrees to indemnify the County if the insurance policy referenced in the COI does not contain, at a minimum, the coverage amounts listed on the COI. Firm agrees to provide complete copies of policies if requested. Failure of Firm to provide timely evidence of insurance, or to place coverage with insurance, or to place coverage with insurance companies acceptable to the County, shall be viewed as Firm's delaying performance entitling the County to all appropriate remedies under the law including termination of the contract.

Section VII Reference Disclosure Form

Firm shall provide information regarding experience in work similar to this scope of work by listing THREE (3) RECENT CLIENTS, ONLY ONE OF WHICH MAY BE A CATAWBA COUNTY GOVERNMENT LISTING. References should be clients of a similar scale as the services requested in this RFQ.

1. FIRM NAME: _____
PERSON TO CONTACT: _____
TELEPHONE NUMBER: _____
EMAIL ADDRESS: _____
TYPE OF PROJECT: _____
SIZE OF PROJECT: _____
JOB DATES:
BEGINNING _____ END _____

2. FIRM NAME: _____
PERSON TO CONTACT: _____
TELEPHONE NUMBER: _____
EMAIL ADDRESS: _____
TYPE OF PROJECT: _____
SIZE OF PROJECT: _____
JOB DATES:
BEGINNING _____ END _____

3. FIRM NAME: _____
PERSON TO CONTACT: _____
TELEPHONE NUMBER: _____
EMAIL ADDRESS: _____
TYPE OF PROJECT: _____
SIZE OF PROJECT: _____
JOB DATES:
BEGINNING _____ END _____

Section VIII
Intent to Submit Statement of Qualifications
RFQ 25-1026

To ensure you receive all addenda issued for this RFQ, please complete and submit this form to Tina M. Wright, at the following email address: tinawright@catawbacountync.gov.

I, _____ a representative of _____
_____ confirm that we intend to submit
a Statement of Qualifications for **Engineering Services – Riverbend Park Utility Bridge**.

Firm Name _____

Firm Address _____

Firm Contact Name _____

Phone (____) _____

E-mail _____

Date _____

Section IX

Uniform Guidance Addendum

Pursuant to the Regulatory Requirements, Catawba County must comply with the Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards, 2 C.F.R. Part 200, and pursuant to 2 C.F.R. §200.327, the County must include within any contract applicable provisions described in Appendix II to 2 C.F.R. Part 200, each of which is contained in this Addendum. The following terms and conditions apply to you as a Subrecipient of the Federal grant funding:

I. Equal Employment Opportunity.

Subrecipient shall comply with all federal and state laws relating to Equal Employment Opportunity (41 CFR Part 60) including the following:

1. Subrecipient will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. Subrecipient will take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. Subrecipient agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.
2. Subrecipient will, in all solicitations or advertisements for employees placed by or on behalf of Subrecipient, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.
3. Subrecipient will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with Subrecipient's legal duty to furnish information.
4. Subrecipient will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of Subrecipient's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
5. Subrecipient will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

6. Subrecipient will furnish to the Administering Agency and the Secretary of Labor all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to its books, records, and accounts by the Administering Agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.
7. In the event of Subrecipient's noncompliance with the nondiscrimination clauses of this Contract or with any of the said rules, regulations, or orders, this Contract may be canceled, terminated, or suspended, in whole or in part, and Subrecipient may be declared ineligible for further Government contracts or Federally Assisted Construction Contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965. Such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.
8. Subrecipient will include the portion of the sentence immediately preceding paragraph I-1. of this Section and the provisions of paragraphs I-1. through I-7. in every Subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each Subcontractor or vendor. Subrecipient will take such action with respect to any Subcontract or purchase order as the Administering Agency may direct as a means of enforcing such provisions, including sanctions for noncompliance. Provided, however, that in the event Subrecipient becomes involved in, or is threatened with, litigation with a Subcontractor or vendor as a result of such direction by the Administering Agency, Subrecipient may request the United States to enter into such litigation to protect the interests of the United States.
Subrecipient further agrees that it will be bound by the above equal opportunity clause with respect to its own employment practices when it participates in federally assisted work. Provided, that the above equal opportunity clause is not applicable to any agency, instrumentality, or subdivision of Subrecipient which does not participate in work on or under this Contract.
9. Subrecipient agrees that it will assist and cooperate actively with the Administering Agency and the Secretary of Labor in obtaining the compliance of Subrecipient and any Subcontractors with the equal opportunity clause and the rules, regulations, and relevant orders of the Secretary of Labor; that it will furnish the Administering Agency and the Secretary of Labor such information as they may require for the supervision of such compliance; and that it will otherwise assist the Administering Agency in the discharge of the agency's primary responsibility for securing compliance.
10. Subrecipient further agrees that it will refrain from entering into any contract or contract modification subject to Executive Order 11246 of September 24, 1965, with a contractor debarred from, or who has not demonstrated eligibility for, Government contracts and Federally Assisted Construction Contracts pursuant to the Executive Order and that it will carry out such sanctions and penalties for violation of the equal opportunity clause as may be imposed upon Subrecipient and any Subcontractors by the Administering Agency or the Secretary of Labor pursuant to Part II, Subpart D of the Executive Order. In addition, Subrecipient agrees that if it fails or refuses to comply with these undertakings, the Administering Agency may take any or all of the following actions: Cancel, terminate, or suspend, in whole or in part, this grant (contract, loan, insurance, guarantee); refrain from extending any further assistance to the applicant under the program with respect to which the failure or refund occurred until satisfactory assurance

of future compliance has been received from such applicant; and refer the case to the Department of Justice for appropriate legal proceedings.

II. Title VI of the Civil Rights Act of 1964 - Compliance.

Subrecipient and any Subcontractor, or the successor, transferee, or assignee of Subrecipient or any Subcontractor, shall comply with Title VI of the Civil Rights Act of 1964, and Catawba County policy which prohibits recipients of federal financial assistance from excluding from a program or activity, denying benefits of, or otherwise discriminating against a person on the basis of race, color, or national origin (42 U.S.C. §§ 2000d et seq.), as implemented by the Department of the Treasury's Title VI regulations, 31 C.F.R. Part 22, which are herein incorporated by reference and made a part of this Contract. Title VI also provides protection to persons with "Limited English Proficiency" in any program or activity receiving federal financial assistance, 42 U.S.C. §§ 2000d et seq., as implemented by Treasury's Title VI regulations, 31 C.F.R. Part 22, and herein incorporated by reference and made a part of this Contract.

Furthermore, pursuant to Catawba County policy, Subrecipient and any Subcontractor, or the successor, transferee, or assignee of Subrecipient or any Subcontractor, shall not discriminate against individuals on the basis of race; religion; creed; color; limited English proficiency; sex; gender identity or expression; pregnancy; childbirth; breastfeeding; medical conditions related to pregnancy, childbirth, or breastfeeding; sexual orientation; marital status; age; national origin; ancestry; genetic information; disability; veteran status; low-income status or any class protected by local, state, or federal law, within its services, programs, or activities pursuant to this Agreement.

III. Copeland "Anti-Kickback" Act.

Subrecipient and any subcontractors performing work under the contract shall comply with 18 U.S.C. §874. Catawba County shall report all suspected or reported violations to Treasury.

IV. Rights to Inventions Made Under a Contract or Agreement.

A. The Federal Government reserves a royalty-free, non-exclusive and irrevocable license to reproduce, publish, or otherwise use, and to authorize others to use for "Government purposes," any subject data or copyright described below. "Government purposes" means use only for the direct purposes of the Government. Without the copyright owner's consent, the Government may not extend its federal license to any other party.

1. Any subject data developed under the Contract, whether or not a copyright has been obtained, and
2. Any rights of copyright purchased by Subrecipient using federal assistance funded in whole or in part by the Department of the Treasury.

B. Unless Treasury determines otherwise, a Subrecipient performing experimental, developmental, or research work required as part of this Contract agrees to permit Treasury to make available to the public either (1) Treasury's license in the copyright to any subject data developed in the course of the Contract or (2) a copy of the subject data first produced under the Contract for which a copyright has not been obtained. If the experimental, developmental, or research work which is the subject of this Contract is not completed for any reason whatsoever, all data developed under the Contract shall become subject data as defined herein and shall be delivered as the Government may direct.

C. Unless prohibited by North Carolina law, upon request by the Government, Subrecipient agrees to indemnify, save, and hold harmless Catawba County, the Federal Government, their officers, agents, and employees acting within the scope of their official duties against any liability, including costs and expenses, resulting from any willful or intentional violation by Subrecipient of proprietary rights, copyrights, or right of privacy

arising out of the publication, translation, reproduction, delivery, use, or disposition of any data furnished under the Contract. Subrecipient shall be required to indemnify Catawba County and/ or the Federal Government for any such liability arising out of the wrongful act of any employee, official, or agent of the Subrecipient.

D. Nothing contained in this clause shall imply a license to the Government under any patent or be construed as affecting the scope of any license or other right otherwise granted to the Government under any patent.

E. Data developed by Subrecipient and financed entirely without using federal assistance provided by the Government that has been incorporated into work required by the underlying Contract is exempt from the requirements herein, provided that Subrecipient identifies those data in writing at the time of delivery of the Contract work. Subrecipient agrees to include these requirements in each Subcontract for experimental, developmental, or research work financed in whole or in part with federal assistance.

F. For the purposes of this Section IV, "subject data" means "recorded information, whether or not copyrighted, . . . that is delivered or specified to be delivered as required by the Contract." Examples of "subject data" include, but are not limited to, "computer software, standards, specifications, engineering drawings and associated lists, process sheets, manuals, technical reports, catalog item identifications, and related information, but do not include financial reports, cost analyses or other similar information used for performance or administration of the Contract."

V. Federal Intellectual Property Bankruptcy Protection Act.

The Parties agree that the County shall be entitled to all rights and benefits of any Federal Intellectual Property Bankruptcy Protection Act, Public Law 100-506, codified at 11 USC 365(n) and any amendments thereto.

VI. Debarment and Suspension.

A. This contract is a covered transaction for purposes of 2 CFR §180.210 and 31 CFR §19.210. Therefore, this Contract is a lower-tier covered transaction for purposes of 2 C.F.R. Part 180 and 31 C.F.R. Part 19 if (1) the amount of this Contract is greater than or equal to \$25,000 (2 C.F.R. § 180.220(b)(1); 31 C.F.R. § 19.220(b)(1)); (2) the Contract requires the consent of an official of the Department of the Treasury (2 C.F.R. § 180.220(b)(2); 31 C.F.R. § 19.220(b)(2)); or (3) this Contract is for federally required audit services (2 C.F.R. § 180.220(b)(3); 31 C.F.R. § 19.220(b)(3)).

B. As such, the Subrecipient is required to verify that Subrecipient's principals (defined at 2 CFR § 180.995) or its affiliates (defined at 2 CFR § 180.905) of both Subrecipient and Subrecipient's principals are not excluded (defined at 2 CFR § 180.935) and are not disqualified (defined at 2 CFR § 180.935). If any of the foregoing persons are excluded or disqualified and the Secretary of the Treasury has not granted an exception pursuant to 31 C.F.R. §19.120(a) (a) this contract shall be void; (b) Catawba County shall not make any payments of federal financial assistance to Subrecipient; and (c) Catawba County shall have no obligations to Subrecipient under this contract.

C. The Subrecipient must comply with 2 CFR pt. 180, subpart C and 31 CFR pt. 19, and must include a requirement to comply with these regulations in any lower tier covered transaction it enters into. This certification is a material representation of fact relied upon by the County and all liability arising from an erroneous representation shall be borne solely by the Subrecipient.

D. If it is later determined that the Subrecipient did not comply with 2 CFR pt. 180, subpart C and 31 CFR pt. 19, in addition to remedies available to Catawba County, the

Federal Government may pursue available remedies, including but not limited to suspension and/or debarment.

VII. Byrd Anti-Lobbying Amendment.

Subrecipient certifies that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, officer or employee of Congress, or an employee of a Member of Congress in connection with obtaining any Federal contract, grant, or any other award covered by 31 U.S.C. §1352. Subrecipient shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier, up to the recipient who in turn will forward the certification(s) to the awarding agency. This certification is a material representation of fact upon which County has relied when entering into this contract, and all liability arising from an erroneous representation shall be borne solely by Subrecipient.

VIII. Trafficking Victims Protection Act.

Subrecipient will comply with the requirements of Section 106(g) of the Trafficking Victims Protection Act of 2000, as amended (22 USC 7104).

IX. False Claims Act.

Subrecipient acknowledges that the Administrative Remedies for False Claims and Statements (31 U.S.C. Chap. 38) applies to the Subrecipient's actions pertaining to this Agreement.

X. Clean Air Act and Federal Water Pollution Control Act.

Subrecipient shall comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 USC 7401-7671q) and the Federal Water Pollution Control Act as amended (33 USC 1251-1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).

XI. Procurement of Recovered Materials.

A. Section XI.B. shall apply if (1) this Contract involves the purchase of an item designated by the Environmental Protection Agency ("EPA") in 40 C.F.R. Part 247 that exceeds \$10,000 or (2) the total value of such designated items acquired during Unit's preceding fiscal year exceeded \$10,000.

B. In the performance of the Contract, Subrecipient shall make maximum use of products containing recovered materials that are EPA-designated items, unless the product cannot (1) be acquired competitively within a timeframe providing for compliance with the Contract performance schedule, (2) meet Contract performance requirements, or (3) be acquired at a reasonable price. Information about this requirement, along with the list of EPA-designated items, is available on EPA's website. Subrecipient also agrees to comply with all other applicable requirements of Section 6002 of the Solid Waste Disposal Act.

XII. Prohibition on Contracting for Covered Telecommunications Equipment or Services.

A. Definitions. Unless otherwise defined in this Contract, capitalized terms used in this Section XII shall have the meanings ascribed thereto in this Section XII.A.

1. "Backhaul" means intermediate links between the core network, or backbone network, and the small subnetworks at the edge of the network (e.g., connecting cell phones/towers to the core telephone network). Backhaul can be wireless (e.g., microwave) or wired (e.g., fiber optic, coaxial cable, Ethernet).

2. "Covered Foreign Country" means the People's Republic of China.

3. “Covered Telecommunications Equipment or Services” means (a) telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities); (b) for the purpose of public safety, security of Government facilities, physical security surveillance of critical infrastructure, and other national security purposes, video surveillance and telecommunications equipment produced by Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities); (c) telecommunications or video surveillance services provided by such entities or using such equipment; or (d) telecommunications or video surveillance equipment or services produced or provided by an entity that the Secretary of Defense, in consultation with the Director of National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a Covered Foreign Country.

4. “Critical Technology” means (1) defense articles or defense services included on the United States Munitions List set forth in the International Traffic in Arms Regulations under subchapter M of chapter I of title 22, Code of Federal Regulations; (2) items included on the Commerce Control List set forth in Supplement No. 1 to part 774 of the Export Administration Regulations under subchapter C of chapter VII of title 15, Code of Federal Regulations and controlled (a) pursuant to multilateral regimes, including for reasons relating to national security, chemical and biological weapons proliferation, nuclear nonproliferation, or missile technology, or (b) for reasons relating to regional stability or surreptitious listening; (3) specially designed and prepared nuclear equipment, parts and components, materials, software, and technology covered by part 810 of title 10, Code of Federal Regulations (relating to assistance to foreign atomic energy activities); (4) nuclear facilities, equipment, and material covered by part 110 of title 10, Code of Federal Regulations (relating to export and import of nuclear equipment and material); (5) select agents and toxins covered by part 331 of title 7, Code of Federal Regulations; part 121 of title 9 of such Code; or part 73 of title 42 of such Code; or (6) emerging and foundational technologies controlled pursuant to section 1758 of the Export Control Reform Act of 2018 (50 U.S.C. § 4817).

5. “Interconnection Arrangements” means arrangements governing the physical connection of two or more networks to allow the use of another’s network to hand off traffic where it is ultimately delivered (e.g., connection of a customer of telephone provider A to a customer of telephone company B) or sharing data and other information resources.

6. “Roaming” means cellular communications services (e.g., voice, video, data) received from a visited network when unable to connect to the facilities of the home network either because signal coverage is too weak or because traffic is too high.

7. “Substantial or Essential Component” means any component necessary for the proper function or performance of a piece of equipment, system, or service.

8. “Telecommunications Equipment or Services” means telecommunications or video surveillance equipment or services, such as, but not limited to, mobile phones, land lines, internet, video surveillance, and cloud services.

B. Prohibitions.

Section 889(b) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019, Pub. L. No. 115-232, and 2 C.F.R. § 200.216 prohibit the head of an executive agency on or after August 13, 2020, from obtaining or expending grant, cooperative agreement, loan, or loan guarantee funds on certain telecommunications products or from certain entities for national security reasons.

1. Unless an exception in Section XII.C. applies, Subrecipient and any Subcontractors may not use any grant, cooperative agreement, loan, or loan guarantee funds (including, without limitation, Fiscal Recovery Funds) received from a federal government to:
 - a. Procure or obtain any equipment, system, or service that uses Covered Telecommunications Equipment or Services as a Substantial or Essential Component of any system or as Critical Technology of any system;
 - b. Enter into, extend, or renew a contract to procure or obtain any equipment, system, or service that uses Covered Telecommunications Equipment or Services as a Substantial or Essential Component of any system or as Critical Technology of any system;
 - c. Enter into, extend, or renew contracts with entities that use Covered Telecommunications Equipment or Services as a Substantial or Essential Component of any system or as Critical Technology as part of any system; or
 - d. Provide, as part of its performance of this Contract, any Subcontract; any other contractual instrument; or any equipment, system, or service that uses Covered Telecommunications Equipment or Services as a Substantial or Essential Component of any system or as Critical Technology as part of any system.

C. Exceptions.

1. This clause does not prohibit Subrecipient or Subcontractors from providing:
 - a. A service that connects to the facilities of a third party, such as Backhaul, Roaming, or Interconnection Agreements, or
 - b. Telecommunications equipment that cannot route or redirect user data traffic or permit visibility into any user data or packets that such equipment transmits or otherwise handles.
2. By necessary implication and regulation, the prohibitions also do not apply to:
 - a. Covered telecommunications equipment that:
 - i. Is not used as a Substantial or Essential Component of any system and
 - ii. Is not used as Critical Technology of any system.
 - b. Other telecommunications equipment or services that are not considered Covered Telecommunications Equipment or Services.

D. Reporting Requirement

1. In the event Subrecipient identifies, during contract performance, covered Telecommunications Equipment or Services used as a Substantial or Essential Component of any system or as Critical Technology as part of any system, or if Subrecipient is notified of such by a Subcontractor at any Tier or by any other source, Subrecipient shall report the information in paragraph D.2(d)(2) of this Section X to Unit, unless procedures for reporting the information are established elsewhere in this Contract.
2. Subrecipient shall report the following information to Unit pursuant to paragraph D.1 of this Section XII:
 - a. Within one business day from the date of such identification or notification: contract number; order number(s), if applicable; supplier name; supplier unique entity identifier (if known); supplier Commercial and Government Entity (CAGE) code (if known); brand; model number (original equipment manufacturer number, manufacturer part number, or wholesaler number); item description; and any readily available information about mitigation actions undertaken or recommended.
 - b. Within ten business days of submitting the information in paragraph D.2.a. of this Section: any further available information about mitigation actions undertaken or recommended. In addition, Subrecipient shall describe (i) the efforts it undertook to prevent use or submission of Covered Telecommunications

Equipment or Services and (ii) any additional efforts that will be incorporated to prevent future use or submission of Covered Telecommunications Equipment or Services.

E. Subcontractor. Subrecipient shall cause to be inserted into all Subcontracts and other contractual instruments relating to the performance of this Contract the substance of this Section XII, including this paragraph E.

XIII. Domestic Preferences for Procurements.

A. For purposes of this Section XIII, the terms below are defined as follows:

1. “Produced in the United States” means, for iron and steel products, that all manufacturing processes, from the initial melting stage through the application of coating, occurred in the United States.

2. “Manufactured Products” means items and construction materials composed, in whole or in part, of non-ferrous metals such as aluminum; plastics and polymer-based products such as polyvinyl chloride pipe; aggregates such as concrete; glass, including optical fiber; and lumber.

B. As applicable, and to the extent consistent with law, Subrecipient should, to the greatest extent practicable, provide a preference for the purchase, acquisition, or use of goods, products or materials Produced in the United States. This includes, but is not limited to, iron, aluminum, steel, cement, and other Manufactured Products. Subrecipient shall cause any Subcontractors to include the requirements of this Section XI in any Subcontracts.

XIV. Solicitation of Minority and Women-Owned Business Enterprises; Veteran-Owned Businesses.

A. If Subrecipient intends to let any Subcontracts, Subrecipient shall (1) place qualified small and minority businesses and women’s business enterprises on its solicitation lists; (2) assure that small and minority businesses and women’s business enterprises are solicited whenever they are potential sources; (3) divide total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority businesses and women’s business enterprises; (4) establish delivery schedules, where the requirement permits, which encourage participation by small and minority businesses and women’s business enterprises; (5) use the services and assistance, as appropriate, of the Small Business Administration, the Minority Business Development Agency of the Department of Commerce, and the North Carolina Office for Historically Underutilized Businesses.

B. For the purposes of Section XII.A., an entity shall qualify (1) as a “minority business” or “women’s business enterprise” if it is currently certified as a North Carolina “historically underutilized business” under Chapter 143, Section 128.4(a) of the N.C. General Statutes (hereinafter G.S.), and (2) as a “small business” if it is independently owned and operated and is qualified under the Small Business Administration criteria and size standards at 13 C.F.R. Part 21.

C. Subrecipient agrees to consider Veteran-Owned Businesses, when possible, for contracts funded with federal financial assistance. (2 CFR 200.321)

XV. Access to Records.

A. Subrecipient agrees to provide Catawba County, the Department of the Treasury, the Treasury Office of Inspector General, the Government Accountability Office, and the Comptroller General of the United States, or any authorized representatives of these entities, access to any records (electronic and otherwise) of Subrecipient which are directly pertinent to this Contract to conduct audits or any other investigations. Subrecipient agrees to permit any of the foregoing parties to reproduce such records by any means whatsoever or to copy excerpts and transcriptions as reasonably needed.

B. Subrecipient agrees to retain all records covered by this Section XV through December 31, 2031, or such longer period as is necessary for the resolution of any litigation, claim, negotiation, audit, or other inquiry involving the Contract.

XVI. Conflicts of Interest; Gifts and Favors.

A. Subrecipient understands that (1) Catawba County will use Federal grant funds to pay for the cost of this Contract and (2) the expenditure of Federal grant funds is governed by the Conflict of Interest Policy of Catawba County, the Regulatory Requirements (including, without limitation, 2 C.F.R. § 200.318(c)(1)), and North Carolina law (including, without limitation, G.S. 14-234(a)(1) and - 234.3(a)).

B. Subrecipient certifies to Catawba County that as of the date hereof, to the best of its knowledge after reasonable inquiry, no employee, officer, or agent of Catawba County involved in the selection, award, or administration of this Contract (each a “Covered Individual”); no member of a Covered Individual’s immediate family; no partner of a Covered Individual; and no organization (including Subrecipient) which employs or is about to employ a Covered Individual has a financial or other interest in, or has received a tangible personal benefit from, Subrecipient. Should Subrecipient obtain knowledge of any such interest or any tangible personal benefit described in the preceding sentence after the date hereof, Subrecipient shall promptly disclose the same to Catawba County in writing.

C. Subrecipient certifies to Catawba County that it has not provided, nor offered to provide, any gratuities, favors, or anything of value to an officer, employee, or agent of Catawba County. Should Subrecipient obtain knowledge of the provision, or offer of any provision, of any gratuity, favor, or anything of value to an officer, employee, or agent described in the preceding sentence after the date hereof, Subrecipient shall promptly disclose the same to Catawba County in writing.

XVII. Other Non-Discrimination Statutes.

Subrecipient acknowledges that Catawba County is bound by and agrees, to the extent applicable to Subrecipient, to abide by the provisions contained in the federal statutes enumerated below and any other federal statutes and regulations that may be applicable to the expenditure of Federal Funds:

1. The Fair Housing Act, Title VIII of the Civil Rights Act of 1968 (42 U.S.C. §§ 3601 et seq.), which prohibits discrimination in housing on the basis of race, color, religion, national origin, sex, familial status, or disability;

2. Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. § 794), which prohibits discrimination on the basis of disability under any program or activity receiving federal financial assistance;

3. The Age Discrimination Act of 1975, as amended (42 U.S.C. §§ 6101 et seq.), and Treasury’s implementing regulations at 31 C.F.R. Part 23, which prohibit discrimination on the basis of age in programs or activities receiving federal financial assistance; and

4. Title II of the Americans with Disabilities Act of 1990, as amended (42 U.S.C. §§ 12101 et seq.), which prohibits discrimination on the basis of disability in programs, activities, and services provided or made available by state and local governments or instrumentalities or agencies thereto.

5. The Parties hereby certify that they do not operate any programs promoting DEI that violate any applicable Federal anti-discrimination laws. The Parties further acknowledge and agree that their compliance with all applicable Federal anti-discrimination laws is material to the Federal government’s payment decisions for purposes of section 3729(b)(4) of title 31, United States Code.

XVIII. Miscellaneous.

A. Increasing Seat Belt Use in the United States. Pursuant to Executive Order 13043, 62 Fed. Reg. 19,216 (Apr. 18, 1997), Catawba County encourages Subrecipient to adopt and enforce on-the-job seat belt policies and programs for its employees when operating company-owned, rented, or personally owned vehicles.

B. Reducing Text Messaging While Driving. Pursuant to Executive Order 13513, 74 Fed. Reg. 51,225 (Oct. 6, 2009), Unit encourages Subrecipient to adopt and enforce policies that ban text messaging while driving.

C. Davis-Bacon Act. Subrecipient shall be in compliance with all applicable provisions of the Davis- Bacon Act (29 C.F.R. §5.5(a)(1)-(10)) and Copeland "Anti-Kickback" Act (18 U.S.C. § 874, 40 U.S.C. § 3145, and the requirements of 29 C.F.R. Part 3) which are incorporated by reference into this Contract. A breach of the contract clauses above may be grounds for termination of the Contract, and for debarment as a contractor and subcontractor as provided in 29 C.F.R. § 5.12.

D. Clean Air Act. Subrecipient shall comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251-1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).

E. Procurement of Recovered Materials. Subrecipient shall comply with section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act. In the performance of this contract, the Subrecipient shall make maximum use of products containing recovered materials that are EPA-designated items unless the product cannot be acquired; competitively within a timeframe providing for compliance with the contract performance schedule; meeting contract performance requirements; or at a reasonable price. The Subrecipient also agrees to comply with all other applicable requirements of Section 6002 of the Solid Waste Disposal Act.

F. False Claims Act. The Subrecipient acknowledges that the Administrative Remedies for False Claims and Statements (31 U.S.C. Chap. 38) applies to the Subrecipient's actions pertaining to this contract.

G. Procurement of Recovered Materials. Subrecipient is encouraged to acquire or use products that are sustainable, including reused, refurbished, and recycled products; biobased or energy and water efficient acquisitions; and compostable items pursuant to 2 CFR 323(b).

XIX. Conflicts and Interpretation.

To the extent that any portion of this Addendum conflicts with any term or condition of this Contract expressed outside of this Addendum, the terms of this Addendum shall govern.

Section X Hydrologic and Hydraulic Report



Hydrologic and Hydraulic Report

Riverbend Park Culvert Repair

Catawba River Basin | Catawba County, NC | March 2025

Prepared By:

Resource Environmental Solutions, LLC
3600 Glenwood Avenue, Suite 100
Raleigh, NC 27612

Engineering Services Provided By:
RES Environmental Operating Company, LLC
NC License No. F-1428





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Introduction

The flooding caused by Hurricane Helene in September 2024 significantly impacted Riverbend Park, including critical damage to the culvert providing access to the back half of the park. The primary objective of this planning document is to outline the cost and materials needed to restore the culvert crossing and the park access it provided prior to Hurricane Helene.

Site Location

The Project is located on an Unnamed Tributary to the Catawba River (UT) within Catawba County's Riverbend Park approximately 0.7 miles east of NC Highway 16 and 0.2 miles south of the Catawba River (35°49'9.08"N, 81°10'39.88"W). The UT has a drainage area of 0.57 sq. miles. The drainage area is predominantly forested and less than 1% of the area is impervious.

Pre-Helene Conditions Summary

Prior to Hurricane Helene the project site included a 20ft wide roadway over the UT that provided sole access to much of Riverbend Park. The UT was conveyed under the roadway via 2 – 30ft long culverts (1 @ 36" HDPE and 1 @ 42" CMP). Note the crossing was destroyed during Hurricane Helene and some measurements were estimated based on historical data, site visit observations, and professional judgment.

Design Approach

The design approach for this project seeks to balance functional needs, ecological improvements, and cost to deliver project alternatives that provide as many benefits for Catawba County as possible. The initial analysis included a peak flow analysis of the watershed. These peak flows were then modeled in HY-8 to determine how the pre-Helene conditions performed during various storm events. RES then modeled several design alternatives to the pre-Helene condition outlined in the Design Alternatives section of this report.

Hydrology

Hydrologic evaluations were performed using USGS Regional Flood Frequency Equations for estimating peak flows in rural North Carolina (SIR 2023-5006). Peak flows were determined using the following equations from the Piedmont and Ridge and Valley Hydrologic Region where DA=drainage area (sq. miles):

- $Q_{2yr} = 149 * (DA)^{0.646} = \mathbf{104 \text{ ft}^3/\text{s}}$
- $Q_{5yr} = 267 * (DA)^{0.631} = \mathbf{187 \text{ ft}^3/\text{s}}$
- $Q_{10yr} = 361 * (DA)^{0.623} = \mathbf{254 \text{ ft}^3/\text{s}}$
- $Q_{25yr} = 491 * (DA)^{0.615} = \mathbf{347 \text{ ft}^3/\text{s}}$
- $Q_{50yr} = 607 * (DA)^{0.610} = \mathbf{431 \text{ ft}^3/\text{s}}$



Design Alternatives

1. One (1) 30-ft culvert @ 36" HDPE + One (1) 30-ft culvert @ 42" CMP (Inverts NOT buried)
 - o Alternative 1, the Build Back alternative, involves restoring the crossing back to the same condition it was in prior to Hurricane Helene.
2. One (1) 30-ft culvert @ 128" x 86" CMPA (Inverts buried 1ft below the channel bed)
 - o Alternative 2, the preferred culvert design approach, is intended to provide the most appropriate culvert size for the project site. This alternative is designed to provide an increase in level of service for the crossing as well as reduced outlet velocities close to expected downstream velocities promoting aquatic passage as well as downstream channel stability.
3. One (1) Pre-fabricated Bridge (8' wide x 40' long)
 - o Alternative 3 provides a non-culvert solution for the crossing. This alternative would be expected to provide the lowest maintenance costs, the highest level of service for the crossing as well as the most natural stream flow through the system. **Note these statements are based on best professional judgment as a Hydraulic Analysis was not performed for this alternative.**

Culvert calculations can be found in **Appendix A**.

Hydraulics

Hydraulic analysis models for each design alternative were analyzed and compared using HY-8 Culvert Hydraulic Analysis Program, developed by the Federal Highway Administration (FHWA, 2025). In addition, potential for aquatic passage was analyzed using the HY-8 Aquatic Organism Passage (AOP) stream simulator with guidance from HEC-26 (FHWA, 2010). The following assumptions were made based on the existing conditions survey, LiDAR, and site visit observations:

- Steady-state flows
- Location and 1-ft spacing of existing culvert barrels
- Culvert length of 30 ft
- No embedment of existing culvert barrels
- Existing culvert and stream slope of 1.3%
- Streambed Gradation $D_{50} = 1.5"$
- There is no backwater from the Catawba River

The analysis focused on evaluating headwater depths, outlet velocities, and aquatic passage potential for a range of design flows (see **Table 1**).

Design Alternative 1 modeling results indicated an overtopping between the 2- and 5-year storm events. The high outlet velocity results indicate a hydraulic barrier that limits aquatic passage through the culvert. Additionally, these outlet velocities pose a concern for downstream channel stability and may lead to erosion of the existing channel during storm events. The barrel sizes for this design are not large enough to include an adequate embedment recommended per the AOP analysis (FHWA, 2025). While this design would build back the existing conditions of the stream, it is not recommended for aquatic passage and may lead to future downstream channel degradation.

Design Alternative 2 results in an overtopping between the 10- and 25-year storm events, increasing the culverts capacity to convey larger storms and therefore improving the level of service of the roadway. To maintain the existing floodplain conveyance, the culvert was sized such that its crown elevation does not exceed the lowest point within the right floodplain, as determined from field measurements. The AOP recommended embedment exceeds 40% of the culvert area and requires an increase in culvert size. The 12-inch embedment was selected to improve AOP conditions while maintaining existing floodplain conveyance and managing project costs. Additionally, outlet velocities are minimized to better match existing tailwater velocities, significantly reducing the risk of downstream erosion in comparison to Design



Alternative 1. These design considerations improve overall aquatic passage capabilities, minimize potential for downstream degradation, and increase overall storm capacity of the culvert.

Table 1. HY-8 Hydraulic Analysis Results

Culvert Design	Discharge (ft ³ /s)	Headwater Depth (ft) (Inlet/Outlet Control) ¹	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
Alternative 1	104 (2yr)	4.25 (I)	10.23	4.49
	187 (5 yr)	7.07 (I)	11.74	5.48
	254 (10yr)	7.46 (I)	10.17	6.08
	347 (25yr)	7.81 (I)	10.47	6.74
	431 (50yr)	8.06 (I)	10.69	7.23
Alternative 2	104 (2yr)	2.77 (O)	5.00	4.49
	187 (5 yr)	4.06 (O)	6.78	5.48
	254 (10yr)	4.99 (O)	7.93	6.08
	347 (25yr)	6.25 (O)	9.36	6.74
	431 (50yr)	7.09 (I)	9.94	7.23

¹ Headwater depth at roadway overtopping = 5.94 ft

Cost

Alternative 1: One (1) 30-ft culvert @ 36" HDPE + One (1) 30-ft culvert @ 42" CMP (Inverts NOT buried)

- o \$122,500

Alternative 2: One (1) 30-ft culvert @ 128" x 86" CMPA (Inverts buried 1ft below the channel bed)

- o \$127,500

Alternative 1 and 2 costs include culvert, culvert installation, downstream dissipator pad, gravel roadway over the culvert, design, survey, and disposal of pipes.

Alternative 3: One (1) 8' x 40' Steel Utility Bridge with 42" Truss Rail (8 Ton Capacity)

- o \$183,000

Alternative 3 costs include bridge, bridge installation, geotechnical report, survey, and disposal of pipes.

Recommendations

Based on the analysis outlined above, Alternative 3 is the recommended alternative to replace the destroyed culvert crossing. The bridge alternative offers the best long-term solution from a level of service, stream stability, and aquatic passage standpoint. By getting the crossing out of the stream it will have the least long-term impact on the stream ecosystem. However, if Alternative 3 is not financially viable, Alternative 2 is recommended as it provides natural downstream velocities and is the best option for aquatic passage when compared to Alternative 1.



References

- Contech Engineered Solutions LLC. (2022). Corrugated Metal Pipe Design Guide. Retrieved from <https://www.conteches.com/media/u2yh4gik/cmp-design-guide.pdf>
- Feaster, T.D., Gotvald, A.J., Musser, J.W., Weaver, J.C., Kolb, K.R., Veilleux, A.G., and Wagner, D.M., 2023, Magnitude and frequency of floods for rural streams in Georgia, South Carolina, and North Carolina, 2017—Results: U.S. Geological Survey Scientific Investigations Report 2023–5006, 75 p., <https://doi.org/10.3133/sir20235006>
- Federal Highway Administration (FHWA). (2010). *Hydraulic Engineering Circular No. 26: Culvert Design for Aquatic Organism Passage*. FHWA-HIF-11-008. Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration.
- Federal Highway Administration (FHWA). (2025). *HY-8 Culvert Hydraulic Analysis Program (Version 7.7.4)* [Software]. Retrieved from <https://www.fhwa.dot.gov/engineering/hydraulics/software/hy8/>
- U.S. Geological Survey (USGS). (2025). *StreamStats – North Carolina (Version 4.28.0)* [Online application]. Retrieved March 2025 from <https://streamstats.usgs.gov/ss/>



Appendix A: Culvert Calculations

HY-8 Culvert Analysis Report- Design Alt 1

Crossing Discharge Data

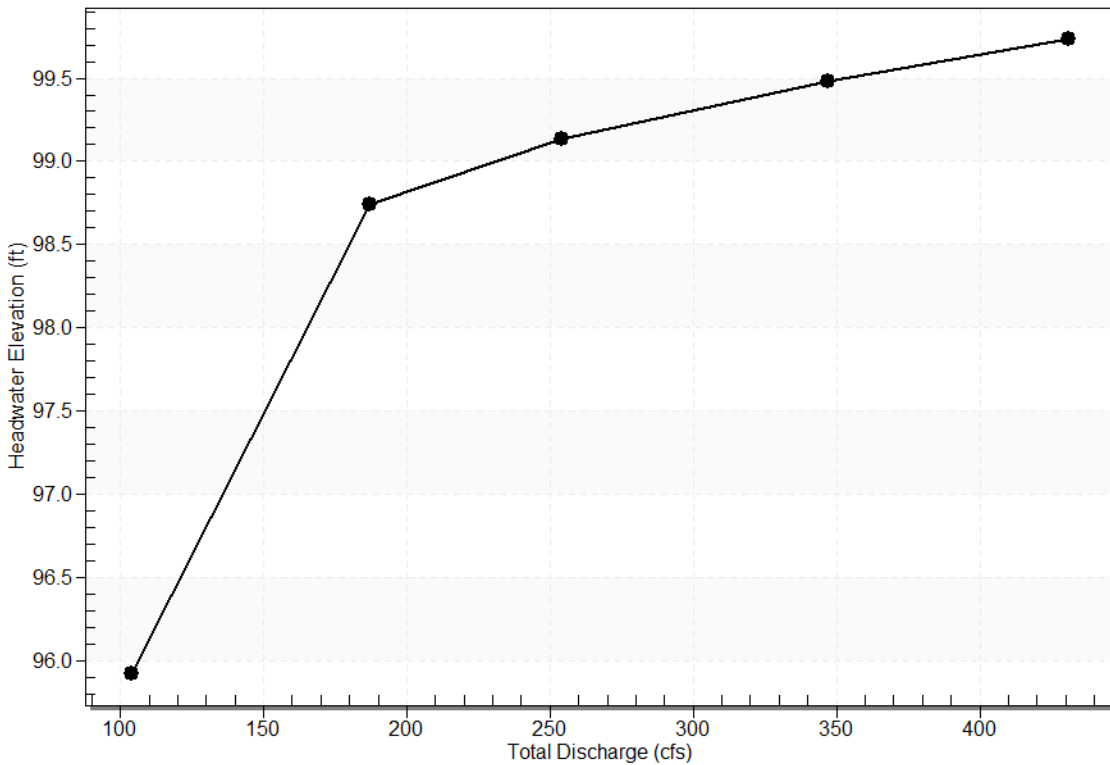
Discharge Selection Method: User Defined

Table 1 - Summary of Culvert Flows at Crossing: Design Alt. 1

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	HDPE Discharge (cfs)	CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
95.92	2yr	104.00	46.52	57.48	0.00	6
98.74	5yr	187.00	69.39	91.67	25.93	9
99.13	10yr	254.00	71.91	95.29	86.76	7
99.48	25yr	347.00	74.04	96.48	176.44	6
99.73	50yr	431.00	75.54	94.27	261.16	5
97.61	Overtopping	141.60	61.44	80.16	0.00	Overtopping

Rating Curve Plot for Crossing: Design Alt. 1

Total Rating Curve
Crossing: Design Alt. 1



Culvert Data: HDPE

Table 1 - Culvert Summary Table: HDPE

Disc harg e Nam es	Total Disc harg e (cfs)	Culv ert Disc harg e (cfs)	Head water Eleva tion (ft)	Inle t Con trol Dep th (ft)	Out let Con trol Dep th (ft)	Fl ow Ty pe	Nor mal Dep th (ft)	Crit ical De pth (ft)	Ou tle t De pth (ft)	Tail water r Dept h (ft)	Outl et Vel ocit y (ft/ s)	Tail water r Velo city (ft/s)
2yr	104.0 0 cfs	46.52 cfs	95.92	4.25	3.22 3	5- S2 n	1.60	2.2 2	1.8 4	2.05	10.2 3	4.49
5yr	187.0 0 cfs	69.39 cfs	98.74	7.07	5.41 4	5- S2 n	2.09	2.6 5	2.3 4	2.70	11.7 4	5.48
10yr	254.0 0 cfs	71.91 cfs	99.13	7.46	6.08 3	4- FF f	2.14	2.6 8	3.0 0	3.13	10.1 7	6.08
25yr	347.0 0 cfs	74.04 cfs	99.48	7.81	6.83 5	4- FF f	2.20	2.7 1	3.0 0	3.68	10.4 7	6.74
50yr	431.0 0 cfs	75.54 cfs	99.73	8.06	7.43 7	4- FF f	2.23	2.7 2	3.0 0	4.14	10.6 9	7.23

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

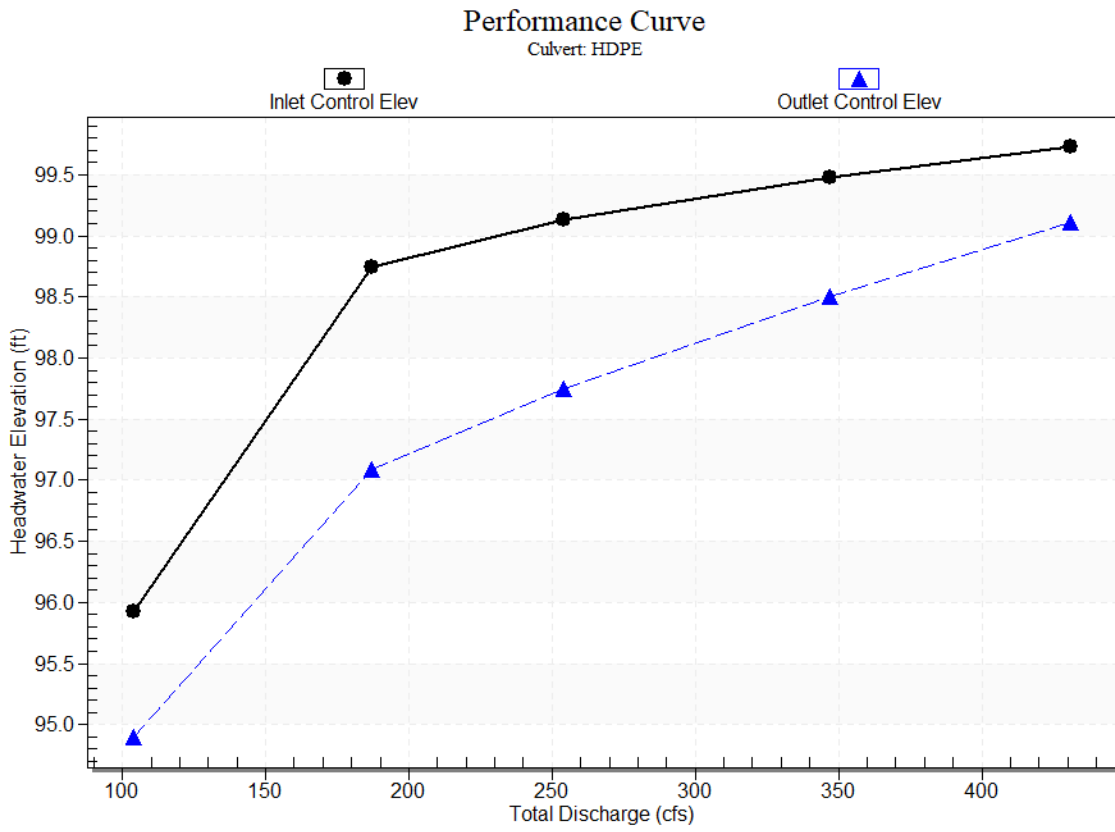
Inlet Elevation (invert): 91.67 ft,

Outlet Elevation (invert): 91.27 ft

Culvert Length: 30.00 ft,

Culvert Slope: 0.0133

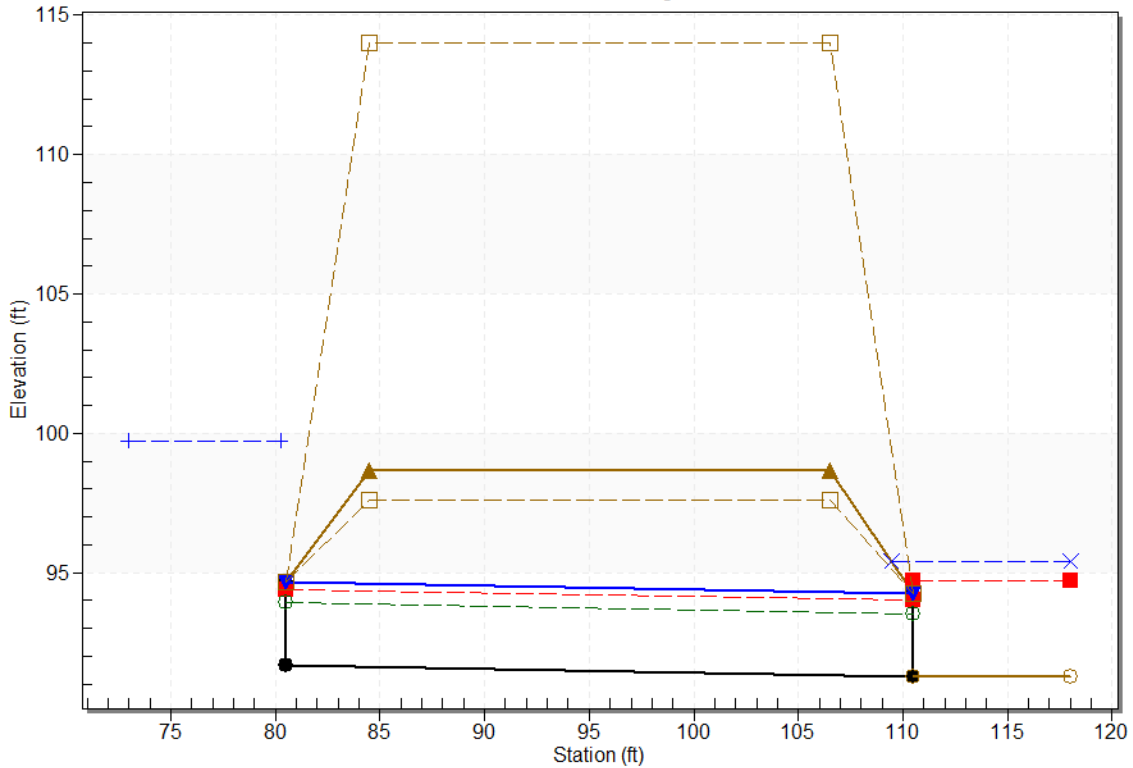
Culvert Performance Curve Plot: HDPE



Water Surface Profile Plot for Culvert: HDPE

Crossing - Design Alt. 1, Design Discharge - 431.0 cfs

Culvert - HDPE, Culvert Discharge - 75.5 cfs



Site Data - HDPE

Site Data Option: Culvert Invert Data

Inlet Station: 80.50 ft

Inlet Elevation: 91.67 ft

Outlet Station: 110.50 ft

Outlet Elevation: 91.27 ft

Number of Barrels: 1

Culvert Data Summary - HDPE

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Smooth HDPE

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Culvert Data: CMP

Table 2 - Culvert Summary Table: CMP

Disc harge Names	Total Disc harge (cfs)	Culv ert Disc harge (cfs)	Head water Eleva tion (ft)	Inle t Con trol Dep th (ft)	Out let Con trol Dep th (ft)	Fl o w Ty pe	Nor mal Dep th (ft)	Crit ical Dep th (ft)	Ou tle t Dep th (ft)	Tail water Dept h (ft)	Outl et Vel ocit y (ft/s)	Tail water Velo city (ft/s)
2yr	104.00 cfs	57.48 cfs	95.92	4.19	4.253	7-2c	3.50	2.37	2.37	2.05	8.27	4.49
5yr	187.00 cfs	91.67 cfs	98.74	7.07	6.933	7-2c	3.50	2.97	2.97	2.70	10.54	5.48
10yr	254.00 cfs	95.29 cfs	99.13	7.46	7.304	7-2t	3.50	3.01	3.13	3.13	10.49	6.08
25yr	347.00 cfs	96.48 cfs	99.48	7.60	7.811	4-FFf	3.50	3.03	3.50	3.68	10.03	6.74
50yr	431.00 cfs	94.27 cfs	99.73	7.35	8.064	4-FFf	3.50	3.00	3.50	4.14	9.80	7.23

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

Inlet Elevation (invert): 91.67 ft,

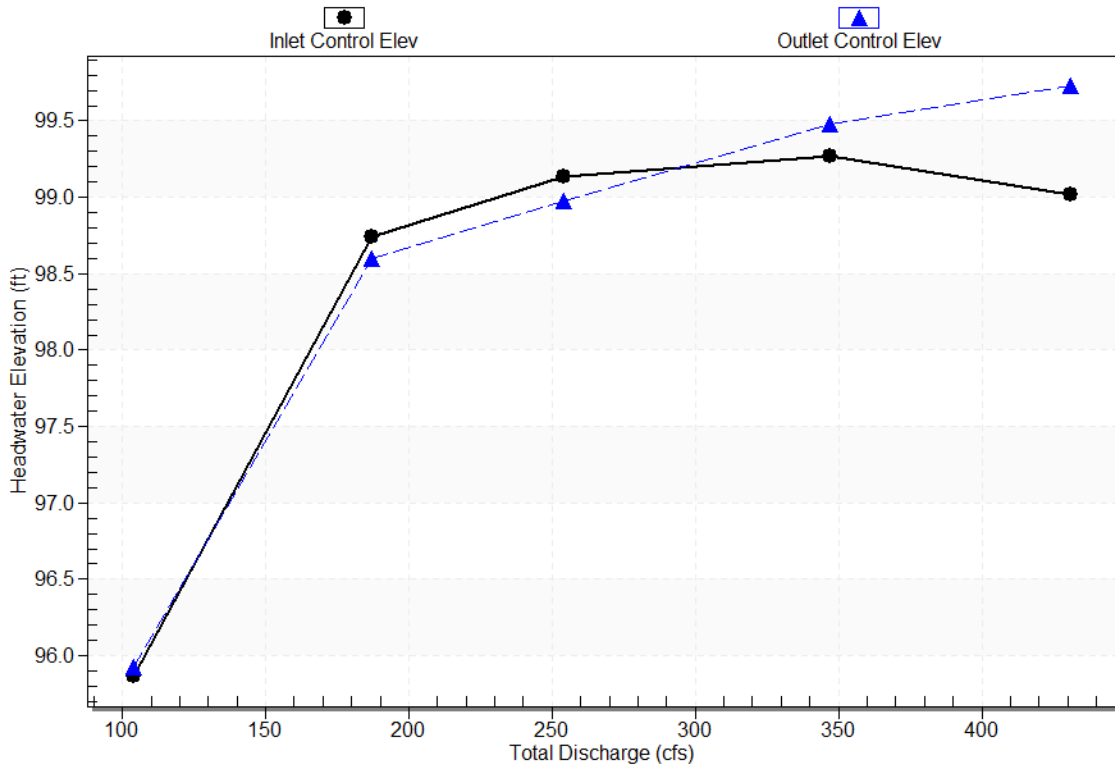
Outlet Elevation (invert): 91.27 ft

Culvert Length: 30.00 ft,

Culvert Slope: 0.0133

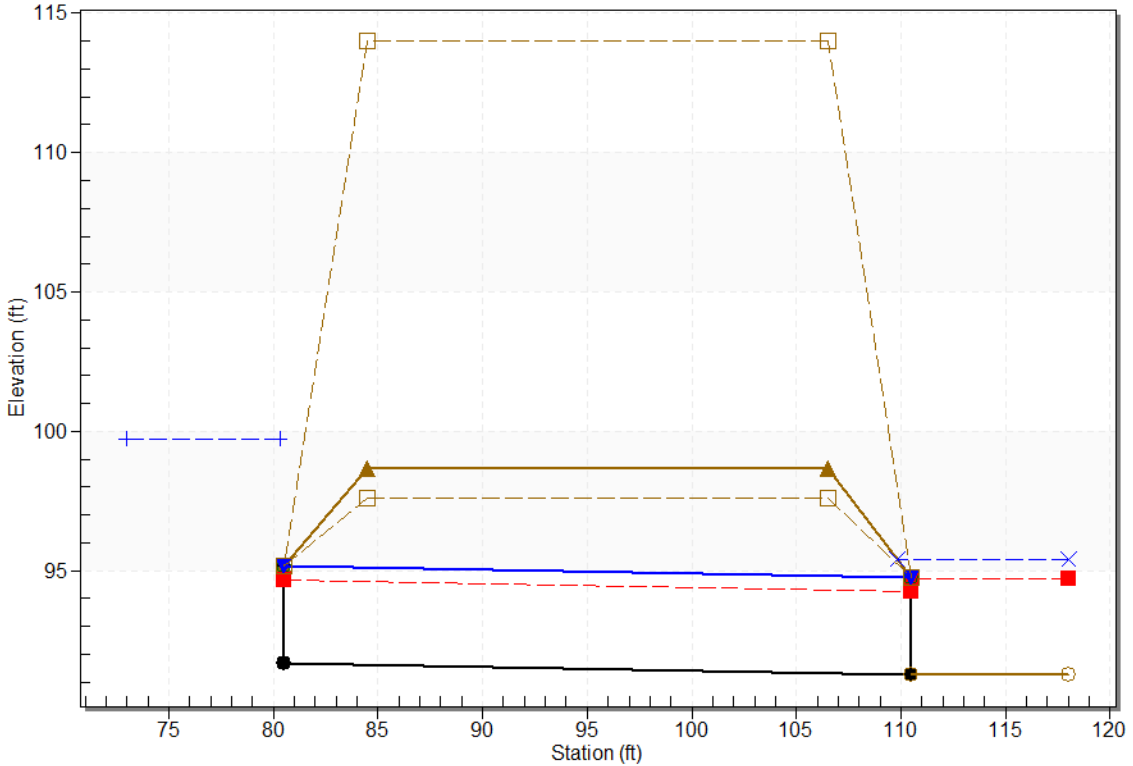
Culvert Performance Curve Plot: CMP

Performance Curve
Culvert: CMP



Water Surface Profile Plot for Culvert: CMP

Crossing - Design Alt. 1, Design Discharge - 431.0 cfs
Culvert - CMP, Culvert Discharge - 94.3 cfs



Site Data - CMP

Site Data Option: Culvert Invert Data

Inlet Station: 80.50 ft

Inlet Elevation: 91.67 ft

Outlet Station: 110.50 ft

Outlet Elevation: 91.27 ft

Number of Barrels: 1

Culvert Data Summary - CMP

Barrel Shape: Circular

Barrel Diameter: 3.50 ft

Barrel Material: Corrugated Aluminum

Embedment: 0.00 in

Barrel Manning's n: 0.0310

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Tailwater Data for Crossing: Design Alt. 1

Table 2 - Downstream Channel Rating Curve (Crossing: Design Alt. 1)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
104.00	93.32	2.05	4.49	1.67	0.67
187.00	93.97	2.70	5.48	2.19	0.69
254.00	94.40	3.13	6.08	2.54	0.69
347.00	94.95	3.68	6.74	2.99	0.70
431.00	95.41	4.14	7.23	3.36	0.70

Tailwater Channel Data - Design Alt. 1

Tailwater Channel Option: Irregular Channel

Channel Slope: Irregular Channel

User Defined Channel Cross-Section

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	98.76	0.0450
2	12.27	98.37	0.0450
3	18.92	98.46	0.0450
4	21.89	97.92	0.0450
5	22.61	93.58	0.0450
6	24.56	92.58	0.0450
7	26.34	91.41	0.0450
8	28.30	91.66	0.0450
9	31.46	91.27	0.0450
10	34.18	91.91	0.0450
11	35.45	92.21	0.0450
12	37.73	91.82	0.0450
13	39.58	93.11	0.0450
14	40.85	97.33	0.0450
15	43.52	98.12	0.0450
16	53.34	98.71	0.0450
17	67.60	97.60	0.0450

Roadway Data for Crossing: Design Alt. 1

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section

Coord No.	Station (ft)	Elevation (ft)
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0	0.00	100.46
1	3.15	100.34
2	6.36	100.00
3	8.55	99.91
4	11.55	99.78
5	14.55	99.61
6	17.52	99.41
7	20.61	99.22
8	23.48	99.16
9	26.52	99.11
10	29.51	99.07
11	32.57	99.00
12	35.65	98.86
13	38.50	98.75
14	41.51	98.67
15	44.52	98.68
16	47.71	98.71
17	50.98	98.73
18	53.40	98.65
19	76.73	98.64
20	77.34	98.57
21	80.40	98.45
22	82.98	98.41
23	85.62	98.31
24	88.90	97.80
25	92.12	97.61
26	95.07	98.42
27	97.37	100.60
28	99.94	102.45
29	102.18	105.33
30	104.78	106.62
31	107.78	107.72
32	110.40	108.96
33	113.64	110.22
34	116.80	111.45
35	119.78	112.29
36	122.59	113.40
37	125.50	114.00

Roadway Surface: Gravel

Roadway Top Width: 22.00 ft

HY-8 Culvert Analysis Report – Design Alt 2

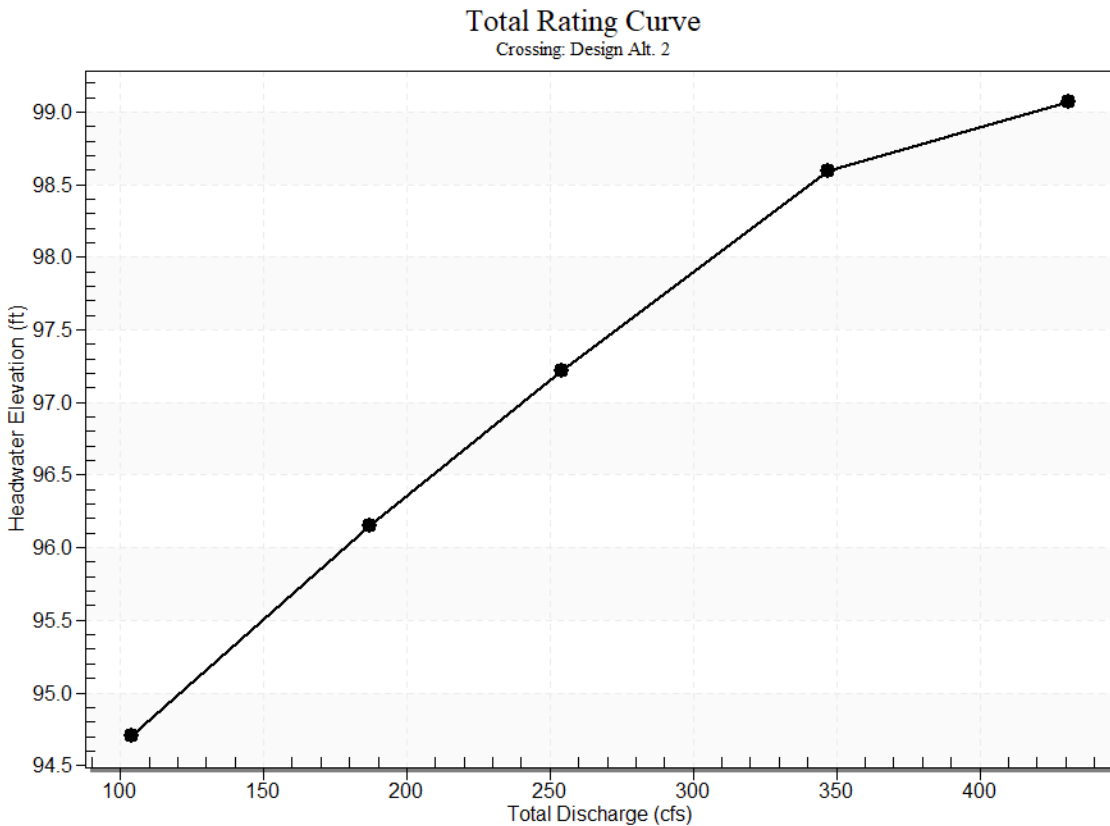
Crossing Discharge Data

Discharge Selection Method: User Defined

Table 1 - Summary of Culvert Flows at Crossing: Design Alt. 2

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	112x75 CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
94.71	2yr	104.00	104.00	0.00	1
96.15	5yr	187.00	187.00	0.00	1
97.22	10yr	254.00	254.00	0.00	1
98.59	25yr	347.00	330.87	16.04	10
99.07	50yr	431.00	357.19	73.76	6
97.61	Overtopping	276.90	276.90	0.00	Overtopping

Rating Curve Plot for Crossing: Design Alt. 2



Culvert Data: 112x75 CMP

Table 1 - Culvert Summary Table: 112x75 CMP

Disc harg e Nam es	Total Disc harg e (cfs)	Culv ert Disc harg e (cfs)	Head water Eleva tion (ft)	Inle t Con trol Dep th (ft)	Out let Con trol Dep th (ft)	Fl ow Ty pe	Nor mal Dep th (ft)	Crit ical De pth (ft)	Ou tle t De pth (ft)	Tail wate r Dept h (ft)	Outl et Vel ocit y (ft/ s)	Tail wate r Velo city (ft/s)
2yr	104.0 0 cfs	104.0 0 cfs	94.71	2.76	3.03 7	3- M 1t	1.91	1.6 8	2.0 5	2.05	5.74	4.49
5yr	187.0 0 cfs	187.0 0 cfs	96.15	4.35	4.47 7	3- M 2t	2.81	2.4 1	2.7 0	2.70	7.82	5.48
10yr	254.0 0 cfs	254.0 0 cfs	97.22	5.53	5.54 8	3- M 2t	3.62	2.9 1	3.1 3	3.13	9.18	6.08
25yr	347.0 0 cfs	330.8 7 cfs	98.59	6.92	6.81 5	3- M 2t	5.25	3.3 9	3.6 8	3.68	10.3 9	6.74
50yr	431.0 0 cfs	357.1 9 cfs	99.07	7.40	7.29 5	3- M 2t	5.25	3.5 3	4.1 4	4.14	10.2 7	7.23

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

Inlet Elevation (invert): 91.67 ft,

Outlet Elevation (invert): 91.27 ft

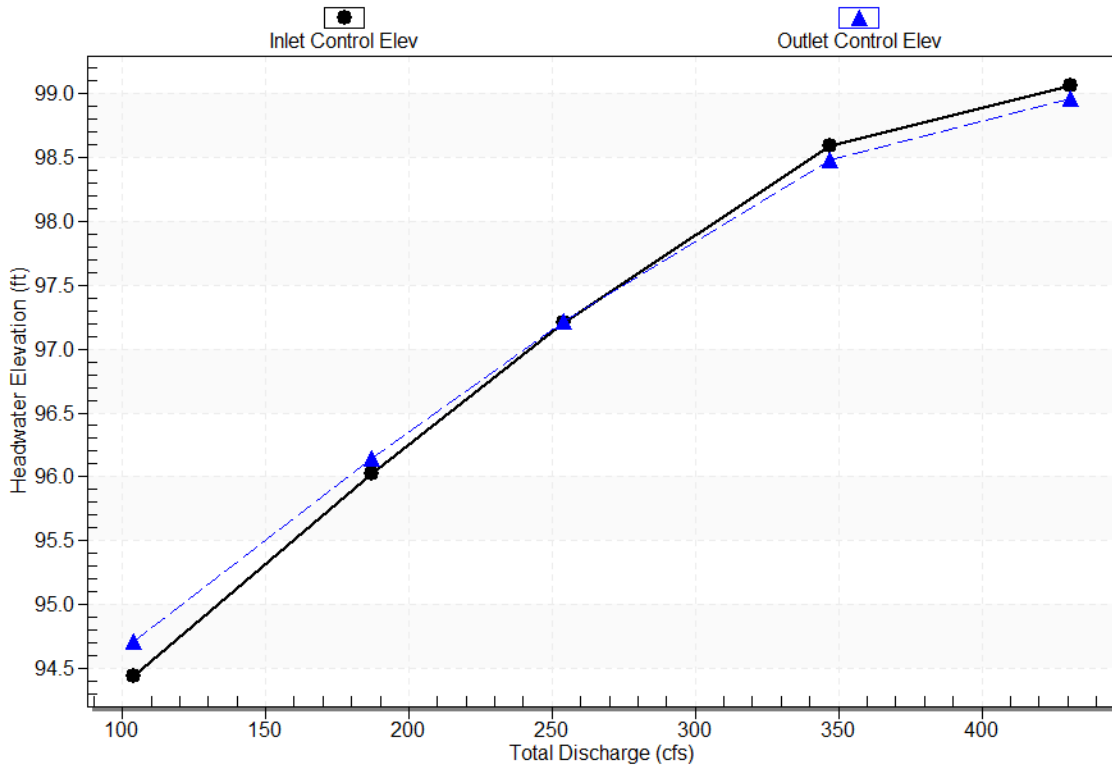
Culvert Length: 30.00 ft,

Culvert Slope: 0.0133

Culvert Performance Curve Plot: 112x75 CMP

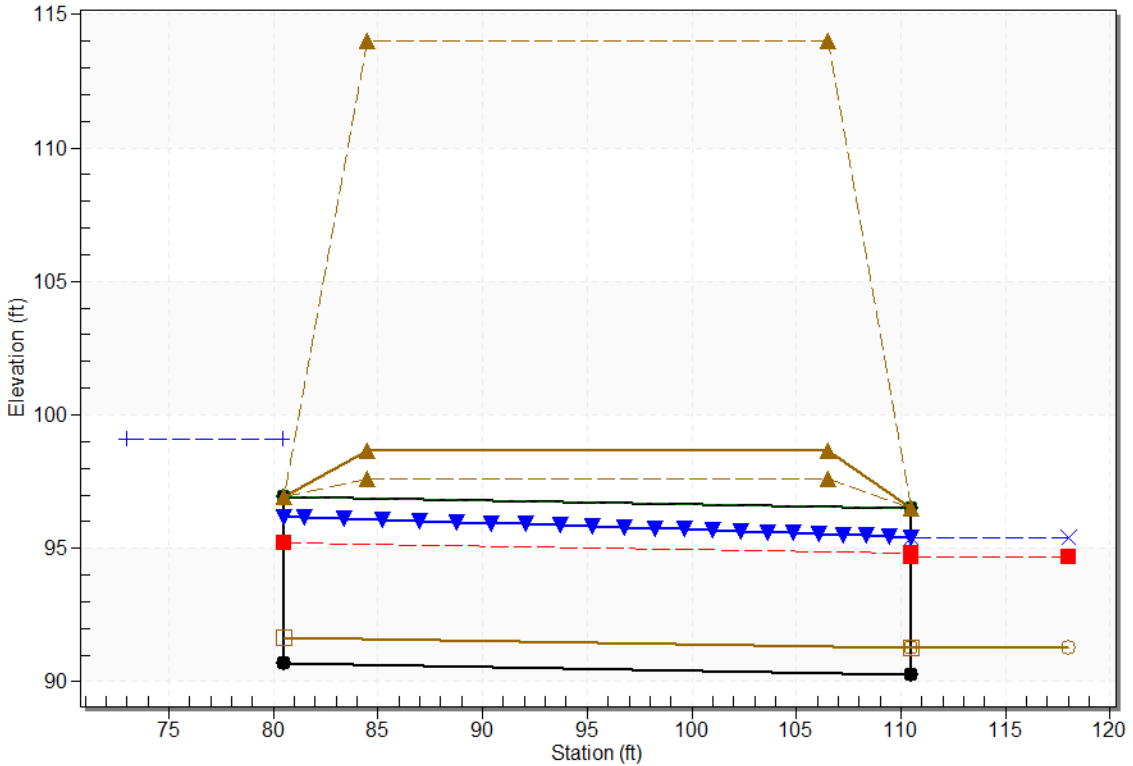
Performance Curve

Culvert: 112x75 CMP



Water Surface Profile Plot for Culvert: 112x75 CMP

Crossing - Design Alt. 2, Design Discharge - 431.0 cfs
Culvert - 112x75 CMP, Culvert Discharge - 357.2 cfs



Site Data - 112x75 CMP

Site Data Option: Culvert Invert Data

Inlet Station: 80.50 ft

Inlet Elevation: 90.67 ft

Outlet Station: 110.50 ft

Outlet Elevation: 90.27 ft

Number of Barrels: 1

Culvert Data Summary - 112x75 CMP

Barrel Shape: Pipe Arch

Barrel Span: 111.92 in

Barrel Rise: 75.00 in

Barrel Material: Steel or Aluminum

Embedment: 12.00 in

Barrel Manning's n: 0.0280 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting (Ke=0.9)

Inlet Depression: None

Tailwater Data for Crossing: Design Alt. 2

Table 2 - Downstream Channel Rating Curve (Crossing: Design Alt. 2)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
104.00	93.32	2.05	4.49	1.67	0.67
187.00	93.97	2.70	5.48	2.19	0.69
254.00	94.40	3.13	6.08	2.54	0.69
347.00	94.95	3.68	6.74	2.99	0.70
431.00	95.41	4.14	7.23	3.36	0.70

Tailwater Channel Data - Design Alt. 2

Tailwater Channel Option: Irregular Channel

Channel Slope: Irregular Channel

User Defined Channel Cross-Section

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	98.76	0.0450
2	12.27	98.37	0.0450
3	18.92	98.46	0.0450
4	21.89	97.92	0.0450
5	22.61	93.58	0.0450
6	24.56	92.58	0.0450
7	26.34	91.41	0.0450
8	28.30	91.66	0.0450
9	31.46	91.27	0.0450
10	34.18	91.91	0.0450
11	35.45	92.21	0.0450
12	37.73	91.82	0.0450
13	39.58	93.11	0.0450
14	40.85	97.33	0.0450
15	43.52	98.12	0.0450
16	53.34	98.71	0.0450
17	67.60	97.60	0.0450

Roadway Data for Crossing: Design Alt. 2

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section

Coord No.	Station (ft)	Elevation (ft)
0	0.00	100.46
1	3.15	100.34
2	6.36	100.00
3	8.55	99.91
4	11.55	99.78
5	14.55	99.61
6	17.52	99.41
7	20.61	99.22
8	23.48	99.16
9	26.52	99.11
10	29.51	99.07
11	32.57	99.00
12	35.65	98.86
13	38.50	98.75
14	41.51	98.67
15	44.52	98.68
16	47.71	98.71
17	50.98	98.73
18	53.40	98.65
19	76.73	98.64
20	77.34	98.57
21	80.40	98.45
22	82.98	98.41
23	85.62	98.31
24	88.90	97.80
25	92.12	97.61
26	95.07	98.42
27	97.37	100.60
28	99.94	102.45
29	102.18	105.33
30	104.78	106.62
31	107.78	107.72
32	110.40	108.96
33	113.64	110.22
34	116.80	111.45
35	119.78	112.29
36	122.59	113.40
37	125.50	114.00

Roadway Surface: Gravel

Roadway Top Width: 22.00 ft

AOP Reach Data

AOP Discharges

Low AOP Flow: 1.00 cfs

High AOP Flow: 104.00 cfs

Peak AOP Flow: 431.00 cfs

Embedment Depth Check

Embedment Depth is NOT Acceptable

Embedment Depth 1.00 ft

Acceptable Embedment Depth 2.51 ft

Shear computed in Reach and Culvert Barrel

Bed is NOT Stable under High Flow

Bed Mobility is NOT Acceptable under High Flow

Shear Applied to Culvert Bed under High Flow 1.54 lb/ft²

Shear Permissible to Culvert Bed's Upper Layer 0.74 lb/ft²

Maximum Shear Applied to Reach Cross-Sections under High Flow 2.09 lb/ft²

Bed is NOT Stable under Peak Flow

Lower Layer Bed is Stable under Peak Flow

Shear Applied to Culvert Bed under Peak Flow 5.39 lb/ft²

Shear Permissible to Culvert Bed's Lower Layer 5.39 lb/ft²

Maximum Shear Applied to Reach Cross-Sections under Peak Flow 4.77 lb/ft²

Velocity computed in Reach and Culvert Barrel

Culvert Velocity is Acceptable

Maximum Velocity within Culvert under High Flow 6.09 ft/s

Maximum Velocity within Reach Cross-Sections under High Flow 7.09 ft/s

Velocity computed in Reach and Culvert Barrel

Culvert Depth is NOT Acceptable

Minimum Depth within Culvert under Low Flow 0.13 ft

Minimum Depth within Reach Cross-Sections under Low Flow 0.26 ft

HY-8 Culvert Analysis Report – Design Alt 3

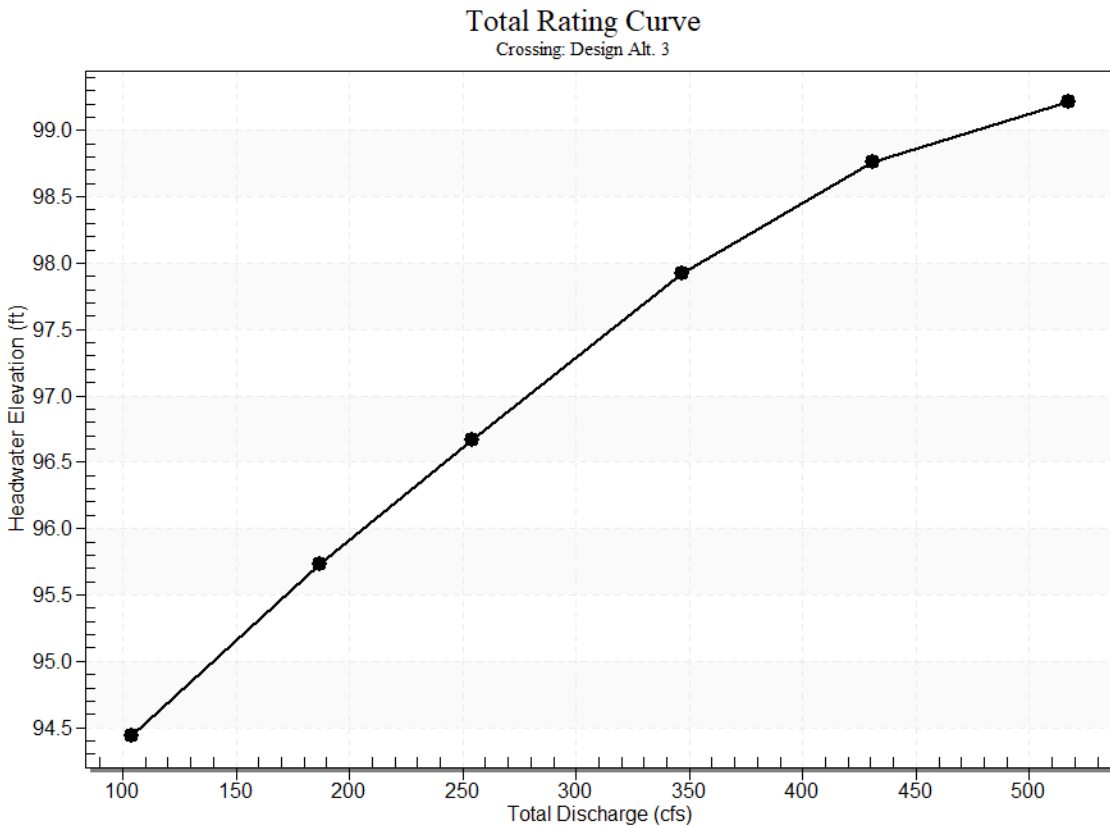
Crossing Discharge Data

Discharge Selection Method: User Defined

Table 1 - Summary of Culvert Flows at Crossing: Design Alt. 3

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	128x83 CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
94.44	2yr	104.00	104.00	0.00	1
95.73	5yr	187.00	187.00	0.00	1
96.66	10yr	254.00	254.00	0.00	1
97.92	25yr	347.00	345.93	1.06	6
98.76	50yr	431.00	404.87	26.12	5
97.61	Overtopping	323.07	323.07	0.00	Overtopping

Rating Curve Plot for Crossing: Design Alt. 3



Culvert Data: 128x83 CMP

Table 1 - Culvert Summary Table: 128x83 CMP

Disc harg e Nam es	Total Disc harg e (cfs)	Culv ert Disc harg e (cfs)	Head water Eleva tion (ft)	Inle t Con trol Dep th (ft)	Out let Con trol Dep th (ft)	Fl ow Ty pe	Nor mal Dep th (ft)	Crit ical De pth (ft)	Ou tle t De pth (ft)	Tail water r Dept h (ft)	Outl et Vel ocit y (ft/ s)	Tail water r Velo city (ft/s)
2yr	104.0 0 cfs	104.0 0 cfs	94.44	2.53	2.77 1	3- M 1t	1.73	1.5 3	2.0 5	2.05	5.00	4.49
5yr	187.0 0 cfs	187.0 0 cfs	95.73	3.83	4.06 5	3- M 1t	2.51	2.2 2	2.7 0	2.70	6.78	5.48
10yr	254.0 0 cfs	254.0 0 cfs	96.66	4.89	4.99 3	3- M 1t	3.10	2.6 9	3.1 3	3.13	7.93	6.08
25yr	347.0 0 cfs	345.9 3 cfs	97.92	6.22	6.25 1	3- M 2t	4.02	3.2 0	3.6 8	3.68	9.36	6.74
50yr	431.0 0 cfs	404.8 7 cfs	98.76	7.09	7.05 1	3- M 2t	4.75	3.5 2	4.1 4	4.14	9.94	7.23

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

Inlet Elevation (invert): 91.67 ft,

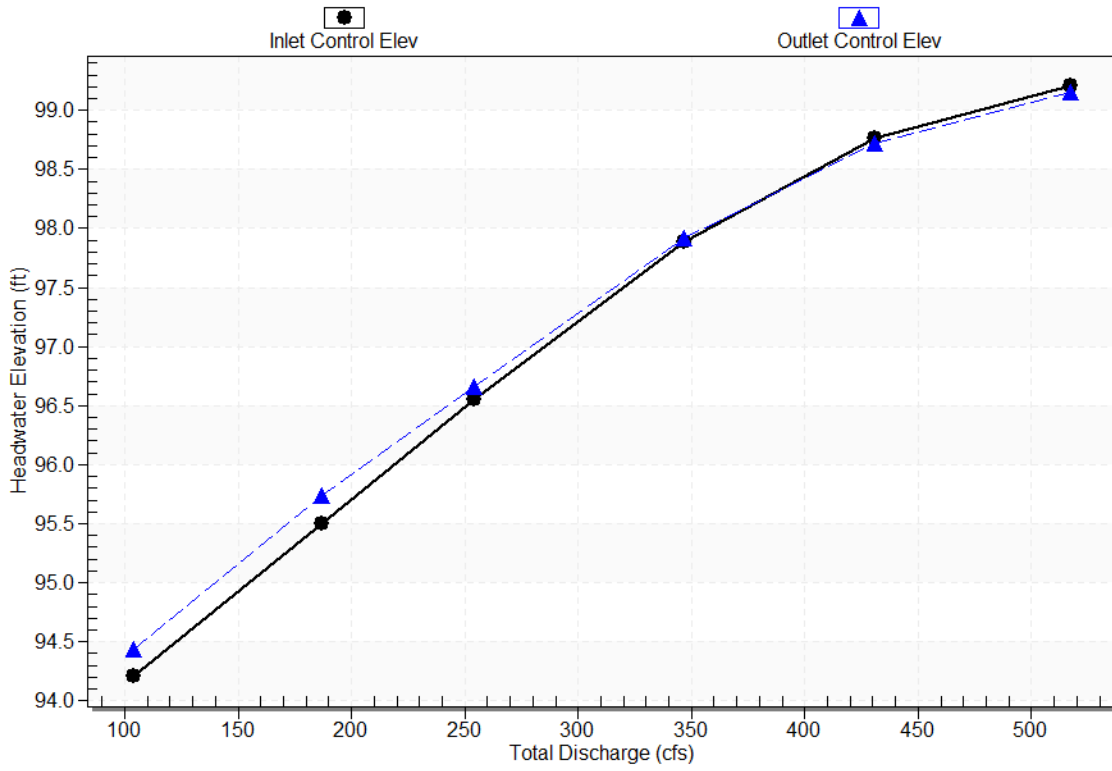
Outlet Elevation (invert): 91.27 ft

Culvert Length: 30.00 ft,

Culvert Slope: 0.0133

Culvert Performance Curve Plot: 128x83 CMP

Performance Curve Culvert: 128x83 CMP



Barrel Manning's n: 0.0270 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

Inlet Configuration: Projecting

Inlet Depression: None

Tailwater Data for Crossing: Design Alt. 3

Table 2 - Downstream Channel Rating Curve (Crossing: Design Alt. 3)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
104.00	93.32	2.05	4.49	1.67	0.67
187.00	93.97	2.70	5.48	2.19	0.69
254.00	94.40	3.13	6.08	2.54	0.69
347.00	94.95	3.68	6.74	2.99	0.70
431.00	95.41	4.14	7.23	3.36	0.70

Tailwater Channel Data - Design Alt. 3

Tailwater Channel Option: Irregular Channel

Channel Slope: Irregular Channel

User Defined Channel Cross-Section

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	98.76	0.0450
2	12.27	98.37	0.0450
3	18.92	98.46	0.0450
4	21.89	97.92	0.0450
5	22.61	93.58	0.0450
6	24.56	92.58	0.0450
7	26.34	91.41	0.0450
8	28.30	91.66	0.0450
9	31.46	91.27	0.0450
10	34.18	91.91	0.0450
11	35.45	92.21	0.0450
12	37.73	91.82	0.0450
13	39.58	93.11	0.0450
14	40.85	97.33	0.0450
15	43.52	98.12	0.0450
16	53.34	98.71	0.0450
17	67.60	97.60	0.0450

Roadway Data for Crossing: Design Alt. 3

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section

Coord No.	Station (ft)	Elevation (ft)
0	0.00	100.46
1	3.15	100.34
2	6.36	100.00
3	8.55	99.91
4	11.55	99.78
5	14.55	99.61
6	17.52	99.41
7	20.61	99.22
8	23.48	99.16
9	26.52	99.11
10	29.51	99.07
11	32.57	99.00
12	35.65	98.86
13	38.50	98.75
14	41.51	98.67
15	44.52	98.68
16	50.67	98.68
17	53.67	99.14
18	56.67	99.60
19	66.67	99.60
20	69.67	99.14
21	72.67	98.68
22	82.98	98.41
23	85.62	98.31
24	88.90	97.80
25	92.12	97.61
26	95.07	98.42
27	97.37	100.60
28	99.94	102.45
29	102.18	105.33
30	104.78	106.62
31	107.78	107.72
32	110.40	108.96
33	113.64	110.22
34	116.80	111.45
35	119.78	112.29
36	122.59	113.40
37	125.50	114.00

Roadway Surface: Gravel

Roadway Top Width: 22.00 ft

AOP Reach Data

AOP Discharges

Low AOP Flow: 1.00 cfs

High AOP Flow: 104.00 cfs

Peak AOP Flow: 431.00 cfs

Embedment Depth Check

Embedment Depth is NOT Acceptable

Embedment Depth 12.00 ft

Acceptable Embedment Depth 2.35 ft

Shear computed in Reach and Culvert Barrel

Bed is NOT Stable under High Flow

Bed Mobility is NOT Acceptable under High Flow

Shear Applied to Culvert Bed under High Flow 1.29 lb/ft²

Shear Permissible to Culvert Bed's Upper Layer 0.74 lb/ft²

Maximum Shear Applied to Reach Cross-Sections under High Flow 2.09 lb/ft²

Bed is NOT Stable under Peak Flow

Lower Layer Bed is Stable under Peak Flow

Shear Applied to Culvert Bed under Peak Flow 4.46 lb/ft²

Shear Permissible to Culvert Bed's Lower Layer 4.46 lb/ft²

Maximum Shear Applied to Reach Cross-Sections under Peak Flow 4.77 lb/ft²

Velocity computed in Reach and Culvert Barrel

Culvert Velocity is Acceptable

Maximum Velocity within Culvert under High Flow 5.64 ft/s

Maximum Velocity within Reach Cross-Sections under High Flow 7.09 ft/s

Velocity computed in Reach and Culvert Barrel

Culvert Depth is NOT Acceptable

Minimum Depth within Culvert under Low Flow 0.10 ft

Minimum Depth within Reach Cross-Sections under Low Flow 0.26 ft