CONTRACT DOCUMENTS AND SPECIFICATIONS FOR AIRPORT IMPROVEMENT PROJECT

For Ennis Municipal Airport
Ennis, Texas
TxDOT Solicitation No.: NTB2618ENNIS00033
TxDOT CSJ/Project No.: 2618ENNIS

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TxDOT Solicitation No.: NTB2618ENNIS00033

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NOTICE TO BIDDERS

NOTICE TO BIDDERS
Ennis Municipal Airport
TxDOT Solicitation No.: NTB2618ENNIS00033

Sealed bids for the construction of airport improvements at the Ennis Municipal Airport need to be addressed and delivered to Sheri Quinlan, TxDOT Aviation Division, 6230 E. Stassney Lane, 2nd Floor, Austin, Texas 78744. The delivered package must be clearly marked as "Bid Proposal". Bids will be received until 1:00 PM September 24, 2026, then publicly opened and read. Any bid received after closing time will be returned unopened.

In general, the Aviation Construction work consists of: Runway widening, Airfield Electrical, pavement rehabilitation and Taxiway A extension.

Engineers' Estimate of Probable Cost for this project is as follows:
Base Bid: $5,115,482.00
Additive Alternate 1: 718,919.00

Bidding documents may be reviewed at: Woolpert, 11750 Katy Freeway, Suite 1260 Houston, Texas 77079

Bidders may view and obtain plan sets, free of charge, from Plans Online at the following link https://www.dot.state.tx.us/business/plansonline/ftpinfo.htm on the TxDOT website. **Bidders are responsible for checking this website regularly for any changes to the bid documents, such as Addendums. TxDOT can only guarantee the accuracy of information on its Aviation Projects website located at http://www.txdot.gov/inside-txdot/division/aviation/projects.html.**

If another agency or construction data website references this project, please also refer to the TxDOT Aviation website mentioned above to verify the accuracy and completeness of the data.

TxDOT Aviation uses the eGrants electronic grant management system for projects beginning Fiscal Year 2017. The awarded bidder will be required to electronically submit contract documents, pay request forms, change order requests, certified payroll, DBE/HUB reports and insurance certificates. Signing the Bid Form certifies that the bidder meets the eGrants minimum system requirements in the External User Manual found at http://www.txdot.gov/government/funding/egrants-2016/aviation.html

To be placed on the Bidders List for this project, please email your company name, mailing address, and your phone & email address to AVNRFQ@txdot.gov.

Technical questions concerning the specifications should be directed at Gregory (Greg) S. Moore at 817-992-2997. Please call Sheri Quinlan, Contract Specialist, TxDOT Aviation at 512-416-4500 for questions concerning the bid document or further information.

Minimum wage rates have been predetermined as required by law and are set forth in the specifications.

Cashier's check, money order, or teller's check drawn by or on a state or national bank, a savings and loan association, or a state or federally chartered credit union (collectively referred to as "bank") in the amount of two percent (2%) of the total bid price stated in the bid, made payable without recourse to TxDOT Aviation, Agent for the Owner or a bid bond in the same amount from a reliable corporate surety authorized to do business in the State of Texas and acceptable to TxDOT Aviation, Agent for the Owner must accompany each bid as a guarantee that the bidder, if successful, will enter into a contract, and make bond in accordance with the requirements of the specifications. TxDOT Aviation reserves the right to retain any check, bank money order or bank draft as liquidated damages in the event the bidder withdraws its bid after the bids are opened and before official rejection of the bid by TxDOT Aviation/Owner, or, if successful in securing the award of the contract, the successful bidder fails to enter into the contract and fails to furnish satisfactory performance and payment bonds.

All noted documents below shall be completed and submitted to be considered a complete Bid Package. If any of the listed documents are incomplete or missing, the bid will be deemed non-responsive.

Required Documents:
☐ Bid Form
☐ Bid Bond (must include the Power Attorney and claim notice page)
☐ Required Language in Proposals for AIP Contracts
☐ Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion
☐ Buy American Certification
☐ Certification of Non-Segregated Facilities
☐ DBE Participation Plan: The DBE Participation Plan to meet the contract goal must be submitted no later than 5 calendar days from bid opening. If the contract goal is 0%, no DBE Participation Plan is required for solicitation. *When computing any period of time described in this part, the day from which the period begins is not counted, and when the last day of the period is a Saturday, Sunday, or Federal holiday, the period extends to the next day that is not a Saturday, Sunday, or Federal holiday. Similarly, in circumstances where the recipient's offices are closed for all or part of the last day, the period extends to the next day on which the agency is open.* 1) DBE Commitment Agreement Form No. SMS.4901, 2) DBE Program Material/Supplier Form No. SMS.4901-MS and, 3) DBE Trucking Commitment Form No. SMS.4901-T. 4) Form 4000 Contractor's Certification Good Faith Effort **(if unable to meet contract goal)** Use the appropriate DBE Commitment Agreement or Good faith effort forms. There are three different DBE commitment forms available. Use the applicable commitment or GFE forms that apply to your subcontract plan. You and the DBE subcontractors must complete and sign the forms. Return them and the signed DBE Participation Plan by the required date.

The successful bidder will be required to furnish a Performance Bond and Payment Bond with the Power of Attorney and claim page, each in the full amount of the contract price, executed by a surety company or surety companies authorized to execute surety bonds under and in accordance with the laws of the State of Texas.

The Agent reserves the right to reject any bid and the right to waive technicalities if such waiver is in the best interest of the Owner and conforms to State and local laws and ordinances pertaining to the letting of construction contracts.

The Agent, in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252, 42 U.S.C. §§ 2000d to 2000d-4) and the Regulations, hereby notifies all bidders that it will affirmatively ensure that any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, or national origin in consideration for an award. The Disadvantage Business Enterprise (DBE) Goal is (0) %.

The proposed contract is subject to 49 CFR Part 26 concerning the participation of Disadvantaged Business Enterprises and is under and subject to Executive Order 11246 of September 24, 1965, and to the Equal Opportunity Clause contained in the bidding documents.

The proposed contract is subject to the Aviation Safety and Capacity Expansion Act of 1990.

A pre-bid conference concerning this project will be held at 1:00 PM on September 8, 2026, at Ennis Municipal Airport, 100 Airport Dr., Ennis Texas 75119.

City of Ennis

REQUIRED LANGUAGE IN PUBLISHED ADVERTISEMENT FOR AIP CONSTRUCTION CONTRACTS

REQUIRED LANGUAGE IN PUBLISHED ADVERTISEMENT FOR BIDS FOR AIP CONSTRUCTION CONTRACTS

A. **Required Language In Published Advertisements For Bids All AIP Contracts:**

(1) Policy. It is the policy of the Department of Transportation (DOT) that disadvantaged business enterprises as defined in 49 CFR Part 26 shall have the maximum opportunity to participate in the performance of contracts financed in whole or in part with Federal funds.

(2) Buy American Provision.

The proposed contract is subject to the Buy American provision under Section 9129 of the Aviation Safety and Capacity Expansion Act of 1990. Details of such requirement are contained in the Specifications.

B. **Additional Language Required in Published Advertisement For Bids For AIP Contract Where The Sponsor Has A DBE Program In Effect Or Is Required By 49 CFR Part 26 To Have An Approved DBE Program**.

All bidders and proposers shall make good faith efforts as defined in Appendix A of 49 CFR Part 26, Regulations of the Office of the Secretary of Transportation, to subcontract 0**%** of the dollar value of the prime contract. The apparent successful bidder (proposer) will be required to submit information concerning the DBEs that will participate in this contract. The information will include the name and address for each DBE, a description of the work to be performed by each named firm, and the dollar value of the contract (subcontract). If the bidder fails to achieve the contract goal as stated herein, it will be required to provide documentation demonstrating that it made good faith efforts in attempting to do so. A bid that fails to meet these requirements will be considered non-responsive.

C. **Required Notes for Contract over $10,000.**

The regulations and orders of the Secretary of Labor, OFCCP and FAR 152.61 require the contractor(s) include, in invitations for bids or negotiations for contract over $10,000, the following notices:

(1) The proposed contract is under and subject to Executive Order 11246 of September 24, 1965, and to the Equal Opportunity Clause. The Bidder's (Proposer's) attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth in the Specifications.

(2) The Bidder (Proposer) must supply all the information required by the bid or proposal form.

(3) The successful bidder will be required to submit a Certification of Non-segregated Facilities prior to award of the contract, and to notify prospective subcontractors of the requirement for such a Certification where the amount of the subcontract exceeds $10,000. Samples of the Certifications and Notice to Subcontractors appear in the Specifications.

(4) Women will be afforded equal opportunity in all areas of employment. However, the employment of women shall not diminish the standards or requirements for the employment of minorities.

D. **Contract in Excess of $50,000.**

For contracts of $50,000 or more, a contractor having 50 or more employees, and his subcontractors having 50 or more employees and who may be awarded a subcontract of $50,000 or more, will be required to maintain an affirmative action program within 120 days of the commencement of the contract.

E. **Additional Notices for $1 Million Contracts.**

(1) Pre-award Equal Opportunity Compliance Reviews. Where the bid of the apparent low responsible bidder is in the amount of $1 million or more, the bidder and his known all-tier subcontractors which will be awarded subcontracts of $1 million or more will be subject to full on-site, pre-award equal opportunity compliance reviews before the award of the contract for the purpose of determining whether the bidder and his subcontractor are able to comply with the provisions of the equal opportunity clause.

(2) Compliance Reports. Within 30 days after award of this contract, the contractor shall file a compliance report (Standard Form 100) if:

(a) The contractor has not submitted a complete compliance report within 12 months preceding the date of award; and

(b) The contractor is within the definition of "employer" in Paragraphs 2e(3) of the instructions included in Standard Form 100.

(3) The contractor shall require the subcontractor on all-tier subcontracts, irrespective of dollar amount, to file Standard Form 100 within 30 days after award of the subcontract if the above two conditions apply. Standard Form 100 will be furnished upon request.

SPECIAL NOTICE TO BIDDERS

SPECIAL NOTICE TO BIDDERS

Buy American-Steel and Manufactured Products for Construction Contracts
(Aviation Safety and Capacity Expansion Act of 1990)

(A) The Aviation Safety and Capacity Expansion Act of 1990 provides that preference be given to steel and manufactured products produced in the United States when funds are expended pursuant to grant issued under this Airport Improvements Program. The following terms apply:

1. Steel and manufactured products. As used in this clause, steel and manufactured products include (1) steel produced in the United States or (2) a manufactured product produced in the United States, if the cost of its components mined, produced or manufactured in the United States exceed 60 percent of the cost of all its components and final assembly has taken place in the United States. Components of foreign origin of the same class or kind as the products referred to in subparagraphs (b) (1) or (2) shall be treated as domestic.

2. Components.As used in this clause, components mean those articles, materials, and supplies incorporated directly into steel and manufactured products.

3. Cost of Components. This means the cost of production of the components, exclusive of final assembly labor costs.

(B) The successful bidder will be required to assure that only domestic steel and manufactured products will be used by the Contractor, subcontractor's materialmen, and suppliers in the performance of this contract, except those

1. That the U.S. Department of Transportation has determined, under the Aviation Safety and Capacity Expansion Act of 1990, are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality;

2. That the U.S. Department of Transportation has determined, under the Aviation Safety and Capacity Expansion Act of 1990, that domestic preference would be inconsistent with the public interest; or

3. That inclusion of domestic material will increase the cost of the overall project by contract more than 25 percent.

BIDDER QUALIFICATIONS

BIDDER QUALIFICATIONS

I. QUALIFICATIONS

A. Each Bidder shall furnish the Texas Department of Transportation, Aviation Division with satisfactory evidence of the Bidder's competency to perform the proposed work. Such evidence of competency shall consist of statements covering the Bidder's past experience on similar work, a list of equipment that would be available for the work, and a list of key personnel that would be available.

B. In addition, each Bidder shall furnish the Texas Department of Transportation, Aviation Division, with satisfactory evidence of the Bidder's financial responsibility. Such evidence shall consist of a confidential statement or report of the Bidder's financial resources and liabilities as of the last calendar year or the Bidder's last fiscal year. Such statements or reports shall be prepared by a public accountant. At the time of submitting such financial statements or reports, the Bidder shall further certify whether the Bidder's financial responsibility is approximately the same as stated or reported by the public accountant. If the Bidder's financial responsibility has changed, the Bidder shall qualify the public accountant's statement or report to reflect the Bidder's true financial condition at the time such qualified statement or report is submitted to the Texas Department of Transportation.

C. If a Bidder is fully prequalified or prequalified under the bidder’s questionnaire with the Texas Department of Transportation (TxDOT) and is on the TxDOT current "bidders list", such evidence of current TxDOT prequalification may be submitted as evidence of financial responsibility and competency in lieu of the above certified statements or reports. The bidders must acknowledge and sign the type of pre-qualification on the bid form. Bidders understand their limitations of prequalification both financially and for approved work experience related to airport development projects.

D. If awarded the contract the bidder shall be required to submit a TxDOT - Certificate of Insurance form naming the Texas Department of Transportation as an additional insured and with a waiver of subrogation in favor of the Texas Department of Transportation. Insurance requirements are listed in the **Aviation Division General Construction Contract Provisions, volume dated February 2013.**

II. SUBMISSION OF QUALIFICATIONS

A. Each bidder shall submit the Bidder's "evidence of competency" and "evidence of financial responsibility", to the Texas Department of Transportation, Aviation Division at the date, time and location specified for opening bids. These items shall be submitted in the envelope with your bid marked with project number, location of airport, and name and business address of the bidder.

B. Bids that do not include the qualification requirements listed above will be considered non-responsive and therefore disqualified.

C. BIDS SUBMITTED WITHOUT AKNOWLEDGEMENT OR SUBMISSION OF ALL QUALIFICATIONS WILL NOT BE READ.

INSTRUCTION TO BIDDERS

INSTRUCTIONS TO BIDDERS

IB-1. **The Bidder shall reference the Aviation Division General Construction Contract Provisions, volume dated February 2013, for all general contract provisions**. General Construction Contract Provisions may be obtained at TxDOT, Aviation Division, 6230 E. Stassney Ln., Second Floor, Austin, Texas 78744; Use latest version of referenced Advisory Circulars.

IB-2. The Bidder shall refer to Section 20, BID REQUIREMENTS AND CONDITIONS of the GENERAL PROVISIONS.

IB-3. The Bidder shall refer to: BIDDER QUALIFICATIONS section of the bid document and Section 20-02, PREQUALIFICATION OF BIDDERS of the GENERAL PROVISIONS.

IB-4. The Bidder must submit the completed bid on the formatted bid form furnished by TxDOT, with all blank spaces in the TxDOT bid form correctly typed in for each and every item for which a quantity is given.

The Bidder shall sign the bid in ink. If the bid is made by an individual, the individual's name and address must be shown. If made by a partnership, the name and address of each member of the partnership must be shown. If made by a corporation, the person signing the bid shall give the name of the state under the laws of which the corporation was chartered and the name, titles, and business address of the president, secretary, and the treasurer.

IB-5. The Bidder shall submit completed copies of all items identified under “Bidder Qualifications”. ***Bids received without Bidder Qualifications will not be read.***

IB-6. The REQUIRED LANGUAGE IN PROPOSALS FOR AIP CONTRACTS, CERTIFICATION REGARDING DEBARMENT, CERTIFICATION REGARDING FOREIGN TRADE, BUY AMERICAN CERTIFICATION, CERTIFICATION OF BIDDER REGARDING EQUAL EMPLOYMENT OPPORTUNITY, and the CERTIFICATION OF NON-SEGREGATED FACILITIES, contained in the bid document shall be completed by the Bidder and submitted with the Bid.

IB-7. Receipt of all addenda issued shall be acknowledged by the Bidder in the space provided on the Bid Form.

IB-8. Bids may be rejected if they show any alteration of words or figures, additions not called for, conditional or uncalled for alternate bids, incomplete bids, any alteration of words or figures or changes not initialed by the person or persons signing the bid, or irregularities of any kind.

IB-9. The bid shall be accompanied by a Bid Guarantee of the character and in the amount as indicated in the bid.

IB-10. Any questions arising during the advertising period as to meaning or intent of the specifications will be answered by an addendum prepared by the Engineer. Contractor shall be responsible for obtaining addenda for each interested project at our website: http://www.txdot.gov/inside-txdot/division/aviation/projects.html. All addenda issued shall become a part of the contract documents.

Bidders are responsible for checking this website regularly for any changes to the bid documents, such as Addendums.

IB-11. The Texas Department of Transportation (TxDOT) shall accept as Disadvantaged Business Enterprises (DBEs) only those firms currently certified as such by the Texas Unified Certification Program (TUCP).

IB-12. Each bid submitted shall be placed in a sealed envelope plainly marked with the project number, location of airport, and name and business address of the Bidder on the outside. When sent by mail, preferably registered, the sealed bid, marked as indicated above, should be enclosed in an additional envelope. Bids, which are transmitted by telephone, by telegraph or by electronic means, will not be accepted.

IB-13. No bid will be considered unless received at the place specified in the advertisement before the time specified for opening all bids. Bids received after the bid opening time shall be returned to the Bidder unopened.

IB-14. Bids will be opened and read publicly at the time and place indicated in the Notice to Bidders.

IB-15. Generally, materials incorporated into a project, such as concrete, rebar, asphalt, etc., are tax exempt. Other items not incorporated into the project such as barricades and equipment rental may be subject to sales tax. A copy of the Texas Sales and Use Tax Exemption form is available through the State Comptroller website at https://comptroller.texas.gov/forms/01-339.pdf This form is a self-certification process. The contractor must complete the form and retain the document in their files. A copy of the form should be sent to the seller/supplier. Bidders should contact their tax consultant or the Texas Office of the Comptroller with any questions related to the payment of sales tax.

IB-16. In accordance with 49 CFR Part 26.53 the bidder/offeror must submit an acceptable DBE plan and commitment or good faith effort to meet the contract goal no later than 5 calendar days after bid opening as a matter of responsibility. (A DBE Participation Plan is not required on contract with 0% DBE Goal.) For all federally funded construction projects with a DBE goal, bidders shall use the attached DBE participation plan and appropriate commitment agreement form/s and submit these documents to TxDOT Aviation within 5 calendar days after the bid opening via email to AVNRFQ@txdot.gov.

BID FORM

BID FORM

To obtain a formatted Bid Form, please go to either:

1. TxDOT Aviation Projects at:
http://www.dot.state.tx.us/AVN/avninfo/proposal/construct/index.htm

Or,

2. TxDOT Plans Online at:
http://www.txdot.gov/inside-txdot/division/support/plans-online.html

- The online formatted bid form should be accessed with Internet Explorer. It will not open when using Chrome.
- The bid form is formatted and allows for online input of numeric unit prices.
- Do not handwrite numeric unit prices on this formatted bid form.
- The formatted bid form should be completed online and then printed, signed and delivered to the appropriate location for the bid opening.

Bid Package Responsiveness Checklist:

The following are required in order for the bid to be responsive. Bids without the following will be deemed non-responsive.

To be included with or on Bid Form

- ☐ All blanks in the bid form filled in electronically
- ☐ Addenda acknowledged (if any) Handwritten acknowledgement of addenda, in excess of 3, is required
- ☐ Bid Form signed, original in ink
- ☐ Bid form qualifications acknowledged and signed, or prequalification letter enclosed (will be used to establish bidder responsibility)
- ☐ Qualification Acknowledgement or Qualification Statement Submitted
- ☐ 2% Bid Bond, Power of Attorney, and claim page with the correct project number
- ☐ Required Language in Proposals for AIP Contracts Form
- ☐ Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion
- ☐ Buy American Certification
- ☐ Certification of Non-Segregated Facilities

☐ within 5 days of bid opening, SUBMIT DBE plan and commitment agreements TO MEET THE CONTRACT GOAL to AVNRFQ@txdot.gov if applicable on federally funded projects with a posted DBE goal

TxDOT may consider a bid non-responsive or disqualify a bidder after the reading of bids per General Provision 20-07 and General provision 20-13.

BID BOND

Bid Bond

Bid Bond - original equal to 2% of total bid.

A bid bond may be issued on any form acceptable to the bidder’s Surety Company.

SPECIAL INSTRUCTION TO BIDDERS REGARDING EEO

SPECIAL INSTRUCTION TO BIDDERS REGARDING EEO

Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity (Executive Order 11246, as amended)

1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth herein.

2. The goals and timetables for minority and female participation, expressed in percentage terms for the contractor's aggregate work force in each trade on all construction work in the covered area, are as follows:

Goals for minority participation in each trade	Goals for female participation in each trade
18.2%	6.9%

These goals are applicable to all the contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area. If the contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the contractor is also subject to the goals for both its federally involved and non-federally involved construction.

The contractor's compliance with the executive order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR Part 60-4.3 (a), and its efforts to meet the goals established for the geographical area where the contract resulting from this solicitation is to be performed. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from contractor to contractor or from project to project, for the sole purpose of meeting the contractor's goals, shall be a violation of the contract, the executive order, and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The contractor shall provide written notifications to the Director, OFCCP, within 10 working days of award of any construction subcontract in excess of $10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address, and telephone number of the subcontractor; employee identification number; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the contract is to be performed.

4. As used in this notice and in the contract resulting from this solicitation, the "covered area" is City of Ennis, Ellis County, Texas.

REQUIRED LANGUAGE IN PROPOSALS FOR AIP CONTRACTS

REQUIRED LANGUAGE IN PROPOSALS FOR AIP CONTRACTS

(Please complete & return in bid package)

Section 60-1.7(b) of the Regulations of the Secretary of Labor requires each bidder or prospective prime contractor and proposed subcontractor, where appropriate, to state in the bid or at the outset of negotiations for the contract whether it has participated in any previous contract or subcontract subject to the equal opportunity clause; and if so, whether it has filed with the Joint Reporting Committee, the Director, an agency, or the former President's Committee on Equal Employment Opportunity all reports due under the applicable filing requirements. In any case in which a bidder or prospective prime contractor or proposed subcontractor which participated in a previous contract subject to Executive Order 10925, 11114. or 11246 has not filed a report due under the applicable filing documents, no contract or subcontract shall be awarded unless such contractor submits a report covering the delinquent period or such other period specified by the FAA or the Director, OFCCP.

Bid or Proposal Form. To effectuate the foregoing requirements, the sponsor is required to include in the bid or proposal form a statement substantially as follows:

The bidder (proposer) shall complete the following statements by checking the appropriate space.

The undersigned certifies on behalf of _____, that

☐ It has developed and has on file at each establishment affirmative action programs pursuant to 41 CFR Part 60-2 (Affirmative Action Programs).

☐ It is not subject to the requirements to develop an affirmative action program under 41 CFR Part 60-2 (Affirmative Action Programs).

The bidder (proposer) has _____ has not _____ participated in a previous contract subject to the equal opportunity clause prescribed by Executive Order 10925, or Executive Order 11114, or Executive Order 11246.

The bidder (proposer) has _____ has not _____ submitted all compliance reports in connection with any such contract due under the applicable filing requirements; and that representations indicating submission of required compliance reports signed by proposed subcontractors will be obtained prior to award of subcontracts.

If the bidder (proposer) has participated in a previous contract subject to the equal opportunity clause and has not submitted compliance reports due under applicable filing requirements, the Bidder (Proposer) shall submit a compliance report on Standard Form 100, 'Employee Information Report EEO-l prior to the award of contract.

Standard Form 100 is normally furnished to contractors annually, based on a mailing list currently maintained by the Joint Reporting Committee. In the event a contractor has not received the form, he may obtain it by writing to the following address:

Joint Reporting Committee
1800 G Street
Washington, DC 20506
(2/92)

_____ _____

Signature of Company Official Date

CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion
(49 CFR PART 29, Executive Order GA-48)
(Please complete & return in bid package)

The bidder (offeror) certifies, by submission of this proposal or acceptance of this contract, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency. It further agrees that by submitting this proposal that it will include this clause without modification in all lower tier transactions, solicitations, proposals, contracts, and subcontracts. Where the bidder/offeror/contractor or any lower tier participant is unable to certify this statement, it shall attach an explanation to this solicitation/proposal.

Certification Regarding Foreign Trade Restrictions
(49 CFR PART 30 and Executive Order GA-48)

The contractor or subcontractor, by submission of an offer and/or execution of a contract, certifies that neither it, nor its holding companies or subsidiaries, is:

a. is not owned or controlled by one or more citizens or nationals of a foreign country included in the list of countries that discriminate against U.S. firms published by the Office of the United States Trade representative (USTR);
b. has not knowingly entered into any contract or subcontract for this project with a contractor that is a citizen or national of a foreign country on said list or is owned or controlled directly or indirectly by one or more citizens or nationals of a foreign country on said list.
c. has not procured any product nor subcontracted for the supply of any product for use on the project that is produced in a foreign country on said list.

By signing and dating this form Bidder is certifying that the responding Company, or any of its holding companies or subsidiaries, is not:

a. Listed in Section 889 of the 2019 National Defense Authorization Act;
b. Listed in Section 1260H of the 2021 National Defense Authorization Act; or
c. Owned by the government of a country on the U.S. Department of Commerce's foreign adversaries list under 15 C.F.R Section 791.4; or
d. Controlled by any governing or regulatory body located in a country on the U.S. Department of Commerce's foreign adversaries list under 15 C.F.R Section 791.4

Unless the restrictions of this clause are waived by the Secretary of Transportation in accordance with 49 CFR 30.17, no contract shall be awarded to a contractor or subcontractor who is unable to certify to the above. If the contractor knowingly procures or subcontracts for the supply of any product or service of a foreign country on said list for use on the project, the Federal Aviation Administration may direct, through the sponsor, cancellation of the contract at no cost to the Government.

Further, the contractor agrees that, if awarded a contract resulting from this solicitation, it will incorporate this provision for certification without modification in each contract and in all lower tier subcontracts. The contractor may rely upon the certification of a prospective subcontractor unless it has knowledge that the certification is erroneous. The contractor shall provide immediate written notice to the sponsor if the contractor learns that its certification or that of a subcontractor was erroneous when submitted or has become erroneous by reason of changed circumstances. The subcontractor agrees to provide immediate written notice to the contractor, if at any time it learns that its certification was erroneous by reason of changed circumstances.

Signature of Company Official: _____

Date: _____

BUY AMERICAN CERTIFICATION

Buy American Certification
(Aviation Safety and Capacity Expansion Act of 1990)
(Please complete & return in bid package)

By submitting a bid/proposal under this solicitation, the contractor agrees to comply with 49 USC § 50101, which provides that Federal funds may not be obligated unless all steel and manufactured goods used in AIP-funded projects are produced in the United States, unless the FAA has issued a waiver for the product; the product is listed as an Excepted Article, Material Or Supply in Federal Acquisition Regulation subpart 25.108; or is included in the FAA Nationwide Buy American Waivers Issued list. Except for those items listed by the offeror below or on a separate and clearly identified attachment to this bid/proposal, the offeror certifies that steel and each manufactured product, is produced in the United States (as defined in the clause Buy American - Steel and Manufactured Products for Construction Contracts) and that components of unknown origin are considered to have been produced or manufactured outside the United States.

☐ We certify that we comply with this provision and don't have any exceptions to list.

-OR-

☐ We certify that we comply with this provision except for the products listed below.

PRODUCT	COUNTRY OF ORIGIN

_____ _____

Signature of Company Official Date

Certification of Non-Segregated Facilities

CERTIFICATION OF NON-SEGREGATED FACILITIES
(Please complete & return in bid package)

NOTICE TO PROSPECTIVE FEDERALLY ASSISTED CONSTRUCTION CONTRACTORS
(41 CFR 60-1.8)

(1) A Certification of Non-Segregated Facilities must be submitted prior to the award of a federally assisted construction contract exceeding $10,000 which is not exempt from the provisions of the equal opportunity clause.

(2) Contractors receiving federally assisted construction contract awards exceeding $10,000 which are not exempt from the provisions of the equal opportunity clause will be required to provide for the forwarding of the following notice to prospective subcontractors for supplies and construction contracts where the subcontracts exceed $10,000 and are not exempt from the provisions of the equal opportunity clause.

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENTS FOR CERTIFICATION OF NON-SEGREGATED FACILITIES

(1) A Certification of Non-Segregated Facilities must be submitted prior to the award of a subcontract exceeding $10,000 which is not exempt from the provisions of the equal opportunity clause.

(2) Contractors receiving subcontract awards exceeding $10,000 which are not exempt from the provisions of the equal opportunity clause will be required to provide for the forwarding of this notice to prospective subcontractors for supplies and construction contracts where the subcontracts exceed $10,000 and are not exempt from the provisions of the equal opportunity clause.

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

_____ _____

Signature of Company Official Date

DISADVANTAGED BUSINESS ENTERPRISE

Disadvantaged Business Enterprise in Federal-Aid Contracts

1. DESCRIPTION

The purpose of this Special Provision is to carry out the U.S. Department of Transportation's (DOT) policy of ensuring nondiscrimination in the award and administration of DOT-assisted Contracts and creating a level playing field on which firms owned and controlled by individuals who are determined to be socially and economically disadvantaged can compete fairly for DOT-assisted Contracts.

2. DISADVANTAGED BUSINESS ENTERPRISE IN FEDERAL-AID CONTRACTS

2.1. **Policy.** It is the policy of the DOT and the Texas Department of Transportation, Aviation Division (Department) that DBEs, as defined in 49 CFR Part 26, Subpart A, and the Department's DBE Program, will have the opportunity to participate in the performance of Contracts financed in whole or in part with federal funds. The DBE requirements of 49 CFR Part 26, and the Department's DBE Program, apply to this Contract as follows.

The Contractor will solicit DBEs through reasonable and available means, as defined in 49 CFR Part 26, Appendix A, and the Department's DBE Program, or show a good faith effort to meet the DBE goal for this Contract.

The Contractor, subrecipient, or subcontractor will not discriminate on the basis of race, color, national origin, or sex in the performance of this Contract. Carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT-assisted Contracts. Failure to carry out these requirements is a material breach of this Contract, which may result in the termination of this Contract or such other remedy as the Department deems appropriate.

The requirements of this Special Provision must be physically included in any subcontract.

By signing the Contract proposal, the Bidder is certifying that the DBE goal as stated in the proposal will be met by obtaining commitments from eligible DBEs or that the Bidder will provide acceptable evidence of good faith effort to meet the commitment.

2.2. **Definitions.**

2.2.1. **Administrative Reconsideration.** A process by which the low bidder may request reconsideration when the Department determines the good faith effort (GFE) requirements have not been met.

2.2.2. **Commercially Useful Function (CUF).** A CUF occurs when a DBE has the responsibility for the execution of the work and carrying out such responsibilities by actually performing, managing, and supervising the work.

2.2.3. **Disadvantaged Business Enterprise (DBE).** A for-profit small business certified through the Texas Unified Certification Program in accordance with 49 CFR Part 26.

2.2.4. **DBE Joint Venture.** An association of a DBE firm and one or more other firms to carry out a single business enterprise for profit for which purpose they combine their property, capital, efforts, skills, and knowledge, and in which the DBE is responsible for a distinct, clearly defined portion of the work of the Contract and whose share in the capital contribution, control, management, risks, and profits of the joint venture are commensurate with its ownership interest.

2.2.5. **DOT.** The U.S. Department of Transportation, including the Office of the Secretary, the Federal Highway Administration (FHWA), the Federal Transit Administration (FTA), and the Federal Aviation Administration (FAA).

2.2.6. **Federal-Aid Contract.** Any Contract between the Department and a Contractor that is paid for in whole or in part with DOT financial assistance.

2.2.7. **Good Faith Effort.** All necessary and reasonable steps to achieve the contract goal which, by their scope, intensity, and appropriateness to the objective, could reasonably be expected to obtain sufficient DBE participation, even if not fully successful. Good faith efforts are evaluated prior to award and throughout performance of the Contract. For guidance on good faith efforts, see 49 CFR Part 26, Appendix A.

2.2.8. **North American Industry Classification System (NAICS).** A designation that best describes the primary business of a firm. The NAICS is described in the North American Industry Classification Manual—United States, which is available on the Internet at the U.S. Census Bureau website: http://www.census.gov/eos/www/naics/.

2.2.9. **DBE-Conscious.** A measure or program that is focused specifically on assisting only DBEs

2.2.10. **DBE-Neutral DBE Participation.** Any participation by a DBE through customary competitive procurement procedures.

2.2.11. **Texas Unified Certification Program (TUCP) Directory.** An online directory listing all DBEs currently certified by the TUCP. The Directory identifies DBE firms whose participation on a Contract may be counted toward achievement of the assigned DBE Contract goal. The Directory can be accessed at the following website: https://txdot.txdotcms.com/FrontEnd/searchcertifieddirectory.asp

2.3. **Contractor's Responsibilities.**

2.3.1. **DBE Liaison Officer**. Designate a DBE liaison officer who will administer the Contractor's DBE program and who will be responsible for maintenance of records of efforts and contacts made to subcontract with DBEs.

2.3.2. **Compliance Tracking System (CTS)**. TxDOT Aviation uses the eGrants electronic grant management system for projects beginning Fiscal Year 2017. The awarded bidder will be required to electronically submit contract documents, pay request forms, change order requests, certified payroll, DBE/HUB reports and insurance certificates. Signing the Bid Form certifies that the bidder meets the eGrants minimum system requirements in the External User Manual found at http://www.txdot.gov/government/funding/egrants-2016/aviation.html.

2.3.3. **Bidder.** If the DBE documentation was not submitted with the bid, the apparent low bidder must submit a DBE plan and commitments to satisfy the DBE goal or submit good faith effort Form 4000. and supporting documentation demonstrating why the goal could not be achieved, in whole or part, **no later than 5 calendar days after bid opening**. The means of transmittal and the risk of timely receipt of the information will be the bidder's responsibility and no extension of the 5-calendar-day timeframe will be allowed for any reason. The bidder may use the DBE forms provided in the bid document and must follow the instructions on the commitment form.

2.3.4. **DBE Contractor.** A DBE Contractor may receive credit toward the DBE goal for work performed by its own forces and work subcontracted to DBEs. In the event a DBE subcontracts to a non-DBE, that information must be reported monthly.

2.3.5. **DBE Committal.** Only those DBEs certified by the TUCP are eligible for goal attainment. The Department maintains the TUCP DBE Directory. The Directory can be accessed at the following website: https://txdot.txdotcms.com/FrontEnd/searchcertifieddirectory.asp

A DBE must be certified on the day the commitment is considered and at time of subcontract execution. It is the Contractor's responsibility to ensure firms identified for participation are approved certified DBE firms.

The Bidder is responsible to ensure that all submittals are checked for accuracy. Any and all omissions, deletions, and/or errors that may affect the end result of the commitment package are the sole liabilities of the bidder.

Commitments in excess of the goal are considered DBE-neutral commitments.

2.3.6. **Good Faith Effort Requirements.** A Contractor who cannot meet the Contract goal, in whole or in part, must make adequate good faith efforts to obtain DBE participation as so stated and defined in 49 CFR Part 26, Appendix A.

2.3.6.1. **Administrative Reconsideration.** If the Department determines that the apparent low bidder has failed to satisfy the good faith efforts requirement, the Department will notify the Bidder of the failure and will give the Bidder an opportunity to provide written documentation or argument concerning the issue of whether it met the goal or made adequate good faith efforts to do so.

The Bidder must request an administrative reconsideration of that determination within 3 days of the date of receipt of the notice. The request must be submitted directly to the Texas Department of Transportation, Aviation Division, 125 East 11th Street, Austin, Texas 78701-2483.

If a request for administrative reconsideration is not filed within the period specified, the determination made is final and further administrative appeal is barred.

If a reconsideration request is timely received, the reconsideration decision will be made by the DBE liaison officer or, if the DBE liaison officer took part in the original determination, the Department Division Director will appoint another employee to perform the administrative reconsideration. The employee will hold a leadership position and will report directly to the Division Director.

The meeting or written documentation must be provided or held within 7 days of the date the request was submitted.

The Department will provide to the Bidder a written decision if the Bidder did or did not make adequate good faith efforts to meet the Contract goal. The reconsideration decision is final and is not administratively appealed to DOT.

2.3.7. **Determination of DBE Participation.** The work performed by the DBE must be reasonably construed to be included in the work area and NAICS work code identified by the Contractor in the approved commitment.

Participation by a DBE on a Contract will not be counted toward DBE goals until the amount of the participation has been paid to the DBE.

Payments made to DBE that was not on the original commitment may be counted toward the Contract goal if that DBE was certified as a DBE before the execution of the subcontract and has performed a Commercially Useful Function.

The total amount paid to the DBE for work performed with its own forces is counted toward the DBE goal. When a DBE subcontracts part of the work of its Contract to another firm, the value of the subcontracted work may be counted toward DBE goals only if the subcontractor is itself a DBE.

DBE Goal credit for the DBE subcontractors leasing equipment or purchasing of supplies from the Contractor or its affiliates is not allowed. Project materials or supplies acquired from an affiliate of the Contractor cannot directly or indirectly (second or lower tier subcontractor) be used for DBE goal credit.

If a DBE firm is declared ineligible due to DBE decertification after the execution of the DBE's subcontract, the DBE firm may complete the work and the DBE firm's participation will be counted toward the Contract goal. If the DBE firm is decertified before the DBE firm has signed a subcontract, the Contractor is obligated to replace the ineligible DBE firm or demonstrate that it has made good faith efforts to do so.

The Contractor may count 100% of its expenditure to a DBE manufacturer. According to 49 CFR 26.55(e)(1)(i), a DBE manufacturer is a firm that owns (or leases) and operates a factory or establishment that produces, on the premises, the materials, supplies, articles, or equipment required under the contract and of the general character described by the specifications..

The Contractor may count only 60% of its expenditure to a DBE regular dealer. According to 49 CFR 26.55(e)(2)(i), a DBE regular dealer is a firm that owns (or leases) and operates a store, warehouse, or other establishment in which the materials, supplies, articles or equipment of the general character described by the specifications and required under the contract are bought, kept in in sufficient quantities, and regularly sold or leased to the public in the usual course of business. A firm must be an established business that engages in, as its principal business, and in its own name, the purchase and sale or lease of the products in question.

A regular dealer in such bulk items as petroleum products, steel, concrete or concrete products, gravel, stone, or asphalt without owning and operating a place of business if the firm both owns and operates distribution equipment used to deliver the products. Any supplementing of regular dealers' own distribution equipment must be by a long-term operating lease and not on an ad hoc or contract-by-contract basis.

The Contractor may count only 40% of its expenditure to a DBE distributor that neither maintains sufficient inventory nor uses its own distribution equipment for the products in question. According to 49 CFR 26.55(e)(3), a DBE distributor is a firm that is an established business that engages in the regular sale or lease of the items specified by the contract. A DBE distributor assumes responsibility for the items it purchases once they leave the point of origin (e.g., a manufacturer's facility), making it liable for any loss or damage not covered by the carrier's insurance. A DBE distributor performs a CUF when it demonstrates ownership of the items in question and assumes all risk for loss or damage during transportation, evidenced by the terms of the purchase order or a bill of lading (BOL) from a third party, indicating Free on Board (FOB) at the point of origin or similar terms that transfer responsibility of the items in question to the DBE distributor.

With respect to materials or supplies purchased from a DBE that is neither a manufacturer nor a regular dealer, the Contractor may count the entire amount of fees or commissions charged for assistance in the procurement of the materials and supplies, or fees or transportation charges for the delivery of materials or supplies required on a job site.

A Contractor may count toward its DBE goal a portion of the total value of the Contract amount paid to a DBE joint venture equal to the distinct, clearly defined portion of the work of the Contract performed by the DBE.

2.3.8. **Commercially Useful Function.** It is the Contractor’s obligation to ensure that each DBE used on federal-assisted contracts performs a commercially useful function on the Contract.

The Department will monitor performance during the Contract to ensure each DBE is performing a CUF.

Under the terms established in 49 CFR 26.55, a DBE performs a CUF when it is responsible for execution of the work of the Contract and is carrying out its responsibilities by actually performing, managing, and supervising the work involved.

With respect to material and supplies used on the Contract, a DBE must be responsible for negotiating price, determining quality and quantity, ordering the material, installing the material, if applicable, and paying for the material itself.

With respect to trucking, the DBE trucking firm must own and operate at least one fully licensed, insured, and operational truck used on the Contract. The DBE may lease trucks from another DBE firm, including an owner-operator who is certified as a DBE.

The DBE who leases trucks from another DBE receives credit for the total value of the transportation services the lessee DBE provides on the Contract. The DBE may also lease trucks from a non-DBE firm, including from an owner-operator. The DBE that leases trucks equipped with drivers from a non-DBE is entitled to credit for the total value of transportation services provided by non-DBE leased trucks equipped with drivers not to exceed the value of transportation services on the Contract provided by DBE-owned trucks or leased trucks with DBE employee drivers. Additional participation by non- DBE owned trucks equipped with drivers receives credit only for the fee or commission it receives as a result of the lease arrangement.

A DBE does not perform a CUF when its role is limited to that of an extra participant in a transaction, Contract, or project through which funds are passed in order to obtain the appearance of DBE participation. The Department will evaluate similar transactions involving non-DBEs in order to determine whether a DBE is an extra participant.

If a DBE does not perform or exercise responsibility for at least 30% of the total cost of its Contract with its own work force, or the DBE subcontracts a greater portion of the work than would be expected on the basis of normal industry practice for the type of work involved, the Department will presume that the DBE is not performing a CUF.

If the Department determines that a DBE is not performing a CUF, no work performed by such DBE will count as eligible participation. The denial period of time may occur before or after a determination has been made by the Department.

In case of the denial of credit for non-performance of a CUF, the Contractor will be required to provide a substitute DBE to meet the Contract goal or provide an adequate good faith effort when applicable.

2.3.8.1. **Rebuttal of a Finding of No Commercially Useful Function.** Consistent with the provisions of 49 CFR 26.55(c)(4) & (5), before the Department makes a final finding that no CUF has been performed by a DBE, the Department will notify the DBE and provide the DBE the opportunity to provide rebuttal information.

CUF determinations are not subject to administrative appeal to DOT.

2.3.9. **Joint Check.** The use of joint checks between a Contractor and a DBE is allowed with Department approval. To obtain approval, the Contractor must submit a completed Form 2178, "DBE Joint Check Approval," to the Department.

The Department will closely monitor the use of joint checks to ensure that such a practice does not erode the independence of the DBE nor inhibit the DBE's ability to perform a CUF. When joint checks are utilized, DBE credit toward the Contract goal will be allowed only when the subcontractor is performing a CUF in accordance with 49 CFR 26.55(c)(1).

Long-term or open-ended joint checking arrangements may be a basis for further scrutiny and may result in the lack of participation towards the Contract goal requirement if DBE independence cannot be established.

Joint checks will not be allowed simply for the convenience of the Contractor.

If the proper procedures are not followed or the Department determines that the arrangements result in a lack of independence for the DBE involved, no credit for the DBE's participation as it relates to the material cost will be used toward the Contract goal requirement, and the Contractor will need to make up the difference elsewhere on the project.

2.3.10. **DBE Termination and Substitution.** No DBE named in the commitment submitted under Section 2.3.5. will be terminated for convenience, in whole or part, without the Department's approval. This includes, but is not limited to, instances in which a Contractor seeks to perform work originally designated for a DBE subcontractor with its own forces or those of an affiliate, a non-DBE firm, or with another DBE firm.

Unless consent is provided, the Contractor will not be entitled to any payment for work or material unless it is performed or supplied by the listed DBE.

The Contractor, prior to submitting its request to terminate, must first give written notice to the DBE of its intent to terminate and the reason for the termination. The Contractor will copy the Department on the Notice of Intent to terminate.

The DBE has 5 calendar days to respond to the Contractor's notice and will advise the Contractor and the Department of the reasons, if any, why it objects to the proposed termination of its subcontract and why the Department should not approve the prime Contractor's request for termination.

The Department may provide a shorter response time if required in a particular case as a matter of public necessity.

The Department will consider both the Contractor's request and DBE's stated position prior to approving the request. The Department may provide a written approval only if it agrees, for reasons stated in its concurrence document, that the Contractor has good cause to terminate the DBE. If the Department does not approve the request, the Contractor must continue to use the committed DBE firm in accordance with the Contract. For guidance on what good cause includes, see 49 CFR 26.53.

Good cause does not exist if the Contractor seeks to terminate, reduce, or substitute a DBE it relied upon to obtain the Contract so that the Contractor can self-perform the work for which the DBE firm was engaged.

When a DBE subcontractor is terminated, make good-faith efforts to find, as a substitute for the original DBE, another DBE to perform, at least to the extent needed to meet the established Contract goal, the work that the original DBE was to have performed under the Contract.

Submit the completed Form 4010, "DBE Termination Request," and Form 4011 "DBE Substitution Request," within seven (7) days, which may be extended for an additional 7 days, if necessary, at the request of the Contractor. The Department will provide a written determination to the Contractor stating whether or not good faith efforts have been demonstrated. If the Department determines that good faith efforts were not demonstrated, the Contractor will have the opportunity to appeal the determination to the Aviation Division.

2.3.11. **Reports and Records.** By the 15th of each month and after work begins, report payments to meet the DBE goal and for DBE-neutral participation on projects with or without goals. These payment reports will be required until all DBE sub-contracting or material supply activity is completed. Negative payment reports are required when no activity has occurred in a monthly period.

2.3.12. Notify the Department if payment to any DBE subcontractor is withheld or reduced. Before receiving final payment from the Department, the Contractor must indicate a final payment on the compliance tracking system. The final payment is a summary of all payments made to the DBEs on the project. All records must be retained for a period of 3 years following completion of the

Contract work and must be available at reasonable times and places for inspection by authorized representatives of the Department or the DOT. Provide copies of subcontracts or agreements and other documentation upon request.

2.3.13. **Failure to Comply.** If the Department determines the Contractor has failed to demonstrate good faith efforts to meet the assigned goal, the Contractor will be given an opportunity for reconsideration by the Department.

A Contractor's failure to comply with the requirements of this Special Provision will constitute a material breach of this Contract. In such a case, the Department reserves the right to terminate the Contract; to deduct the amount of DBE goal not accomplished by DBEs from the money due or to become due the Contractor; or to secure a refund, not as a penalty but as liquidated damages, to the Department or such other remedy or remedies as the Department deems appropriate.

2.3.14. **Investigations.** The Department may conduct reviews or investigations of participants as necessary. All participants, including, but not limited to, DBEs and complainants using DBE Subcontractors to meet the Contract goal, are required to cooperate fully and promptly with compliance reviews, investigations, and other requests for information.

2.3.15. **Falsification and Misrepresentation.** If the Department determines that a Contractor or subcontractor was a knowing and willing participant in any intended or actual subcontracting arrangement contrived to artificially inflate DBE participation or any other business arrangement determined by the Department to be unallowable, or if the Contractor engages in repeated violations, falsification, or misrepresentation, the Department may:

- refuse to count any fraudulent or misrepresented DBE participation;
- withhold progress payments to the Contractor commensurate with the violation;
- reduce the Contractor's prequalification status;
- refer the matter to the Office of Inspector General of the US Department of Transportation for investigation; and/or
- seek any other available contractual remedy.

2.3.16. **Prompt Payment.** Texas Administrative Code, Title 43, Rule 9.208 requires contractors to promptly pay all subcontractors within 10 days after the date that the contractor receives payment for work performed by a subcontractor. In order to enforce Rule 9.208, the Contractor shall list the name and amount of each subcontract including DBE subcontractors that are proposed to meet the DBE goal, if any, in the CTS. The contractor will report payments to each subcontractor on a monthly basis and list reasons for nonpayment in the CTS.

DBE PARTICIPATION PLAN

TO DEMONSTRATE COMPLIANCE WITH CONTRACT GOAL THIS FORM MUST BE SUBMITTED AND RECEIVED NO LATER THAN 5 CALENDAR DAYS FROM BID OPENING at the following email address: AVNRFQ@txdot.gov

TxDOT Project No.: 2618ENNIS	**Project Airport: Ennis Municipal Airport**
Percentage Goal: 0%	**Contractor:**
Contractor Bid Amount:	**Notes:**

TX TAX Vendor Number (11 Digit #)	Name of DBE Sub/Supplier*	Type of Work	Amount ($)
			$
			$
			$
			$
			$
		b) Total Dollar Value of Participation	$

I propose to use the following DBE Plan in accordance with the requirements of the Disadvantaged Business Enterprise Assurances Attachment of the bid document and intend to utilize the following DBE firm(s) in performance of the contract. **Commitment Agreement Forms from these DBE firm(s) are attached to this DBE Participation Plan.**

*The VENDOR NUMBER(s) and SUBCONTRACTOR NAME(s) supplied on this report must match what appears in the Texas Unified Certification Program (TUCP) Directory (https://txdot.txdotcms.com/FrontEnd/searchcertifieddirectory.asp).

Acceptance of this DBE Participation Plan fulfills the requirements for only this DBE contract(s), between General Contractor and Subcontractor(s).

_____ _____

Signature of Company Official Date

Construction Contractors:
Use the appropriate DBE Commitment Agreement or Good faith effort forms. There are three available DBE commitment forms.
1) DBE Commitment Agreement Form No. SMS.4901,
2) DBE Program Material/Supplier Form No. SMS.4901-MS and
3) DBE Trucking Commitment Form No. SMS.4901-T.
4) Form 4000 Contractor's Certification Good Faith Effort **(if unable to meet contract goal)**

Use the applicable commitment or GFE forms that apply to your subcontract plan. You and your DBE subcontractors must complete and sign the forms. Return them and the signed DBE Participation Plan by the required date.

SPECIAL PROVISIONS

SPECIAL PROVISIONS

The following Special Provisions modify, amplify, or amend the Construction Contract General Provisions (February 2013) with respect to the clauses cited below and no other clauses or requirements of these items are waived or changed hereby. The Special Provisions shall take precedence over the General Provisions.

SP-1 TxDOT, Aviation will not withhold retainage in any amount on any partial payment made to the contractor. The contractor is eligible to receive payment up to 95% of the contract amount or installed work items if over or under the current contract amount before final acceptance of the project. Final payment will be made after acceptance of the work by the Engineer and TxDOT.

SP-2 Add to Section 90-06 PARTIAL PAYMENTS:

Upon receipt and approval of each partial payment request, the Agent shall pay the approved partial amount which is due and payable as provided herein within thirty (30) days of receipt by TxDOT Aviation.

SP-3 Add to Section 90-09 ACCEPTANCE AND FINAL PAYMENT

Upon receipt and approval of the final payment request, the Agent shall pay the approved final amount which is due and payable as provided herein within thirty (30) days of receipt by TxDOT Aviation.

SP-4 Add to Section 80-01 Subcontracting of Contract:

The following is applicable on contracts equal to or greater than $500,000:

The prime contractor shall perform work with its own organization on at least 30% of the total original contract cost. The term “perform work with own organization” includes only:

- workers employed and paid directly by the Contractor or wholly owned subsidiary;
- equipment owned by the Contractor or wholly owned subsidiary;
- rented or leased equipment operated by the Contractor’s employees or wholly owned subsidiary’s employees;
- materials incorporated into the work; and
- labor provided by staff leasing firms licensed under Chapter 91 of the Texas Labor Code for nonsupervisory personnel if the Contractor or wholly owned subsidiary maintains direct control over the activities of the leased employees and includes them in the weekly payrolls. When staff leasing firms provide materials or equipment, they are considered subcontractors. In these instances, approval of staff leasing firms as a subcontractor may be required. Copies of cancelled checks and certified statements may be required to verify compliance with the requirements of this Section.

On projects with Performance Bonds, this requirement will be suspended if the contractor defaults and a takeover agreement is executed.

SP-5 Add Additional Federal Provisions

Compliance with Nondiscrimination Requirements

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the “contractor”) agrees as follows:

1. **Compliance with Regulations:** The contractor (hereinafter includes consultants) will comply with the **Title VI List of Pertinent Nondiscrimination Statutes and Authorities**, as they may be amended from time to time, which are herein incorporated by reference and made a part of this contract.

2. **Non-discrimination:** The contractor, with regard to the work performed by it during the contract, will not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor will not participate directly or indirectly in the discrimination prohibited by the Acts and the Regulations, including employment practices when the contract covers any activity, project, or program set forth in Appendix B of 49 CFR part 21.

3. **Solicitations for Subcontracts, Including Procurements of Materials and Equipment:** In all solicitations, either by competitive bidding, or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials, or leases of equipment, each potential subcontractor or supplier will be notified by the contractor of the contractor’s obligations under this contract and the Acts and the Regulations relative to Non-discrimination on the grounds of race, color, or national origin.

4. **Information and Reports:** The contractor will provide all information and reports required by the Acts, the Regulations, and directives issued pursuant thereto and will permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the sponsor or the Federal Aviation Administration to be pertinent to ascertain compliance with such Acts, Regulations, and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish the information, the contractor will so

certify to the sponsor or the Federal Aviation Administration, as appropriate, and will set forth what efforts it has made to obtain the information.

5. **Sanctions for Noncompliance:** In the event of a contractor's noncompliance with the non-discrimination provisions of this contract, the sponsor will impose such contract sanctions as it or the Federal Aviation Administration may determine to be appropriate, including, but not limited to:

    a. Withholding payments to the contractor under the contract until the contractor complies; and/or

    b. Cancelling, terminating, or suspending a contract, in whole or in part.

6. **Incorporation of Provisions:** The contractor will include the provisions of paragraphs one through six in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts, the Regulations and directives issued pursuant thereto. The contractor will take action with respect to any subcontract or procurement as the sponsor or the Federal Aviation Administration may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided that if the contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, the contractor may request the sponsor to enter into any litigation to protect the interests of the sponsor. In addition, the contractor may request the United States to enter into the litigation to protect the interests of the United States.

(Source: Appendix E of Appendix 4 of FAA Order 1400.11, Nondiscrimination in Federally Assisted Programs at the Federal Aviation Administration)

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the "contractor") agrees to comply with the following non-discrimination statutes and authorities; including but not limited to:

- Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d et seq., 78 stat. 252), (prohibits discrimination on the basis of race, color, national origin);

- 49 CFR part 21 (Non-discrimination in Federally-Assisted Programs of The Department of Transportation—Effectuation of Title VI of The Civil Rights Act of 1964);

- The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 U.S.C. § 4601), (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);

- Section 504 of the Rehabilitation Act of 1973, (29 U.S.C. § 794 et seq.), as amended, (prohibits discrimination on the basis of disability); and 49 CFR part 27;

- The Age Discrimination Act of 1975, as amended, (42 U.S.C. § 6101 et seq.), (prohibits discrimination on the basis of age);

- Airport and Airway Improvement Act of 1982, (49 USC § 471, Section 47123), as amended, (prohibits discrimination based on race, creed, color, national origin, or sex);

- The Civil Rights Restoration Act of 1987, (PL 100-209), (Broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, The Age Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms “programs or activities” to include all of the programs or activities of the Federal-aid recipients, sub-recipients and contractors, whether such programs or activities are Federally funded or not);

- Titles II and III of the Americans with Disabilities Act of 1990, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 U.S.C. §§ 12131 – 12189) as implemented by Department of Transportation regulations at 49 CFR parts 37 and 38;

- The Federal Aviation Administration’s Non-discrimination statute (49 U.S.C. § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex);

- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures non-discrimination against minority populations by discouraging programs, policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations;

- Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to ensure that LEP

persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100);

- Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 U.S.C. 1681 et seq.).

FEDERAL FAIR LABOR STANDARDS ACT (FEDERAL MINIMUM WAGE)
(Reference: 29 USC § 201, et seq.)

APPLICABILITY
The federal minimum wage provisions are contained in the Fair Labor Standards Act (FLSA) which is administered by the United States Department of Labor Wage and Hour Division. All contracts and subcontracts must meet and comply with the FLSA, including the recordkeeping standards of the Act**.**

MANDATORY CONTRACT LANGUAGE
All contracts and subcontracts that result from this solicitation incorporate the following provisions by reference, with the same force and effect as if given in full text. The contractor has full responsibility to monitor compliance to the referenced statute or regulation. The contractor must address any claims or disputes that pertain to a referenced requirement directly with the Federal Agency with enforcement responsibilities.

Requirement	**Federal Agency with Enforcement Responsibilities**
Federal Fair Labor Standards Act (29 USC 201)	U.S. Department of Labor – Wage and Hour Division

OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970
(Reference 20 CFR part 1910)

APPLICABILITY
The United States Department of Labor Occupational Safety & Health Administration (OSHA) oversees the workplace health and safety standards wage provisions from the Occupational Safety and Health Act of 1970. All contracts and subcontracts must meet and comply with the Occupational Safety and Health Act of 1970.

MANDATORY CONTRACT LANGUAGE
All contracts and subcontracts that result from this solicitation incorporate the following provisions by reference, with the same force and effect as if given in full text.

The contractor has full responsibility to monitor compliance to the referenced statute or regulation. The contractor must address any claims or disputes that pertain to a referenced requirement directly with the Federal Agency with enforcement responsibilities.

Requirement	Federal Agency with Enforcement Responsibilities
Occupational Safety and Health Act of 1970 (20 CFR Part 1910)	U.S. Department of Labor – Occupational Safety and Health Administration

ACCESS TO RECORDS AND REPORTS.

(Reference: 2 CFR § 200.326, 2 CFR § 200.333)

APPLICABILITY
Applies to all AIP-funded projects and must be included in all contracts and subcontracts.

MANDATORY CONTRACT LANGUAGE
The mandatory language that must be used on AIP funded project contracts is as follows:

ACCESS TO RECORDS AND REPORTS

The Contractor must maintain an acceptable cost accounting system. The Contractor agrees to provide the Sponsor, the Federal Aviation Administration, and the Comptroller General of the United States or any of their duly authorized representatives access to any books, documents, papers, and records of the contractor which are directly pertinent to the specific contract for the purpose of making audit, examination, excerpts and transcriptions. The Contractor agrees to maintain all books, records and reports required under this contract for a period of not less than three years after final payment is made and all pending matters are closed.

TRADE RESTRICTION

(Reference: 49 CFR part 30)

APPLICABILITY
The trade restriction clause applies to all AIP-funded projects and must be included in all contracts and subcontracts.

MANDATORY CONTRACT LANGUAGE
The mandatory language is as follows:

TRADE RESTRICTION CLAUSE

The contractor or subcontractor, by submission of an offer and/or execution of a contract, certifies that it:

a. is not owned or controlled by one or more citizens of a foreign country included in the list of countries that discriminate against U.S. firms published by the Office of the United States Trade Representative (USTR);

b. has not knowingly entered into any contract or subcontract for this project with a person that is a citizen or national of a foreign country on said list, or is owned or controlled directly or indirectly by one or more citizens or nationals of a foreign country on said list;

c. has not procured any product nor subcontracted for the supply of any product for use on the project that is produced in a foreign country on said list.

Unless the restrictions of this clause are waived by the Secretary of Transportation in accordance with 49 CFR 30.17, no contract shall be awarded to a contractor or subcontractor who is unable to certify to the above. If the contractor knowingly procures or subcontracts for the supply of any product or service of a foreign country on said list for use on the project, the Federal Aviation Administration may direct through the Sponsor cancellation of the contract at no cost to the Government.

Further, the contractor agrees that, if awarded a contract resulting from this solicitation, it will incorporate this provision for certification without modification in each contract and in all lower tier subcontracts. The contractor may rely on the certification of a prospective subcontractor unless it has knowledge that the certification is erroneous.

The contractor shall provide immediate written notice to the sponsor if the contractor learns that its certification or that of a subcontractor was erroneous when submitted or has become erroneous by reason of changed circumstances. The subcontractor agrees to provide written notice to the contractor if at any time it learns that its certification was erroneous by reason of changed circumstances.

This certification is a material representation of fact upon which reliance was placed when making the award. If it is later determined that the contractor or subcontractor knowingly rendered an erroneous certification, the Federal Aviation Administration may direct through the Sponsor cancellation of the contract or subcontract for default at no cost to the Government.

Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by this provision. The knowledge and information of a contractor is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

This certification concerns a matter within the jurisdiction of an agency of the United States of America and the making of a false, fictitious, or fraudulent certification may render the maker subject to prosecution under Title 18, United States Code, Section 1001.

BREACH OF CONTRACT TERMS
(Reference 2 CFR § 200 Appendix II(A))

APPLICABILITY
This provision is required in all contracts that exceed the simplified acquisition threshold. This threshold, fixed at 41 USC 403(11), is presently set at $100,000.

MANDATORY CONTRACT LANGUAGE
The regulation does not prescribe mandatory language; however, the following clause represents sample language that meets the intent of 2 CFR **§ 200 Appendix II(A)**. This provision requires grantees to incorporate administrative, contractual or legal remedies in instances where contractors violate or breach contract terms.

BREACH OF CONTRACT TERMS

Any violation or breach of terms of this contract on the part of the contractor or its subcontractors may result in the suspension or termination of this contract or such other action that may be necessary to enforce the rights of the parties of this agreement. The duties and obligations imposed by the Contract Documents and the rights and remedies available thereunder are in addition to, and not a limitation of, any duties, obligations, rights and remedies otherwise imposed or available by law.

CLEAN AIR AND WATER POLLUTION CONTROL.

(Reference: 49 CFR § 18.36(i)(12)) Note, when the DOT adopts 2 CFR 200, this reference will change to 2 CFR § 200 Appendix II(G))

APPLICABILITY.
Incorporate in all professional service agreements, construction contracts and subcontracts that exceed $100,000. (Note that the 2 CFR 200 will raise this level to $150,000)

MANDATORY CONTRACT LANGUAGE.

CLEAN AIR AND WATER POLLUTION CONTROL

Contractors and subcontractors agree:

1. That any facility to be used in the performance of the contract or subcontract or to benefit from the contract is not listed on the Environmental Protection Agency (EPA) List of Violating Facilities;

2. To comply with all the requirements of Section 114 of the Clean Air Act, as amended, 42 U.S.C. 1857 et seq. and Section 308 of the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1251 et seq. relating to inspection, monitoring, entry, reports, and information, as well as all other requirements specified in Section 114 and Section 308 of the Acts, respectively, and all other regulations and guidelines issued thereunder;

3. That, as a condition for the award of this contract, the contractor or subcontractor will notify the awarding official of the receipt of any communication from the EPA indicating that a facility to be used for the performance of or benefit from the contract is under consideration to be listed on the EPA List of Violating Facilities;

4. To include or cause to be included in any construction contract or subcontract which exceeds $100,000 the aforementioned criteria and requirements.

CONTRACT WORKHOURS AND SAFETY STANDARDS ACT REQUIREMENTS.

(Reference: 2 CFR § 200 Appendix II (E))

APPLICABILITY.
Incorporate in all professional service agreements, construction contracts and subcontracts that exceed $100,000.
MANDATORY CONTRACT LANGUAGE

CONTRACT WORKHOURS AND SAFETY STANDARDS ACT REQUIREMENTS

1. Overtime Requirements.

No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic, including watchmen and guards, in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

2. Violation; Liability for Unpaid Wages; Liquidated Damages.

In the event of any violation of the clause set forth in paragraph (1) above, the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph 1 above, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph 1 above.

3. Withholding for Unpaid Wages and Liquidated Damages.

The Federal Aviation Administration or the Sponsor shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any monies payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other Federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph 2 above.

4. Subcontractors.

The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraphs 1 through 4 and also a clause requiring the subcontractor to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs 1 through 4 of this section.

CERTIFICATION OF OFFERER/BIDDER REGARDING TAX DELINQUENCY AND FELONY CONVICTIONS

The Engineer certifies, by acceptance of this Agreement, that the Engineer:

1.) is not a corporation that has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

2.) is not a corporation that was convicted of a criminal violation under any Federal law within the preceding 24 months.

If the Engineer cannot certify both of the above representations, the Engineer is ineligible to accept this Agreement unless the Agent has received notification from the agency suspension and debarment official (SDO) that the SDO has considered suspension or debarment and determined that further action is not required to protect the Government’s interests. The Engineer therefore must provide information to the Agent and the Sponsor about its tax liability or conviction to the Agent and the Sponsor, who will then notify the FAA Airports District Office, which will then notify the agency’s SDO to facilitate completion of the required considerations before award decisions are made. The Engineer agrees that it will incorporate this provision for certification in all lower tier subcontracts.

VETERAN'S PREFERENCE

In the employment of labor (excluding executive, administrative, and supervisory positions), the Contractor and all sub-tier contractors must give preference to covered veterans as defined within Title 49 United States Code Section 47112. Covered veterans include Vietnam-era veterans, Persian Gulf veterans, Afghanistan-Iraq war veterans, disabled veterans, and small business concerns (as defined by 15 USC 632) owned and controlled by disabled veterans. This preference only applies when there are covered veterans readily available and qualified to perform the work to which the employment relates.

ENERGY CONSERVATION REQUIREMENTS

Contractor and Subcontractor agree to comply with mandatory standards and policies relating to energy efficiency as contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (42 USC 6201et seq.).

TEXTING WHEN DRIVING

In accordance with Executive Order 13513, "Federal Leadership on Reducing Text Messaging While Driving", (10/1/2009) and DOT Order 3902.10, "Text Messaging While Driving", (12/30/2009), the Federal Aviation Administration encourages recipients of Federal grant funds to adopt and enforce safety policies that decrease crashes by distracted drivers, including policies to ban text messaging while driving when performing work related to a grant or subgrant. In support of this initiative, the Owner encourages the Contractor to promote policies and initiatives for its employees and other work personnel that decreases crashes by distracted drivers, including policies that ban text messaging while driving motor vehicles while performing work activities associated with the project. The Contractor must include the substance of this clause in all sub-tier contracts exceeding $3,500 that involve driving a motor vehicle in performance of work activities associated with the project.

SP-6 Add Notice Regarding Certificate of Interested Parties

A contract for $1,000,000 or more will not be issued until the selected contractor submits a signed and notarized Certificate of Interested Parties (Form 1295), along with a Certification of Filing. The Certification of Filing may be obtained through the Texas Ethics Commission's filing application, https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm.
The awarded contractor shall submit these documents with the signed agreement.

The Certificate of Interested Parties is mandated by Government Code §2252.908 and 1 Tex. Admin. Code §46.5.

SP-7 Change or replace definitions in Section 10

10-16 CHANGE ORDER. A written order to the Contractor covering changes in the plans, specifications, quantities and/or any other modification to the contract and establishes the basis of payment and contract time adjustment, if any, for the work affected by such changes.

10-47 SUPPLEMENTAL AGREEMENT. Written agreement entered into between the Contractor and the Agent and approved by the Surety, covering alterations and changes in the Contract. A supplemental agreement is used whenever the modifications include assignment of the Contract from one entity to another or other cases as desired by TxDOT.

SP-8 Amend the second and third paragraphs in Section 40-02.

A Change Order will be issued covering significant changes to the Contract. Significant changes occur when (1) the aggregate amount of altered work increases or decreases the awarded contract, or any major contract item, by more than 25 percent, assuming such increased or decreased work is within the scope of the originally awarded contract; or (2) work that is not within the scope of the originally awarded contract. Provide cost justification as requested, in an acceptable format. Payment will not be made for anticipated profits on work that is eliminated. These alterations and changes will not invalidate the Contract nor release the Surety. The Contractor is responsible for notifying the surety of any changes to the Contract. If TxDOT and the Contractor are unable to agree on a unit adjustment for any significant changes, it reserves the right to terminate negotiations with respect to the significant changes and make other arrangements for completion.

For AIP contracts, all change orders and/or supplemental agreements shall be approved by TxDOT and shall include valid wage determinations of the U.S. Secretary of Labor when the amount of the change order/supplemental agreement exceeds $2,000. However, if the contractor elects to waive the limitations on work that increases or decreases the originally awarded contract or any major contract item by more than 25 percent, the change order/supplemental agreement shall be subject to the same U.S. Secretary of Labor wage determination as was included in the originally awarded contract.

Delete the fourth paragraph in Section 40-02 as this is now covered in Section 10

40-03 OMITTED ITEMS. The Engineer may, in TxDOT’s best interest, omit any contract item except major contract items. Such omissions of contract items shall not invalidate any other contract provision or requirement.

40-04 EXTRA WORK. Extra work that is necessary for acceptable completion of the project but is not within the general scope of the work covered by the original contract shall be covered by a Change Order as herein before defined in the subsection titled CHANGE ORDER of Section 10.

SP-9 CONSTRUCTION CONTRACT GENERAL PROVISIONS, VOLUME FEBRUARY 2013, SECTION 20

Delete the following sentence from Section 20-02 BID REQUIREMENTS AND CONDITIONS: “Each bidder shall submit written evidence from the State Comptroller’s office that all applicable franchise taxes owed the State of Texas have been paid.”

Delete Section 20-03 CONTENTS OF BID FORMS in its entirety and replace with:
20-03 CONTENTS OF BID FORMS. TxDOT shall furnish bidders with formatted bid forms. All statements, certifications, and other qualifications indicated in “Instructions to Bidders” or attached to the bid forms are necessary parts.

The Bidder must submit the completed bid on the bid form furnished by TxDOT, with all blank spaces in the TxDOT bid form correctly typed in for each and every item for which a quantity is given.

The Bidder shall sign the bid in ink. If the bid is made by an individual, the individual's name and address must be shown. If made by a partnership, the name and address of each member of the partnership must be shown. If made by a corporation, the person signing the bid shall give the name of the state under the laws of which the corporation was chartered and the name, titles, and business address of the president, secretary, and the treasurer.

The plans, specifications, and other documents designated in the bid form shall be considered a part of the bid whether attached or not.

The Bidder may also submit an electronically printed bid. The bid must have pay items in the same order and with the exact information as on this bid form. If submitting an electronically printed bid, submit qualification/signature page of the bid form. The bidder is responsible for incorrect information and will be considered non-responsive if pay items are incorrect.

Delete the following sentences from Section 20-06 PREPARATION OF BID
“Make entries in ink.”
“As an Alternative to hand-writing the unit prices in works in ink in the bid, submit a computer printout signed by the person authorized to bind the bidder.

In the case of a joint venture, the persons authorized to bid the Bidders must sign the computer printout. As a General Provisions GP-20-3 minimum, computer printouts must contain the information in the format shown on the “Example of Bid Prices Submitted by Computer Printout” form in the bid.”

Add the following sentence to Section 20-06 PREPARATION OF BID:
“The bidder may also submit an electronically printed bid. The bid must have pay items in the same order and with the exact information as on this bid form. If submitting an electronically printed bid, include signed qualification/signature page form the bid form.

The bidder is responsible for incorrect information and will be considered non-responsive if pay items are incorrect.

Change Section 20-06 PREPARATION OF BID, from “Execute the bid in ink.” to “Sign the bid in ink.”

Delete Items “l” from Section 20-07 NON-RESPONSIVE BIDS.

Delete the following sentence in Section 30-01 CONSIDERATION OF BIDS “If a bidder’s bid contains a discrepancy between unit bid prices written in words and unit bid prices written in numbers, the unit price written in words shall govern, unless obviously incorrect.

SP-10
Change DEFINITION OF TERMS Section 10-11 BID to read:
The offer of the bidder, when submitted on the approved formatted bid form or electronically printed alternative with qualifications/signature page, to perform the contemplated work and furnish the necessary materials in accordance with the provisions of the plans and specifications.

SP-11
The Agent, in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252, 42 U.S.C. §§ 2000d to 2000d-4) and the Regulations, hereby notifies all bidders that it will affirmatively ensure that any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, or national origin in consideration for an award.

SP-12

Israel Boycott Certification and Prohibition: Pursuant to Texas Govt. Code Chap. 808 (HB89) and Chap. 2270 (SB253):

(a) “Boycott Israel” means refusing to deal with, terminating business activities with, or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations specifically with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory but does not include an action made for ordinary business purposes.

(b) Bidder hereby certifies (1) it does not boycott Israel, and (2) shall not boycott Israel during the term of contract agreement.

WAGE RATES

"General Decision Number: TX20260294 05/18/2026

State: Texas

Construction Types: Highway

Counties: Texas Counties of
Collin, Dallas, Delta, Denton, Ellis,
Grayson, Hunt, Johnson, Kaufman, Parker,
Rockwall, Tarrant and Wise

Modification Number	Publication Date
0	01/02/2026
1	05/18/2026

SATX2025-007 11/15/2023

	Rates	Fringes
WORK ZONE BARRICADE SERVICER	$ 18.01	0.00
WELDER	$ 23.72	0.00
TRUCK DRIVER, TRANSIT-MIX	$ 21.97	0.00
TRUCK DRIVER, TANDEM AXLE TRACTOR WITH SEMI TRAILER	$ 23.22	0.00
TRUCK DRIVER, SINGLE OR TANDEM AXLE DUMP TRUCK	$ 22.64	0.00
TRUCK DRIVER, SINGLE AXLE	$ 20.60	0.00
TRUCK DRIVER LOWBOY FLOAT	$ 25.57	0.00
TELECOMMUNICATION TECHNICIAN	$ 23.14	0.00
SPREADER BOX OPERATOR	$ 23.59	0.00
SMALL SLIPFORM MACHINE OPERATOR	$ 25.09	0.00
SIGN ERECTOR	$ 18.01	0.00
SERVICER	$ 24.86	0.00
SCRAPER OPERATOR	$ 21.54	0.00
ROLLER OPERATOR, OTHER	$ 18.60	0.00
ROLLER OPERATOR, ASPHALT	$ 20.35	0.00
REINFORCING STEEL WORKER	$ 23.50	0.00
RECLAIMER/PULVERIZER OPERATOR	$ 22.17	0.00
PIPELAYER	$ 22.46	0.00
PAVEMENT MARKING MACHINE OPERATOR	$ 22.35	0.00
OFF ROAD HAULER	$ 23.70	0.00
MOTOR GRADER OPERATOR, ROUGH	$ 24.90	0.00
MOTOR GRADER OPERATOR, FINE GRADE	$ 27.09	0.00
MILLING MACHINE OPERATOR	$ 20.94	0.00
MECHANIC	$ 27.44	0.00
LOADER/BACKHOE OPERATOR	$ 23.22	0.00
LABORER, UTILITY	$ 19.32	0.00
LABORER, COMMON	$ 18.01	0.00
FRONT END LOADER OPERATOR, OVER 3 CY	$ 22.56	0.00
FRONT END LOADER OPERATOR, 3 CY OR LESS	$ 20.93	0.00
FOUNDATION DRILL OPERATOR, TRUCK MOUNTED	$ 29.86	0.00
FOUNDATION DRILL OPERATOR, CRAWLER MOUNTED	$ 29.25	0.00
FORM SETTER, PAVING & CURB	$ 20.89	0.00
FORM BUILDER/SETTER, STRUCTURES	$ 22.50	0.00
FLAGGER	$ 14.80	0.00
EXCAVATOR OPERATOR, OVER 50,000 POUNDS	$ 25.34	0.00
EXCAVATOR OPERATOR, 50,000 POUNDS OR LESS	$ 25.08	0.00
ELECTRICIAN	$ 36.10	0.00

CRAWLER TRACTOR OPERATOR.....$ 24.06 0.00
CRANE OPERATOR, LATTICE BOOM OVER 80 TONS.....$ 33.55 0.00
CRANE OPERATOR, LATTICE BOOM 80 TONS OR LESS.....$ 29.90 0.00
CRANE OPERATOR, HYDRAULIC 80 TONS OR LESS.....$ 31.32 0.00
CONCRETE SAW OPERATOR.....$ 20.34 0.00
CONCRETE PAVEMENT FINISHING MACHINE OPERATOR.....$ 24.07 0.00
CONCRETE FINISHER, PAVING AND STRUCTURES.....$ 22.48 0.00
BROOM OR SWEEPER OPERATOR.....$ 18.01 0.00
ASPHALT RAKER.....$ 19.87 0.00
ASPHALT PAVING MACHINE OPERATOR.....$ 22.52 0.00
ASPHALT DISTRIBUTOR OPERATOR.....$ 24.40 0.00

WELDERS - Receive rate prescribed for craft performing
operation to which welding is incidental.
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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave
for Federal Contractors applies to all contracts subject to the
Davis-Bacon Act for which the contract is awarded (and any
solicitation was issued) on or after January 1, 2017. If this
contract is covered by the EO, the contractor must provide
employees with 1 hour of paid sick leave for every 30 hours
they work, up to 56 hours of paid sick leave each year.
Employees must be permitted to use paid sick leave for their
own illness, injury or other health-related needs, including
preventive care; to assist a family member (or person who is
like family to the employee) who is ill, injured, or has other
health-related needs, including preventive care; or for reasons
resulting from, or to assist a family member (or person who is
like family to the employee) who is a victim of, domestic
violence, sexual assault, or stalking. Additional information
on contractor requirements and worker protections under the EO
is available at
https://www.dol.gov/agencies/whd/government-contracts.

Note: Executive Order 13658 generally applies to contracts subject
to the Davis-Bacon Act that were awarded on or between January 1,
2015 and January 29, 2022, and that have not been renewed or
extended on or after January 30, 2022. Executive Order 13658 does
not apply to contracts subject only to the Davis-Bacon Related Acts
regardless of when they were awarded. If a contract is subject to
Executive Order 13658, the contractor must pay all covered workers
at least $13.65 per hour (or the applicable wage rate listed on this
wage determination, if it is higher) for all hours spent performing on
the contract from May 11, 2026, through December 31, 2026. The
applicable Executive Order minimum wage rate will be adjusted annually.
Additional information on contractor requirements and worker
protections under Executive Order 13658 is available at
www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within
the scope of the classifications listed may be added after
award only as provided in the labor standards contract clauses
(29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classifications
and wage rates that have been found to be prevailing for the
type(s) of construction and geographic area covered by the wage
determination. The classifications are listed in alphabetical
order under rate identifiers indicating whether the particular
rate is a union rate (current union negotiated rate), a survey
rate, a weighted union average rate, a state adopted rate, or a
supplemental classification rate.

Union Rate Identifiers

A four-letter identifier beginning with characters other than
�SU�, �UAVG�, �SA�, or �SC� denotes that a union rate was
prevailing for that classification in the survey. Example:
PLUM0198-005 07/01/2024. PLUM is an identifier of the union
whose collectively bargained rate prevailed in the survey for
this classification, which in this example would be Plumbers.
0198 indicates the local union number or district council
number where applicable, i.e., Plumbers Local 0198. The next
number, 005 in the example, is an internal number used in
processing the wage determination. The date, 07/01/2024 in the
example, is the effective date of the most current negotiated
rate.

Union prevailing wage rates are updated to reflect all changes
over time that are reported to WHD in the rates
in the collective bargaining agreement (CBA) governing the
classification.

Union Average Rate Identifiers

The UAVG identifier indicates that no single rate prevailed for
those classifications, but that 100% of the data reported for
the classifications reflected union rates. EXAMPLE:
UAVG-OH-0010 01/01/2024. UAVG indicates that the rate is a
weighted union average rate. OH indicates the State of Ohio.
The next number, 0010 in the example, is an internal number
used in producing the wage determination. The date, 01/01/2024
in the example, indicates the date the wage determination was
updated to reflect the most current union average rate.

A UAVG rate will be updated once a year, usually in January, to
reflect a weighted average of the current rates in the
collective bargaining agreements on which the rate is based.

Survey Rate Identifiers

The �SU� identifier indicates that either a single non-union
rate prevailed (as defined in 29 CFR 1.2) for this
classification in the survey or that the rate was derived by
computing a weighted average rate based on all the rates
reported in the survey for that classification. As a weighted
average rate includes all rates reported in the survey, it may
include both union and non-union rates. Example: SUFL2022-007
6/27/2024. SU indicates the rate is a single non-union
prevailing rate or a weighted average of survey data for that
classification. FL indicates the State of Florida. 2022 is the
year of the survey on which these classifications and rates are
based. The next number, 007 in the example, is an internal
number used in producing the wage determination. The date,
6/27/2024 in the example, indicates the survey completion date
for the classifications and rates under that identifier.

�SU� wage rates typically remain in effect until a new survey
is conducted. However, the Wage and Hour Division (WHD) has the
discretion to update such rates under 29 CFR 1.6(c)(1).

State Adopted Rate Identifiers

The �SA� identifier indicates that the classifications and
prevailing wage rates set by a state (or local) government were
adopted under 29 C.F.R 1.3(g)-(h). Example: SAME2023-007
01/03/2024. SA reflects that the rates are state adopted. ME
refers to the State of Maine. 2023 is the year during which the

state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which the classifications and rates under the "SA" identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

1) Has there been an initial decision in the matter? This can be:

a) a survey underlying a wage determination
b) an existing published wage determination
c) an initial WHD letter setting forth a position on a wage determination matter
d) an initial conformance (additional classification and rate) determination

On survey related matters, initial contact, including requests for summaries of surveys, should be directed to the WHD Branch of Wage Surveys. Requests can be submitted via email to davisbaconinfo@dol.gov or by mail to:

Branch of Wage Surveys
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

Regarding any other wage determination matter such as conformance decisions, requests for initial decisions should be directed to the WHD Branch of Construction Wage Determinations. Requests can be submitted via email to BCWD-Office@dol.gov or by mail to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2) If an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to dba.reconsideration@dol.gov or by mail to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210.

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END OF GENERAL DECISION

"

TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS

Construction Plans for Pavement and Electrical Improvements to Ennis Municipal Airport

TXDOT CSJ No. 2618ENNIS

Ennis, Texas

May 15, 2026

STATE OF TEXAS
ZACHARY C. AMBARIANTZ
146546
05/15/2026
LICENSED PROFESSIONAL ENGINEER

STATE OF TEXAS
GREGORY S. MOORE
157775
LICENSED PROFESSIONAL ENGINEER
05/15/2026

WOOLPERT
ARCHITECTURE | ENGINEERING | GEOSPATIAL

TBPE #1001

Note: Specifications herein make references made to other standard FAA or TxDOT Specifications. These specifications are considered part of this project documentation by reference, using the latest version of FAA and TxDOT Standard Specifications.

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6. ITEM TX-164 SEEDING FOR EROSION CONTROL
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19. ITEM P-101 PREPARATION/REMOVAL OF EXISTING PAVEMENTS
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Item C-100 Contractor Quality Control Program

100-1 General. Quality is more than test results. Quality is the combination of proper materials, testing, workmanship, equipment, inspection, and documentation of the project. Establishing and maintaining a culture of quality is key to achieving a quality project. The Contractor shall establish, provide, and maintain an effective Contractor Quality Control Program (CQCP) that details the methods and procedures that will be taken to assure that all materials and completed construction required by this contract conform to contract plans, technical specifications and other requirements, whether manufactured by the Contractor, or procured from subcontractors or vendors. Although guidelines are established and certain minimum requirements are specified here and elsewhere in the contract technical specifications, the Contractor shall assume full responsibility for accomplishing the stated purpose.

The Contractor shall establish a CQCP that will:

a. Provide qualified personnel to develop and implement the CQCP.

b. Provide for the production of acceptable quality materials.

c. Provide sufficient information to assure that the specification requirements can be met.

d. Document the CQCP process.

The Contractor shall not begin any construction or production of materials to be incorporated into the completed work until the CQCP has been reviewed and approved by the Resident Project Representative (RPR). No partial payment will be made for materials subject to specific quality control (QC) requirements until the CQCP has been reviewed and approved.

The QC requirements contained in this section and elsewhere in the contract technical specifications are in addition to and separate from the quality assurance (QA) testing requirements. QA testing requirements are the responsibility of the RPR or Contractor as specified in the specifications.

A Quality Control (QC)/Quality Assurance (QA) workshop with the Engineer, Resident Project Representative (RPR), Contractor, subcontractors, testing laboratories, and Owner's representative must be held prior to start of construction. The QC/QA workshop will be facilitated by the Contractor. The Contractor shall coordinate with the Airport and the RPR on time and location of the QC/QA workshop. Items to be addressed, at a minimum, will include:

a. Review of the CQCP including submittals, QC Testing, Action & Suspension Limits for Production, Corrective Action Plans, Distribution of QC reports, and Control Charts.

b. Discussion of the QA program.

c. Discussion of the QC and QA Organization and authority including coordination and information exchange between QC and QA.

d. Establish regular meetings to discuss control of materials, methods and testing.

e. Establishment of the overall QC culture.

100-2 Description of program.

a. General description. The Contractor shall establish a CQCP to perform QC inspection and testing of all items of work required by the technical specifications, including those performed by subcontractors. The CQCP shall ensure conformance to applicable specifications and plans with respect to materials, off-site fabrication, workmanship, construction, finish, and functional performance. The CQCP shall be effective for control of all construction work performed under this Contract and shall specifically include surveillance and tests required by the technical specifications, in addition to other requirements of this section and any other activities deemed necessary by the Contractor to establish an effective level of QC.

b. Contractor Quality Control Program (CQCP). The Contractor shall describe the CQCP in a written document that shall be reviewed and approved by the RPR prior to the start of any production, construction, or off-site fabrication. The written CQCP shall be submitted to the RPR for review and approval at least 10 calendar days before the CQCP Workshop. The Contractor's CQCP and QC testing laboratory must be approved in writing by the RPR prior to the Notice to Proceed (NTP).

The CQCP shall be organized to address, as a minimum, the following:

1. QC organization and resumes of key staff
2. Project progress schedule
3. Submittals schedule
4. Inspection requirements
5. QC testing plan
6. Documentation of QC activities and distribution of QC reports
7. Requirements for corrective action when QC and/or QA acceptance criteria are not met
8. Material quality and construction means and methods. Address all elements applicable to the project that affect the quality of the pavement structure including subgrade, subbase, base, and surface course. Some elements that must be addressed include, but is not limited to mix design, aggregate grading, stockpile management, mixing and transporting, placing and finishing, quality control testing and inspection, smoothness, laydown plan, equipment, and temperature management plan.

The Contractor must add any additional elements to the CQCP that is necessary to adequately control all production and/or construction processes required by this contract.

100-3 CQCP organization. The CQCP shall be implemented by the establishment of a QC organization. An organizational chart shall be developed to show all QC personnel, their authority, and how these personnel integrate with other management/production and construction functions and personnel.

The organizational chart shall identify all QC staff by name and function, and shall indicate the total staff required to implement all elements of the CQCP, including inspection and testing for each item of work. If necessary, different technicians can be used for specific inspection and testing functions for different items of work. If an outside organization or independent testing laboratory is used for implementation of all or part of the CQCP, the personnel assigned shall be subject to the qualification requirements of paragraphs 100-03a and 100-03b. The organizational chart shall indicate which personnel are Contractor employees and which are provided by an outside organization.

The QC organization shall, as a minimum, consist of the following personnel:

a. Program Administrator. The Contractor Quality Control Program Administrator (CQCPA) must be an on-site employee of the Contractor, or a consultant engaged by the Contractor. The CQCPA must have a minimum of five (5) years of experience in QC pavement construction with prior QC experience on a project of comparable size and scope as the contract.

Included in the five (5) years of paving/QC experience, the CQCPA must meet at least one of the following requirements:

(1) Professional Engineer with one (1) year of airport paving experience.

(2) Engineer-in-training with two (2) years of airport paving experience.

(3) National Institute for Certification in Engineering Technologies (NICET) Civil Engineering Technology Level IV with three (3) years of airport paving experience.

(4) An individual with four (4) years of airport paving experience, with a Bachelor of Science Degree in Civil Engineering, Civil Engineering Technology or Construction.

The CQCPA must have full authority to institute any and all actions necessary for the successful implementation of the CQCP to ensure compliance with the contract plans and technical specifications. The CQCPA authority must include the ability to immediately stop production until materials and/or processes are in compliance with contract specifications. The CQCPA must report directly to a principal officer of the construction firm. The CQCPA may supervise the Quality Control Program on more than one project provided that person can be at the job site within two (2) hours after being notified of a problem.

b. QC technicians. A sufficient number of QC technicians necessary to adequately implement the CQCP must be provided. These personnel must be either Engineers, engineering technicians, or experienced craftsman with qualifications in the appropriate field equivalent to NICET Level II in Civil Engineering Technology or higher and shall have a minimum of two (2) years of experience in their area of expertise.

The QC technicians must report directly to the CQCPA and shall perform the following functions:

(1) Inspection of all materials, construction, plant, and equipment for conformance to the technical specifications, and as required by paragraph 100-6.

(2) Performance of all QC tests as required by the technical specifications and paragraph100-8.

(3) Performance of tests for the RPR when required by the technical specifications.

Certification at an equivalent level of qualification and experience by a state or nationally recognized organization will be acceptable in lieu of NICET certification.

c. Staffing levels. The Contractor shall provide sufficient qualified QC personnel to monitor each work activity at all times. Where material is being produced in a plant for incorporation into the work, separate plant and field technicians shall be provided at each plant and field placement location. The scheduling and coordinating of all inspection and testing must match the type and pace of work activity. The CQCP shall state where different technicians will be required for different work elements.

100-4 Project progress schedule. Critical QC activities must be shown on the project schedule as required by Section 80, paragraph 80-03, *Execution and Progress*.

100-5 Submittals schedule. The Contractor shall submit a detailed listing of all submittals (for example, mix designs, material certifications) and shop drawings required by the technical specifications. The listing can be developed in a spreadsheet format and shall include as a minimum:

a. Specification item number

b. Item description

c. Description of submittal

d. Specification paragraph requiring submittal

e. Scheduled date of submittal

100-6 Inspection requirements. QC inspection functions shall be organized to provide inspections for all definable features of work, as detailed below. All inspections shall be documented by the Contractor as specified by paragraph 100-9.

Inspections shall be performed as needed to ensure continuing compliance with contract requirements until completion of the particular feature of work. Inspections shall include the following minimum requirements:

a. During plant operation for material production, QC test results and periodic inspections shall be used to ensure the quality of aggregates and other mix components, and to adjust and control mix proportioning to meet the approved mix design and other requirements of the technical specifications. All equipment used in proportioning and mixing shall be inspected to ensure its proper operating condition. The CQCP shall detail how these and other QC functions will be accomplished and used.

b. During field operations, QC test results and periodic inspections shall be used to ensure the quality of all materials and workmanship. All equipment used in placing, finishing, and compacting shall be inspected to ensure its proper operating condition and to ensure that all such operations are in conformance to the technical specifications and are within the plan dimensions, lines, grades, and tolerances specified. The CQCP shall document how these and other QC functions will be accomplished and used.

100-7 Contractor QC testing facility.

a. The Contractor shall ensure facilities, including all necessary equipment, materials, and current reference standards, are provided that meet requirements in the following paragraphs of ASTM D3666, *Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials*:

- 8.1.3 Equipment Calibration and Checks;
- 8.1.9 Equipment Calibration, Standardization, and Check Records;
- 8.1.12 Test Methods and Procedures

b. For projects that include P-501, the Contractor shall ensure facilities, including all necessary equipment, materials, and current reference standards, are provided that meet requirements in the following paragraphs of ASTM C1077, Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation:

- 7 Test Methods and Procedures
- 8 Facilities, Equipment, and Supplemental Procedures

100-8 QC testing plan. As a part of the overall CQCP, the Contractor shall implement a QC testing plan, as required by the technical specifications. The testing plan shall include the minimum tests and test frequencies required by each technical specification Item, as well as any additional QC tests that the Contractor deems necessary to adequately control production and/or construction processes.

The QC testing plan can be developed in a spreadsheet fashion and shall, as a minimum, include the following:

a. Specification item number (e.g., P-401)

b. Item description (e.g., Hot Mix Asphalt Pavements)

c. Test type (e.g., gradation, grade, asphalt content)

d. Test standard (e.g., ASTM or American Association of State Highway and Transportation Officials (AASHTO) test number, as applicable)

e. Test frequency (e.g., as required by technical specifications or minimum frequency when requirements are not stated)

f. Responsibility (e.g., plant technician)

g. Control requirements (e.g., target, permissible deviations)

The QC testing plan shall contain a statistically-based procedure of random sampling for acquiring test samples in accordance with ASTM D3665. The RPR shall be provided the opportunity to witness QC sampling and testing.

All QC test results shall be documented by the Contractor as required by paragraph 100-9.

100-9 Documentation. The Contractor shall maintain current QC records of all inspections and tests performed. These records shall include factual evidence that the required QC inspections or tests have been performed, including type and number of inspections or tests involved; results of inspections or tests; nature of defects, deviations, causes for rejection, etc.; proposed remedial action; and corrective actions taken.

These records must cover both conforming and defective or deficient features and must include a statement that all supplies and materials incorporated in the work are in full compliance with the terms of the contract. Legible copies of these records shall be furnished to the RPR daily. The records shall cover all work placed subsequent to the previously furnished records and shall be verified and signed by the CQCPA.

Contractor QC records required for the contract shall include, but are not necessarily limited to, the following records:

a. Daily inspection reports. Each Contractor QC technician shall maintain a daily log of all inspections performed for both Contractor and subcontractor operations. These technician's daily reports shall provide factual evidence that continuous QC inspections have been performed and shall, as a minimum, include the following:

(1) Technical specification item number and description

(2) Compliance with approved submittals

(3) Proper storage of materials and equipment

(4) Proper operation of all equipment

(5) Adherence to plans and technical specifications

(6) Summary of any necessary corrective actions

(7) Safety inspection.

The daily inspection reports shall identify all QC inspections and QC tests conducted, results of inspections, location and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed.

The daily inspection reports shall be signed by the responsible QC technician and the CQCPA. The RPR shall be provided at least one copy of each daily inspection report on the work day following the day of record. When QC inspection and test results are recorded and transmitted electronically, the results must be archived.

b. Daily test reports. The Contractor shall be responsible for establishing a system that will record all QC test results. Daily test reports shall document the following information:

(1) Technical specification item number and description

(2) Test designation

(3) Location

(4) Date of test

(5) Control requirements

(6) Test results

(7) Causes for rejection

(8) Recommended remedial actions

(9) Retests

Test results from each day's work period shall be submitted to the RPR prior to the start of the next day's work period. When required by the technical specifications, the Contractor shall maintain statistical QC charts. When QC daily test results are recorded and transmitted electronically, the results must be archived.

100-10 Corrective action requirements. The CQCP shall indicate the appropriate action to be taken when a process is deemed, or believed, to be out of control (out of tolerance) and detail what action will be taken to bring the process into control. The requirements for corrective action shall include both general requirements for operation of the CQCP as a whole, and for individual items of work contained in the technical specifications.

The CQCP shall detail how the results of QC inspections and tests will be used for determining the need for corrective action and shall contain clear rules to gauge when a process is out of control and the type of correction to be taken to regain process control.

When applicable or required by the technical specifications, the Contractor shall establish and use statistical QC charts for individual QC tests. The requirements for corrective action shall be linked to the control charts.

100-11 Inspection and/or observations by the RPR. All items of material and equipment are subject to inspection and/or observation by the RPR at the point of production, manufacture or shipment to determine if the Contractor, producer, manufacturer or shipper maintains an adequate QC system in conformance with the requirements

detailed here and the applicable technical specifications and plans. In addition, all items of materials, equipment and work in place shall be subject to inspection and/or observation by the RPR at the site for the same purpose.

Inspection and/or observations by the RPR does not relieve the Contractor of performing QC inspections of either on-site or off-site Contractor's or subcontractor's work.

100-12 Noncompliance.

a. The Resident Project Representative (RPR) will provide written notice to the Contractor of any noncompliance with their CQCP. After receipt of such notice, the Contractor must take corrective action.

b. When QC activities do not comply with either the CQCP or the contract provisions or when the Contractor fails to properly operate and maintain an effective CQCP, and no effective corrective actions have been taken after notification of non-compliance, the RPR will recommend the Owner take the following actions:

(1) Order the Contractor to replace ineffective or unqualified QC personnel or subcontractors and/or

(2) Order the Contractor to stop operations until appropriate corrective actions are taken.

METHOD OF MEASUREMENT

100-13 Basis of measurement and payment. Contractor Quality Control Program (CQCP) is for the personnel, tests, facilities and documentation required to implement the CQCP. The CQCP will be paid as a lump sum with the following schedule of partial payments:

a. With first pay request, 25% with approval of CQCP and completion of the Quality Control (QC)/Quality Assurance (QA) workshop.

b. When 25% or more of the original contract is earned, an additional 25%.

c. When 50% or more of the original contract is earned, an additional 20%.

d. When 75% or more of the original contract is earned, an additional 20%

e. After final inspection and acceptance of project, the final 10%.

BASIS OF PAYMENT

100-14 Payment will be made under:

Item C-100	Contractor Quality Control Program	per Lump Sum

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

National Institute for Certification in Engineering Technologies (NICET)

ASTM International (ASTM)

ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation

ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D3666	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

END OF ITEM C-100

ITEM C-105_MOBILIZATION
Summary of Changes

1. Paragraph 105-5.d revised as follows:
    a. d. After Final Inspection, Staging area clean-up and delivery of all Project Closeout materials ~~as required by Section 90, paragraph 90-11, Contractor Final Project Documentation~~, the final 10%.

Item C-105 Mobilization

105-1 Description. This item of work shall consist of, but is not limited to, work and operations necessary for the movement of personnel, equipment, material and supplies to and from the project site for work on the project except as provided in the contract as separate pay items.

105-2 Mobilization limit. Mobilization shall be limited to 10 percent of the total project cost.

105-3 Posted notices. Prior to commencement of construction activities, the Contractor must post the following documents in a prominent and accessible place where they may be easily viewed by all employees of the prime Contractor and by all employees of subcontractors engaged by the prime Contractor: Equal Employment Opportunity (EEO) Poster "Equal Employment Opportunity is the Law" in accordance with the Office of Federal Contract Compliance Programs Executive Order 11246, as amended; Davis Bacon Wage Poster (WH 1321) - DOL "Notice to All Employees" Poster; and Applicable Davis-Bacon Wage Rate Determination. These notices must remain posted until final acceptance of the work by the Owner.

105-4 Engineer/RPR field office. The Contractor shall provide dedicated space for the use of the field RPR and inspectors, as a field office for the duration of the project. This space shall be located conveniently near the construction and shall be separate from any space used by the Contractor. The Contractor shall furnish water, sanitary facilities, heat, air conditioning, and electricity in accordance with local building codes.

METHOD OF MEASUREMENT

105-5 Basis of measurement and payment. Based upon the contract lump sum price for "Mobilization" partial payments will be allowed as follows:

a. With first pay request, 25%.

b. When 25% or more of the original contract is earned, an additional 25%.

c. When 50% or more of the original contract is earned, an additional 40%.

d. After Final Inspection, Staging area clean-up and delivery of all Project Closeout materials, the final 10%.

BASIS OF PAYMENT

105-6 Payment will be made under:

Item C-105	Mobilization	per Lump Sum

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Office of Federal Contract Compliance Programs (OFCCP)

Executive Order 11246, as amended

EEOC-P/E-1 – Equal Employment Opportunity is the Law Poster

United States Department of Labor, Wage and Hour Division (WHD)

WH 1321 – Employee Rights under the Davis-Bacon Act Poster

END OF ITEM C-105

ITEM TX-105 REMOVING TREATED AND UNTREATED BASE AND ASPHALT PAVEMENT
Summary of Changes

1. Section 2 Construction
    a. Added the following note:
        i. Removal of material adjacent to existing pavement will require a sawcut joint as indicated on the plans.
2. Section 3 Measurement
    a. Revised as follows:
        i. This Item will be measured ~~by the 100-ft. station along the baseline of each roadbed,~~ by the square yard of existing treated or untreated base and asphalt pavement in their original position~~, or by the cubic yard of existing treated or untreated base and asphalt pavement in their original position, as calculated by the average end area method or~~ as shown on the plans. Square yard ~~and cubic yard~~ measurement will be established by the widths and depths shown on the plans and the lengths measured in the field.

3. Section 4 Payment
    a. Revised as follows:
        i. The work performed in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for ~~"Removing Treated and Untreated Base and Asphalt Pavement"~~ TX-105a Full Depth Asphalt Pavement and Base Removal (Runway/Taxiway), TX-105b Full Depth Asphalt Pavement and Base Removal (Apron) and TX-105c Remove Existing Asphalt Pavement (Apron) ~~of the depth specified~~. This price is full compensation for breaking the material, loading, hauling, unloading, and stockpiling or disposing; repair to areas outside designated locations for removal; and equipment, labor, tools, and incidentals.

Item 105

Removing Treated and Untreated Base and Asphalt Pavement

1. DESCRIPTION

Break, remove, and store or dispose of existing asphalt pavement, including surface treatments, and treated or untreated base materials.

2. CONSTRUCTION

Break material retained by the Department into pieces not larger than 24 in. unless otherwise shown on the plans. Remove existing asphalt pavement before disturbing stabilized base. Avoid contamination of the asphalt materials and damage to adjacent areas. Repair material damaged by operations outside the designated locations.

Stockpile materials designated salvageable at designated sites when shown on the plans or as directed. Prepare stockpile site by removing vegetation and trash and by providing for proper drainage. Material not designated to be salvaged will become the property of the Contractor. When this material is disposed of, do so in conformance with federal, state, and local regulations.

Removal of material adjacent to existing pavement will require a sawcut joint as indicated on the plans.

3. MEASUREMENT

This Item will be measured ~~by the 100-ft. station along the baseline of each roadbed,~~ by the square yard of existing treated or untreated base and asphalt pavement in their original position~~, or by the cubic yard of existing treated or untreated base and asphalt pavement in their original position, as calculated by the average end area method or~~ as shown on the plans. Square yard ~~and cubic yard~~ measurement will be established by the widths and depths shown on the plans and the lengths measured in the field.

4. PAYMENT

The work performed in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for ~~“Removing Treated and Untreated Base and Asphalt Pavement”~~ TX-105a Full Depth Asphalt Pavement and Base Removal (Runway/Taxiway), TX-105b Full Depth Asphalt Pavement and Base Removal (Apron) and TX-105c Remove Existing Asphalt Pavement (Apron) ~~of the depth specified~~. This price is full compensation for breaking the material, loading, hauling, unloading, and stockpiling or disposing; repair to areas outside designated locations for removal; and equipment, labor, tools, and incidentals.

ITEM TX-110_EXCAVATION
Summary of Changes

1. Section 3 Construction
    a. Deleted Section 3.3.1.1 – **Staged Construction**. ~~Grade to within 1.25 in. in the cross-section and 1.25 in. in 16 ft. measured longitudinally.~~ **Not Used.**

2. Section 4 Measurement
    a. Revised as follows:
        i. This Item will be measured by the cubic yard ~~in its original position as computed by the method of average end areas or~~ as shown on the plans.

3. Section 5 Payment
    a. First paragraph revised as follows:
        i. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for ~~"Excavation (Roadway)," "Excavation (Channel)," "Excavation (Special)," or "Excavation (Roadway and Channel)."~~ "TX-110 Excavation". This price is full compensation for authorized excavation; drying; undercutting subgrade in rock cuts and reworking or replacing the undercut material; hauling; disposal of material not used elsewhere on the project; scarification and compaction; and equipment, labor, materials, tools, and incidentals.
    b. Second paragraph revised as follows:
        i. Payment includes drying subgrade deeper than shown on plans, and/or removal and replacement of unsuitable material as required to construct a subgrade platform to place the pavement section. ~~Drying subgrade deeper than 6 in. below grade as shown on the plans will be paid for in accordance with Article 9.7., "Payment for Extra Work and Force Account Method." Excavation and replacement of unsuitable material below grade as shown on the plans will be performed and paid for in conformance with the applicable bid items. However, if Item 132, "Embankment," is not included in the Contract, payment for replacement of unsuitable material will be paid for in accordance with Article 9.7., "Payment for Extra Work and Force Account Method."~~

Item 110
Excavation

1. DESCRIPTION

Excavate areas as shown on the plans or as directed. Remove materials encountered to the lines, grades, and typical sections shown on the plans and cross-sections.

2. MATERIALS

Accept ownership of unsuitable or excess material and dispose of material in conformance with local, state, and federal regulations, at locations outside the right of way.

3. CONSTRUCTION

Maintain drainage in the excavated area to avoid damage to the roadway section. Correct any damage to the subgrade caused by weather at no additional cost to the Department.

Shape slopes to avoid loosening material below or outside the proposed grades. Remove and dispose of slides or slope failures as directed.

Excavate to the grade and sections shown on the plans. Manipulate and compact subgrade in accordance with Section 132.3.4., "Compaction Methods," unless excavation is to clean homogenous rock at final grade.

Correct unsuitable material encountered at or below subgrade as directed.

3.1. **Rock Cuts**. Use approved embankment material compacted in accordance with Section 132.3.4., "Compaction Methods," to replace undercut material at no additional cost if excavation extends below the grade shown on the plans.

3.2. **Earth Cuts**. Scarify remaining material to a depth at least 6 in. below the grade shown on the plans in areas where pavement structure will be placed. Compact subgrade in accordance with Section 132.3.4., "Compaction Methods."

3.3. **Acceptance Criteria**.

3.3.1. **Grade Tolerances**.

3.3.1.1. **Staged Construction**. ~~Grade to within 1.25 in. in the cross-section and 1.25 in. in 16 ft. measured longitudinally.~~ **Not Used.**

3.3.1.2. **Turnkey Construction**. Grade to within 0.5 in. in the cross-section and 0.5 in. in 16 ft. measured longitudinally.

4. MEASUREMENT

This Item will be measured by the cubic yard ~~in its original position as computed by the method of average end areas or~~ as shown on the plans.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

Limits of measurement for excavation in retaining wall areas will be as shown on the plans.

Shrinkage or swelling factors will not be considered in determining the calculated quantities.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for ~~"Excavation (Roadway)," "Excavation (Channel)," "Excavation (Special)," or "Excavation (Roadway and Channel)."~~ "TX-110 Excavation". This price is full compensation for authorized excavation; drying; undercutting subgrade in rock cuts and reworking or replacing the undercut material; hauling; disposal of material not used elsewhere on the project; scarification and compaction; and equipment, labor, materials, tools, and incidentals.

Payment includes drying subgrade deeper than shown on plans, and/or removal and replacement of unsuitable material as required to construct a subgrade platform to place the pavement section. ~~Drying subgrade deeper than 6 in. below grade as shown on the plans will be paid for in accordance with Article 9.7., "Payment for Extra Work and Force Account Method." Excavation and replacement of unsuitable material below grade as shown on the plans will be performed and paid for in conformance with the applicable bid items. However, if Item 132, "Embankment," is not included in the Contract, payment for replacement of unsuitable material will be paid for in accordance with Article 9.7., "Payment for Extra Work and Force Account Method."~~

Removing, reworking, reshaping, or re-laying existing pavement structure will be paid for in conformance with the appropriate Item.

When a slide or slope failure not due to the Contractor's negligence or operation occurs, payment for removal and disposal of the slide material will be in accordance with Article 9.7., "Payment for Extra Work and Force Account Method."

Excavation in backfill areas of retaining walls will not be measured or paid for directly, but will be subsidiary to pertinent Items.

ITEM TX-132 EMBANKMENT
Summary of Changes

1. Section 4 Measurement
    a. Sections 4.1, 4.2, 4.3 deleted and replaced with:

~~Shrinkage or swell factors are the Contractor's responsibility. When shown on the plans, factors are for informational purposes only.~~

~~Measurement of retaining wall backfill in embankment areas will be paid for as embankment unless otherwise shown on the plans. Limits of measurement for embankment in retaining wall areas are shown on the plans.~~

~~Embankment will be measured by the cubic yard. Measurement will be further defined for payment as follows.~~

~~1.1. **Final**. The cubic yard will be measured in its final position using the average end area method or as shown on the plans. The volume is computed between the original ground surface or the surface upon which the embankment is to be constructed and the lines, grades, and slopes of the embankment. In areas of salvaged topsoil, payment for embankment will be made in accordance with Item 160, "Topsoil." Shrinkage or swell factors will not be considered in determining the calculated quantities.~~

~~When measured by the cubic yard in its final position, this is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.~~

~~1.2. **Original**. The cubic yard will be measured in its original and natural position using the average end area method or as shown on the plans.~~

~~1.3. **Vehicle**. The cubic yard will be measured in vehicles at the point of delivery.~~

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

2. Section 5 Payment
    a. Paragraph one revised as follows:
        i. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for Embankment (Type D) ~~"Embankment (Final)," "Embankment (Original)," or "Embankment (Vehicle)" of the compaction method and type specified. This price is full compensation for furnishing embankment; hauling; placing, compacting, finishing, and reworking; disposal of waste material; and equipment, labor, tools, and incidentals~~.
    b. Paragraph two deleted:
        i. ~~When proof rolling is directed, it will be paid for in accordance with Item 216.~~
    c. Paragraph three revised as follows:
        i. All sprinkling and rolling, ~~except~~ including proof rolling, will not be paid for directly, but will be subsidiary to this Item, unless otherwise shown on the plans.

Item 132
Embankment

1. DESCRIPTION

Furnish, place, and compact materials for construction of roadways, embankments, levees, dikes, or any designated section of the roadway where additional material is required.

2. MATERIALS

Furnish approved material capable of forming a stable embankment from required excavation in the areas shown on the plans or from sources outside the right of way. Provide one or more of the following types as shown on the plans.

- **Type A**. Granular material that is free of vegetation or other objectionable material and meets the requirements shown in Table 1.

Table 1
Testing Requirements

Property	Test Method	Specification Limit
Liquid limit	Tex-104-E	≤45
Plasticity index (PI)	Tex-106-E	≤15
Bar linear shrinkage	Tex-107-E	≥2

Perform the linear shrinkage test only as indicated in Tex-104-E.

- **Type B**. Materials such as rock, loam, clay, or other approved materials.
- **Type C**. Material meeting the specification requirements shown on the plans. Type C may be further designated as Type C1, C2, etc.
- **Type D**. Material from required excavation areas shown on the plans.

Meet the requirements of the pertinent retaining wall Items for retaining wall backfill material.

3. CONSTRUCTION

Meet the requirements of Item 7, “Legal Relations and Responsibilities,” when off right of way sources are used. Notify the Engineer before opening a material source to allow for required testing. Complete preparation of the right of way in accordance with Item 100, “Preparing Right of Way,” for areas to receive embankment.

Backfill tree-stump holes or other minor excavations with approved material and tamp. Restore the ground surface, including any material disked loose or washed out, to its original slope. Compact the ground surface by sprinkling in accordance with Item 204, “Sprinkling,” and by rolling using equipment complying with Item 210, “Rolling,” when directed.

Scarify and loosen the unpaved surface areas, except rock, to a depth of at least 6 in. unless otherwise shown on the plans. Bench slopes before placing material. Begin placement of material at the toe of slopes. Do not place trees, stumps, roots, vegetation, or other objectionable material in the embankment. Simultaneously recompact scarified material with the placed embankment material. Do not exceed the layer depth specified in Section 132.3.4., “Compaction Methods.”

Construct embankments to the grade and sections shown on the plans. Construct the embankment in layers approximately parallel to the finished grade for the full width of the individual roadway cross-sections unless

otherwise shown on the plans. Ensure that each section of the embankment conforms to the detailed sections or slopes. Maintain the finished section, density, and grade until the project is accepted.

3.1. **Earth Embankments**. Earth embankment is mainly composed of material other than rock. Construct embankments in successive layers, evenly distributing materials in lengths suited for sprinkling and rolling.

Obtain approval to incorporate rock and broken concrete produced by the construction project in the lower layers of the embankment. Place the rock and concrete outside the limits of the completed roadbed when the size of approved rock or broken concrete exceeds the layer thickness requirements in Section 132.3.4., "Compaction Methods." Cut and remove all exposed reinforcing steel from the broken concrete.

Move the material dumped in piles or windrows by blading or by similar methods and incorporate it into uniform layers. Featheredge or blend abutting layers of dissimilar material for at least 100 ft. to ensure there are no abrupt changes in the material. Break down clods or lumps of material.

Apply water free of industrial wastes and other objectionable matter to achieve the uniform moisture content specified for compaction.

Roll and sprinkle each embankment layer in accordance with Section 132.3.4.1., "Ordinary Compaction," when ordinary compaction is specified. Compact the layer to the required density in accordance with Section 132.3.4.2., "Density and Moisture Control," when density control is specified.

3.2. **Rock Embankments**. Rock embankment is mainly composed of rock. Construct rock embankments in successive layers for the full width of the roadway cross-section with a depth of 18 in. or less. Increase the layer depth for large rock sizes as approved. Do not exceed a depth of 2-1/2 ft. in any case. Fill voids created by the large stone matrix with smaller stones during the placement and filling operations.

Ensure the depth of the embankment layer is greater than the maximum dimension of any rock. Do not place rock greater than 2 ft. in its maximum dimension, unless otherwise approved. Construct the final layer with graded material so that the density and uniformity are in accordance with Section 132.3.4., "Compaction Methods." Break up exposed oversized material as approved.

Roll and sprinkle each embankment layer in accordance with Section 132.3.4.1., "Ordinary Compaction," when ordinary compaction is specified. Compact each layer to the required density in accordance with Section 132.3.4.2., "Density and Moisture Control," when density control is specified. Proof-roll each rock layer as directed, where density testing is not possible, in accordance with Item 216, "Proof Rolling," to ensure proper compaction.

3.3. **Embankments Adjacent to Culverts and Bridges**. Compact embankments adjacent to culverts and bridges in accordance with Item 400, "Excavation and Backfill for Structures."

3.4. **Compaction Methods**. Begin rolling longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least 1/2 the width of the roller. Begin rolling at the lower side and progress toward the high side on superelevated curves. Alternate roller trips to attain slightly different lengths. Compact embankments in accordance with Section 132.3.4.1., "Ordinary Compaction," or Section 132.3.4.2., "Density and Moisture Control," as shown on the plans.

3.4.1. **Ordinary Compaction**. Use approved rolling equipment complying with Item 210, "Rolling," to compact each layer. Use specific equipment when required by the Engineer or as shown on the plans. Do not allow the loose depth of any layer to exceed 8 in., unless otherwise approved. Bring each layer to the moisture content directed before and during rolling operations. Compact each layer until there is no evidence of further consolidation. Maintain a level layer to ensure uniform compaction. Recompact and refinish the subgrade at no additional expense to the Department if the required stability or finish is lost for any reason.

3.4.2. **Density and Moisture Control**. Compact each layer to the required density using equipment complying with Item 210. Determine the maximum lift thickness based on the ability of the compacting operation and

equipment to meet the required density. Do not exceed layer thickness of 16 in. loose or 12 in. compacted material unless otherwise approved. Maintain a level layer to ensure uniform compaction.

The Engineer will use Tex-114-E to determine the maximum dry density (D_a) and optimum moisture content (W_{opt}). Meet the requirements for field density and moisture content shown in Table 2 unless otherwise shown on the plans.

Table 2
Field Density Control Requirements

Description	Density	Moisture Content
	Tex-115-E	
PI ≤15	≥98% D_a	–
15 <PI ≤35	≥98% D_a and ≤102% D_a	≥$W_{opt.}$
PI> 35	≥ 95%D_a and ≤100% D_a	≥$W_{opt.}$

Each layer is subject to testing by the Engineer for density and moisture content. Each layer must be brought to the moisture content necessary to obtain the required density and placed in a manner to ensure uniform compaction over the entire layer. The density and moisture contents for the descriptions shown in Table 2 are illustrated in the Moisture-Density Curve of Tex-114-E.

Provide the Engineer with the beginning and ending station numbers of the area completed for testing. The Engineer will determine roadway density and moisture content of completed sections in accordance with Tex-115-E, Part I. The Engineer will determine random locations for testing in accordance with Tex-115-E, Part IV. When the density is less than the required density shown in Table 2, the Engineer may perform additional testing to determine the extent of the area to correct.

Remove small areas of the layer to allow for density tests as required. Replace the removed material and recompact at no additional expense to the Department. Proof-roll in accordance with Item 216, when shown on the plans or as directed. Correct soft spots as directed.

3.5. **Maintenance of Moisture and Reworking**. Maintain the density and moisture content once all requirements shown in Table 2 are met. Maintain the moisture content no lower than 4% below optimum for soils with a PI greater than 15. Rework the material to obtain the specified compaction when the material loses the required stability, density, moisture, or finish. Alter the compaction methods and procedures on subsequent work to obtain specified density as directed.

3.6. **Acceptance Criteria**.

3.6.1. **Grade Tolerances**.

3.6.1.1. **Staged Construction**. Grade to within 1.25 in. in the cross-section and 1.25 in. in 16 ft. measured longitudinally.

3.6.1.2. **Turnkey Construction**. Grade to within 0.5 in. in the cross-section and 0.5 in. in 16 ft. measured longitudinally.

3.6.2. **Gradation Tolerances**. Ensure no more than one of the five most recent gradation tests is outside the specified limits on any individual sieve by more than 5% when gradation requirements are shown on the plans.

3.6.3. **Density Tolerances**. Ensure no more than one of the five most recent density tests for compaction work is outside the specified density limits and no test is outside the limits by more than 3 pcf.

3.6.4. **Plasticity Tolerances**. Ensure no more than one of the five most recent PI tests for material is outside the specified limit by more than 2 points.

4. MEASUREMENT

~~Shrinkage or swell factors are the Contractor's responsibility. When shown on the plans, factors are for informational purposes only.~~

~~Measurement of retaining wall backfill in embankment areas will be paid for as embankment unless otherwise shown on the plans. Limits of measurement for embankment in retaining wall areas are shown on the plans.~~

Embankment will be measured by the cubic yard. Measurement will be further defined for payment as follows.

~~4.1. **Final**. The cubic yard will be measured in its final position using the average end area method or as shown on the plans. The volume is computed between the original ground surface or the surface upon which the embankment is to be constructed and the lines, grades, and slopes of the embankment. In areas of salvaged topsoil, payment for embankment will be made in accordance with Item 160, "Topsoil." Shrinkage or swell factors will not be considered in determining the calculated quantities.~~

~~When measured by the cubic yard in its final position, this is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.~~

~~4.2. **Original**. The cubic yard will be measured in its original and natural position using the average end area method or as shown on the plans.~~

~~4.3. **Vehicle**. The cubic yard will be measured in vehicles at the point of delivery.~~

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for Embankment (Type D) ~~"Embankment (Final)," "Embankment (Original)," or "Embankment (Vehicle)" of the compaction method and type specified. This price is full compensation for furnishing embankment; hauling; placing, compacting, finishing, and reworking; disposal of waste material; and equipment, labor, tools, and incidentals.~~

~~When proof rolling is directed, it will be paid for in accordance with Item 216.~~

All sprinkling and rolling, ~~except~~ including proof rolling, will not be paid for directly, but will be subsidiary to this Item, unless otherwise shown on the plans.

In fill sections, excavation and replacement of unsuitable material below existing elevations will be performed and paid for in conformance with the applicable bid items. However, if Item 110, "Excavation," is not included in the Contract, payment for replacement of unsuitable material will be paid for in accordance with Article 9.7., "Payment for Extra Work and Force Account Method."

Where subgrade is constructed under this Contract, correction of soft spots in the subgrade will be at the Contractor's expense. Where subgrade is not constructed under this Contract, correction of soft spots in the subgrade will be paid for in accordance with Article 9.7., "Payment for Extra Work and Force Account Method."

When rework, removal, or scarification is required for existing pavement structure that will remain, it will be measured and paid for as shown on the plans for the appropriate type.

ITEM TX-164 SEEDING FOR EROSION CONTROL
Summary of Changes

1. Section 3 Construction
    a. Removed Paragraph 3.3 Straw or Hay Mulch Seeding
        i. **Straw or Hay Mulch Seeding**. ~~Plant seed in accordance with Section 164.3.2., "Broadcast Seeding." Apply straw or hay mulch uniformly over the seeded area immediately after planting the seed or seed mixture. Apply straw or hay mulch in accordance with Section 164.3.6., "Straw or Hay Mulching." Apply tack in accordance with Section 164.2.6., "Tacking Methods."~~ **Not Used.**
    b. Removed Paragraph 3.6 Straw or Hay Mulching
        i. **Straw or Hay Mulching**. ~~Apply straw or hay mulch uniformly over the area as shown on the plans. Apply straw mulch at 2–2.5 ton per acre. Apply hay mulch at 1.5–2 ton per acre. Use a tacking method over the mulched area in accordance with Section 164.2.6., "Tacking Methods."~~ **Not Used**

2. Section 4 Measurement
    a. First paragraph revised as follows:
        i. This Item will be measured by ~~the square yard or by~~ the acre.

3. Section 5 Payment
    a. Revised first paragraph as follows:
        i. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Broadcast Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, ~~"Broadcast Seeding (Temp)" of warm or cool season specified, "Straw or Hay Mulch Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, "Straw or Hay Mulch Seeding (Temp)" of warm or cool season specified, "Hydro Mulch Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, "Hydro Mulch Seeding (Temp)" of warm or cool season specified, "Drill Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, "Drill Seeding (Temp)" of warm or cool season specified, and "Straw or Hay Mulching."~~ This price is full compensation for furnishing materials, seeding mix, flower seeding mix, HEL seeding mix, water for hydro-seeding and hydro-mulching operations, mowing, tacking, labor, equipment, tools, supplies, and incidentals.

Item 164
Seeding for Erosion Control

1. DESCRIPTION

Prepare the surface and provide and distribute temporary or permanent seeding for erosion control as shown on the plans or as directed.

2. MATERIALS

2.1. **Seed**. Provide seed from the previous season's crop meeting the requirements of the Texas Seed Law, including the testing and labeling for pure live seed (PLS = Purity × Germination). Furnish seed of the designated species in labeled unopened bags or containers to the Engineer before planting. Use within 12 mo. from the date of the analysis. When Buffalograss is specified, use seed that is treated with potassium nitrate (KNO_3) to overcome dormancy.

Use Tables 1–5 to determine the appropriate seeding mix and rates as shown on the plans. Include flower seeding mix in accordance with Table 5 with seeding mix shown in Table 1 and Table 2.

If a grass plant species is not available by the producers, the other grass plant species in the seeding mix will be increased proportionally by the percentage of the missing plant grass species. If a flower plant species is not available by the producers, the other flower species in the seeding mix will be increased proportionally by the percentage of the missing flower species. Substitute species and rates require approval of the Engineer before being incorporated into the seeding mx. The rates listed in the tables are for drill seeding. All other methods of placing seed will require a 25% increase in rate.

Table 1
Permanent Rural Seeding Mix

District	Clay Soils Species, Percent, and Rate (lb. PLS per acre)			Sandy Soils Species, Percent, and Rate (lb. PLS per acre)		
1 (Paris)	Hooded Windmillgrass (Burnet)	15%	0.3	Hooded Windmillgrass (Burnet)	15%	0.3
	White Tridens (Guadalupe)	20%	0.4	Sand Dropseed (Taylor)	15%	0.3
	Little Bluestem (Coastal Plains)	20%	2.0	Little Bluestem (Coastal Plains)	20%	2.0
	Florida Paspalum (Harrison)	15%	2.25	Florida Paspalum (Harrison)	15%	2.25
	Sideoats Grama (Haskell)	05%	0.5	Splitbeard Bluestem (Neches)	10%	1.0
	Splitbeard Bluestem (Neches)	05%	0.5	Sand Lovegrass (Mason)	10%	0.4
	Sand Dropseed (Taylor)	05%	0.1	Green Sprangletop (Van Horn)	15%	0.6
	Canada Wildrye (Lavaca)	10%	2.0			
	Green Sprangletop (Van Horn)	05%	0.2			
2 (Fort Worth)	Hooded Windmillgrass (Burnet)	15%	0.3	Sand Dropseed (Taylor)	15%	0.3
	White Tridens (Guadalupe)	15%	0.3	Sideoats Grama (Haskell)	15%	1.5
	Sideoats Grama (Haskell)	10%	1.0	Little Bluestem (OK Select)	15%	1.05
	Little Bluestem (OK Select)	10%	0.7	Hairy Grama (Chaparral)	15%	0.6
	Buffalograss (Texoka)	10%	1.5	Green Sprangletop (Van Horn)	10%	0.2
	Silver Bluestem (Santiago)	10%	0.4	Hooded Windmillgrass (Burnet)	10%	0.2
	Green Sprangletop (Van Horn)	10%	0.4	Shortspike Windmillgrass (Welder)	10%	0.2
	Sand Dropseed (Taylor)	10%	0.2	Silver Bluestem (Stantiago)	10%	0.4
	Canada Wildrye (Lavaca)	10%	2.0			

Table 1 (continued)
Permanent Rural Seeding Mix

District	Clay Soils Species, Percent, and Rate (lb. PLS per acre)	Sandy Soils Species, Percent, and Rate (lb. PLS per acre)
3 (Wichita Falls)	Sideoats Grama (Haskell) 15% 1.5 Green Sprangletop (Van Horn) 10% 0.4 Hooded Windmillgrass (Burnet) 10% 0.2 White Tridens (Guadalupe) 10% 0.2 Little Bluestem (OK Select) 15% 1.05 Silver Bluestem (Santiago) 10% 0.4 Buffalograss (Texoka) 10% 1.5 Blue Grama (Hachita) 05% 0.2 Sand Dropseed (Taylor) 05% 0.1 Canada Wildrye (Lavaca) 10% 2.0	Hooded Windmillgrass (Burnet) 10% 0.2 Sand Dropseed (Taylor) 15% 0.3 Green Sprangletop (Van Horn) 15% 0.6 Sideoats Grama (Haskell) 10% 1.0 Little Bluestem (OK Select) 10% 0.7 Silver Bluestem (Santiago) 10% 0.4 Hairy Grama (Chaparral) 10% 0.4 Arizona Cottontop (La Salle) 10% 0.4 Blue Grama (Hachita) 10% 0.4
4 (Amarillo)	Sideoats Grama (Haskell) 15% 1.5 Silver Bluestem (Santiago) 15% 0.6 Buffalograss (Texoka) 15% 2.25 Green Sprangletop (Van Horn) 10% 0.4 Blue Grama (Hachita) 15% 0.6 Hooded Windmillgrass (Burnet) 05% 0.1 White Tridens (Guadalupe) 10% 0.2 Western Wheatgrass (Barton) 10% 3.0 Canada Wildrye (Lavaca) 05% 1.0	Green Sprangletop (Van Horn) 15% 0.6 Sideoats Grama (Haskell) 10% 1.0 Sand Dropseed (Taylor) 10% 0.2 Silver Bluestem (Santiago) 10% 0.4 Little Bluestem (OK Select) 15% 1.05 Arizona Cottontop (La Salle) 10% 0.4 Blue Grama (Hachita) 10% 0.4 Sand Lovegrass (Mason) 10% 0.3 Hooded Windmillgrass (Burnet) 10% 0.2
5 (Lubbock)	Sideoats Grama (Haskell) 15% 1.5 Blue Grama (Hachita) 15% 0.6 Silver Bluestem (Santiago) 15% 0.6 Buffalograss (Texoka) 10% 1.5 White Tridens (Guadalupe) 10% 0.2 Green Sprangletop (Van Horn) 10% 0.4 Hooded Windmillgrass (Burnet) 05% 0.1 Galleta Grass (Viva) 05% 0.3 Western Wheatgrass (Barton) 10% 3.0 Canada Wildrye (Lavaca) 05% 1.0	Green Sprangletop (Van Horn) 15% 0.6 Blue Grama (Hachita) 15% 0.6 Sideoats Grama (Haskell) 10% 1.0 Little Bluestem (OK Select) 10% 0.7 Hooded Windmillgrass (Burnet) 10% 0.2 Sand Dropseed (Taylor) 10% 0.2 Silver Bluestem (Santiago) 10% 0.4 Arizona Cottontop (La Salle) 10% 0.4 Sand Lovegrass (Mason) 10% 0.3
6 (Odessa)	Whiplash Pappusgrass (Permian) 15% 0.9 Green Sprangletop (Van Horn) 10% 0.4 Silver Bluestem (Santiago) 15% 0.6 Sideoats Grama (Brewster) 10% 1.0 Sand Dropseed (Taylor) 10% 0.2 Alkali Sacaton (Saltalk) 10% 0.2 Arizona Cottontop (La Salle) 10% 0.4 Blue Grama (Hachita) 10% 0.4 Galleta Grass (Viva) 10% 0.6	Sand Dropseed (Taylor) 15% 0.3 Green Sprangletop (Van Horn) 10% 0.4 Sideoats Grama (Brewster) 15% 1.5 Whiplash Pappusgrass (Permian) 10% 0.6 Hooded Windmillgrass (Burnet) 10% 0.2 Blue Grama (Hachita) 10% 0.4 Hairy Grama (Chaparral) 10% 0.4 Sand Lovegrass (Mason) 10% 0.3 Little Bluestem (Pastura) 05% 0.5 Galleta Grass (Viva) 05% 0.3
7 (San Angelo)	Sideoats Grama (Brewster) 15% 1.5 Hooded Windmillgrass (Burnet) 10% 0.2 Silver Bluestem (Santiago) 10% 0.4 Sand Dropseed (Taylor) 10% 0.2 White Tridens (Guadalupe) 10% 0.2 Whiplash Pappusgrass (Permian) 15% 0.9 Texas Grama (Atascosa) 05% 0.5 Green Sprangletop (Van Horn) 10% 0.4 Little Bluestem (OK Select) 05% 0.35 Blue Grama (Hachita) 05% 0.2 Galleta Grass (Viva) 05% 0.3	Sand Dropseed (Taylor) 15% 0.3 Green Sprangletop (Van Horn) 15% 0.6 Hooded Windmillgrass (Burnet) 15% 0.3 Shortspike Windmillgrass (Welder) 10% 0.2 Hairy Grama (Chaparral) 10% 0.4 Sand Lovegrass (Mason) 10% 0.3 Sideoats Grama (Brewster) 10% 1.0 Little Bluestem (OK Select) 10% 0.7 Whiplash Pappusgrass (Permian) 05% 0.3

Table 1 (continued)
Permanent Rural Seeding Mix

District	Clay Soils Species, Percent, and Rate (lb. PLS per acre)		Sandy Soils Species, Percent, and Rate (lb. PLS per acre)	
8 (Abilene)	Sideoats Grama (Haskell)	10% 1.0	Sand Dropseed (Taylor)	15% 0.3
	Hooded Windmillgrass (Burnet)	10% 0.2	Green Sprangletop (Van Horn)	10% 0.4
	Buffalograss (Texoka)	10% 1.5	Hooded Windmillgrass (Burnet)	15% 0.3
	Blue Grama (Hachita)	10% 0.4	Silver Bluestem (Santiago)	10% 0.4
	Silver Bluestem (Santiago)	10% 0.4	Little Bluestem (OK Select)	10% 0.7
	White Tridens (Guadalupe)	15% 0.2	Shortspike Windmillgrass (Welder)	10% 0.2
	Little Bluestem (OK Select)	10% 0.7	Hairy Grama (Chaparral)	10% 0.4
	Green Sprangletop (Van Horn)	10% 0.4	Sand Lovegrass (Mason)	10% 0.3
	Whiplash Pappusgrass (Permian)	10% 0.6	Arizona Cottontop (La Salle)	10% 0.4
	Galleta Grass (Viva)	10% 0.6		
9 (Waco)	Sideoats Grama (Haskell)	15% 1.5	Hooded Windmillgrass (Burnet)	15% 0.3
	White Tridens (Guadalupe)	15% 0.3	Shortspike Windmillgrass (Welder)	10% 0.2
	Hooded Windmillgrass (Burnet)	10% 0.2	Hairy Grama (Chaparral)	10% 0.4
	Little Bluestem (OK Select)	10% 0.7	Sand Dropseed (Taylor)	15% 0.3
	Buffalograss (Texoka)	10% 1.6	Sideoats Grama (Haskell)	10% 1.0
	Halls Panicum (Oso)	05% 0.1	Little Bluestem (OK Select)	10% 0.7
	Silver Bluestem (Santiago)	10% 0.4	Green Sprangletop (Van Horn)	10% 0.4
	Sand Dropseed (Taylor)	05% 0.1	Texas Grama (Atascosa)	05% 0.15
	Green Sprangletop (Van Horn)	10% 0.4	Silver Bluestem (Santiago)	10% 0.4
	Canada Wildrye (Lavaca)	05% 1.0	Canada Wildrye (Lavaca)	05% 1.0
	Texas Grama (Atascosa)	05% 0.5		
10 (Tyler)	Hooded Windmillgrass (Burnet)	15% 0.3	Hooded Windmillgrass (Burnet)	15% 0.3
	White Tridens (Guadalupe)	15% 0.3	Sand Dropseed (Taylor)	10% 0.2
	Sand Dropseed (Taylor)	05% 0.1	Little Bluestem (Coastal Plains)	20% 2.0
	Little Bluestem (Coastal Plains)	20% 2.0	Florida Paspalum (Harrison)	15% 2.25
	Florida Paspalum (Harrison)	15% 2.25	Splitbeard Bluestem (Neches)	10% 1.0
	Splitbeard Bluestem (Neches)	10% 1.0	Green Sprangletop (Van Horn)	05% 0.2
	Green Sprangletop (Van Horn)	05% 0.2	Sand Lovegrass (Mason)	10% 0.4
	Sideoats Grama (Haskell)	05% 0.5	Red Lovegrass (Duval)	10% 0.2
	Canada Wildrye (Lavaca)	10% 2.0	Hairy Grama (Chaparral)	05% 0.2
11 (Lufkin)	Hooded Windmillgrass (Burnet)	15% 0.3	Hooded Windmillgrass (Burnet)	15% 0.3
	White Tridens (Guadalupe)	15% 0.3	Sand Dropseed (Taylor)	10% 0.2
	Little Bluestem (Coastal Plains)	20% 2.0	Little Bluestem (Coastal Plains)	20% 2.0
	Florida Paspalum (Harrison)	15% 2.25	Florida Paspalum (Harrison)	15% 2.25
	Green Sprangletop (Van Horn)	05% 0.2	Splitbeard Bluestem (Neches)	10% 1.0
	Sideoats Grama (Haskell)	05% 0.5	Green Sprangletop (Van Horn)	05% 0.2
	Splitbeard Bluestem (Neches)	10% 1.0	Red Lovegrass (Duval)	10% 0.2
	Sand Dropseed (Taylor)	05% 0.1	Sand Lovegrass (Mason)	10% 0.4
	Canada Wildrye (Lavaca)	10% 2.0	Hairy Grama (Chaparral)	05% 0.2
12 (Houston)	White Tridens (Guadalupe)	10% 0.2	Hooded Windmillgrass (Mariah)	15% 0.3
	Hooded Windmillgrass (Mariah)	10% 0.2	Sand Dropseed (Nueces)	15% 0.3
	Shortspike Windmillgrass (Welder)	15% 0.3	Shortspike Windmillgrass (Welder)	10% 0.2
	Little Bluestem (Coastal Plains)	15% 1.5	Little Bluestem (Coastal Plains)	15% 1.5
	Florida Paspalum (Harrison)	15% 2.25	Red Lovegrass (Duval)	10% 0.2
	Red Lovegrass (Duval)	05% 0.1	Florida Paspalum (Harrison)	15% 2.25
	Halls Panicum (Oso)	10% 0.2	Splitbeard Bluestem (Neches)	10% 1.0
	Splitbeard Bluestem (Neches)	05% 0.5	Hairy Grama (Chaparral)	05% 0.2
	Sand Dropseed (Nueces)	05% 0.1	Green Sprangletop (Van Horn)	05% 0.2
	Canada Wildrye (Lavaca)	10% 2.0		
13 (Yoakum)	White Tridens (Guadalupe)	15% 0.3	Hairy Grama (Chaparral)	15% 0.6
	Shortspike Windmillgrass (Welder)	15% 0.3	Hooded Windmillgrass (Mariah)	15% 0.3
	Halls Panicum (Oso)	10% 0.2	Shortspike Windmillgrass (Welder)	10% 0.2
	Plains Bristlegrass (Catarina Blend)	10% 0.6	Sand Dropseed (Nueces)	10% 0.2
	Little Bluestem (Coastal Plains)	15% 1.5	Little Bluestem (Carrizo)	10% 1.5
	Sideoats Grama (South Texas)	05% 0.75	Red Lovegrass (Duval)	10% 0.2
	Texas Grama (Atascosa)	10% 1.0	Slender Grama (Dilley)	10% 1.0
	Hooded Windmillgrass (Mariah)	05% 0.1	Plains Bristlegrass (Catarina)	10% 0.4
	Sand Dropseed (Nueces)	05% 0.1	Green Sprangletop (Van Horn)	10% 0.4
	Canada Wildrye (Lavaca)	10% 2.0		

Table 1 (continued)
Permanent Rural Seeding Mix

District	Clay Soils Species, Percent, and Rate (lb. PLS per acre)		Sandy Soils Species, Percent, and Rate (lb. PLS per acre)	
14 (Austin)	Hooded Windmillgrass (Burnet)	20% 0.4	Hairy Grama (Chaparral)	15% 0.6
	White Tridens (Guadalupe)	10% 0.2	Shortspike Windmillgrass (Welder)	10% 0.2
	Sideoats Grama (South Texas)	10% 1.5	Hooded Windmillgrass (Burnet)	10% 0.2
	Shortspike Windmillgrass (Welder)	10% 0.2	Red Lovegrass (Duval)	10% 0.2
	Plains Bristlegrass (Catarina Blend)	10% 0.6	Sand Dropseed (Nueces)	10% 0.2
	Silver Bluestem (Santiago)	10% 0.4	Little Bluestem (Carrizo)	10% 1.5
	Little Bluestem (OK Select)	10% 0.7	Sideoats Grama (South Texas)	10% 1.5
	Halls Panicum (Oso)	05% 0.1	Silver Bluestem (Santiago)	10% 0.4
	Texas Grama (Atascosa)	05% 0.5	Plains Bristlegrass (Catarina)	10% 0.4
	Canada Wildrye (Lavaca)	10% 2.0	Arizona Cottontop (La Salle)	05% 0.2
15 (San Antonio)	Sideoats Grama (South Texas)	15% 2.25	Slender Grama (Dilley)	15% 1.5
	White Tridens (Guadalupe)	15% 0.3	Hairy Grama (Chaparral)	15% 0.6
	Shortspike Windmillgrass (Welder)	10% 0.2	Shortspike Windmillgrass (Welder)	10% 0.2
	Halls Panicum (Oso)	10% 0.2	Hooded Windmillgrass (Mariah)	10% 0.2
	Plains Bristlegrass (Catarina Blend)	10% 0.6	Red Lovegrass (Duval)	10% 0.2
	False Rhodes Grass (Kinney)	05% 0.1	Sand Dropseed (Nueces)	10% 0.2
	Hooded Windmillgrass (Mariah)	05% 0.1	Pink Pappusgrass (Maverick)	05% 0.3
	Pink Pappusgrass (Maverick)	10% 0.6	Little Bluestem (Carrizo)	10% 1.5
	Texas Grama (Atascosa)	05% 0.5	Arizona Cottontop (La Salle)	05% 0.2
	Multiflower False Rhodes Grass (Hidalgo)	10% 0.2	Multiflower False Rhodes Grass (Hidalgo)	05% 0.1
	Arizona Cottontop (La Salle)	05% 0.2	Plains Bristlegrass (Catarina)	05% 0.2
16 (Corpus Christi)	Shortspike Windmillgrass (Welder)	15% 0.3	Slender Grama (Dilley)	15% 1.5
	Pink Pappusgrass (Maverick)	10% 0.6	Hairy Grama (Chaparral)	15% 0.6
	Halls Panicum (Oso)	10% 0.2	Hooded Windmillgrass (Mariah)	10% 0.2
	Plains Bristlegrass (Catarina Blend)	10% 0.6	Red Lovegrass (Duval)	10% 0.2
	White Tridens (Guadalupe)	10% 0.2	Sand Dropseed (Nueces)	10% 0.2
	Multiflower Galse Rhodes Grass (Hidalgo)	10% 0.2	Shortspike Windmillgrass (Welder)	10% 0.2
			Pink Pappusgrass (Maverick)	10% 0.6
	Hooded Windmillgrass (Mariah)	10% 0.2	Multiflower False Rhodes Grass (Hidalgo)	10% 0.2
	Arizona Cottontop (La Salle)	05% 0.2		
	Sand Dropseed (Nueces)	05% 0.1	Arizona Cottontop (La Salle)	05% 0.2
	Sideoats Grama (South Texas)	10% 1.5	Little Bluestem (Carrizo)	05% 0.75
	Texas Grama (Atascosa)	05% 0.5		
17 (Bryan)	White Tridens (Guadalupe)	15% 0.3	Sand Dropseed (Taylor)	10% 0.2
	Hooded Windmillgrass (Burnet)	15% 0.3	Shortspike Windmillgrass (Welder)	10% 0.2
	Little Bluestem (Coastal Plains)	15% 1.5	Little Bluestem (Coastal Plains)	15% 1.5
	Florida Paspalum (Harrison)	15% 2.25	Green Sprangletop (Van Horn)	05% 0.2
	Shortspike Windmillgrass (Welder)	10% 0.2	Florida Paspalum (Harrison)	15% 2.25
	Splitbeard Bluestem (Neches)	05% 0.5	Splitbeard Bluestem (Neches)	10% 1.0
	Green Sprangletop (Van Horn)	05% 0.2	Hooded Windmillgrass (Burnet)	15% 0.3
	Halls Panicum (Oso)	05% 0.1	Red Lovegrass (Duval)	10% 0.2
	Sand Dropseed (Taylor)	05% 0.1	Hairy Grama (Chaparral)	10% 0.4
	Canada Wildrye (Lavaca)	10% 2.0		
18 (Dallas)	Sideoats Grama (Haskell)	15% 1.5	Shortspike Windmillgrass (Welder)	10% 0.2
	Hooded Windmillgrass (Burnet)	15% 0.3	Hairy Grama (Chaparral)	15% 0.6
	White Tridens (Guadalupe)	15% 0.3	Sand Dropseed (Taylor)	10% 0.2
	Little Bluestem (OK Select)	15% 1.05	Little Bluestem (OK Select)	15% 1.05
	Buffalograss (Texoka)	10% 1.5	Sideoats Grama (Haskell)	10% 1.0
	Silver Bluestem (Santiago)	05% 0.2	Green Sprangletop (Van Horn)	10% 0.4
	Green Sprangletop (Van Horn)	05% 0.2	Hooded Windmillgrass (Burnet)	10% 0.2
	Shortspike Windmillgrass (Welder)	05% 0.1	Sand Lovegrass (Mason)	10% 0.4
	Canada Wildrye (Lavaca)	10% 2.0	Silver Bluestem (Santiago)	10% 0.4
	Sand Dropseed (Taylor)	05% 0.1		

Table 1 (continued)
Permanent Rural Seeding Mix

District	Clay Soils Species, Percent, and Rate (lb. PLS per acre)		Sandy Soils Species, Percent, and Rate (lb. PLS per acre)	
19 (Atlanta)	White Tridens (Guadalupe)	15% 0.3	Hooded Windmillgrass (Burnet)	15% 0.3
	Hooded Windmillgrass (Burnet)	15% 0.3	Sand Dropseed (Taylor)	10% 0.2
	Little Bluestem (Coastal Plains)	20% 2.0	Little Bluestem (Coastal Plains)	20% 2.0
	Florida Paspalum (Harrison)	15% 2.25	Florida Paspalum (Harrison)	15% 2.25
	Sideoats Grama (Haskell)	10% 1.0	Splitbeard Bluestem (Neches)	10% 1.0
	Splitbeard Bluestem (Neches)	05% 0.5	Sand Lovegrass (Mason)	10% 0.4
	Green Sprangletop (Van Horn)	05% 0.2	Red Lovegrass (Duval)	10% 0.2
	Sand Dropseed (Taylor)	05% 0.1	Hairy Grama (Chaparral)	10% 0.4
	Canada Wildrye (Lavaca)	10% 2.0		
20 (Beaumont)	White Tridens (Guadalupe)	10% 0.2	Hooded Windmillgrass (Mariah)	15% 0.3
	Hooded Windmillgrass (Mariah)	10% 0.2	Sand Dropseed (Nueces)	15% 0.3
	Shortspike Windmillgrass (Welder)	15% 0.3	Shortspike Windmillgrass (Welder)	10% 0.2
	Little Bluestem (Coastal Plains)	15% 1.5	Little Bluestem (Coastal Plains)	15% 1.5
	Florida Paspalum (Harrison)	15% 2.25	Red Lovegrass (Duval)	10% 0.2
	Red Lovegrass (Duval)	05% 0.1	Florida Paspalum (Harrison)	15% 2.25
	Halls Panicum (Oso)	10% 0.2	Splitbeard Bluestem (Neches)	10% 1.0
	Splitbeard Bluestem (Neches)	05% 0.5	Hairy Grama (Chaparral)	05% 0.2
	Sand Dropseed (Nueces)	05% 0.1	Green Sprangletop (Van Horn)	05% 0.2
	Canada Wildrye (Lavaca)	10% 2.0		
21 (Pharr)	Shortspike Windmillgrass (Welder)	10% 0.2	Slender Grama (Dilley)	10% 1.0
	Halls Panicum (Oso)	10% 0.2	Hairy Grama (Chaparral)	10% 0.4
	White Tridens (Guadalupe)	10% 0.2	Shortspike Windmillgrass (Welder)	10% 0.2
	Plains Bristlegrass (Catarina Blend)	10% 0.6	Red Lovegrass (Duval)	10% 0.2
	Pink Pappusgrass (Maverick)	10% 0.6	Sand Dropseed (Nueces)	10% 0.2
	Texas Grama (Atascosa)	10% 1.0	Hooded Windmillgrass (Mariah)	10% 0.2
	Multiflower False Rhodes Grass (Hidalgo)	05% 0.1	Pink Pappusgrass (Maverick)	10% 0.6
			Whiplash Pappusgrass (Webb)	10% 0.6
	Hooded Windmillgrass (Mariah)	10% 0.2	Multiflower False Rhodes Grass (Hidalgo)	10% 0.2
	Arizona Cottontop (La Salle)	10% 0.4		
	Sand Dropseed (Nueces)	05% 0.1	Arizona Cottontop (La Salle)	10% 0.4
	Whiplash Pappusgrass (Webb)	10% 0.6		
22 (Laredo)	Sideoats Grama (South Texas)	15% 2.25	Slender Grama (Dilley)	15% 1.5
	Pink Pappusgrass (Maverick)	10% 0.6	Hairy Grama (Chaparral)	15% 0.6
	Halls Panicum (Oso)	10% 0.2	Hooded Windmillgrass (Mariah)	10% 0.2
	Plains Bristlegrass (Catarina Blend)	10% 0.6	Red Lovegrass (Duval)	10% 0.2
	White Tridens (Guadalupe)	10% 0.2	Sand Dropseed (Nueces)	10% 0.2
	Whiplash Pappusgrass (Webb)	10% 0.6	Pink Pappusgrass (Maverick)	10% 0.6
	Shortspike Windmillgrass (Welder)	05% 0.1	Arizona Cottontop (La Salle)	10% 0.4
	Texas Grama (Atascosa)	10% 1.0	Little Bluestem (Carrizo)	05% 0.75
	False Rhodes Grass (Kinney)	10% 0.2	Sideoats Grama (South Texas)	10% 1.5
	Hooded Windmillgrass (Mariah)	10% 0.2	Shortspike Windmillgrass (Welder)	05% 0.1
23 (Brownwood)	Sideoats Grama (Haskell)	15% 1.5	Green Sprangletop (Van Horn)	15% 0.6
	Hooded Windmillgrass (Burnet)	15% 0.3	Sand Dropseed (Taylor)	15% 0.3
	White Tridens (Guadalupe)	15% 0.3	Sideoats Grama (Haskell)	10% 1.0
	Texas Grama (Atascosa)	10% 1.0	Little Bluestem (OK Select)	15% 1.05
	Little Bluestem (OK Select)	10% 0.7	Silver Bluestem (Santiago)	10% 0.4
	Buffalograss (Texoka)	10% 1.5	Hooded Windmillgrass (Burnet)	10% 0.2
	Silver Bluestem (Santiago)	10% 0.4	Shortspike Windmillgrass (Welder)	10% 0.2
	Shortspike Windmillgrass (Welder)	05% 0.1	Hairy Grama (Chaparral)	10% 0.4
	Sand Dropseed (Taylor)	05% 0.1	Sand Lovegrass (Mason)	05% 0.2
	Green Sprangletop (Van Horn)	05% 0.2		

Table 1 (continued)
Permanent Rural Seeding Mix

District	Clay Soils Species, Percent, and Rate (lb. PLS per acre)			Sandy Soils Species, Percent, and Rate (lb. PLS per acre)		
24 (El Paso)	Green Sprangletop (Van Horn)	10%	0.4	Sand Dropseed (Taylor)	20%	0.4
	Sideoats Grama (Brewster)	10%	1.0	Sideoats Grama (Brewster)	15%	1.5
	Whiplash Pappusgrass (Permian)	10%	0.6	Green Sprangletop (Van Horn)	15%	0.6
	Silver Bluestem (Santiago)	10%	0.4	Hooded Windmillgrass (Burnet)	10%	0.2
	Blue Grama (Hachita)	10%	0.4	Blue Grama (Hachita)	10%	0.4
	Galleta Grass (Viva)	10%	0.6	Hairy Grama (Chaparral)	05%	0.2
	Alkali Sacaton (Saltalk)	10%	0.2	Spike Dropseed (Potter)	10%	0.1
	Arizona Cottontop (La Salle)	10%	0.4	Little Bluestem (Pastura)	05%	0.5
	Plains Bristlegrass (Catarina Blend)	10%	0.4	Galleta grass (Viva)	10%	0.6
	False Rhodes Grass (Kinney)	10%	0.2			
25 (Childress)	Sideoats Grama (Haskell)	15%	1.5	Sideoats Grama (Haskell)	15%	1.5
	Hooded Windmillgrass (Burnet)	15%	0.3	Green Sprangletop (Van Horn)	10%	0.4
	Blue Grama (Hachita)	10%	0.4	Sand Dropseed (Taylor)	10%	0.2
	Buffalograss (Texoka)	10%	1.5	Hooded Windmillgrass (Burnet)	10%	0.2
	Galleta Grass (Viva)	10%	0.6	Arizona Cottontop (La Salle)	10%	0.4
	Silver Bluestem (Santiago)	15%	0.6	Blue Grama (Hachita)	10%	0.4
	White Tridens (Guadalupe)	10%	0.2	Little Bluestem (OK select)	10%	1.0
	Green Sprangletop (Van Horn)	05%	0.2	Galleta Grass (Viva)	10%	0.6
	Western Wheatgrass (Barton)	05%	1.5	Sand Lovegrass (Mason)	05%	0.15
	Canada Wildrye (Lavaca)	05%	1.0	Canada Wildrye (Lavaca)	10%	2.0

Table 2
Permanent Urban Seeding Mix

District	Clay Soils Species and Rates (lb. PLS per acre)		Sandy Soils Species and Rates (lb. PLS per acre)	
1 (Paris)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
2 (Fort Worth)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Sideoats Grama (El Reno)	3.6
	Bermudagrass	2.4	Bermudagrass	2.1
	Buffalograss (Texoka)	1.6	Sand Dropseed (Borden Co.)	0.3
3 (Wichita Falls)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	4.5	Sideoats Grama (El Reno)	3.6
	Bermudagrass	1.8	Bermudagrass	1.8
	Buffalograss (Texoka)	1.6	Sand Dropseed (Borden Co.)	0.4
4 (Amarillo)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Sideoats Grama (El Reno)	2.7
	Blue Grama (Hachita)	1.2	Blue Grama (Hachita)	0.9
	Buffalograss (Texoka)	1.6	Sand Dropseed (Borden Co.)	0.4
			Buffalograss (Texoka)	1.6
5 (Lubbock)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Sideoats Grama (El Reno)	2.7
	Blue Grama (Hachita)	1.2	Blue Grama (Hachita)	0.9
	Buffalograss (Texoka)	1.6	Sand Dropseed (Borden Co.)	0.4
			Buffalograss (Texoka)	1.6
6 (Odessa)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Sideoats Grama (Haskell)	2.7
	Blue Grama (Hachita)	1.2	Sand Dropseed (Borden Co.)	0.4
	Buffalograss (Texoka)	1.6	Blue Grama (Hachita)	0.9
			Buffalograss (Texoka)	1.6
7 (San Angelo)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	7.2	Sideoats Grama (Haskell)	3.2
	Buffalograss (Texoka)	1.6	Sand Dropseed (Borden Co.)	0.3
			Blue Grama (Hachita)	0.9
			Buffalograss (Texoka)	1.6

Table 2 (continued)
Permanent Urban Seeding Mix

District	Clay Soils Species and Rates (lb. PLS per acre)		Sandy Soils Species and Rates (lb. PLS per acre)	
8 (Abilene)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Sand Dropseed (Borden Co.)	0.3
	Blue Grama (Hachita)	1.2	Sideoats Grama (Haskell)	3.6
	Buffalograss (Texoka)	1.6	Blue Grama (Hachita)	0.8
			Buffalograss (Texoka)	1.6
9 (Waco)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	1.8	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	3.6
	Sideoats Grama (Haskell)	4.5	Sand Dropseed (Borden Co.)	0.4
10 (Tyler)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
11 (Lufkin)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
12 (Houston)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	4.5	Bermudagrass	5.4
	Bermudagrass	2.4		
13 (Yoakum)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (South Texas)	4.5	Bermudagrass	5.4
	Bermudagrass	2.4		
14 (Austin)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	4.8
	Sideoats Grama (South Texas)	3.6	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6		
15 (San Antonio)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (South Texas)	3.6	Bermudagrass	4.8
	Bermudagrass	2.4	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6		
16 (Corpus Christi)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (South Texas)	3.6	Bermudagrass	4.8
	Bermudagrass	2.4	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6		
17 (Bryan)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
18 (Dallas)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	3.6
	Bermudagrass	2.4	Sand Dropseed (Borden Co.)	0.4
19 (Atlanta)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
20 (Beaumont)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
21 (Pharr)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (South Texas)	3.6	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	3.6
	Bermudagrass	2.4	Sand Dropseed (Borden Co.)	0.4
22 (Laredo)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (South Texas)	4.5	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	3.6
	Bermudagrass	1.8	Sand Dropseed	0.4
23 (Brownwood)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Buffalograss (Texoka)	1.6
	Bermudagrass	1.2	Bermudagrass	3.6
	Blue Grama (Hachita)	0.9	Sand Dropseed (Borden Co.)	0.4

Table 2 (continued)
Permanent Urban Seeding Mix

District	Clay Soils Species and Rates (lb. PLS per acre)		Sandy Soils Species and Rates (lb. PLS per acre)	
24 (El Paso)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (South Texas)	3.6	Buffalograss (Texoka)	1.6
	Blue Grama (Hachita)	1.2	Sand Dropseed (Borden Co.)	0.4
	Buffalograss (Texoka)	1.6	Blue Grama (Hachita)	1.8
25 (Childress)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Sand Dropseed (Borden Co.)	0.4
	Blue Grama (Hachita)	1.2	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	1.8

Table 3
Temporary Cool Seeding Mix

District	All Soils Species and Rates (lb. PLS per acre)	
1 (Paris), 2 (Fort Worth), 3 (Wichita Falls), 4 (Amarillo), 5 (Lubbock), 6 (Odessa), 7 (San Angelo), 8 (Abilene), 18 (Dallas), 19 (Atlanta), 23 (Brownwood), 24 (El Paso), 25 (Childress)	Oats	30.0
	Wheat	30.0
	Little Barley	5.0
	Western Wheatgrass	5.0
9 (Waco), 10 (Tyler), 11 (Lufkin), 12 (Houston), 13 (Yoakum), 14 (Austin), 15 (San Antonio), 16 (Corpus Christi), 17 (Bryan), 20 (Beaumont), 21 (Pharr), 22 (Laredo)	Oats	40.0
	Little Barley	5.0

Table 4
Temporary Warm Seeding Mix

District	All Soils Species and Rates (lb. PLS per acre)	
All	Brownton Millet	20.0

Table 5
Flower Seeding Mix

District	All Soils Species and Rates (lb. PLS per acre)	
1 (Paris), 10 (Tyler), 11 (Lufkin), 12 (Houston), 17 (Bryan), 19 (Atlanta), 20 (Beaumont)	Herbaceous Mimosa (Crockett)	1.5
	Illinois Bundleflower (Sabine)	1.5
	Thickspike Gayfeather (Pineywoods)	1.5
	Purple Prairie Clover (Kaneb)	0.6
	Rio Grange Clammyweed (Zapata)	2.0
2 (Fort Worth), 3 (Wichita Falls), 4 (Amarillo), 5 (Lubbock), 6 (Odessa), 7 (San Angelo), 8 (Abilene), 9 (Waco), 18 (Dallas), 23 (Brownwood), 25 (Childress)	Engelmann Daisy (Eldorado)	1.5
	Awnless Bushsunflower (Plateau)	1.5
	Partridge Pea	1.5
	Illinois Bundleflower (Sabine)	1.5
	Rio Grande Clammyweed (Zapata)	2.0
13 (Yoakum), 14 (Austin), 15 (San Antonio), 16 (Corpus Christi, 21 (Pharr), 22 (Laredo), 24 (El Paso)	Indian Blanket (Fuego)	1.0
	Awnless Bushsunflower (Venado)	0.4
	Prostrate Bundleflower (Balli)	1.5
	Orange Zexmenia (Goliad)	0.4
	Rio Grande Clammyweed (Zapata)	2.0

2.2. **Fertilizer**. Use fertilizer in accordance with Article 166.2., “Materials.”

2.3. **Water**. Use water in accordance with Article 168.2, “Materials.”

2.4. **Highly Erodible Land (HEL)**. Add Bermudagrass to the mix shown in Table 1 at 1.0 PLS per acre if shown on the plans.

2.5. **Mulch**.

2.5.1. **Straw or Hay Mulch**. Use straw or hay mulch in accordance with Section 162.2.5., "Mulch."

2.5.2. **Hydro Mulch**. Use mulches that are on the Approved Products List. Submit one full set of manufacturer's literature for the selected material. Keep mulch dry until applied. Do not use molded or rotted material.

2.6. **Tacking Methods**. Use a tacking agent applied in conformance with the manufacturer's recommendations or by a crimping method on all straw or hay mulch operations. Use tacking agents as approved or as shown on the plans.

3. CONSTRUCTION

Scarify the area to a depth of 4 in. before placing the seed, unless otherwise directed. Use approved equipment to vertically track the seedbed as shown on the plans or as directed. Scarify the seedbed to a depth of 4 in. or mow the area before placement of the permanent seed mix when performing permanent seeding after an established temporary seeding. Plant the seed mix specified and mulch, if required, after the area has been completed to lines and grades as shown on the plans.

Apply fertilizer in accordance with Article 166.3., "Construction." Grass seed, flower seed, and fertilizer may be distributed simultaneously during dry seeding operations, provided each component is applied at the specified rate. Do not combine fertilizer and seed in the same slurry during hydro mulch seeding operations. Apply half of the required fertilizer during the temporary seeding operation and the other half during the permanent seeding operation when temporary and permanent seeding are both specified for the same area.

Water the seeded areas at the rates and frequencies as shown on the plans or as directed.

Distribute the seed or seed mixture uniformly over the areas shown on the plans. Provide equipment with an agitator or method to maintain a uniform seed mixture during distribution.

3.1. **Planting Season**.

3.1.1. **Temporary Seed**. Plant cool seeding mix September 1–January 31. Plant warm seeding mix February 1–August 30.

3.1.2. **Permanent Seed**. End planting season for all Districts by May 15. Begin planting season for each District based on the following.

- **January 15**. 1 (Paris), 10 (Tyler), 11 (Lufkin), 12 (Houston), 13 (Yoakum), 15 (San Antonio), 16 (Corpus Christi), 17 (Bryan), 19 (Atlanta), 20 (Beaumont), 21 (Pharr), and 22 (Laredo).
- **February 1**. 2 (Fort Worth), 3 (Wichita Falls), 6 (Odessa), 7 (San Angelo), 8 (Abilene), 9 (Waco), 14 (Austin), 18 (Dallas), 23 (Brownwood), 24 (El Paso), and 25 (Childress).
- **February 15**. 4 (Amarillo) and 5 (Lubbock).

3.2. **Broadcast Seeding**. Use hand or mechanical distribution or hydro-seeding on top of the soil unless otherwise directed. Apply the mixture to the area to be seeded within 30 min. of placement of components in the equipment when seed and water are to be distributed as a slurry during hydro-seeding. Roll the planted area using a light roller or other suitable equipment. Roll sloped areas along the contour of the slopes.

3.3. **Straw or Hay Mulch Seeding**. ~~Plant seed in accordance with Section 164.3.2., "Broadcast Seeding." Apply straw or hay mulch uniformly over the seeded area immediately after planting the seed or seed mixture. Apply straw or hay mulch in accordance with Section 164.3.6., "Straw or Hay Mulching." Apply tack in accordance with Section 164.2.6., "Tacking Methods."~~ **Not Used.**

3.4. **Hydro Mulch Seeding**. Plant seed in accordance with Section 164.3.2, "Broadcast Seeding," before placing mulch. Apply mulch uniformly over the seeded area immediately after planting the seed or seed mixture at the following rates.

- **Sandy Soils with Slopes of 3:1 or Less**. 2,500 lb. per acre.
- **Sandy Soils with Slopes Greater than 3:1**. 3,000 lb. per acre.
- **Clay Soils with Slopes of 3:1 or Less**. 2,000 lb. per acre.
- **Clay Soils with Slopes Greater than 3:1**. 2,300 lb. per acre.

Mulch rates are based on dry weight of mulch per acre. Mix mulch and water to make a slurry and apply uniformly over the seeded area using suitable equipment.

3.5. **Drill Seeding**. Plant at a depth of 1/4–1/3 in. using a pasture- or rangeland-type drill unless otherwise directed. Plant seed along the contour of the slopes.

3.6. **Straw or Hay Mulching**~~. Apply straw or hay mulch uniformly over the area as shown on the plans. Apply straw mulch at 2–2.5 ton per acre. Apply hay mulch at 1.5–2 ton per acre. Use a tacking method over the mulched area in accordance with Section 164.2.6., "Tacking Methods."~~ **Not Used.**

4. MEASUREMENT

This Item will be measured by ~~the square yard or by~~ the acre.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Broadcast Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, ~~"Broadcast Seeding (Temp)" of warm or cool season specified, "Straw or Hay Mulch Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, "Straw or Hay Mulch Seeding (Temp)" of warm or cool season specified, "Hydro Mulch Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, "Hydro Mulch Seeding (Temp)" of warm or cool season specified, "Drill Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, "Drill Seeding (Temp)" of warm or cool season specified, and "Straw or Hay Mulching."~~ This price is full compensation for furnishing materials, seeding mix, flower seeding mix, HEL seeding mix, water for hydro-seeding and hydro-mulching operations, mowing, tacking, labor, equipment, tools, supplies, and incidentals.

Fertilizer will not be paid for directly but will be subsidiary to this Item.

Water for irrigating the seeded area, when necessary, will be subsidiary to this Item.

ITEM TX-247 FLEXIBLE BASE
Summary of Changes

1. Section 5 Measurement
    a. Revised first paragraph as follows:
        i. Flexible base will be measured as follows.
        Flexible Base (Complete in Place). The ton, square yard, or any cubic yard method.
        ~~**Flexible Base (Roadway Delivery)**. The ton or any cubic yard method.~~
        ~~**Flexible Base (Stockpile Delivery)**. The ton, cubic yard in vehicle, or cubic yard in stockpile.~~

2. Section 6 Payment
    a. First paragraph revised as follows:
        i. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for the types of work described below. No additional payment will be made for thickness or width exceeding that shown on the typical section or provided on the plans for cubic yard in the final position or square yard measurement. To be paid for under items TX-247a 6.5" Crushed Aggregate Base Course (Type A, Grade 1-2) TX-247b 9" Crushed Aggregate Base Course (Type A, Grade 1-2).

    b. Deleted paragraphs 6.2 and 6.3
        ~~**Flexible Base (Roadway Delivery).** Payment will be made for the type and grade specified. For cubic yard measurement, "In Vehicle," "In Stockpile," or "In Final Position" will be specified. The unit price bid will not include processing at the roadway. This price is full compensation for furnishing materials, temporary stockpiling, assistance provided in stockpile sampling and operations to level stockpiles for measurement, loading, hauling, delivery of materials, furnishing scales and labor for weighing and measuring, equipment, labor, tools, and incidentals.~~
        ~~**Flexible Base (Stockpile Delivery).** Payment will be made for the type and grade specified. For cubic yard measurement, "In Vehicle" or "In Stockpile" will be specified. The unit price bid will not include processing at the roadway. This price is full compensation for furnishing and disposing of materials, preparing the stockpile area, temporary or permanent stockpiling, assistance provided in stockpile sampling and operations to level stockpiles for measurement, loading, hauling, delivery of materials to the stockpile, furnishing scales and labor for weighing and measuring, equipment, labor, tools, and incidentals.~~

Item 247
Flexible Base

1. DESCRIPTION

Construct a foundation course composed of flexible base.

2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications. Notify the Engineer of the proposed material sources and of changes to material sources. The Engineer may sample and test project materials at any time before compaction throughout the duration of the project to assure specification compliance.

2.1. **Aggregate**. Furnish aggregate of the type and grade shown on the plans and meeting the requirements shown in Table 1. Each source must meet Table 1 requirements for liquid limit, plasticity index, and wet ball mill for the grade specified. Do not use additives, such as but not limited to lime, cement, or fly ash to modify aggregates to meet the requirements of Table 1, unless shown on the plans.

Unless otherwise shown on the plans, the unconfined compressive strength is waived when the flexible base material meets the #200 sieve requirement. When the #200 sieve requirement does not meet the specification in Table 1, the unconfined compressive strength is required.

Table 1
Material Requirements

Property	Test Method	Grade 1–2[3]	Grade 3	Grade 4	Grade 5
Master gradation sieve size (cumulative % retained)	Tex-110-E			As shown on the plans	
2-1/2"		0	0		0
1-3/4"		0–10	0–10		0–5
7/8"		10–35	–		10–35
3/8"		30–65	–		35–65
#4		45–75	45–75		45–75
#40		65–90	50–85		70–90
#200[1, 2]		85–95	–		–
Liquid limit, % Max	Tex-104-E	40	40		35
Plasticity index, Max	Tex-106-E	10	12		10
Plasticity index, Min		As shown on the plans	As shown on the plans		As shown on the plans
Wet ball mill, % Max	Tex-116-E	40	–		40
Wet ball mill, % Max increase passing the #40 sieve		20	–		20
Min compressive strength[2], psi	Tex-117-E				
lateral pressure 0 psi		35	–		–
lateral pressure 3 psi		–	–		90
lateral pressure 15 psi		175	–		175

1. The #200 sieve test is only required to meet the waiver of the unconfined compressive strength requirement. The #200 sieve test requirement is only applicable to stockpile samples from Section 247.2.4.
2. Compressive strength and #200 sieve test requirements are waived when the flexible base is mixed with or without existing material and treated with cement, emulsion, foamed asphalt, or lime, unless otherwise shown on the plans.
3. Grade 3 may be substituted for Grade 1–2 or Grade 5 when the flexible base is mixed with or without existing material and treated with cement, emulsion, foamed asphalt, or lime, as approved. The Grade 3 flexible base must meet the wet ball mill requirements of Grade 1–2 or Grade 5 as applicable.

2.1.1. **Material Tolerances**. The Engineer may accept material if no more than one of the five most recent gradation tests has an individual sieve outside the specified limits of the gradation. This allowance does not apply to the #200 sieve requirement.

The Engineer may accept material if no more than one of the five most recent liquid limit or plasticity index tests is outside the specified limit. No single failing liquid limit or plasticity index test may exceed the allowable limit by more than 2 percentage points.

2.1.2. **Material Types**. Do not use fillers or binders unless approved. Furnish the type shown on the plans in accordance with the following.

2.1.2.1. **Type A**. Crushed stone produced and graded from oversize quarried aggregate that originates from a single, naturally occurring source. Do not use gravel or multiple sources.

2.1.2.2. **Type B**. Crushed or uncrushed gravel. Blending of two or more sources is allowed.

2.1.2.3. **Type C**. Crushed gravel with a minimum of 60% of the particles retained on a No. 4 sieve with two or more crushed faces as determined in accordance with Tex-460-A, Part I. Blending of two or more sources is allowed.

2.1.2.4. **Type D**. Type A material or crushed concrete. Crushed concrete containing gravel will be considered Type D material. Crushed concrete must meet the requirements of Section 247.2.1.2.6., "Recycled Material," and be managed in a way to provide for uniform quality. The Engineer may require separate dedicated stockpiles to verify compliance.

2.1.2.5. **Type E**. Caliche, iron ore, or as otherwise shown on the plans.

2.1.2.6. **Recycled Material**. Reclaimed asphalt pavement (RAP) and other recycled materials may be used when shown on the plans. Request approval to blend two or more sources of recycled materials. When RAP is allowed, do not exceed 20% RAP by weight, unless otherwise shown on the plans. The percentage limitations for other recycled materials will be as shown on the plans.

Provide recycled materials, other than RAP, that have a maximum sulfate content of 3,000 ppm when tested in accordance with Tex-145-E. Certify compliance with DMS-11000, "Evaluating and Using Nonhazardous Recyclable Materials Guidelines." In addition, recycled materials must be free of reinforcing steel and other objectionable material and have at most 1.5% deleterious material when tested in accordance with Tex-413-A. The liquid limit, plasticity index, wet ball mill, and compressive strength for all recycled materials are waived. When using RAP, crush RAP so that 100% passes the 2-in. sieve and does not exceed a maximum percent loss from decantation of 5.0% when tested in accordance with Tex-406-A. Test RAP without removing the asphalt. The final product must meet the requirements shown in Table 1 for the grade specified except when the Department requires a specific amount of Department-furnished RAP be added to the blend, unless otherwise shown on the plans.

The Contractor is responsible for uniformly blending the recycled material with the flexible base material to build a stockpile to meet the percentages required. Any Contractor-furnished surplus of recycled materials will remain the property of the Contractor. Remove Contractor-owned recycled materials from the project and dispose of them in accordance with federal, state, and local regulations before project acceptance.

2.2. **Water**. Furnish water free of industrial wastes and other objectionable matter.

2.3. **Material Sources**. Expose the vertical faces of all strata of material proposed for use when non-commercial sources are used. Secure and process the material by successive vertical cuts extending through all exposed strata, when directed.

2.4. **Stockpile Approval**. Stockpile is approved when the Engineer's test results meet the material requirements shown in Table 1.

2.4.1. **Sampling**. The Contractor and the Engineer will sample flexible base from completed stockpiles in accordance with Tex-100-E. Personnel conducting sampling must be certified by the Department-approved soils and base certification program.

Sampling stockpiles may be located at the production site or at the project location. The Contractor will witness the Engineer's sampling and sample the stockpile for their own testing, and label as deemed necessary.

Sample the stockpile for the Engineer when shown on the plans. When the Contractor samples the stockpile for the Engineer, the Engineer must witness the sampling of material designated for the Engineer and the Materials and Tests Division (MTD). The Engineer will label their sampling containers as "Engineer" and "MTD," or as deemed necessary.

The Engineer will take immediate possession of the sample containers for the Engineer and MTD. The Engineer will maintain custody of the samples until all testing and reporting are completed.

2.4.2. **Referee Testing**. Referee testing is applicable for stockpile testing only. MTD is the referee laboratory. MTD may designate a laboratory from the Department's MPL for Commercial Laboratories Approved for Flexible Base Referee Requests as the referee laboratory as deemed necessary. The designated laboratory cannot be performing any testing under this Item for the Engineer or Contractor.

The Contractor may request referee testing when the Engineer's test results fail to meet any of the material requirements shown in Table 1 and the Contractor's sample from Section 2.4.1., "Sampling," for the same failing Department test, passes. The tests must be performed by a laboratory listed on the Department's MPL for Commercial Laboratories Approved for Flexible Base Referee Requests. Submit the request by email within 5 working days after receiving failing test results from the Engineer. Include completed test reports passing the applicable requirements shown in Table 1 in the email.

Record and submit completed test reports electronically on Department-provided templates in their original format meeting the applicable material requirements shown in Table 1. Use Department-provided templates to record and calculate all test data. The Engineer and the Contractor will provide any available test results to the other party when requested.

3. EQUIPMENT

Provide machinery, tools, and equipment necessary for proper execution of the work.

3.1. **Rollers**. Provide rollers in accordance with Item 210, "Rolling." Provide proof rollers in accordance with Item 216, "Proof Rolling," when required.

3.2. **Inertial Profiler**. When ride quality measurement is required, provide a high-speed or lightweight inertial profiler certified at the Texas A&M Transportation Institute. Provide equipment certification documentation. Display a current decal on the equipment indicating the certification expiration date.

4. CONSTRUCTION

Construct each layer uniformly, free of loose or segregated areas, and with the required density and moisture content. Provide a smooth surface that conforms to the typical sections, lines, and grades shown on the plans or as directed.

Stockpile base material temporarily at an approved location before delivery to the roadway. Build stockpiles in layers no greater than 2 ft. thick. Stockpiles must have a total height between 10 and 16 ft. unless otherwise approved. After construction and acceptance of the stockpile in accordance with Section 247.2.4., "Stockpile Approval," loading from the stockpile for delivery is allowed. Load by making successive vertical cuts through the entire depth of the stockpile.

Do not add or remove material from temporary stockpiles that require sampling and testing before delivery, unless otherwise approved. Charges for additional sampling and testing required as a result of adding or removing material will be deducted from the Contractor's estimates.

Haul approved flexible base in clean trucks. Deliver the required quantity to each 100-ft. station or designated stockpile site as shown on the plans. Prepare stockpile sites as directed. When delivery is to the 100-ft. station, manipulate in conformance with the applicable Items.

4.1. **Preparation of Subgrade or Existing Base**. Remove or scarify existing asphalt concrete pavement in accordance with Item 105, "Removing Treated and Untreated Base and Asphalt Pavement," when shown on the plans or as directed. Shape the subgrade or existing base to conform to the typical sections shown on the plans or as directed.

When new base is required to be mixed with existing base, deliver, place, and spread the new flexible base in the required amount per station. Manipulate and thoroughly mix the new base with existing material to provide a uniform mixture to the specified depth before shaping.

Proof roll the roadbed in accordance with Item 216 before pulverizing or scarifying when shown on the plans or directed. Correct soft spots as directed.

4.2. **Placing**. Spread and shape flexible base into a uniform layer using an approved spreader the same day as delivered unless otherwise approved. Construct layers to the thickness shown on the plans. Maintain the shape of the course. Control dust by sprinkling, as directed. Correct or replace segregated areas as directed at no additional expense to the Department.

Place successive base courses and finish courses using the same construction methods required for the first course.

4.3. **Compaction**. Compact using density control unless otherwise shown on the plans. Multiple lifts are permitted when shown on the plans or approved. Bring each layer to the moisture content directed. When necessary, sprinkle the material in accordance with Item 204, "Sprinkling." Maintain moisture during compaction within ±2.0% of the optimum moisture content as determined in accordance with Tex-113-E.

Begin rolling longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least 1/2 the width of the roller unit. Begin rolling at the low side and progress toward the high side on superelevated curves. Offset alternating trips of the roller. Operate rollers at a speed between 2 and 6 mph as directed.

Rework, recompact, and refinish material that fails to meet or that loses required moisture, density, stability, or finish requirements before the next course is placed or the project is accepted. Continue work until specification requirements are met. Perform the work at no additional expense to the Department.

Before final acceptance, the Engineer will select the locations of tests and measure the flexible base depth in accordance with Tex-140-E. Correct areas deficient by more than 1/2 in. in thickness by scarifying, adding material as required, reshaping, recompacting, and refinishing at the Contractor's expense.

4.3.1. **Ordinary Compaction**. Roll using approved compaction equipment as directed. Correct irregularities, depressions, and weak spots immediately by scarifying the areas affected, adding or removing approved material as required, reshaping, and recompacting.

4.3.2. **Density and Moisture Control**. Compact to a minimum of 100% of the maximum dry density and within ±2.0% of the optimum moisture content as determined in accordance with Tex-113-E, unless otherwise shown on the plans. Provide the Engineer with the beginning and ending station numbers of the area completed for testing. The Engineer will determine roadway density and moisture content of completed sections in accordance with Tex-115-E, Part I. The Engineer will determine random locations for testing in accordance with Tex-115-E, Part IV. Do not achieve density by drying the material after compaction.

When the density is less than 100% of the maximum dry density, the Engineer may perform additional testing to determine the extent of the area to correct. The Engineer may accept the section if no more than one of the five most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

4.3.3. **Miscellaneous and Small Areas**. Miscellaneous areas are those that typically involve handwork or discontinuous paving operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Miscellaneous and small areas are not subject to density testing but may be tested as directed.

4.4. **Finishing**. After completing compaction, clip, skin, or tight-blade the surface using a maintainer or subgrade trimmer to a depth of approximately 1/4 in. Remove loosened material and dispose of it at an approved location. Seal the clipped surface immediately by rolling using a pneumatic tire roller until a smooth surface is attained. Add small increments of water as needed during rolling. Shape and maintain the course and surface in conformity with the typical sections, lines, and grades as shown on the plans or as directed.

Correct grade deviations greater than 1/4 in. in 16 ft. measured longitudinally. Correct grade deviations greater than 1/4 in. over the entire width of the cross-section in areas where surfacing is to be placed. Correct by loosening and adding or removing material. Reshape and recompact in accordance with Section 247.4.3., "Compaction."

4.5. **Curing**. Cure the finished section until the moisture content is at least 2 percentage points below optimum or as directed before applying the next successive course or prime coat.

4.6. **Ride Quality**. Measurement of ride quality only applies to the final travel lanes that receive a one- or two-course surface treatment for the final riding surface, unless otherwise shown on the plans. Measure the ride quality of the base course either before or after the application of the prime coat, as directed, and before placement of the surface treatment. Use a certified profiler operator listed on the Department's MPL. When requested, furnish the Engineer with documentation for the person certified to operate the profiler.

Provide all profile data to the Engineer in electronic data files within 3 days of measuring the ride quality using the format specified in Tex-1001-S. The Engineer will use Department software to evaluate longitudinal profiles to determine areas requiring corrective action. Correct 0.1-mi. sections with an average international roughness index (IRI) value greater than 100 in. per mile to an IRI value of 100 in. per mile or less, unless otherwise shown on the plans. Reprofile and correct sections that fail to maintain ride quality before the placement of the surface treatment, as directed. Unless ride deterioration is due to environmental impact, traffic, or other incidents outside the Contractor's control, perform this work at no additional expense to the Department, as approved.

5. MEASUREMENT

Flexible base will be measured as follows.

- **Flexible Base (Complete in Place)**. The ton, square yard, or any cubic yard method.
- ~~**Flexible Base (Roadway Delivery)**. The ton or any cubic yard method.~~
- ~~**Flexible Base (Stockpile Delivery)**. The ton, cubic yard in vehicle, or cubic yard in stockpile.~~

Measurement by the cubic yard in final position and square yard is a plans quantity measurement. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

Measurement is further defined for payment as follows.

5.1. **Cubic Yard in Vehicle**. By the cubic yard in vehicles of uniform capacity at the point of delivery.

5.2. **Cubic Yard in Stockpile**. By the cubic yard in the final stockpile position, by the method of average end areas, or as shown on the plans.

5.3. **Cubic Yard in Final Position**. By the cubic yard in the completed and accepted final position. The volume of base course is computed in place by the method of average end areas between the original subgrade or existing base surfaces and the lines, grades, and slopes of the accepted base course, or as shown on the plans.

5.4. **Square Yard**. By the square yard of surface area in the completed and accepted final position. The surface area of the base course is based on the width of flexible base, or as shown on the plans.

5.5. **Ton**. By the ton of dry weight in vehicles as delivered. The dry weight is determined by deducting the weight of the moisture in the material at the time of weighing from the gross weight of the material. The Engineer will determine the moisture content in the material in accordance with Tex-103-E from samples taken at the time of weighing.

When material is measured in trucks, the weight of the material will be determined on certified scales, or the Contractor must provide a set of standard platform truck scales at an approved location. Scales must meet the requirements of Item 520, "Weighing and Measuring Equipment."

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for the types of work described below. No additional payment will be made for thickness or width exceeding that shown on the typical section or provided on the plans for cubic yard in the final position or square yard measurement. To be paid for under items TX-247a 6.5" Crushed Aggregate Base Course (Type A, Grade 1-2) TX-247b 9" Crushed Aggregate Base Course (Type A, Grade 1-2).

Sprinkling and rolling, including proof rolling, will not be paid for directly, but will be subsidiary to this Item unless otherwise shown on the plans. When proof rolling is shown on the plans or directed, it will be paid for in accordance with Item 216.

Where subgrade is constructed under this Contract, correction of soft spots in the subgrade will be at the Contractor's expense. Where subgrade is not constructed under this Contract, correction of soft spots in the subgrade will be paid in conformance with pertinent Items or in accordance with Article 4.4., "Changes in the Work."

6.1. **Flexible Base (Complete in Place)**. Payment will be made for the type and grade specified. For cubic yard measurement, "In Vehicle," "In Stockpile," or "In Final Position" will be specified. For square yard measurement, a depth will be specified. This price is full compensation for furnishing materials, temporary stockpiling, assistance provided in stockpile sampling and operations to level stockpiles for measurement, loading, hauling, delivery of materials, spreading, blading, mixing, shaping, placing, compacting, reworking, finishing, correcting locations where thickness is deficient, curing, furnishing scales and labor for weighing and measuring, equipment, labor, tools, and incidentals.

~~6.2. **Flexible Base (Roadway Delivery)**. Payment will be made for the type and grade specified. For cubic yard measurement, "In Vehicle," "In Stockpile," or "In Final Position" will be specified. The unit price bid will not include processing at the roadway. This price is full compensation for furnishing materials, temporary stockpiling, assistance provided in stockpile sampling and operations to level stockpiles for measurement, loading, hauling, delivery of materials, furnishing scales and labor for weighing and measuring, equipment, labor, tools, and incidentals.~~

~~6.3. **Flexible Base (Stockpile Delivery)**. Payment will be made for the type and grade specified. For cubic yard measurement, "In Vehicle" or "In Stockpile" will be specified. The unit price bid will not include processing at~~

~~the roadway. This price is full compensation for furnishing and disposing of materials, preparing the stockpile area, temporary or permanent stockpiling, assistance provided in stockpile sampling and operations to level stockpiles for measurement, loading, hauling, delivery of materials to the stockpile, furnishing scales and labor for weighing and measuring, equipment, labor, tools, and incidentals.~~

ITEM TX-260 LIME TREATMENT (ROAD-MIXED)
Summary of Changes

1. Section 6 Payment
    a. Revised third paragraph as follows:
        i. Sprinkling and rolling, ~~except~~ including proof rolling, will not be paid for directly, but will be subsidiary to this Item, unless otherwise shown on the plans. When proof rolling is shown on the plans or directed by the Engineer, it will be paid for in accordance with Item 216.
    b. Revised Paragraph 6.1, first sentence as follows:
        i. **Lime**. Lime will be paid for at the unit price bid for ~~"Quicklime (Dry)" or "Commercial or Quicklime (Slurry)."~~ TX-260c Lime. This price is full compensation for materials, delivery, equipment, labor, tools, and incidentals.
    c. Revised Paragraph 6.2 as follows:
        i. **Lime Treatment**. Lime treatment will be paid for at the unit price bid for "~~Lime Treatment (Existing Material)," "Lime Treatment (New Base)," or "Lime Treatment (Mixing Existing Material and New Base)~~ TX-260a Lime Treated Subgrade – 12 Inch and TX-260b Lime Treated Subgrade – 6 Inch," for the depth specified. No payment will be made for thickness or width exceeding that shown on the plans. This price is full compensation for shaping existing material, loosening, mixing, pulverizing, spreading, applying lime, compacting, finishing, curing, curing materials, blading, shaping and maintaining shape, replacing mixture, disposing of loosened materials, processing, hauling, preparing secondary subgrade, water, equipment, labor, tools, and incidentals.

Item 260
Lime Treatment (Road-Mixed)

1. DESCRIPTION

Mix and compact lime, water, and subgrade or base (with or without asphaltic concrete pavement) in the roadway.

2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications. Notify the Engineer of the proposed material sources and of changes to material sources. Obtain verification from the Engineer that the specification requirements are met before using the sources. The Engineer may sample and test project materials at any time before compaction. Use material definitions in accordance with Tex-100-E.

2.1. **Lime**. Furnish lime that meets the requirements of DMS-6350, "Lime and Lime Slurry." When dry lime is required, provide dry quicklime. When lime slurry is required, provide commercial lime slurry or quicklime slurry. Do not use dry quicklime when sulfates are present in quantities greater than 3,000 parts per million (ppm). When furnishing quicklime, provide it in bulk.

2.2. **Subgrade**. The Engineer will determine the sulfate content of the subgrade in accordance with Tex-145-E and organic content in accordance with Tex-148-E before lime treatment begins. Suspend operations when material to be treated has a sulfate content greater than 7,000 ppm or an organic content greater than 2.0%, unless otherwise directed.

2.3. **Flexible Base**. Unless otherwise shown on the plans, furnish base material that meets the requirements of Item 247, "Flexible Base," for the type and grade shown on the plans, before the addition of lime. Unless otherwise shown on the plans, the compressive strength of the flexible base is waived.

2.4. **Water**. Furnish water free of industrial wastes and other objectionable material.

2.5. **Asphalt**. When asphalt or emulsion is permitted for curing purposes, furnish materials that meet the requirements of Item 300, "Asphalts, Oils, and Emulsions," as shown on the plans or as directed.

2.6. **Mix Design**. The Engineer will determine the target lime content and optimum moisture content in accordance with Tex-121-E or prior experience with the project materials. The Contractor may propose a mix design developed in accordance with Tex-121-E. The Engineer will use Tex-121-E to verify the Contractor's proposed mix design before acceptance. Reimburse the Department for subsequent mix designs or partial designs necessitated by changes in the material or requests by the Contractor. Limit the amount of recycled asphalt pavement to no more than 50% of the mix, unless otherwise shown on the plans or directed.

3. EQUIPMENT

Provide machinery, tools, and equipment necessary for proper execution of the work. Provide rollers in accordance with Item 210, "Rolling." Provide proof rollers in accordance with Item 216, "Proof Rolling," when required.

3.1. **Storage Facility**. Store quicklime in closed, weatherproof containers.

3.2. **Slurry Equipment**. Use slurry tanks equipped with agitation devices to slurry quicklime on the project or other approved location. The Engineer may approve other slurrying methods.

Provide a pump for agitating the slurry when the distributor truck is not equipped with an agitator. Equip the distributor truck with a sampling device in accordance with Tex-600-J, Part I, when using commercial lime slurry.

3.3. **Hydrated Lime Distribution Equipment**. Provide equipment to spread lime evenly across the area to be treated. Provide equipment with a rotary vane feeder to spread lime, when shown on the plans.

3.4. **Pulverization Equipment**. Provide pulverization equipment that:

- cuts and pulverizes material uniformly to the proper depth using cutters that plane to a uniform surface over the entire width of the cut,
- provides a visible indication of the depth of cut at all times, and
- uniformly mixes the materials.

4. CONSTRUCTION

Construct each layer uniformly, free of loose or segregated areas, and with the required density and moisture content. Provide a smooth surface that conforms to the typical sections, lines, and grades shown on the plans or as directed.

4.1. **Preparation of Subgrade or Existing Base for Treatment**. Before treating, remove existing asphalt concrete pavement in accordance with Item 105, "Removing Treated and Untreated Base and Asphalt Pavement," when shown on the plans or as directed. Shape existing material in conformance with applicable bid items to conform to typical sections shown on the plans and as directed.

Unless otherwise approved, proof roll the roadbed in accordance with Item 216 before pulverizing or scarifying existing material. Correct soft spots as directed.

When material is imported from a borrow source, notify the Engineer of the location of the borrow source well in advance to allow time for testing and approval to avoid delay to the project. Stockpile as directed. The Engineer will test the borrow source and determine the sulfate and organic contents. When the borrow source has a sulfate content greater than 3,000 ppm or an organic content greater than 2.0%, proceed as directed.

When new base material is required to be mixed with existing base, deliver, place, and spread the new material in the required amount per station. Manipulate and thoroughly mix new base with existing material to provide a uniform mixture to the specified depth before shaping.

4.2. **Pulverization**. Pulverize or scarify existing material after shaping. If the material cannot be uniformly processed to the required depth in a single pass, excavate and windrow the material to expose a secondary grade to achieve processing to plan depth.

4.3. **Application of Lime**. Uniformly apply lime using dry or slurry placement as shown on the plans or as directed. Add lime at the percentage determined in accordance with Section 260.2.6., "Mix Design." Apply lime only on an area where mixing can be completed during the same working day.

Start lime application only when the air temperature is at least 35°F and rising or is at least 40°F. The temperature will be taken in the shade and away from artificial heat. Suspend application when the Engineer determines that weather conditions are unsuitable.

Minimize dust and scattering of lime by wind. Do not apply lime when wind conditions, in the opinion of the Engineer, cause blowing lime to become dangerous to traffic or objectionable to adjacent property owners. When pebble grade quicklime is placed dry, mix the material and lime thoroughly at the time of lime

application. Use of quicklime can be dangerous. Inform users of the recommended precautions for handling and storage.

4.3.1. **Dry Placement**. Before applying lime, bring the prepared roadway to approximately two percentage points above optimum moisture content. When necessary, sprinkle in accordance with Item 204, "Sprinkling." Distribute the required quantity of pebble grade quicklime using approved equipment.

4.3.2. **Slurry Placement**. Provide slurry free of objectionable materials, at or above the minimum dry solids content, and with a uniform consistency that will allow ease of handling and uniform application. Deliver commercial lime slurry to the jobsite or use quicklime to prepare lime slurry at the jobsite or other approved location, as specified. When dry quicklime is applied as slurry, use 80% of the amount shown on the plans.

Distribute slurry uniformly by making successive passes over a measured section of roadway until the specified lime content is reached. Uniformly spread the residue from quicklime slurry over the length of the roadway being processed, unless otherwise directed.

4.4. **Mixing**. Begin mixing within 6 hr. of application of lime. Lime exposed to the open air for 6 hr. or more between application and mixing, or that experiences excessive loss due to washing or blowing, will not be accepted for payment. Thoroughly mix the material and lime using approved equipment. When treating subgrade, bring the moisture content above the optimum moisture content to ensure adequate chemical reaction of the lime and subgrade materials.

Ensure 100% of the material passes a 2-1/2 in. sieve, except rock, before mellowing. Allow the mixture to mellow for 1–4 days, as directed. When pebble grade quicklime is used, allow the mixture to mellow for 2--4 days, as directed. Sprinkle the treated materials during the mixing and mellowing operation, as directed, to achieve adequate hydration and proper moisture content. When the material to be treated has a sulfate content greater than 3,000 ppm but less than or equal to 7,000 ppm, mellow for a minimum of 7 days. Maintain in a continuously moist condition by sprinkling in accordance with Item 204. After mellowing, resume mixing until a homogeneous, friable mixture is obtained. After mixing, the Engineer may sample the mixture at roadway moisture and test in accordance with Tex-101-E, Part III, to determine compliance with the gradation requirements shown in Table 1.

Table 1
Gradation Requirements (Min % Passing)

Sieve Size	Base	Subgrade
1-3/4"	100	100
3/4"	85	85
#4	–	60

4.5. **Strength Testing**. The Engineer will sample and test the lime-treated mixture for unconfined compressive strength in accordance with Tex-117-E, Part II. The unconfined compressive strength must be greater than 50 psi for lime-treated subgrade and 150 psi for lime-treated flexible base or lime-treated flexible base with existing material, unless otherwise shown on the plans.

4.6. **Compaction**. Compact the mixture using density control, unless otherwise shown on the plans. Multiple lifts are permitted when shown on the plans or approved. Bring each layer to the moisture content directed. Sprinkle the treated material in accordance with Item 204, or aerate the treated material to adjust the moisture content during compaction so that it is no more than 1.0% below optimum and 2.0% above optimum as determined in accordance with Tex-121-E.

Begin rolling longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least one-half the width of the roller unit. On superelevated curves, begin rolling at the low side and progress toward the high side. Offset alternating trips of the roller. Operate rollers at a speed between 2 and 6 mph as directed.

Before final acceptance, the Engineer will select the locations of tests in each unit and measure the treated depth in accordance with Tex-140-E. Correct areas deficient by more than 1/2 in. in thickness or more than

1/2% in target lime content by adding lime as required, reshaping, recompacting, and refinishing at the Contractor's expense.

Rework, recompact, and refinish material that fails to meet or that loses required moisture, density, stability, or finish before the next course is placed or the project is accepted. Continue work until specification requirements are met. Rework in accordance with Section 260.4.7., "Reworking a Section." Perform the work at no additional expense to the Department.

4.6.1. **Ordinary Compaction**. Roll using approved compaction equipment, as directed. Correct irregularities, depressions, and weak spots immediately by scarifying the areas affected, adding or removing treated material as required, reshaping, and recompacting.

4.6.2. **Density and Moisture Control**. Compact to at least 95% of the maximum density, and moisture content no more than 1.0% below optimum and 2.0% above optimum as determined in accordance with Tex-121-E, unless otherwise shown on the plans. Provide the Engineer with the beginning and ending station numbers of the area completed for testing. The Engineer will determine roadway density and moisture content of completed sections in accordance with Tex-115-E, Part I. The Engineer will determine random locations for testing in accordance with Tex-115-E, Part IV.

When the density is less than 95% of the maximum dry density, the Engineer may perform additional testing to determine the extent of the area to correct. The Engineer may accept the section if no more than one of the five most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

4.7. **Reworking a Section**. When a section is reworked within 72 hr. after completion of compaction, rework the section to provide the required density. When a section is reworked more than 72 hr. after completion of compaction, add additional lime at 25% of the percentage determined in accordance with Section 260.2.6., "Mix Design." Reworking includes loosening, adding material or removing unacceptable material if necessary, mixing as directed, compacting, and finishing. When density control is specified, determine a new maximum density of the reworked material in accordance with Tex-121-E, and compact to at least 95% of this density.

4.8. **Finishing**. Immediately after completing compaction of the final course, clip, skin, or tight-blade the surface of the lime-treated material using a maintainer or subgrade trimmer to a depth of approximately 1/4 in. Remove loosened material and dispose of at an approved location. Roll the clipped surface immediately using a pneumatic tire roller until a smooth surface is attained. Add small amounts of water as needed during rolling. Shape and maintain the course and surface in conformity with the typical sections, lines, and grades shown on the plans or as directed.

Finish grade of constructed subgrade to within 0.1 ft. in the cross-section and 0.1 ft. in 16 ft. measured longitudinally.

Correct grade deviations of constructed base greater than 1/4 in. in 16 ft. measured longitudinally or greater than 1/4 in. over the entire width of the cross-section in areas where surfacing is to be placed. Remove excess material, reshape, and roll using a pneumatic-tire roller. Correct as directed if material is more than 1/4 in. low. Do not surface patch. The 72-hr. time limit required for completion of placement, compaction, and finishing does not apply to finishing required just before applying the surface course.

4.9. **Miscellaneous and Small Areas**. Miscellaneous areas are those that typically involve handwork or discontinuous paving operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Miscellaneous and small areas are not subject to density testing but may be tested as directed.

4.10. **Curing**. Cure for the minimum number of days shown in Table 2 by sprinkling in accordance with Item 204, or by applying an asphalt material at a rate of 0.05–0.20 gal. per square yard, as shown on the plans or as directed. Maintain moisture during curing. Upon completion of curing, maintain the moisture content in

accordance with Section 132.3.5., "Maintenance of Moisture and Reworking," for subgrade and Section 247.4.5., "Curing," for bases before placing subsequent courses. Do not allow equipment on the finished course during curing except as required for sprinkling, unless otherwise approved. Apply seals or additional courses within 14 calendar days of final compaction.

Table 2
Min Curing Requirements before Placing Subsequent Courses[1]

Untreated Material	Curing (Days)
PI ≤35	2
PI >35	5

1. Subject to approval. Proof rolling may be required as an indicator of adequate curing.

5. MEASUREMENT

5.1. **Lime**. When lime is furnished in trucks, the weight of lime will be determined on certified scales, or the Contractor must provide a set of standard platform truck scales at an approved location approved. Scales must meet the requirements of Item 520, "Weighing and Measuring Equipment."

5.1.1. **Commercial Lime Slurry**. Lime slurry will be measured by the ton (dry weight) as calculated from the minimum percent dry solids content of the slurry, multiplied by the weight of the slurry in tons delivered.

5.1.2. **Quicklime**.

5.1.2.1. **Dry**. Lime will be measured by the ton (dry weight) of the quicklime.

5.1.2.2. **Slurry**. Lime slurry will be measured by the ton (dry weight) of the quicklime used to prepare the slurry multiplied by a conversion factor of 1.28 to determine the quantity of equivalent hydrated lime, which will be the basis of payment.

5.2. **Lime Treatment**. Lime treatment will be measured by the square yard of surface area. The dimensions for determining the surface areas are established by the widths shown on the plans and the lengths measured at placement.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for in accordance with Section 260.6.1., "Lime," and Section 260.6.2., "Lime Treatment."

Furnishing and delivering new base will be paid for in accordance with Section 247.6.2., "Flexible Base (Roadway Delivery)." Mixing, spreading, blading, shaping, compacting, and finishing new or existing base material will be paid for under Section 260.6.2., "Lime Treatment." Removal and disposal of existing asphalt concrete pavement will be paid for in conformance with pertinent Items or in accordance with Article 4.4., "Changes in the Work."

Sprinkling and rolling, ~~except~~ including proof rolling, will not be paid for directly, but will be subsidiary to this Item, unless otherwise shown on the plans. When proof rolling is shown on the plans or directed by the Engineer, it will be paid for in accordance with Item 216.

Where subgrade is constructed under this Contract, correction of soft spots in the subgrade or existing base will be at the Contractor's expense. Where subgrade is not constructed under this Contract, correction of soft spots in the subgrade or existing base will be paid for in accordance with pertinent Items or Article 4.4., "Changes in the Work."

Where subgrade to be treated under this Contract has sulfates greater than 7,000 ppm, work will be paid for in accordance with Article 4.4., "Changes in the Work."

Asphalt used solely for curing will not be paid for directly, but will be subsidiary to this Item. Asphalt placed for curing and priming will be paid for under Item 310, "Prime Coat."

6.1. **Lime**. Lime will be paid for at the unit price bid for ~~"Quicklime (Dry)" or "Commercial or Quicklime (Slurry)."~~ TX-260c Lime. This price is full compensation for materials, delivery, equipment, labor, tools, and incidentals.

Lime used for reworking a section in accordance with Section 260.4.7., "Reworking a Section," will not be paid for directly, but will be subsidiary to this Item.

6.2. **Lime Treatment**. Lime treatment will be paid for at the unit price bid for "~~Lime Treatment (Existing Material), "Lime Treatment (New Base)," or "Lime Treatment (Mixing Existing Material and New Base)~~ TX-260a Lime Treated Subgrade – 12 Inch and TX-260b Lime Treated Subgrade – 6 Inch," for the depth specified. No payment will be made for thickness or width exceeding that shown on the plans. This price is full compensation for shaping existing material, loosening, mixing, pulverizing, spreading, applying lime, compacting, finishing, curing, curing materials, blading, shaping and maintaining shape, replacing mixture, disposing of loosened materials, processing, hauling, preparing secondary subgrade, water, equipment, labor, tools, and incidentals.

ITEM TX-300 ASPHALTS, OILS, AND EMULSIONS
Summary of Changes

1. Section 5 Measurement and Payment
    a. Revised first paragraph as follows:
        a. The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly but will be subsidiary to or are included in payment for other pertinent Items. **Exception: Tack Coat will be measured and paid by the square yard under TX-300 Tack Coat**.

Item 300
Asphalts, Oils, and Emulsions

1. DESCRIPTION

Provide asphalt cements, cutback and emulsified asphalts, performance-graded asphalt binders, and other miscellaneous asphalt materials as shown on the plans.

2. MATERIALS

Provide asphalt materials that meet the stated requirements when tested in conformance with the referenced Department, AASHTO, and ASTM test methods. Use asphalt containing recycled materials only if the recycled components meet the requirements of Article 6.9., "Recycled Materials." Provide asphalt materials that the Department has preapproved for use in accordance with Tex-545-C.

Inform the Department of all additives or modifiers included in the asphalt binder as part of the facility quality plan, as required by Tex-545-C, and provide that information to Department personnel. The Department reserves the right to prohibit the use of any asphalt additive or modifier.

Limit the use of polyphosphoric acid to no more than 0.5% by weight of the asphalt binder.

The use of re-refined engine oil bottoms is prohibited.

Acronyms used in this Item are defined in Table 1.

Table 1
Acronyms

Acronym	Definition
Test Procedure Designations	
Tex	Department
T or R	AASHTO
D	ASTM
Polymer Modifier Designations	
P	polymer-modified
SBS	styrene-butadiene-styrene block co-polymer
TR	tire rubber modifier (obtained from ground truck and passenger vehicle post-consumer tires)
AC	asphalt cement
AE	asphalt emulsion
AE-P	asphalt emulsion prime
A-R	asphalt-rubber
ARA	emulsified asphalt recycling agent
C	cationic
CRM	crumb rubber modifier
CSS	cationic slow setting
EAP&T	emulsified asphalt prime and tack
EBL	emulsified bonding layer
FDR	full-depth reclamation
H-suffix	harder residue (lower penetration)
HA	hot-applied
HF	high float
HRSS	hard residue surface sealant
HY	high yield

Acronym	Definition
MC	medium-curing
MS	medium-setting
MSCR	multiple stress creep recovery
NT	non-tracking
PCE	prime, cure, and erosion control
PG	performance grade
RC	rapid-curing
RS	rapid-setting
S-suffix	stockpile usage
SCM	special-use cutback material
SS	slow-setting
SY	standard yield
TRAIL	tracking resistant asphalt interlayer

2.1. **Asphalt Cement**. Provide AC that is homogeneous, water-free, and non-foaming when heated to 347°F, and in accordance with Table 2.

Table 2
Asphalt Cement

Property	Test Procedure	Viscosity Grade			
		AC-0.6		AC-1.5	
		Min	Max	Min	Max
Viscosity	T 202				
140°F, poise		40	80	100	200
275°F, poise		0.4	–	0.7	–
Penetration, 77°F, 100g, 5 sec.	T 49	350	–	250	–
Flash point, C.O.C., °F	T 48	425	–	425	–
Solubility, %	T 44	99.0	–	99.0	–
Spot test	Tex-509-C	Neg.		Neg.	
Tests on residue from RTFOT:	T 240				
Viscosity, 140°F, poise	T 202	–	400	–	1,000
Ductility,[1] 77°F 5 cm/min., cm	T 51	100	–	100	–

1. If AC-0.6 or AC-1.5 ductility at 77°F is less than 100 cm, material is acceptable if ductility at 60°F is more than 100 cm.

2.2. **Polymer-Modified Asphalt Cement**. Provide polymer-modified AC that is smooth, homogeneous, and meets the requirements shown in Table 3. Supply samples of the base AC and polymer additives if requested.

Table 3
Polymer-Modified Asphalt Cement

Property	Test Procedure	Polymer-Modified Viscosity Grade											
		AC-12-5TR		NT-HA[1]		AC-15P		AC-20XP		AC-10-2TR		AC-20-5TR	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Polymer		TR		–		SBS		SBS		TR		TR	
Polymer content, % (solids basis)	Tex-533-C or Tex-553-C	5.0	–	–	–	3.0	–	–	–	2.0	–	5.0	–
Dynamic shear, G*/sin δ, 82°C, 10 rad/s, kPa	T 315	–	–	1.0	–	–	–	–	–	–	–	–	–
Dynamic shear, G*/sin δ, 64°C, 10 rad/s, kPa	T 315	–	–	–	–	–	–	1.0	–	–	–	1.0	–
Dynamic shear, G*/sin δ, 58°C, 10 rad/s, kPa	T 315	1.0	–	–	–	–	–	–	–	1.0	–	–	–
Viscosity													
140°F, poise	T 202	1,200	–	–	–	1,500	–	2,000	–	1,000	–	2,000	–
275°F, poise	T 202	–	–	–	–	–	8.0	–	–	–	8.0	–	10.0
275°F, Pa-s	T 316	–	–	–	4.0	–	–	–	–	–	–	–	–
Penetration, 77°F, 100 g, 5 sec.	T 49	110	150	–	25	100	150	75	115	95	130	75	115
Elastic recovery, 50°F, %	Tex-539-C	55	–	–	–	55	–	55	–	30	–	55	–
Polymer separation	Tex-540-C	None		–		None		None		None		None	
Flash point, C.O.C., °F	T 48	425	–	425	–	425	–	425	–	425	–	425	–
Tests on residue from RTFOT aging and pressure aging:	T 240 and R 28												
Creep stiffness	T 313												
S, -18°C, MPa		–	300	–	–	–	300	–	300	–	300	–	300
m-value, -18°C		0.300	–	–	–	0.300	–	0.300	–	0.300	–	0.300	–

1. This is a hot-applied TRAIL product.

2.3. **Cutback Asphalt**. Provide cutback asphalt that meets the requirements shown in Tables 4, 5, and 6 for the specified type and grade. Supply samples of the base AC and polymer additives if requested.

Table 4
Rapid-Curing Cutback Asphalt

Property	Test Procedure	Type–Grade	
		RC-250	
		Min	Max
Kinematic viscosity, 140°F, cSt	T 201	250	400
Water, %	D95	–	0.2
Flash point, T.O.C., °F	T 79	80	–
Distillation test:	T 78		
Distillate, percentage by volume of total distillate to 680°F			
to 437°F		40	75
to 500°F		65	90
to 600°F		85	–
Residue from distillation, volume %		70	–
Tests on distillation residue:			
Viscosity, 140°F, poise	T 202	600	2,400
Ductility, 5 cm/min., 77°F, cm	T 51	100	–
Solubility, %	T 44	99.0	–
Spot test	Tex-509-C	Neg.	

Table 5
Medium-Curing Cutback Asphalt

Property	Test Procedure	Type–Grade					
		MC-30		MC-800		MC-3000	
		Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	30	60	800	1,600	3,000	6,000
Water, %	D95	–	0.2	–	0.2	–	0.2
Flash point, T.O.C., °F	T 79	95	–	140	–	149	–
Distillation test:	T 78						
Distillate, percentage by volume of total distillate to 680°F							
to 437°F		–	35	–	–	–	–
to 500°F		30	75	–	40	–	15
to 600°F		75	95	45	85	15	75
Residue from distillation, volume %		50	–	75	–	80	–
Tests on distillation residue:							
Viscosity, 140°F, poise	T 202	300	1,200	300	1,200	300	1,200
Ductility, 5 cm/min., 77°F, cm	T 51	100	–	100	–	100	–
Solubility, %	T 44	99.0	–	99.0	–	99.0	–
Spot test	Tex-509-C	Neg.		Neg.		Neg.	

Table 6
Special-Use Cutback Asphalt

Property	Test Procedure	Type–Grade	
		SCM I	
		Min	Max
Kinematic viscosity, 140°F, cSt	T 201	500	1,000
Water, %	D95	–	0.2
Flash point, T.O.C., °F	T 79	175	–
Distillation test:	T 78		
Distillate, percentage by volume of total distillate to 680°F			
to 437°F		–	–
to 500°F		–	0.5
to 600°F		20	60
Residue from distillation, volume %		76	–
Tests on distillation residue:			
Penetration, 100 g, 5 sec., 77°F	T 49	180	–
Solubility, %	T 44	99.0	–

2.4. **Emulsified Asphalt**. Provide emulsified asphalt that is homogeneous, does not separate after thorough mixing, and meets the requirements for the specified type and grade shown in Tables 7, 8, 9, 10, and 10A–C.

Table 7
Emulsified Asphalt

Property	Test Procedure	Type–Grade							
		Rapid-Setting		Medium-Setting		Slow-Setting			
		HFRS-2		MS-2		SS-1		SS-1H	
		Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72								
77°F, sec.		–	–	–	–	20	100	20	100
122°F, sec.		150	400	100	300	–	–	–	–
Sieve test, %	T 59	–	0.1	–	0.1	–	0.1	–	0.1
Miscibility	T 59	–		–		Pass		Pass	
Cement mixing, %	T 59	–	–	–	–	–	2.0	–	2.0
Demulsibility, 35 mL of 0.02 N $CaCl_2$, %	T 59	50	–	–	30	–	–	–	–
Storage stability, 1 day, %	T 59	–	1	–	1	–	1	–	1
Freezing test, 3 cycles[1]	T 59	–		Pass		Pass		Pass	
Distillation test:	T 59								
Residue by distillation, % by wt.		65	–	65	–	60	–	60	–
Oil distillate, % by volume of emulsion		–	0.5	–	0.5	–	0.5	–	0.5
Tests on residue from distillation:									
Penetration, 77°F, 100 g, 5 sec.	T 49	100	140	90	160	90	160	40	100
Solubility, %	T 44	97.5	–	97.5	–	97.5	–	97.5	–
Ductility, 77°F, 5 cm/min., cm	T 51	100	–	100	–	100	–	80	–
Float test, 140°F, sec.	T 50	1,200	–	–	–	–	–	–	–

1. Applies only when the Engineer designates material for winter use.

Table 8
Cationic Emulsified Asphalt

Property	Test Procedure	Type–Grade							
		Rapid-Setting		Medium-Setting		Slow-Setting			
		CRS-2		CMS-2		CSS-1		CSS-1H	
		Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72								
77°F, sec.		–	–	–	–	20	100	20	100
122°F, sec.		150	400	100	350	–	–	–	–
Sieve test, %	T 59	–	0.1	–	0.1	–	0.1	–	0.1
Cement mixing, %	T 59	–	–	–	–	–	0.2	–	0.2
Coating ability and water resistance:	T 59								
Dry aggregate/after spray		–		Good/Fair		–		–	
Wet aggregate/after spray		–		Fair/Fair		–		–	
Demulsibility, 35 mL of 0.8% Sodium dioctyl sulfosuccinate, %	T 59	70	–	–	–	–	–	–	–
Storage stability, 1 day, %	T 59	–	1	–	1	–	1	–	1
Particle charge	T 59	Positive		Positive		Positive		Positive	
Distillation test:	T 59								
Residue by distillation, % by wt.		65	–	65	–	60	–	60	–
Oil distillate, % by volume of emulsion		–	0.5	–	7	–	0.5	–	0.5
Tests on residue from distillation:									
Penetration, 77°F, 100 g, 5 sec.	T 49	90	160	90	200	90	160	40	110
Solubility, %	T 44	97.5	–	97.5	–	97.5	–	97.5	–
Ductility, 77°F, 5 cm/min., cm	T 51	100	–	100	–	100	–	80	–

Table 9
Polymer-Modified Emulsified Asphalt

Property	Test Procedure	Type–Grade	
		Rapid-Setting	
		HFRS-2P	
		Min	Max
Viscosity, Saybolt Furol 122°F, sec.	T 72	150	400
Sieve test, %	T 59	–	0.1
Demulsibility, 35 mL of 0.02 N $CaCl_2$, %	T 59	50	–
Storage stability, 1 day, %	T 59	–	1
Distillation test:[1]	T 59		
Residue by distillation, % by wt.		65	–
Oil distillate, % by volume of emulsion		–	0.5
Tests on residue from distillation:			
Polymer content, wt. % (solids basis)	Tex-533-C	3.0	–
Penetration, 77°F, 100 g, 5 sec.	T 49	90	140
Solubility, %	T 44	97.0	–
Viscosity, 140°F, poise	T 202	1,500	–
Float test, 140°F, sec.	T 50	1,200	–
Ductility,[2] 39.2°F, 5 cm/min., cm	T 51	50	–
Elastic recovery,[2] 50°F, %	Tex-539-C	55	–

1. Exception to T 59: Bring the temperature on the lower thermometer slowly to 350 ± 10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 ± 5 min. from the first application of heat.
2. HFRS-2P must meet one of either the ductility or elastic recovery requirements.

Table 10
Polymer-Modified Cationic Emulsified Asphalt

Property	Test Procedure	Type-Grade											
		Rapid-Setting						Medium-Setting				Slow-Setting	
		CRS-2P		CHFRS-2P		CRS-2TR		CMS-1P[3]		CMS-2P[3]		CSS-1P	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72												
77°F, sec.		–	–	–	–	--	--	10	100	–	–	20	100
122°F, sec.		150	400	100	400	150	500	–	–	50	400	–	–
Sieve test, %	T 59	–	0.1	–	0.1	--	0.1	–	0.1	–	0.1	–	0.1
Demulsibility, 35 ml of 0.8% sodium dioctyl sulfosuccinate, %	T 59	70	–	60	–	40	--	–	–	–	–	–	–
Storage stability, 1 day, %	T 59	–	1	–	1	--	1	–	1	–	1	–	1
Particle charge	T 59	Positive		Positive		Positive		Positive		Positive		Positive	
Distillation test[1]:	T 59												
Residue by distillation, % by weight		65	–	65	–	65	--	30	–	60	–	62	–
Oil distillate, % by volume of emulsion		–	0.5	–	0.5	--	3	–	0.5	–	0.5	–	0.5
Tests on residue from distillation:													
Polymer content, wt. % (solids basis)	Tex-533-C or Tex-553-C	3.0	–	3.0	–	5.0[4]	--	–	–	–	–	3.0	–
Penetration, 77°F, 100 g, 5 sec.	T 49	90	150	80	130	90	150	30	–	30	–	55	90
Viscosity, 140°F, poise	T 202	1,300	–	1,300	–	1,000	--	–	–	–	–	–	–
Solubility, %	T 44	97.0	–	95.0	–	98	--	–	–	–	–	97.0	–
Ductility, 77°F, 5 cm/min., cm	T 51	–	–	–	–	40	--	–	–	–	–	70	–
Float test, 140°F, sec.	T 50	–	–	1,800	–	--	--	–	–	–	–		
Ductility,[2] 39.2°F, 5 cm/min., cm	T 51	50	–	–	–	--	--	–	–	–	–	–	–
Elastic recovery,[2] 50°F, %	Tex-539-C	55	–	55	–	--	--	–	–	–	–	–	–
Tests on residue from evaporative recovery:	R 78, Procedure B												
Nonrecoverable creep compliance of residue, 3.2 kPa, 52°C, kPa^{-1}	T 350	–	–	–	–	–	–	–	2.0	–	4.0	–	–

1. Exception to T 59: Bring the temperature on the lower thermometer slowly to 350 ± 10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 ± 5 min. from the first application of heat.
2. CRS-2P must meet one of either the ductility or elastic recovery requirements.
3. With all precertification samples of CMS-1P or CMS-2P, submit certified test reports showing the type and percent of rejuvenator and/or latex added. Submit samples of these raw materials if requested by the Engineer.
4. Modifier type is TR. Determined in accordance with Tex-553-C.

Table 10A
Non-Tracking Tack Coat Emulsion[1]

Property	Test Procedure	NT-HRE		NT-RRE		NT-SRE	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol, 77°F, sec.	T 72	15	–	15	–	10	100
Storage stability, 1 Day, %	T 59	–	1	–	1	–	1
Settlement, 5-day, %	T 59	–	5	–	5	–	5
Sieve test, %	T 59	–	0.30	–	0.30	–	0.1
Distillation test:[2]	T 59						
Residue by distillation, % by wt.		50	–	58	–	50	–
Oil distillate, by volume of emulsion		–	1.0	–	1.0	–	1.0
Test on residue from distillation:							
Penetration, 77°F, 100 g, 5 sec.	T 49	–	20	15	45	40	90
Solubility, %	T 44	97.5	–	97.5	–	97.5	–
Dynamic shear, G*/sin(δ), 82°C, 10 rad/s, kPa	T 315	1.0	–	–	–	–	–

1. These are emulsion-based TRAILs. Due to the hardness of the residue, these emulsions should be heated to 120–140° F prior to thorough mixing as the emulsion is being prepared for testing.
2. Exception to T 59: Bring the temperature on the lower thermometer slowly to 350 ± 10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 ± 5 min. from first application of heat.

Table 10B
Spray-Applied Underseal Membrane Polymer-Modified Emulsions

Property	Test Procedure	EBL	
		Min	Max
Viscosity @ 77°F, SSF	T 72	20	100
Storage Stability[1], %	T 59	–	1
Demulsibility[2] Anionic emulsions — 35 mL of 0.02 N CaCl2, % Cationic emulsions — 35 mL 0.8% sodium dioctyl sulfosuccinate, %	T 59	55	–
Sieve Test[3], %	T 59	–	0.05
Distillation Test[4]	T 59		
Residue by distillation, % by wt.		63	–
Oil portion of distillate, % by vol.		–	0.5
Test on Residue from Distillation			
Elastic Recovery @ 50°F, 50 mm/min., %	Tex-539-C	60	–
Penetration @ 77°F, 100 g, 5 sec, 0.1 mm	T 49	80	130

1. After standing undisturbed for 24 hr., the surface must be smooth, must not exhibit a white or milky colored substance, and must be a homogeneous color throughout.
2. Material must meet demulsibility test for emulsions.
3. May be required by the Engineer only when the emulsion cannot be easily applied in the field.
4. The temperature on the lower thermometer should be brought slowly to 350 ± 10°F and maintained at this temperature for 20 min. The total distillation should be completed in 60 ± 5 min. from the first application of heat.

Table 10C
Full-Depth Reclamation Emulsion

Property	Test Procedure	Standard Yield (FDR EM-SY)		High Yield (FDR EM-HY)[2]	
		Min	Max	Min	Max
Viscosity Saybolt Furol @ 77°F, sec.	T 72	20	100	20	100
Sieve test, %	T 59	–	0.1	–	0.1
Cement mixing, %	T 59	–	2.0	–	2.0
% Storage stability, 1 day, %	T 59	–	1	–	1
Distillation test[1]:	T 59				
Residue by distillation, % by wt.		60	–	63	–
Oil portion of distillate, % by vol.		–	0.5	–	0.5
Test on residue from distillation:					
Penetration @ 77°F, dmm	T 49	40	95	120	–

1. The temperature on the lower thermometer should be brought slowly to 350 ± 10°F and maintained at this temperature for 20 min. The total distillation should be completed in 60 ± 5 min. from the first application of heat.
2. Provide a manufacturer's certificate of analysis (COA) with the type and percent of rejuvenator added.

2.5. **Specialty Emulsions**. Provide specialty emulsion that is either asphalt-based or resin-based and meets the requirements shown in Table 11 or Table 11A.

Table 11
Specialty Emulsions

Property	Test Procedure	Type–Grade					
		Medium-Setting				Slow-Setting	
		AE–P		EAP&T		PCE[1]	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72						
77°F, sec.		–	–	–	–	10	100
122°F, sec.		15	150	–	–	–	–
Sieve test, %	T 59	–	0.1	–	0.1	–	0.1
Miscibility[2]	T 59	–		Pass		Pass	
Demulsibility, 35 mL of 0.10 N $CaCl_2$, %	T 59	–	70	–	–	–	–
Storage stability, 1 day, %	T 59	–	1	–	1	–	–
Particle size,[5] % by volume < 2.5 μm	Tex-238-F[3]	–	–	90	–	90	–
Asphalt emulsion distillation to 500°F followed by Cutback asphalt distillation of residue to 680°F:	T 59 and T 78						
Residue after both distillations, % by wt.		40	–	–	–	–	–
Total oil distillate from both distillations, % by volume of emulsion		25	40	–	–	–	–
Residue by distillation, % by wt.	T 59	–	–	60	–	–	–
Residue by evaporation,[4] % by wt.	T 59	–	–	–	–	60	–
Tests on residue after all distillation(s):							
Viscosity, 140°F, poise	T 202	–	–	800	–	–	–
Kinematic viscosity,[5] 140°F, cSt	T 201	–	–	–	–	100	350
Flash point C.O.C., °F	T 48	–	–	–	–	400	–
Solubility, %	T 44	97.5	–	–	–	–	–
Float test, 122°F, sec.	T 50	50	200	–	–	–	–

1. Supply with each shipment of PCE:
   - a copy of a lab report from an approved analytical lab, signed by a lab official, indicating the PCE formulation does not meet any characteristics of a Resource Conservation Recovery Act (RCRA) hazardous waste;
   - a certification from the producer that the formulation supplied does not differ from the one tested and that no listed RCRA hazardous wastes or Polychlorinated Biphenyls have been mixed with the product; and
   - a Safety Data Sheet.
2. Exception to T 59: In dilution, use 350 mL of distilled or deionized water and a 1,000-mL beaker.
3. Use Tex-238-F, beginning at "Particle Size Analysis by Laser Diffraction," with distilled or deionized water as a medium and no dispersant, or use another approved method.
4. Exception to T 59: Leave sample in the oven until foaming ceases, then cool and weigh.
5. PCE must meet either the kinematic viscosity requirement or the particle size requirement.

Table 11A
Hard Residue Surface Sealant

Property	Test Procedure	HRSS	
		Min	Max
Viscosity, Krebs unit, 77°F, Krebs units	D 562	45	75
Softening point, °F	Tex-505-C[1]	250	–
Uniformity	D 2939	Pass[2]	
Resistance to heat	D 2939	Pass[3]	
Resistance to water	D 2939	Pass[4]	
Wet flow, mm	D 2939	–	0
Resistance to Kerosene (optional)[5]	D 2939	Pass[6]	
Ultraviolet exposure, UVA-340, 0.77 W/m^2, 50°C chamber, 8 hr. UV lamp, 5 min. spray, 3 hr. 55 min. condensation, 1,000 hr. total exposure[7]	G 154	Pass[8]	
Abrasion loss, 1.6 mm thickness, liquid only, %	ISSA TB-100	–	1.0
Residue by evaporation, % by weight	D 2939	33	–
Tests on residue from evaporation:			
Penetration, 77°F, 100 g, 5 sec.	T 49	15	30
Flash point, Cleveland open cup, °F	T 48	500	–
Tests on base asphalt before emulsification			
Solubility, %	T 44	98	–

1. Cure the emulsion in the softening point ring in a 200 ± 5°F oven for 2 hr.
2. Product must be homogenous and show no separation or coagulation that cannot be overcome by moderate stirring.
3. No sagging or slippage of film beyond the initial reference line.
4. No blistering or re-emulsification.
5. Recommended for airport applications or where fuel resistance is desired.
6. No absorption of Kerosene into the clay tile past the sealer film. Note sealer surface condition and loss of adhesion.
7. Other exposure cycles with similar levels of irradiation and conditions may be used with Department approval.
8. No cracking, chipping, surface distortion, or loss of adhesion. No color fading or lightening.

2.6. **Diluted Emulsions**. Provide emulsified asphalt that is homogeneous, does not separate after thorough mixing, and meets the requirements for the specified type and grade shown in Tables 12 and 12A, where the suffixes 50/50, 40/60, and 30/70 mean 50% emulsion diluted with 50% water; 40% emulsion diluted with 60% water, and 30% emulsion diluted with 70% water, respectively. For example, CSS-1H 40/60 means 40% CSS-1H diluted with 60% water and AE-P 30/70 means 30% AE-P diluted with 70% water.

Table 12
Cationic Diluted Emulsified Asphalt

Property	Test Procedure	Type-Grade					
		Diluted Slow-Setting					
		CSS-1H 50/50		CSS-1H 40/60		CSS-1H 30/70	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec.	T 72	Report only		Report only		Report only	
Distillation test							
Residue by distillation, % by wt.	T 59	30	–	24	–	18	–
Oil distillate, % by volume of emulsion		–	0.5	–	0.5	–	0.5
Tests on residue from distillation:							
Penetration, 77°F, 100 g, 5 sec.	T 49	40	110	40	110	40	110
Solubility, %	T 44	97.5	–	97.5	–	97.5	–
Ductility, 77°F, 5 cm/min., cm	T 51	80	–	80	–	80	–

Table 12A
Diluted Specialty Emulsions

Property	Test Procedure	Type-Grade					
		Diluted Slow-Setting					
		AE-P 50/50		AE-P 40/60		AE-P 30/70	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 122°F, sec.	T 72	Report only		Report only		Report only	
Asphalt emulsion distillation to 500°F followed by cutback asphalt distillation of residue to 680°F:	T 59 and T 78						
Residue after both distillations, % by wt.		20	–	16	–	12	–
Total oil distillate from both distillations, % by volume of emulsion		12.5	20	10.0	16	7.5	12
Tests on residue after all distillations:							
Solubility, %	T 44	97.5	–	97.5	–	97.5	–
Float test, 122°F, sec.	T 50	50	200	50	200	50	200

2.7. **Recycling Agent**. Recycling agent and emulsified asphalt recycling agent (ARA) must meet the requirements shown in Table 13. Additionally, recycling agent and residue from ARA, when added in the specified proportions to the recycled asphalt, must meet the properties shown on the plans.

Table 13
Recycling Agent and Emulsified Asphalt Recycling Agent

Property	Test Procedure	Recycling Agent		ARA-1		ARA-1P	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol, 77°F, sec.	T 72	–	–	15	100	15	110
Sieve test, %	T 59	–	–	–	0.1	–	0.1
Miscibility[1]	T 59	–		No coagulation		–	
Residue by evaporation[2], % by wt.	T 59	–	–	60	–	–	–
Distillation test[3]:	T 59						
Residue by distillation, % by wt.		–	–	–	–	60	65
Oil distillate, % by volume of emulsion		–	–	–	–	–	2
Penetration of distillation residue at 39.2°F, 100 g, 5 sec.	T 49	–	–	–	–	110	190
Tests on recycling agent or residue from evaporation:							
Flash point, C.O.C., °F	T 48	400	–	400	–	400	–
Kinematic viscosity	T 201						
140°F, cSt		75	200	75	200	–	–
275°F, cSt		–	10.0	–	10.0	–	–

1. Exception to T 59: Use 0.02 N $CaCl_2$ solution in place of water.
2. Exception to T 59: Maintain sample at 300°F until foaming ceases, then cool and weigh.
3. Exception to T 59: Bring the temperature on the lower thermometer slowly to 350 ± 10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 ± 5 min. from first application of heat.

2.8. **Crumb Rubber Modifier**. CRM consists of automobile and truck tires processed by ambient temperature grinding.

CRM must be:

- free of contaminants, including fabric, metal, and mineral and other non-rubber substances;
- free-flowing; and
- non-foaming when added to hot asphalt binder.

Ensure rubber gradation meets the requirements of the grades shown in Table 14 when tested in accordance with Tex-200-F, Part I, using a 50-g sample.

Table 14
CRM Gradations

Sieve Size (% Passing)	Grade A		Grade B		Grade C		Grade D	Grade E
	Min	Max	Min	Max	Min	Max		
#8	100	–	–	–	–	–	As shown on the plans	As approved
#10	95	100	100	–	–	–		
#16	–	–	70	100	100	–		
#30	–	–	25	60	90	100		
#40	–	–	–	–	45	100		
#50	0	10	–	–	–	–		
#200	–	–	0	5	–	–		

2.9. **Crack Sealer**. Provide polymer-modified emulsified asphalt crack sealer meeting the requirements shown in Table 15. Provide rubber-asphalt crack sealer meeting the requirements shown in Table 16.

Table 15
Polymer-Modified Emulsified Asphalt Crack Sealer

Property	Test Procedure	Min	Max
Rotational viscosity, 77°F, cP	D2196, Method A	10,000	25,000
Sieve test, %	T 59	–	0.1
Storage stability, 1 day, %	T 59	–	1
Evaporation Residue by evaporation, % by wt.	Tex-543-C	 65	 –
Tests on residue from evaporation: Penetration, 77°F, 100 g, 5 sec. Softening point, °F Ductility, 39.2°F, 5 cm/min., cm	 T 49 T 53 T 51	 35 140 100	 75 – –

Table 16
Asphalt-Rubber Crack Sealer

Property	Test Procedure	Class A		Class B	
		Min	Max	Min	Max
CRM content, Grade A or Grade B, % by wt.	Tex-544-C	22	26	–	–
CRM content, Grade B, % by wt.	Tex-544-C	–	–	13	17
Virgin rubber content[1], % by wt.		–	–	2	–
Flash point[2], C.O.C., °F	T 48	400	–	400	–
Penetration[3], 77°F, 150 g, 5 sec.	T 49	30	50	30	50
Penetration[3], 32°F, 200 g, 60 sec.	T 49	12	–	12	–
Softening point, °F	T 53	–	–	170	–
Bond test, non-immersed, 0.5 in specimen, 50% extension, 3 cycles, 20°F[4]	D5329	–		Pass	

1. Provide certification that the Min % virgin rubber was added.
2. Agitate the sealing compound using a 3/8–1/2-in. (9.5–12.7-mm) wide, square-end metal spatula to bring the material on the bottom of the cup to the surface (i.e., turn the material over) before passing the test flame over the cup. Start at one side of the thermometer, move around to the other, and then return to the starting point using 8–10 rapid circular strokes. Accomplish agitation in 3–4 sec. Pass the test flame over the cup immediately after stirring is completed.
3. Exception to T 49: Substitute the cone specified in D217 for the penetration needle.
4. Allow no crack in the crack-sealing materials or break in the bond between the sealer and the mortar blocks more than 1/4 in. deep for any specimen after completion of the test.

2.10. **Asphalt-Rubber Binders**. Provide A-R binders that are mixtures of asphalt binder and CRM that have been reacted at elevated temperatures. Provide A-R binders meeting D6114 and containing at least 15% CRM by weight. Provide Type I or Type II, containing CRM Grade C, for use in hot-mix aggregate mixtures. Provide Type II or Type III, containing CRM Grade B, for use in surface treatment binder. Ensure binder properties meet the requirements shown in Table 17.

Table 17
A-R Binders

Property	Test Procedure	Binder Type					
		Type I		Type II		Type III	
		Min	Max	Min	Max	Min	Max
Apparent viscosity, 347°F, cP	D2196, Method A	1,500	5,000	1,500	5,000	1,500	5,000
Penetration, 77°F, 100 g, 5 sec.	T 49	25	75	25	75	50	100
Penetration, 39.2°F, 200 g, 60 sec.	T 49	10	–	15	–	25	–
Softening point, °F	T 53	135	–	130	–	125	–
Resilience, 77°F, %	D5329	25	–	20	–	10	–
Flash point, C.O.C., °F	T 48	450	–	450	–	450	–
Tests on residue from RTFOT: Retained penetration ratio, 39.2°F, 200 g, 60 sec., % of original	T 240 T 49	75	–	75	–	75	–

2.11. **Performance-Graded Binders**. Provide PG binders that are smooth and homogeneous, show no separation when tested in accordance with Tex-540-C, and meet the requirements shown in Table 18.

Separation testing is not required if:

- a modifier is introduced separately at the mix plant by injection in either the asphalt line or mixer,
- the binder is blended onsite in continuously agitated tanks, or
- binder acceptance is based on field samples taken from an in-line sampling port at the hot-mix plant after the addition of modifiers.

Table 18
Performance-Graded Binders

Property and Test Method	Performance Grade																		
	PG 58			PG 64				PG 70				PG 76				PG 82		
	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28
Average 7-day Max pavement design temperature, °C[1]	58			64				70				76				82		
Min pavement design temperature, °C[1]	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28
Original Binder																		
Flash point, T 48, Min, °C	230																	
Viscosity, T 316[2, 3]: Max, 3.0 Pa·s, test temperature, °C	135																	
Dynamic shear, T 315[4]: G*/sin(δ), Min, 1.00 kPa, Max, 2.00 kPa[5], Test temperature @ 10 rad/sec., °C	58			64				70				76				82		
Elastic recovery, D6084, 50°F, % Min[6]	–	–	30	–	–	30	50	–	30	50	60	30	50	60	70	50	60	70
Rolling Thin Film Oven (RTFO) (T 240)																		
Mass change, T 240, Max, %	1.0																	
Dynamic shear, T 315 G*/sin(δ), Min, 2.20 kPa, Max, 5.00 kPa[5], Test temperature @ 10 rad/sec., °C	58			64				70				76				82		
MSCR, T 350, recovery, 0.1 kPa, high PG temperature, % Min[6]	–	–	20	–	–	20	30	–	20	30	40	20	30	40	50	30	40	50
Pressure Aging Vessel (PAV) Residue (R 28)																		
PAV aging temperature, °C	100																	
Dynamic shear, T 315 G*.sin (δ), Max, 5,000 kPa (Max, 6,000 kPa for δ ≥42°) Test temperature @ 10 rad/sec., °C	25	22	19	28	25	22	19	28	25	22	19	28	25	22	19	28	25	22
Creep stiffness, T 313[7, 8] S, Max, 300 MPa, m-value, Min, 0.300 Test temperature @ 60 sec., °C	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18
Direct tension, T 314[8] Failure strain, Min, 1.0% Test temperature @ 1.0 mm/min., °C	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18

1. Pavement temperatures are estimated from air temperatures using an algorithm contained in a Department-supplied computer program, may be provided by the Department, or may be obtained by following procedures outlined in AASHTO M 323 and R 25.
2. This requirement may be waived at the Department's discretion if the supplier warrants that the asphalt binder can be adequately pumped, mixed, and compacted at temperatures that meet all applicable safety, environmental, and constructability requirements. At test temperatures where the binder is a Newtonian fluid, any suitable standard means of viscosity measurement may be used, including capillary (T 201 or T 202) or rotational viscometry (T 316).
3. Viscosity at 135°C is an indicator of mixing and compaction temperatures that can be expected in the lab and field. High values may indicate high mixing and compaction temperatures. Additionally, significant variation can occur from batch to batch. Contractors should be aware that variation could significantly impact their mixing and compaction operations. Contractors are therefore responsible for addressing any constructability issues that may arise.
4. For quality control of unmodified asphalt binder production, measurement of the viscosity of the original asphalt binder may be substituted for dynamic shear measurements of G*/sin (δ) at test temperatures where the asphalt is a Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary (T 201 or T 202) or rotational (T 316) viscometry.
5. Max values for unaged and RTFO-aged dynamic shear apply only to materials used as substitute binders, as described in Item 341, "Dense-Graded Hot-Mix Asphalt," and Item 344, "Superpave Mixtures."
6. Elastic recovery (D6084) is not required unless MSCR (T 350) is less than the Min % recovery. Elastic recovery will be used for the acceptance criteria in this instance.
7. Silicone beam molds, as described in AASHTO TP 1-93, are acceptable for use.
8. If creep stiffness is below 300 MPa, direct tension test is not required. If creep stiffness is between 300 and 600 MPa, the direct tension failure strain requirement can be used instead of the creep stiffness requirement. The m-value requirement must be satisfied in both cases.

3. EQUIPMENT

Provide all equipment necessary to transport, store, sample, heat, apply, and incorporate asphalts, oils, and emulsions.

4. CONSTRUCTION

4.1. **Typical Material Use**. Use materials shown in Table 19, unless otherwise determined by the Engineer.

Table 19
Typical Material Use

Material Application	Typically Used Materials
Hot-mixed, hot-laid asphalt mixtures	PG binders, A-R binder Types I and II
Surface treatment	PG 58-22, AC-15P, AC-20XP, AC-10-2TR, AC-20-5TR, HFRS-2, MS-2, CRS-2, CRS-2TR, CMS-2P, HFRS-2P, CRS-2P, CHFRS-2P, A-R binder Types II and III
Surface treatment (cool weather)	AC12-5TR, RC-250, MC-800, MC-3000, CMS-2P
Precoating	PG 58-22, PG 64-22, SS-1, SS-1H, CSS-1, CSS-1H
Tack coat	PG binders, SS-1H, CSS-1H, EAP&T, TRAIL, EBL
Fog seal	SS-1, SS-1H, CSS-1, CSS-1H, CSS-1H 50/50, CSS-1H 40/60, CSS-1H 30/70, CMS-1P
Hot-mixed, cold-laid asphalt mixtures	AC-0.6, AC-1.5, PG 58-22, CMS-2
Patching mix	MC-800, SCM I
Recycling	AC-0.6, AC-1.5, recycling agent, ARA-1, ARA-1P
Crack sealing	Polymer-modified AE crack sealant, asphalt-rubber crack sealers (Class A, Class B)
Microsurfacing	CSS-1P
Prime	MC-30, AE-P, AE-P 50/50, AE-P 40/60, AE-P 30/70, EAP&T, PCE
Curing membrane	SS-1, SS-1H, CSS-1, CSS-1H, PCE
Erosion control	SS-1, SS-1H, CSS-1, CSS-1H, PCE
FDR-foaming	PG 64-22, FDR EM-SY, FDR EM-HY

4.2. **Storage and Application Temperatures**. Use storage and application temperatures in accordance with Table 20. Store and apply materials at the lowest temperature yielding satisfactory results. Follow the manufacturer's instructions for any agitation requirements in storage. Manufacturer's instructions regarding recommended application and storage temperatures supersede those shown in Table 19.

Table 20
Storage and Application Temperatures

Type-Grade	Application		Storage
	Recommended Range (°F)	Max Allowable (°F)	Max (°F)
AC-0.6, AC-1.5	200–300	350	350
AC-15P, AC-20-5TR, AC12-5TR, and AC10-2TR	300–375	375	360
RC-250	125–180	200	200
MC-30, AE-P	70–150	175	175
MC-800, SCM I	175–260	275	275
MC-3000	225–275	290	290
HFRS-2, MS-2, CRS-2, HFRS-2P, CRS-2P, CMS-2, CRS-2TR	120–160	180	180
SS-1, SS-1H, CSS-1, CSS-1H, PCE, EAP&T, CSS-1P, recycling agent, emulsified recycling agent, polymer-modified AE crack sealant	50–130	140	140
PG binders	275–350	350	350
Asphalt-rubber crack sealers (Class A, Class B)	350–375	400	–
A-R binder Types I, II, and III	325–425	425	425

5. MEASUREMENT AND PAYMENT

The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly, but will be subsidiary to or are included in payment for other pertinent Items. **Exception: Tack Coat will be measured and paid by the square yard under TX-300 Tack Coat.**

ITEM TX-341 DENSE-GRADED HOT-MIX ASPHALT
Summary of Changes

1. Section 2 Materials
   a. Paragraph 2.1.1 – Revised last paragraph to read as follows:
      i. Provide coarse aggregate with **a minimum SAC "B".** ~~at least the minimum SAC shown on the plans. SAC requirements apply only to aggregates used on the surface of travel lanes, unless otherwise shown on the plans.~~ The SAC for sources in the Department's *Aggregate Quality Monitoring Program* (AQMP) (Tex-499-A) is listed in the BRSQC.
   b. Table 1 revised as shown:

Table 1
Aggregate Quality Requirements

Property	Test Method	Requirement
Coarse Aggregate		
SAC	Tex-499-A (AQMP)	**Minimum "B"**

   c. Paragraph 2.4 revised to read as follows:
      i. **Asphalt Binder**. Furnish ~~the type and grade of performance graded~~ **64-22** (PG) asphalt binder ~~shown on the plans~~ that meets the requirements of Item 300, "Asphalts, Oils, and Emulsions." **The JMF target asphalt content shall not be less than 5.3%.**
   d. Paragraph 2.6.2 – Second sentence revised as follows:
      i. WMA is **not allowed for use on the project**. ~~allowed for use on all projects and is required when shown on the plans.~~ When WMA is required, the maximum placement or target discharge temperature for WMA will be set at a value at or below 275°F.
   e. Paragraph 2.7 – Section is eliminated in its' entirety:

Recycled Materials. Use of RAP and RAS is not permitted on the project. ~~permitted unless otherwise shown on the plans. Use of RAS is restricted to only intermediate and base mixes unless otherwise shown on the plans. Do not exceed the maximum allowable percentages of RAP and RAS in accordance with Table 4. The allowable percentages in accordance with Table 4 may be decreased or increased when shown on the plans. Determine the asphalt binder content and gradation of the RAP and RAS stockpiles for mixture design purposes in accordance with Tex-236-F, Part I. The Engineer may verify the asphalt binder content of the stockpiles anytime during production. Perform other tests on RAP and RAS when shown on the plans. Asphalt binder from RAP and RAS is designated as recycled asphalt binder. Calculate and ensure that the ratio of the recycled asphalt binder to total binder does not exceed the percentages in accordance with Table 5 during mixture design and HMA production when RAP or RAS is used. Use a separate cold feed bin for each stockpile of RAP and RAS during HMA production. Surface, intermediate, and base mixes referenced in Table 4 and Table 5 are defined as follows, unless otherwise shown on the plans.~~

~~Surface. The final HMA lift placed at the top of the pavement structure.~~

~~Intermediate. Mixtures placed below an HMA surface mix and less than or equal to 8.0 in. below the riding surface.~~

~~Base. Mixtures placed greater than 8.0 in. below the riding surface. Unless otherwise shown on the plans, mixtures used for bond breaker are defined as base mixtures.~~

RAP. The usage of RAP is not allowed on the project. ~~RAP is salvaged, milled, pulverized, broken, or crushed asphalt pavement. Fractionated RAP is defined as a stockpile that contains RAP material with at least 95.0% passing the 1/2-in. sieve, before burning in~~

the ignition oven, unless otherwise approved. The Engineer may allow the Contractor to use an alternate to the 1/2 in. screen to fractionate the RAP.

Use of Contractor-owned RAP, including HMA plant waste, is permitted unless otherwise shown on the plans. Department-owned RAP stockpiles are available for the Contractor's use when the stockpile locations are shown on the plans. If Department-owned RAP is available for the Contractor's use, the Contractor may use Contractor-owned fractionated RAP and replace it with an equal quantity of Department-owned RAP. Department-owned RAP generated by required work on the Contract is available for the Contractor's use when shown on the plans. Perform any necessary tests to ensure Contractor- or Department-owned RAP is appropriate for use. The Department will not perform any tests or assume any liability for the quality of the Department-owned RAP unless otherwise shown on the plans. The Contractor will retain ownership of RAP generated on the project when shown on the plans.

Do not use Department- or Contractor-owned RAP contaminated with dirt or other objectionable materials. Do not use Department- or Contractor-owned RAP if the decantation value exceeds 5% and the plasticity index is greater than 8. Test the stockpiled RAP for decantation in accordance with Tex-406-A, Part I. Determine the plasticity index in accordance with Tex-106-E if the decantation value exceeds 5%. The decantation and plasticity index requirements do not apply to RAP samples with asphalt removed by extraction or ignition.

Do not intermingle Contractor-owned RAP stockpiles with Department-owned RAP stockpiles. Remove unused Contractor-owned RAP material from the project site upon completion of the project. Return unused Department-owned RAP to the designated stockpile location.

Table 4
Max Allowable Amounts of RAP[1]

Max Allowable Fractionated RAP (%)		
Surface	Intermediate	Base
20.0	30.0	35.0

1. Must also meet the recycled binder to total binder ratio shown in Table 5.

RAS. The usage of RAS is not allowed on the project. RAS is defined as processed asphalt shingle material from manufacturing of asphalt roofing shingles or from re-roofing residential structures. Post-manufactured RAS is processed manufacturer's shingle scrap byproduct. Post-consumer RAS is processed shingle scrap removed from residential structures. Use of post-manufactured RAS or post-consumer RAS (tear-offs) is not permitted in surface mixtures unless otherwise shown on the plans. RAS may be used in intermediate and base mixtures unless otherwise shown on the plans. Up to 3% RAS may be used separately or as a replacement for fractionated RAP in accordance with Table 4 and

~~Table 5. RAS may be used separately or in conjunction with RAP. Comply with all regulatory requirements stipulated for RAS by TCEQ.~~

~~Process the RAS by ambient grinding or granulating such that 100% of the particles pass the 3/8 in. sieve when tested in accordance with Tex-200-F, Part I. Perform a sieve analysis on processed RAS material before extraction (or ignition) of the asphalt binder.~~

~~Add sand meeting the requirements of Table 1 and Table 2, or fine RAP, to RAS stockpiles if needed to keep the processed material workable. Any stockpile that contains RAS will be considered a RAS stockpile and be limited to no more than 3.0% of the HMA mixture in accordance with Table 4.~~

~~Certify compliance of the RAS with DMS-11000, "Evaluating and Using Nonhazardous Recyclable Materials Guidelines." Treat RAS as an established nonhazardous recyclable material if it has not come into contact with any hazardous materials. Use RAS from shingle sources on the MPL. Remove all materials that are not part of the shingle, such as wood, paper, metal, plastic, and felt paper, before use. Determine the deleterious content of RAS material for mixture design purposes in accordance with Tex-217-F, Part III. Do not use RAS if deleterious materials are more than 0.5% of the stockpiled RAS, unless otherwise approved. Submit a sample for approval before submitting the mixture design. The Department will perform the testing for deleterious material of RAS to determine specification compliance.~~

2. Section 4 Construction
   a. Paragraph 4.4.2.2.2 first sentence is revised to read as follows:
      i. **Conditional Approval of JMF1 and Authorizing Trial Batch**. The Engineer will review and verify conformance with the following information within **seven** ~~2~~ working days of receipt.
   b. Paragraph 4.4.2.2.7 first sentence is revised to read as follows:
      i. **Approval of JMF2.** The Engineer will approve JMF2 within ~~1~~ **seven** working day**s** if the mixture meets the requirements shown in Table 5 and Table 8.
   c. Paragraph 4.7 Placement Operations second paragraph, first sentence is revised as follows:
      i. Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture and in accordance with Item P-101 Preparation/Removal of Existing Pavements
   d. Paragraph 4.9.5 – Ride Quality is revised as follows:
      Ride Quality. ~~Measure ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.~~ The Contractor shall perform smoothness testing in transverse and longitudinal directions daily to verify that the construction processes are producing pavement with variances less than ¼ inch in 12 feet, identifying areas that may pond water which could lead to hydroplaning of aircraft. If the smoothness criteria is not met, appropriate changes and corrections to the construction process shall be made by the Contractor before construction continues.

      The Contractor may use a 12-foot (3.7 m) "straightedge, a rolling inclinometer meeting the requirements of ASTM E2133 or rolling external reference device that can simulate a 12-foot (3.7m) straightedge approved by the RPR. Straight-edge testing shall start with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. Testing shall be continuous across all joints. The surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between the two high points. If the rolling inclinometer or external reference device is used, the data may be evaluated using either the

FAA profile program, ProFAA, or FHWA ProVal, using the 12-foot straightedge simulation function.

Smoothness readings shall not be made across grade changes or cross slope transitions. The transition between new and existing pavement shall be evaluated separately for conformance with the plans.

(1) Transverse measurements. Transverse measurements shall be taken for each day's production placed. Transverse measurements shall be taken perpendicular to the pavement centerline each 50 feet (15 m) or more often as determined by the RPR. The joint between lanes shall be tested separately to facilitate smoothness between lanes.
(2) Longitudinal measurements. Longitudinal measurements shall be taken for each day's production placed. Longitudinal tests shall be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet (6 m); and at the third points of paving lanes when widths of paving lanes are 20 ft (6 m) or greater. When placement abuts previously placed material the first measurement shall start with one half the length of the straight edge on the previously placed material.
Deviations on the final surface course in either the transverse or longitudinal direction that will trap water greater than 1/4 inch (6 mm) shall be corrected with diamond grinding per paragraph 401-4.16 or by removing and replacing the surface course to full depth. Grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. All areas in which diamond grinding has been performed shall be subject to the final pavement thickness tolerances specified in paragraph 401-6.1d(3). Areas that have been ground shall be sealed with a surface treatment in accordance with Item P-608. To avoid the surface treatment creating any conflict with runway or taxiway markings, it may be necessary to seal a larger area.

Control charts shall be kept to show area of each day's placement and the percentage of corrective grinding required. Corrections to production and placement shall be initiated when corrective grinding is required. If the Contractor's machines and/or methods produce significant areas that need corrective actions in excess of 10 percent of a day's production, production shall be stopped until corrective measures are implemented by the Contractor.

3. Section 5 Measurement
    a. Paragraph 5.2 – Tack Coat is revised as follows:
        i. **Tack Coat**. Tack coat will be measured **by the square yard and paid separately.** ~~at the applied temperature by strapping the tank before and after road application and determining the net volume in gallons from the calibrated distributor. The Engineer will witness all strapping operations for volume determination. All tack, including emulsions, will be measured by the gallon applied.~~

4. Section 6 Payment
    a. Paragraph one is revised as follows:
        i. The work performed and materials furnished in accordance with this Item and measured as provided under Section 341.5.1., "Dense-Graded HMA," will be paid for at the unit price bid for "~~Dense-Graded Hot-Mix Asphalt~~ TX-341a Hot Mix Asphalt Surface Course (Taxiways), TX-341b Hot Mix Asphalt Surface Course (Runway) and TX-341c Hot Mix Asphalt Surface Course (Apron) " of the mixture type, SAC, and binder specified. These prices are full compensation for surface preparation, materials, placement, equipment, labor, tools, and incidentals.
    b. Paragraph two, first sentence is revised as follows:
        i. The work performed and materials furnished in accordance with this Item and measured as provided under Section 341.5.2., "Tack Coat," will be paid for at the unit price bid for "Tack Coat" ~~of the tack coat provided~~.
    c. Paragraph 6.3 the following sentence is added:
        i. The maximum pay factor shall not exceed 1.0.

Item 341
Dense-Graded Hot-Mix Asphalt

1. DESCRIPTION

Construct a hot-mix asphalt (HMA) pavement layer composed of a compacted, dense-graded mixture of aggregate, asphalt binder, and additives mixed hot in a mixing plant. Payment adjustments will apply to HMA placed under this Specification unless the HMA is deemed exempt in accordance with Section 341.4.9.4., "Exempt Production."

2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

Notify the Engineer of all material sources and before changing any material source or formulation. The Engineer will verify that the specification requirements are met and document all material source changes when the Contractor makes a source or formulation change. The Engineer may sample and test project materials anytime during the project to verify specification compliance in accordance with Item 6, "Control of Materials."

2.1. **Aggregate**. Furnish aggregates from sources that conform to the requirements shown in Table 1 and this Section. Aggregate requirements in this Section, including those shown in Table 1, may be modified or eliminated when shown on the plans. Additional aggregate requirements may be specified when shown on the plans. Provide aggregate stockpiles that meet the definitions in this Section for coarse, intermediate, or fine aggregate. Aggregate from reclaimed asphalt pavement (RAP) is not required to meet Table 1 requirements unless otherwise shown on the plans. Supply aggregates that meet the definitions in Tex-100-E for crushed gravel or crushed stone. The Engineer will designate the plant or the quarry as the sampling location. Provide samples from materials produced for the project. The Engineer will establish the Surface Aggregate Classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests shown in Table 1. Document all test results in the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis in accordance with Tex-200-F, Part II.

2.1.1. **Coarse Aggregate**. Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve. Aggregates from sources listed in the Department's *Bituminous Rated Source Quality Catalog* (BRSQC) are preapproved for use. Use only the rated values for HMA listed in the BRSQC. Rated values for surface treatment (ST) do not apply to coarse aggregate sources used in HMA.

For sources not listed in the Department's BRSQC:

- build an individual stockpile for each material;
- request the Department test the stockpile for specification compliance;
- allow 30 calendar days for the Engineer to sample, test, and report results;
- use only when tested and approved; and
- once approved, do not add additional material to the stockpile unless otherwise allowed by the Engineer.

Provide coarse aggregate with **a minimum SAC "B".** ~~at least the minimum SAC shown on the plans. SAC requirements apply only to aggregates used on the surface of travel lanes, unless otherwise shown on the plans~~. The SAC for sources in the Department's *Aggregate Quality Monitoring Program* (AQMP) (Tex-499-A) is listed in the BRSQC.

2.1.1.1. **Blending Class A and Class B Aggregates**. Class B aggregate meeting all other requirements shown in Table 1 may be blended with a Class A aggregate to meet requirements for Class A materials, unless otherwise shown on the plans. When blending Class A and Class B aggregates to meet a Class A requirement, ensure that at least 50% by weight, or volume if required, of the material retained on the No. 4 sieve comes from the Class A aggregate source, unless otherwise shown on the plans. Blend by volume if the bulk specific gravities of the Class A and Class B aggregates differ by more than 0.300. Coarse aggregate from RAP and recycled asphalt shingles (RAS) will be considered as Class B aggregate for blending purposes.

The Engineer may perform tests anytime during production, when the Contractor blends Class A and Class B aggregates to meet a Class A requirement. The Engineer will use the Department's mix design template, when electing to verify conformance, to calculate the percent of Class A aggregate retained on the No. 4 sieve by inputting the bin percentages shown from readouts in the control room at the time of production and stockpile gradations measured at the time of production. The Engineer may determine the gradations based on either washed or dry sieve analysis from samples obtained from individual aggregate cold feed bins or aggregate stockpiles. The Engineer may perform spot checks to verify the percent of Class A aggregate retained on the No. 4 sieve. The Engineer will use the gradations supplied by the Contractor in the mixture design report as an input for the template. A failing spot check will require confirmation with a stockpile gradation determined by the Engineer.

2.1.1.2. **Micro-Deval Abrasion**. The Engineer will perform at least one Micro-Deval abrasion test in accordance with Tex-461-A for each coarse aggregate source used in the mixture design that has a rated source soundness magnesium (RSSM) loss value greater than 15 as listed in the BRSQC. The Engineer will perform testing before the start of production and may perform additional testing anytime during production. The Engineer may obtain the coarse aggregate samples from each coarse aggregate source or may require the Contractor to obtain the samples. The Engineer may waive all Micro-Deval testing based on a satisfactory test history of the same aggregate source.

The Engineer will estimate the magnesium sulfate soundness loss for each coarse aggregate source, when tested, using the following formula:

$$Mg_{est.} = (RSSM)(MD_{act.}/RSMD)$$

where:
$Mg_{est.}$ = magnesium sulfate soundness loss
$RSSM$ = rated source soundness magnesium
$MD_{act.}$ = actual Micro-Deval percent loss
$RSMD$ = rated source Micro-Deval

When the estimated magnesium sulfate soundness loss is greater than the maximum magnesium sulfate soundness loss specified, the coarse aggregate source will not be allowed for use unless otherwise approved. The Engineer will consult the Materials and Tests Division, and additional testing may be required before granting approval.

2.1.2. **Intermediate Aggregate**. Aggregates not meeting the definition of coarse or fine aggregate will be defined as intermediate aggregate. Supply intermediate aggregates, when used, that are free of organic impurities. Supply intermediate aggregate from coarse aggregate sources, when used, that meet the requirements shown in Table 1, unless otherwise approved.

Test the stockpile if 10% or more of the stockpile is retained on the No. 4 sieve, and verify that it meets the requirements in Table 1 for crushed face count (Tex-460-A) and flat and elongated particles (Tex-280-F).

2.1.3. **Fine Aggregate**. Fine aggregates consist of manufactured sands, screenings, and field sands. Fine aggregate stockpiles must meet the fine aggregate properties in accordance with Table 1 and the gradation requirements in accordance with Table 2. Supply fine aggregates that are free of organic impurities. The Engineer may test the fine aggregate in accordance with Tex-408-A to verify the material is free of organic impurities. Unless otherwise shown on the plans, at most 10% of the total aggregate may be field sand or other uncrushed fine aggregate. Use fine aggregate, except field sand, from coarse aggregate sources that meet the requirements shown in Table 1, unless otherwise approved.

Test the stockpile if 10% or more of the stockpile is retained on the No. 4 sieve and verify that it meets the requirements in Table 1 for crushed face count (Tex-460-A) and flat and elongated particles (Tex-280-F).

Table 1
Aggregate Quality Requirements

Property	Test Method	Requirement
Coarse Aggregate		
SAC	Tex-499-A (AQMP)	**Minimum "B"**
Deleterious material, %, Max	Tex-217-F, Part I	1.5
Decantation, %, Max	Tex-217-F, Part II	1.5
Micro-Deval abrasion, %	Tex-461-A	Note [1]
Los Angeles abrasion, %, Max	Tex-410-A	40
Magnesium sulfate soundness, 5 cycles, %, Max	Tex-411-A	30
Crushed face count,[2] %, Min	Tex-460-A, Part I	85
Flat and elongated particles @ 5:1, %, Max	Tex-280-F	10
Fine Aggregate		
Linear shrinkage, %, Max	Tex-107-E	3
Sand equivalent, %, Min	Tex-203-F	45[3]
Organic impurities	Tex-408-A	Note [4]

1. Used to estimate the magnesium sulfate soundness loss in accordance with Section 341.2.1.1.2., "Micro-Deval Abrasion."
2. Only applies to crushed gravel.
3. The Department may perform Tex-252-F on fine aggregates not meeting this minimum requirement. Fine aggregates with a methylene blue value of 10.0 mg/g or less may be used.
4. Optional test.

Table 2
Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Wt. Or Volume
3/8"	100
#8	70–100
#200	0–30

2.2. **Mineral Filler**. Mineral filler consists of finely divided mineral matter such as agricultural lime, crusher fines, hydrated lime, or fly ash. Mineral filler is allowed unless otherwise shown on the plans. Use no more than 2% hydrated lime or fly ash, unless otherwise shown on the plans. Use no more than 1% hydrated lime if a substitute binder is used, unless otherwise shown on the plans or allowed. Test all mineral fillers except hydrated lime and fly ash in accordance with Tex-107-E to ensure specification compliance. The plans may require or disallow specific mineral fillers. Provide mineral filler, when used, that:

- is dry enough, free-flowing, and free of clumps and foreign matter as determined by the Engineer;
- does not exceed 3% linear shrinkage when tested in accordance with Tex-107-E; and
- meets the gradation requirements shown in Table 3, unless otherwise shown on the plans.

Table 3
Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Wt. or Volume
#8	100
#200	55–100

2.3. **Baghouse Fines**. Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.

2.4. **Asphalt Binder**. Furnish ~~the type and grade of performance-graded~~ **64-22** (PG) asphalt binder ~~shown on the plans~~ that meets the requirements of Item 300, "Asphalts, Oils, and Emulsions." **The JMF target asphalt content shall not be less than 5.3%.**

2.5. **Tack Coat**. Furnish CSS-1H, SS-1H, EBL, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300. Specialized tack coat materials on the MPL for *Tracking Resistant Asphalt Interlayer* (TRAIL) will be allowed or required when shown on the plans. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use, unless required in conformance with the manufacturer's recommendation for approved TRAIL products on the MPL.

2.6. **Additives**. Use the type of additive specified when shown on the plans. Use the rate of additive specified in conformance with the manufacturer's recommendation. Additives that facilitate mixing and compaction or improve the quality of the mixture are allowed when approved. Provide the Engineer with documentation such as the bill of lading showing the quantity of additives used in the project unless otherwise directed.

2.6.1. **Lime and Liquid Antistripping Agent**. Lime or liquid antistripping agent is required when shown on the plans. When lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime into the drum.

2.6.2. **Warm-Mix Asphalt (WMA)**. WMA is defined as HMA that is produced within a target temperature discharge range of 215°F and 275°F using approved WMA additives or processes from the MPL.

WMA is **not allowed for use on the project**. ~~allowed for use on all projects and is required when shown on the plans~~. When WMA is required, the maximum placement or target discharge temperature for WMA will be set at a value at or below 275°F.

Department-approved WMA additives or processes may be used to facilitate mixing and compaction of HMA produced at target discharge temperatures above 275°F; however, such mixtures will not be defined as WMA.

2.6.3. **Compaction Aid**. Compaction aid is defined as a Department-approved chemical warm-mix additive, denoted as "chemical additive" on the MPL, that is used to facilitate mixing and compaction of HMA at a discharge temperature greater than 275°F.

Compaction aid is allowed for use on all projects. Compaction aid is required when shown on the plans or as required in Section 341.4.7.1., "Weather Conditions."

Warm-mix foaming processes, denoted as "foaming process" on the MPL, may be used to facilitate mixing and compaction of HMA at target discharge temperatures greater than 275°F; however, warm-mix foaming processes are not defined as a compaction aid.

~~2.7.~~ **Recycled Materials**. Use of RAP and RAS **is not permitted on the project.** ~~permitted unless otherwise shown on the plans. Use of RAS is restricted to only intermediate and base mixes unless otherwise shown on the plans. Do not exceed the maximum allowable percentages of RAP and RAS in accordance with Table 4. The allowable percentages in accordance with Table 4 may be decreased or increased when shown on the plans.~~

Determine the asphalt binder content and gradation of the RAP and RAS stockpiles for mixture design purposes in accordance with Tex-236-F, Part I. The Engineer may verify the asphalt binder content of the stockpiles anytime during production. Perform other tests on RAP and RAS when shown on the plans. Asphalt binder from RAP and RAS is designated as recycled asphalt binder. Calculate and ensure that the ratio of the recycled asphalt binder to total binder does not exceed the percentages in accordance with Table 5 during mixture design and HMA production when RAP or RAS is used. Use a separate cold feed bin for each stockpile of RAP and RAS during HMA production. Surface, intermediate, and base mixes referenced in Table 4 and Table 5 are defined as follows, unless otherwise shown on the plans.

- **Surface**. The final HMA lift placed at the top of the pavement structure.
- **Intermediate**. Mixtures placed below an HMA surface mix and less than or equal to 8.0 in. below the riding surface.
- **Base**. Mixtures placed greater than 8.0 in. below the riding surface. Unless otherwise shown on the plans, mixtures used for bond breaker are defined as base mixtures.

2.7.1. **RAP**. **The usage of RAP is not allowed on the project.** RAP is salvaged, milled, pulverized, broken, or crushed asphalt pavement. Fractionated RAP is defined as a stockpile that contains RAP material with at least 95.0% passing the 1/2-in. sieve, before burning in the ignition oven, unless otherwise approved. The Engineer may allow the Contractor to use an alternate to the 1/2-in. screen to fractionate the RAP.

Use of Contractor-owned RAP, including HMA plant waste, is permitted unless otherwise shown on the plans. Department-owned RAP stockpiles are available for the Contractor's use when the stockpile locations are shown on the plans. If Department-owned RAP is available for the Contractor's use, the Contractor may use Contractor-owned fractionated RAP and replace it with an equal quantity of Department-owned RAP. Department-owned RAP generated by required work on the Contract is available for the Contractor's use when shown on the plans. Perform any necessary tests to ensure Contractor- or Department-owned RAP is appropriate for use. The Department will not perform any tests or assume any liability for the quality of the Department-owned RAP unless otherwise shown on the plans. The Contractor will retain ownership of RAP generated on the project when shown on the plans.

Do not use Department- or Contractor-owned RAP contaminated with dirt or other objectionable materials. Do not use Department- or Contractor-owned RAP if the decantation value exceeds 5% and the plasticity index is greater than 8. Test the stockpiled RAP for decantation in accordance with Tex-406-A, Part I. Determine the plasticity index in accordance with Tex-106-E if the decantation value exceeds 5%. The decantation and plasticity index requirements do not apply to RAP samples with asphalt removed by extraction or ignition.

Do not intermingle Contractor-owned RAP stockpiles with Department-owned RAP stockpiles. Remove unused Contractor-owned RAP material from the project site upon completion of the project. Return unused Department-owned RAP to the designated stockpile location.

Table 4
Max Allowable Amounts of RAP[1]

Max Allowable Fractionated RAP (%)		
Surface	**Intermediate**	**Base**
20.0	30.0	35.0

1. Must also meet the recycled binder to total binder ratio shown in Table 5.

2.7.2. **RAS**. **The usage of RAS is not allowed on the project.** RAS is defined as processed asphalt shingle material from manufacturing of asphalt roofing shingles or from re-roofing residential structures. Post-manufactured RAS is processed manufacturer's shingle scrap byproduct. Post-consumer RAS is processed shingle scrap removed from residential structures. Use of post-manufactured RAS or post-consumer RAS (tear-offs) is not permitted in surface mixtures unless otherwise shown on the plans. RAS may be used in intermediate and base mixtures unless otherwise shown on the plans. Up to 3% RAS may be used separately or as a

~~replacement for fractionated RAP in accordance with Table 4 and Table 5. RAS may be used separately or in conjunction with RAP. Comply with all regulatory requirements stipulated for RAS by TCEQ.~~

~~Process the RAS by ambient grinding or granulating such that 100% of the particles pass the 3/8-in. sieve when tested in accordance with Tex-200-F, Part I. Perform a sieve analysis on processed RAS material before extraction (or ignition) of the asphalt binder.~~

~~Add sand meeting the requirements of Table 1 and Table 2, or fine RAP, to RAS stockpiles if needed to keep the processed material workable. Any stockpile that contains RAS will be considered a RAS stockpile and be limited to no more than 3.0% of the HMA mixture in accordance with Table 4.~~

~~Certify compliance of the RAS with DMS-11000, "Evaluating and Using Nonhazardous Recyclable Materials Guidelines." Treat RAS as an established nonhazardous recyclable material if it has not come into contact with any hazardous materials. Use RAS from shingle sources on the MPL. Remove all materials that are not part of the shingle, such as wood, paper, metal, plastic, and felt paper, before use. Determine the deleterious content of RAS material for mixture design purposes in accordance with Tex-217-F, Part III. Do not use RAS if deleterious materials are more than 0.5% of the stockpiled RAS, unless otherwise approved. Submit a sample for approval before submitting the mixture design. The Department will perform the testing for deleterious material of RAS to determine specification compliance.~~

2.8. **Substitute Binders**. No binder substitution will be allowed when shown on the plans. The Contractor may use a substitute PG binder shown in Table 5 instead of the PG binder originally specified, if using recycled materials, and if the substitute PG binder and mixture made with the substitute PG binder meet the following.

- The substitute binder meets the specification requirements for the substitute binder grade in accordance with Section 300.2.11., "Performance-Graded Binders."
- The mixture has less than 10.0 mm of rutting on the Hamburg wheel test (Tex-242-F) after the number of passes required for the originally specified binder. Use of substitute PG binders may be allowed only at the discretion of the Engineer if the Hamburg wheel test results are between 10.0 mm and 12.5 mm.

Table 5
Allowable PG Binders and Max Recycled Binder Ratios

Originally Specified PG Binder	Allowable Substitute PG Binder for Surface Mixes	Allowable Substitute PG Binder for Intermediate and Base Mixes	Maximum Ratio of Recycled Binder[1] to Total Binder (%)		
			Surface	Intermediate	Base
76-22	70-22	70-22	15.0	25.0	30.0
70-22	Note [2]	64-22	15.0	25.0	30.0
64-22	Note [2]	Note [2]	15.0	25.0	30.0
76-28	70-28	70-28	15.0	25.0	30.0
70-28	Note [2]	64-28	15.0	25.0	30.0
64-28	Note [2]	Note [2]	15.0	25.0	30.0

1. Combined recycled binder from RAP and RAS. RAS is not permitted in surface mixtures unless otherwise shown on the plans.
2. No binder substitution is allowed.

3. EQUIPMENT

Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement."

4. CONSTRUCTION

Produce, haul, place, and compact the specified paving mixture. In addition to tests required in accordance with the Specification, the Contractor may perform other QC tests as necessary. Anytime during the project, the Engineer may perform production and placement tests as necessary in accordance with Item 5, "Control

of the Work." Schedule and participate in a mandatory pre-paving meeting with the Engineer on or before the first day of paving unless otherwise shown on the plans.

4.1. **Certification**. Personnel certified by the Department-approved HMA certification program must conduct all mixture designs, sampling, and testing in accordance with Table 6. Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning production and when personnel changes are made. Provide a mixture design developed and signed by a Level 2-certified specialist. Provide Level 1A-certified specialists at the plant during production operations. Provide Level 1B-certified specialists to conduct placement tests. Provide Level AGG101-certified specialists for aggregate testing.

Table 6
Test Methods, Test Responsibility, and Min Certification Levels

Test Description	Test Method	Contractor	Engineer	Level[1]
Aggregate and Recycled Material Testing				
Sampling	Tex-221-F	✓	✓	1A/AGG101
Dry sieve	Tex-200-F, Part I	✓	✓	1A/AGG101
Washed sieve	Tex-200-F, Part II	✓	✓	1A/AGG101
Deleterious material	Tex-217-F, Part I and Part III	✓	✓	AGG101
Decantation	Tex-217-F, Part II	✓	✓	AGG101
Los Angeles abrasion	Tex-410-A	–	✓	Department
Magnesium sulfate soundness	Tex-411-A	–	✓	Department
Micro-Deval abrasion	Tex-461-A	–	✓	AGG101
Crushed face count	Tex-460-A	✓	✓	AGG101
Flat and elongated particles	Tex-280-F	✓	✓	AGG101
Linear shrinkage	Tex-107-E	✓	✓	AGG101
Sand equivalent	Tex-203-F	✓	✓	AGG101
Methylene blue test	Tex-252-F	–	✓	Department
Bulk-specific gravity	Tex-201-F	✓	✓	AGG101
Organic impurities	Tex-408-A	✓	✓	AGG101
Asphalt Binder and Tack Coat Sampling				
Asphalt binder sampling	Tex-500-C, Part II	✓	✓	1A/1B
Tack coat sampling	Tex-500-C, Part III	✓	✓	1A/1B
Mix Design and Verification				
Design and job-mix formula (JMF) changes	Tex-204-F	✓	✓	2
Mixing	Tex-205-F	✓	✓	2
Molding (Superpave gyratory compactor [SGC])	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F, Part I and Part VI	✓	✓	1A
Rice gravity	Tex-227-F, Part II	✓	✓	1A
Ignition oven correction factors[2]	Tex-236-F, Part II	✓	✓	1A
Indirect tensile strength	Tex-226-F	✓	✓	1A
Hamburg wheel test	Tex-242-F	✓	✓	1A
Witnessing mixing of correction factors	Tex-236-F, Part III	–	✓	Department
Boil test	Tex-530-C	✓	✓	1A
Production Testing				
Selecting production random numbers	Tex-225-F, Part I	–	✓	1A
Mixture sampling	Tex-222-F	✓	✓	1A/1B
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F, Part I and Part VI	✓	✓	1A
Rice gravity	Tex-227-F, Part II	✓	✓	1A
Gradation and asphalt binder content[2]	Tex-236-F, Part I	✓	✓	1A
Control charts	Tex-233-F	✓	✓	1A
Moisture content	Tex-212-F, Part II	✓	✓	1A/AGG101
Hamburg wheel test	Tex-242-F	✓	✓	1A
Micro-Deval abrasion	Tex-461-A	–	✓	AGG101

Test Description	Test Method	Contractor	Engineer	Level[1]
Boil test	Tex-530-C	✓	✓	1A
Abson recovery	Tex-211-F	–	✓	Department
Placement Testing				
Selecting placement random numbers	Tex-225-F, Part II	–	✓	1B
Trimming roadway cores	Tex-251-F, Part I and Part II	✓	✓	1A/1B
In-place air voids	Tex-207-F, Part I and Part VI	✓	✓	1A
In-place density (nuclear method)	Tex-207-F, Part III	✓	–	1B
Establish rolling pattern	Tex-207-F, Part IV	✓	–	1B
Control charts	Tex-233-F	✓	✓	1A
Ride quality measurement	Tex-1001-S	✓	✓	Note[3]
Segregation (density profile)	Tex-207-F, Part V	✓	✓	1B
Longitudinal joint density	Tex-207-F, Part VII	✓	✓	1B
Thermal profile	Tex-244-F	✓	–	1B
Shear bond strength test	Tex-249-F	–	✓	Department

1. Levels 1A, 1B, AGG101, and 2 are certification levels provided by the Hot Mix Asphalt Center certification program.
2. Refer to Section 341.4.9.2.3., "Production Testing," for exceptions to using an ignition oven.
3. Profiler and operator are required to be certified at the Texas A&M Transportation Institute facility when surface test Type B is specified.

4.2. **Reporting and Responsibilities**. Use Department-provided templates to record and calculate all test data, including mixture design, production and placement QC and QA, control charts, thermal profiles, segregation density profiles, and longitudinal joint density. Obtain the current version of the templates from the Department's website or from the Engineer. The Engineer and the Contractor will provide any available test results to the other party when requested. The maximum allowable time for the Contractor and Engineer to exchange test data is as shown in Table 7, unless otherwise approved. The Engineer and the Contractor will immediately report to the other party any test result that requires suspension of production or placement, or a payment adjustment less than 1.000, or that fails to meet the specification requirements. Record and electronically submit all test results and pertinent information on Department-provided templates.

Subsequent sublots placed after test results are available to the Contractor, which require suspension of operations, may be considered unauthorized work. Unauthorized work will be accepted or rejected at the discretion of the Engineer in accordance with Article 5.3., "Conformity with Plans, Specifications, and Special Provisions."

Table 7
Reporting Schedule

Description	Reported By	Reported To	To Be Reported Within
Production Quality Control			
Gradation[1]	Contractor	Engineer	1 working day of completion of the sublot
Asphalt binder content[1]			
Laboratory-molded density[2]			
Moisture content[3]			
Boil test[4]			
Production Quality Assurance			
Gradation[3]	Engineer	Contractor	1 working day of completion of the sublot
Asphalt binder content[3]			
Laboratory-molded density[1]			
Hamburg wheel test[5]			
Boil test[4]			
Binder tests[5]			

Description	Reported By	Reported To	To Be Reported Within
Placement Quality Control			
In-place air voids[2]	Contractor	Engineer	1 working day of completion of the lot
Segregation[1]			
Longitudinal joint density[1]			
Thermal profile[1]			
Placement Quality Assurance			
In-place air voids[1]	Engineer	Contractor	1 working day after receiving the trimmed cores6
Segregation[3]			1 working day of completion of the lot
Longitudinal joint density[3]			
Thermal profile[3]			
Aging ratio[5]			
Shear bond strength test[5]			5 working days after receiving the cores
Payment adjustment summary	Engineer	Contractor	2 working days of performing all required tests and receiving Contractor test data

1. These tests are required on every sublot.
2. Optional test. When performed on split samples, report the results as soon as they become available.
3. To be performed at the frequency shown in Table 16 or as shown on the plans.
4. When shown on the plans.
5. To be reported as soon as the results become available.
6. Two days are allowed if cores cannot be dried to constant weight within 1 day.

The Engineer will use the Department-provided template to calculate all payment adjustment factors for the lot. Sublot samples may be discarded after the Engineer and Contractor sign off on the payment adjustment summary documentation for the lot.

Use the procedures described in Tex-233-F to plot the results of all QC and QA testing. Update the control charts as soon as test results for each sublot become available. Make the control charts readily accessible at the field laboratory. The Engineer may suspend production for failure to update control charts.

4.3. **Quality Control Plan (QCP)**. Develop and follow the QCP in detail. Obtain approval for changes to the QCP made during the project. The Engineer may suspend operations if the Contractor fails to comply with the QCP.

Submit a written QCP before the mandatory pre-paving meeting. Receive approval of the QCP before beginning production. Include the following items in the QCP.

4.3.1. **Project Personnel**. For project personnel, include:

- a list of individuals responsible for QC with authority to take corrective action,
- current contact information for each individual listed, and
- current copies of certification documents for individuals performing specified QC functions.

4.3.2. **Material Delivery and Storage**. For material delivery and storage, include:

- the sequence of material processing, delivery, and minimum quantities to assure continuous plant operations;
- aggregate stockpiling procedures to avoid contamination and segregation;
- frequency, type, and timing of aggregate stockpile testing to assure conformance with material requirements before mixture production; and
- procedure for monitoring the quality and variability of asphalt binder.

4.3.3. **Production**. For production, include:

- loader operation procedures to avoid contamination in cold bins;
- procedures for calibrating and controlling cold feeds;
- procedures to eliminate debris or oversized material;
- procedures for adding and verifying rates of each applicable mixture component (e.g., aggregate, asphalt binder, RAP, RAS, lime, liquid antistrip, compaction aid, foaming process, and WMA);
- procedures for reporting job control test results; and
- procedures to avoid segregation and drain-down in the silo.

4.3.4. **Loading and Transporting**. For loading and transporting, include:

- type and application method for release agents, and
- truck-loading procedures to avoid segregation.

4.3.5. **Placement and Compaction**. For placement and compaction, include:

- proposed agenda for mandatory pre-paving meeting, including date and location;
- proposed paving plan (e.g., production rate, paving widths, joint offsets, and lift thicknesses);
- type and application method for release agents in the paver and on rollers, shovels, lutes, and other utensils;
- procedures for the transfer of mixture into the paver while avoiding physical and thermal segregation and preventing material spillage;
- process to balance production, delivery, paving, and compaction to achieve continuous placement operations and good ride quality;
- paver operations (e.g., speed, operation of wings, and height of mixture in auger chamber) to avoid physical and thermal segregation and other surface irregularities; and
- procedures to construct quality longitudinal and transverse joints.

4.4. **Mixture Design**.

4.4.1. **Design Requirements**. Use the dense-graded design procedure provided in Tex-204-F, unless otherwise shown on the plans. Design the mixture to meet the requirements shown in Tables 1, 2, 3, 4, 5, 8, 9, and 10.

Design the mixture using an SGC, and 50 gyrations as the design number of gyrations (Ndesign). Use a target laboratory-molded density of 96.0% to design the mixture; however, adjustments can be made to the Ndesign value as shown in Table 9. The Ndesign level may be reduced to at least 35 gyrations at the Contractor's discretion.

Use a Department-approved laboratory on the MPL to perform the Hamburg wheel test and provide results with the mixture design, or provide the laboratory mixture and request that the Department perform the Hamburg wheel test. Upon receiving the sample from the Contractor, the Engineer will be allowed 10 working days to provide the Contractor with Hamburg wheel test results on the laboratory mixture design.

The Engineer will provide the mixture design when shown on the plans. The Contractor may submit a new mixture design anytime during the project. The Engineer will verify and approve all mixture designs (JMF1) before the Contractor can begin production.

Provide the Engineer with a mixture design report using the Department-provided template. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- the binder source and optimum design asphalt content;
- asphalt binder content and aggregate gradation of RAP and RAS stockpiles;
- the Ndesign level used on the SGC;

- results of all applicable tests;
- the mixing and molding temperatures;
- the signature of the Level 2 person or persons who performed the design;
- the date the mixture design was performed; and
- a unique identification number for the mixture design.

Table 8
Master Gradation Limits (% Passing by Wt. or Volume) and Void in Mineral Aggregate (VMA) Requirements

Sieve Size	DG-B Fine Base	DG-C Coarse Surface	DG-D Fine Surface	DG-F Fine Mixture
2"	–	–	–	–
1-1/2"	100.0[1]	–	–	–
1"	98.0–100.0	100.0[1]	–	–
3/4"	84.0–98.0	95.0–100.0	100.0[1]	–
1/2"	—	—	98.0–100.0	100.0[1]
3/8"	60.0–80.0	70.0–85.0	85.0–100.0	98.0–100.0
#4	40.0–60.0	43.0–63.0	50.0–70.0	70.0–90.0
#8	29.0–43.0	32.0–44.0	35.0–46.0	38.0–48.0
#30	13.0–28.0	14.0–28.0	15.0–29.0	12.0–27.0
#50	6.0–20.0	7.0–21.0	7.0–20.0	6.0–19.0
#200	2.0–7.0	2.0–7.0	2.0–7.0	2.0–7.0
Design (VMA), % Min				
–	13.0	14.0	15.0	16.0
Production (Plant-Produced) (VMA), % Min				
–	12.5	13.5	14.5	15.5

1. Defined as Max sieve size. No tolerance allowed.

Table 9
Laboratory Mixture Design Properties

Mixture Property	Test Method	Requirement
Target laboratory-molded density, %	Tex-207-F	96.0
Design gyrations (Ndesign)	Tex-241-F	50[1]
Indirect tensile strength (dry), psi	Tex-226-F	85–200[2]
Boil test[3]	Tex-530-C	–

1. Adjust within a range of 35–100 gyrations when shown on the plans, in accordance with the specification, or when mutually agreed between the Engineer and Contractor.
2. The Engineer may allow the indirect tensile test strength to exceed 200 psi if the corresponding Hamburg wheel rut depth is >2.5 mm and <12.5 mm.
3. When shown on the plans. Used to establish baseline for comparison to production results.

Table 10
Hamburg Wheel Test Requirements

High-Temperature Binder Grade	Test Method	Min # of Passes at 12.5-mm[1] Rut Depth, Tested at 50°C
PG 64 or lower	Tex-242-F	10,000[2]
PG 70		15,000[3]
PG 76 or higher		20,000

1. The Hamburg wheel test will have a minimum rut depth of 2.5 mm.
2. May be decreased to at least 5,000 passes when shown on the plans.
3. May be decreased to at least 10,000 passes when shown on the plans.

4.4.2. **Job-Mix Formula Approval**. The JMF is the combined aggregate gradation, Ndesign level, and target asphalt percentage used to establish target values for hot-mix production. JMF1 is the original laboratory mixture design used to produce the trial batch. When WMA is used, JMF1 may be designed and submitted to the

Engineer without including the WMA additive, foaming process, or compaction aid. When WMA or a compaction aid is used, document the additive or process used and recommended rate in the JMF1 submittal. The Engineer and the Contractor will verify JMF1 based on plant-produced mixture from the trial batch, unless otherwise approved. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF1. The Department may require the Contractor to reimburse the Department for verification tests if more than two trial batches per design are required.

4.4.2.1. **Contractor's Responsibilities**.

4.4.2.1.1. **Providing Superpave Gyratory Compactor**. Provide an SGC in accordance with Item 504, "Field Office and Laboratory," and make the SGC available to the Engineer for use in molding production samples.

4.4.2.1.2. **Gyratory Compactor Correlation Factors**. Use Tex-206-F, Part II, to perform a gyratory compactor correlation when the Engineer uses a different SGC. Apply the correlation factor to all subsequent production test results.

4.4.2.1.3. **Submitting JMF1**. Furnish a mix design report (JMF1) with representative samples of all component materials and request approval to produce the trial batch. Provide approximately 25 lb. of the design mixture if opting to have the Department perform the Hamburg wheel test on the laboratory mixture, and request that the Department perform the test.

4.4.2.1.4. **Supplying Aggregates**. Provide approximately 40 lb. of each aggregate stockpile unless otherwise directed.

4.4.2.1.5. **Supplying Asphalt**. Provide at least 1 gal. of the asphalt material and enough quantities of any additives proposed for use.

4.4.2.1.6. **Ignition Oven Correction Factors**. Notify the Engineer before performing Tex-236-F, Part II. Allow the Engineer to witness the mixing of ignition oven correction factor sample. Determine the aggregate and asphalt correction factors from the ignition oven in accordance with Tex-236-F, Part II.

If the Engineer witnesses the mixing of the ignition oven correction factor samples, provide the Engineer with identically prepared samples of the mixtures before the trial batch production, including all additives (except water), and blank samples used to determine the correction factors for the ignition oven used for QA testing during production.

Correction factors established from a previously approved mixture design may be used for the current mixture design if the mixture design and ignition oven are the same as previously used, unless otherwise directed. Correction factors must be performed every 12 mo.

4.4.2.1.7. **Boil Test**. When shown on the plans, perform the test and retain the tested sample from Tex-530-C until completion of the project or as directed. Use this sample for comparison purposes during production.

4.4.2.1.8. **Trial Batch Production**. Provide a plant-produced trial batch upon receiving conditional approval of JMF1 and authorization to produce a trial batch. If applicable, include the WMA additive, foaming process, or compaction aid for verification testing of JMF1 and development of JMF2. Produce a trial batch mixture that meets the requirements shown in Tables 4, 5, and 11. The Engineer may accept test results from recent production of the same mixture instead of a new trial batch.

4.4.2.1.9. **Trial Batch Production Equipment**. Use only equipment and materials proposed for use on the project to produce the trial batch.

4.4.2.1.10. **Trial Batch Quantity**. Produce enough quantity of the trial batch to ensure that the mixture meets the specification requirements.

4.4.2.1.11. **Number of Trial Batches**. Produce trial batches as necessary to obtain a mixture that meets the specification requirements.

4.4.2.1.12. **Trial Batch Sampling**. Obtain a representative sample of the trial batch and split it into three equal portions in accordance with Tex-222-F. Label these portions as "Contractor," "Engineer," and "Referee." Deliver samples to the appropriate laboratory as directed.

4.4.2.1.13. **Trial Batch Testing**. Test the trial batch to ensure the mixture produced using the proposed JMF1 meets the mixture requirements shown in Table 11. Ensure the trial batch mixture is also in compliance with the Hamburg wheel requirement shown in Table 10. Use a Department-approved laboratory listed on the MPL to perform the Hamburg wheel test on the trial batch mixture, or request that the Department perform the Hamburg wheel test. Provide approximately 25 lb. of the trial batch mixture if opting to have the Department perform the Hamburg wheel test, and request that the Department perform the test. Upon receiving the sample from the Contractor, the Engineer will be allowed 10 working days to provide the Contractor with Hamburg wheel test results on the trial batch. Provide the Engineer with a copy of the trial batch test results.

4.4.2.1.14. **Development of JMF2**. After the Engineer grants full approval of JMF1, evaluate the trial batch test results, determine the optimum mixture proportions, and submit as JMF2. Adjust the asphalt binder content or gradation to achieve the specified target laboratory-molded density. The asphalt binder content established for JMF2 is not required to be within any tolerance of the optimum asphalt binder content established for JMF1; however, mixture produced using JMF2 must meet the VMA requirements for production shown in Table 8. If the optimum asphalt binder content for JMF2 is more than 0.5% lower than the optimum asphalt binder content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 production to confirm the indirect tensile strength does not exceed 200 psi. Verify that JMF2 meets the mixture requirements shown in Table 4 and Table 5.

4.4.2.1.15. **Mixture Production**. Use JMF2 to produce Lot 1 in accordance with Section 341.4.9.3.1.1., "Lot 1 Placement," after receiving approval for JMF2 and a passing Hamburg wheel result on the trial batch from a laboratory listed on the MPL. Once JMF2 is approved, and without receiving the results from the Department's Hamburg wheel test on the trial batch, the Contractor may proceed to Lot 1 production at their own risk.

Notify the Engineer if electing to proceed without Hamburg wheel test results from the trial batch. Note that the Engineer may require up to the entire sublot of any mixture failing the Hamburg wheel test to be removed and replaced at the Contractor's expense.

4.4.2.1.16. **Development of JMF3**. Evaluate the test results from Lot 1, determine the optimum mixture proportions, and submit as JMF3 for use in Lot 2.

4.4.2.1.17. **JMF Adjustments**. If JMF adjustments are necessary to achieve the specified requirements, make the adjustments before beginning a new lot. The adjusted JMF must:

- be provided to the Engineer in writing before the start of a new lot,
- be numbered in sequence to the previous JMF,
- meet the mixture requirements in accordance with Table 4 and Table 5,
- meet the master gradation limits in accordance with Table 8, and
- be within the operational tolerances of JMF2 in accordance with Table 11.

4.4.2.1.18. **Requesting Referee Testing**. Use referee testing, if needed, in accordance with Section 341.4.9.1., "Referee Testing," to resolve testing differences with the Engineer.

Table 11
Operational Tolerances

Description	Test Method	Allowable Difference Between JMF2 and JMF1 Target[1]	Allowable Difference Between Current JMF and JMF2[2]	Allowable Difference Between Contractor and Engineer[3]
Individual % retained on #8 sieve and larger	Tex-200-F or Tex-236-F	Must be Within Master Gradation Limits in Table 8	±5.04	±5.0
Individual % retained on sieves smaller than #8 and larger than #200			±3.04	±3.0
% passing the #200 sieve			±2.04	±1.6
Asphalt binder content, %	Tex-236-F	±0.5	±0.3	±0.3
Laboratory-molded density, %	Tex-207-F	±1.0	±1.0	±1.0
In-place air voids, %		–	–	±1.0
Laboratory-molded bulk specific gravity		–	–	±0.020
VMA, %, Min	Tex-204-F	Note[5]	Note[5]	–
Theoretical maximum specific (Rice) gravity	Tex-227-F	–	–	±0.020

1. JMF1 is the approved laboratory mixture design used for producing the trial batch. JMF2 is the approved mixture design developed from the trial batch used to produce Lot 1.
2. Current JMF is JMF3 or higher. JMF3 is the approved mixture design used to produce Lot 2.
3. Contractor may request referee testing when values exceed these tolerances.
4. When within these tolerances, mixture production gradations may fall outside the master gradation limits; however, the % passing the #200 will be considered out of tolerance when outside the master gradation limits.
5. Verify that Table 8 requirements are met for VMA.

4.4.2.2. **Engineer's Responsibilities**.

4.4.2.2.1. **Superpave Gyratory Compactor**. The Engineer will use a Department SGC, calibrated in accordance with Tex-241-F, to mold samples for laboratory mixture design verification. For molding trial batch and production specimens, the Engineer will use the Contractor-provided SGC at the field laboratory or provide and use a Department SGC at an alternate location.

4.4.2.2.2. **Conditional Approval of JMF1 and Authorizing Trial Batch**. The Engineer will review and verify conformance with the following information within **seven** ~~2~~ working days of receipt:

- the Contractor's mix design report (JMF1);
- the Contractor-provided Hamburg wheel test results;
- all required materials including aggregates, asphalt, additives, and recycled materials; and
- the mixture specifications.

The Engineer will grant the Contractor conditional approval of JMF1 if the information provided on the paper copy of JMF1 indicates that the Contractor's mixture design meets the specifications. When the Contractor does not provide Hamburg wheel test results with laboratory mixture design, 10 working days are allowed for conditional approval of JMF1. The Engineer will base full approval of JMF1 on the test results on mixture from the trial batch.

Unless waived, the Engineer will determine the Micro-Deval abrasion loss in accordance with Section 341.2.1.1.2., "Micro-Deval Abrasion." If the Engineer's test results are pending after 2 working days, conditional approval of JMF1 will still be granted within 2 working days of receiving JMF1. When the Engineer's test results become available, they will be used for specification compliance.

The Contractor is authorized to produce a trial batch after the Engineer grants conditional approval of JMF1.

4.4.2.2.3. **Hamburg Wheel Testing of JMF1**. If the Contractor requests the option to have the Department perform the Hamburg wheel test on the laboratory mixture, the Engineer will mold samples in accordance with Tex-242-F to verify compliance with the Hamburg wheel test requirement shown in Table 10. Upon receiving the sample from the Contractor, the Engineer will be allowed 10 working days to provide the Contractor with Hamburg wheel test results on the laboratory mixture design.

4.4.2.2.4. **Ignition Oven Correction Factors**. The Engineer will determine ignition oven correction factors by one of the following options.

- Witness the mixing of ignition oven correction factor samples by the Contractor in accordance with Tex-236-F, Part III. The Engineer will use the identically prepared samples provided by the Contractor to determine the aggregate and asphalt correction factors for the ignition oven in accordance with Tex-236-F, Part II.
- If the Engineer does not witness the mixing of ignition oven correction factor samples, the Engineer will prepare the samples to determine the aggregate and asphalt correction factors for the ignition oven in accordance with Tex-236-F, Part II. Notify the Contractor before performing Tex-236-F, Part II. Allow the Contractor to witness the Engineer performing Tex-236-F, Part II.

Correction factors must be performed every 12 mo. to be used for QA testing during production.

4.4.2.2.5. **Testing the Trial Batch**. Within 1 full working day, the Engineer will sample and test the trial batch to ensure that the mixture meets the requirements shown in Table 11. If the Contractor requests the option to have the Department perform the Hamburg wheel test on the trial batch mixture, the Engineer will mold samples in accordance with Tex-242-F to verify compliance with the Hamburg wheel test requirement shown in Table 10.

The Engineer will have the option to perform the following tests on the trial batch.

- Tex-226-F, to verify that the indirect tensile strength meets the requirement shown in Table 9.
- Tex-530-C, to retain and use for comparison purposes during production.

4.4.2.2.6. **Full Approval of JMF1**. The Engineer will grant full approval of JMF1 and authorize the Contractor to proceed with developing JMF2 if the Engineer's results for the trial batch meet the requirements shown in Tables 8, 9, and 10. The Engineer will notify the Contractor that an additional trial batch is required if the trial batch does not meet these requirements.

4.4.2.2.7. **Approval of JMF2.** The Engineer will approve JMF2 within ~~1~~ **seven** working day**s** if the mixture meets the requirements shown in Table 5 and Table 8. The asphalt binder content established for JMF2 is not required to be within any tolerance of the optimum asphalt binder content established for JMF1; however, mixture produced using JMF2 must meet the VMA requirements shown in Table 8. If the optimum asphalt binder content for JMF2 is more than 0.5% lower than the optimum asphalt binder content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 production to confirm the indirect tensile strength does not exceed 200 psi.

4.4.2.2.8. **Approval of Lot 1 Production**. The Engineer will authorize the Contractor to proceed with JMF2 for Lot 1 production after a passing Hamburg wheel test result on the trial batch is achieved from a laboratory listed on the MPL. The Contractor may proceed at their own risk with Lot 1 production without the results from the Hamburg wheel test on the trial batch.

If the Department-approved laboratory's sample from the trial batch fails the Hamburg wheel test, the Engineer will suspend production until further Hamburg wheel tests meet the specified values. The Engineer may require up to the entire sublot of any mixture failing the Hamburg wheel test be removed and replaced at the Contractor's expense.

4.4.2.2.9. **Approval of JMF3 and Subsequent JMF Changes**. JMF3 and subsequent JMF changes are approved if they meet the mixture requirements shown in Table 4 and Table 5, and the master gradation limits shown in Table 8, and they are within the operational tolerances of JMF2 shown in Table 11. The addition of a WMA additive to facilitate mixing or as a compaction aid does not require a new laboratory mixture design or trial batch. Current JMF changes that exceed the operational tolerances of JMF2 in accordance with Table 11 may require a new laboratory mixture design, trial batch, or both.

4.5. **Production Operations**. Perform a new trial batch when the plant or plant location is changed. All source changes for asphalt will require a passing Hamburg wheel test result from a laboratory listed on the MPL. The Contractor may proceed at their own risk with Lot 1 production without the results from the Hamburg wheel test on the trial batch. All aggregate source changes will require a new laboratory mixture design and trial batch. Take corrective action and receive approval to proceed after any production suspension for noncompliance with the specification. Submit a new mix design and perform a new trial batch when the asphalt binder content of:

- any RAP stockpile used in the mix is more than 0.5% higher than the value shown in the mixture design report, or
- RAS stockpile used in the mix is more than 2.0% higher than the value shown in the mixture design report.

4.5.1. **Storage and Heating of Materials**. Do not heat the asphalt binder above the temperatures specified in Item 300, or outside the manufacturer's recommended values. Provide the Engineer with daily records of asphalt binder and HMA discharge temperatures (in legible and discernible increments) in accordance with Item 320, unless otherwise directed. Do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr. unless otherwise approved.

4.5.2. **Mixing and Discharge of Materials.** Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed the maximum production temperatures shown in Table 12. The Department will not pay for or allow placement of any mixture produced above the maximum production temperatures shown in Table 12.

Table 12
Max Production Temperature

High-Temperature Binder Grade[1]	Max Production Temperature (°F)
PG 64	325[2]
PG 70	335[2]
PG 76	345[2]

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. The Max production temperature of WMA is 275°F.

Produce WMA within the target discharge temperature range of 215–275°F when WMA is required. Take corrective action anytime the discharge temperature of the WMA exceeds the target discharge range. The Engineer may suspend production operations if the Contractor's corrective action is not successful at controlling the production temperature within the target discharge range. Note that when WMA is produced, it may be necessary to adjust burners to ensure complete combustion such that no burner fuel residue remains in the mixture.

Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant. Determine the moisture content, if requested, by oven-drying in accordance with Tex-212-F, Part II, and verify that the mixture contains no more than 0.2% of moisture by weight. Obtain the sample immediately after discharging the mixture into the truck and perform the test promptly.

4.6. **Hauling Operations**. Clean all truck beds before use to ensure that mixture is not contaminated. Use a release agent listed on the MPL to coat the inside bed of the truck when necessary. Do not use diesel or any release agent not listed on the MPL.

Use equipment for hauling as defined in Section 341.4.7.3.3., "Hauling Equipment." Use other hauling equipment only when allowed.

4.7. **Placement Operations**. Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer approximately every hour, or as directed. Use a handheld thermal camera or infrared thermometer, when a thermal imaging system is not used, to measure and record the internal temperature of the mixture as discharged from the truck or material transfer device (MTD) before or as the mix enters the paver. Measure the mixture temperature at a minimum frequency of one per ten trucks, or as approved. Include an approximate station number or Global Positioning System coordinates of the location where the temperature was taken on each ticket. Ensure the mixture meets the temperature requirements shown in Table 12. Calculate the daily yield and cumulative yield for the specified lift and provide to the Engineer at the end of paving operations for each day unless otherwise directed. The Engineer may suspend production if the Contractor fails to produce and provide haul tickets and yield calculations by the end of paving operations for each day.

Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture and in accordance with Item P-101 Preparation/Removal of Existing Pavments. Remove vegetation from pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of hot mix by at least 6 in. Place mixture so that longitudinal joints on the surface course coincide within 6 in. of lane lines, are not placed in the wheel path, or will not be covered with pavement markings, or as directed. Ensure that all finished surfaces will drain properly. Place the mixture at the rate or thickness shown on the plans. The Engineer will use the guidelines shown in Table 13 to determine the compacted lift thickness of each layer when multiple lifts are required. The thickness determined is based on the rate of 110 lb. per square yard for each inch of pavement, unless otherwise shown on the plans.

Table 13
Compacted Lift Thickness and Required Core Height

Mixture Type	Compacted Lift Thickness Guidelines		Min Untrimmed Core Height Eligible for Testing (in.)
	Min (in.)	Max (in.)	
DG-B	2.50	5.00	1.75
DG-C	2.00	4.00	1.50
DG-D	1.50	3.00	1.25
DG-F	1.25	2.50	1.25

4.7.1. **Weather Conditions**.

4.7.1.1. **When Using a Thermal Imaging System**. Place mixture when the roadway surface is dry and the roadway surface temperature is at or above the temperatures shown in Table 14A, unless otherwise approved or as shown on the plans. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. Provide output data from the thermal imaging system to demonstrate to the Engineer that no recurring severe thermal segregation exists in accordance with Section 341.4.7.3.1.2., "Thermal Imaging System."

Table 14A
Min Pavement Surface Temperatures

High-Temperature Binder Grade[1]	Min Pavement Surface Temperatures (°F)	
	Subsurface Layers	Surface Layers
PG 64	35	40
PG 70	45[2]	50[2]
PG 76	45[2]	50[2]

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. The Contractor may pave at temperatures 10°F lower than these values when a chemical WMA additive is used as a compaction aid in the mixture or when using WMA.

4.7.1.2. **When Not Using a Thermal Imaging System**. When using a thermal camera instead of the thermal imaging system, place mixture when the roadway surface temperature is at or above the temperatures shown in Table 14B, unless otherwise approved or as shown on the plans. Measure the roadway surface temperature using a handheld thermal camera or infrared thermometer. The Engineer may allow mixture placement to begin before the roadway surface reaches the required temperature if conditions are such that the roadway surface will reach the required temperature within 2 hr. of beginning placement operations. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer.

Table 14B
Min Pavement Surface Temperatures

High-Temperature Binder Grade[1]	Min Pavement Surface Temperatures (°F)	
	Subsurface Layers	Surface Layers
PG 64	45	50
PG 70	55[2]	60[2]
PG 76	60[2]	60[2]

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. The Contractor may pave at temperatures 10°F lower than these values when a chemical WMA additive is used as a compaction aid in the mixture, when using WMA, or when using a paving process with equipment that eliminates thermal segregation. In such cases, for each sublot and in the presence of the Engineer, use a handheld thermal camera operated in accordance with Tex-244-F to demonstrate to the satisfaction of the Engineer that the uncompacted mat has no more than 10°F of thermal segregation.

4.7.2. **Tack Coat**.

4.7.2.1. **Application.** Clean the surface before placing the tack coat. The Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area. Apply a uniform tack coat at the specified rate unless otherwise directed. Apply the tack coat in a uniform manner to avoid streaks and other irregular patterns. Apply the tack coat to all surfaces that will come in contact with the subsequent HMA placement, unless otherwise directed. Apply adequate overlap of the tack coat in the longitudinal direction during placement of the mat to ensure bond of adjacent mats, unless otherwise directed. Allow adequate time for emulsion to break completely before placing any material. Prevent splattering of tack coat when placed adjacent to curb, gutter, and structures. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use, unless required in conformance with the manufacturer's recommendation for approved TRAIL product use, or when shown on the plans.

4.7.2.2. **Sampling.** The Engineer will obtain at least one sample of the tack coat binder per project per source in accordance with Tex-500-C, Part III, and test it to verify compliance with Item 300. The Engineer will notify the Contractor when the sampling will occur and will witness the collection of the sample from the asphalt distributor immediately before use. Label the can with the corresponding lot and sublot numbers, producer,

producer facility location, grade, district, date sampled, all applicable bills of lading (if available), and project information, including highway and control-section-job (CSJ) number. For emulsions, the Engineer may test as often as necessary to ensure the residual of the emulsion is greater than or equal to the specification requirement in Item 300.

4.7.3. **Lay-Down Operations**. Use the placement temperatures shown in Table 15 to establish the minimum placement temperature of the mixture delivered to the paving operation.

Table 15
Min Mixture Placement Temperature

High-Temperature Binder Grade[1]	Min Placement Temperature[2,3,4] (°F)
PG 64	260
PG 70	270
PG 76	280

1. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
2. The mixture temperature must be measured using a handheld thermal camera or infrared thermometer immediately before entering MTD or paver.
3. Min placement temperatures may be reduced 20°F if using a chemical WMA additive as a compaction aid, MTD with remixing capabilities, or paver hopper insert with remixing capabilities.
4. When using WMA, the minimum placement temperature is 215°F.

4.7.3.1. **Thermal Profile**. Use a handheld thermal camera or a thermal imaging system to obtain a continuous thermal profile in accordance with Tex-244-F. Thermal profiles are not applicable in areas described in Section 341.4.9.3.1.4., "Miscellaneous Areas."

4.7.3.1.1. **Thermal Segregation**.

4.7.3.1.1.1. **Moderate**. Any areas that have a temperature differential greater than 25°F, but not exceeding 50°F.

4.7.3.1.1.2. **Severe**. Any areas that have a temperature differential greater than 50°F.

4.7.3.1.2. **Thermal Imaging System**. Review the output results when a thermal imaging system is used, and provide the automated report described in Tex-244-F to the Engineer daily, unless otherwise directed. Modify the paving process as necessary to eliminate any recurring (moderate or severe) thermal segregation identified by the thermal imaging system.

The Engineer may suspend paving operations if the Contractor cannot successfully modify the paving process to eliminate recurring severe thermal segregation. Density profiles are not required and not applicable when using a thermal imaging system.

Provide the Engineer with electronic copies of all daily data files that can be used with the thermal imaging system software to generate temperature profile plots daily or as requested.

4.7.3.1.3. **Thermal Camera**. Provide the Engineer with the thermal profile of every sublot within 1 working day of the completion of each lot. When requested by the Engineer, provide the thermal images generated using the thermal camera. Report the results of each thermal profile in accordance with Section 341.4.2., "Reporting and Responsibilities." The Engineer will use a handheld thermal camera to obtain a thermal profile at least once per project.

Take immediate corrective action to eliminate recurring moderate thermal segregation when a handheld thermal camera is used.

Suspend operations and take immediate corrective action to eliminate severe thermal segregation unless otherwise directed. Resume operations when the Engineer determines that subsequent production will meet the requirements of this Section. No production or placement payment adjustments greater than 1.000 will be paid for any sublot that contains severe thermal segregation. Evaluate areas with severe thermal segregation by performing density profiles in accordance with Section 341.4.9.3.3.3., "Segregation (Density Profile)." Remove and replace the material in any areas that have severe thermal segregation and a failing result for segregation (density profile), unless otherwise directed. The sublot in question may receive a production and placement payment adjustment greater than 1.000, if applicable, when the defective material is successfully removed and replaced.

4.7.3.2. **Windrow Operations**. Operate windrow pickup equipment so that when hot mix is placed in windrows, substantially all the mixture deposited on the roadbed is picked up and loaded into the paver.

4.7.3.3. **Hauling Equipment**. Use belly dump, live-bottom, or end dump trucks to haul and transfer mixture. Except for paving miscellaneous areas, end dump trucks are allowed only when used in conjunction with an MTD with remixing capability or when a thermal imaging system is used, unless otherwise approved.

4.7.3.4. **Screed Heaters**. Turn off screed heaters to prevent overheating of the mat if the paver stops for more than 5 min. The Engineer may evaluate the suspect area in accordance with Section 341.4.9.3.3.5., "Recovered Asphalt Dynamic Shear Rheometer (DSR)," if the screed heater remains on for more than 5 min. while the paver is stopped.

4.8. **Compaction**. Compact the pavement uniformly to contain between 3.8% and 8.5% in-place air voids. Take immediate corrective action to bring the operation within 3.8% and 8.5% when the in-place air voids exceed the range of these tolerances. The Engineer will allow paving to resume when the proposed corrective action is likely to yield between 3.8% and 8.5% in-place air voids.

Obtain cores in areas placed under exempt production, as directed, at locations determined by the Engineer. The Engineer may test these cores and suspend operations or require removal and replacement if the in-place air voids are less than 2.7% or more than 9.9%. Areas defined in Section 341.4.9.3.1.4., "Miscellaneous Areas," are not subject to in-place air void determination.

Furnish the type, size, and number of rollers necessary to ensure desired compaction. Use additional rollers as required to remove any roller marks. Use only water or an approved release agent on rollers, tamps, and other compaction equipment unless otherwise directed.

Use the control strip method shown in Tex-207-F, Part IV, on the first day of production to establish the rolling pattern that will produce the desired in-place air voids, unless otherwise directed.

Use tamps to thoroughly compact the edges of the pavement along curbs, headers, and similar structures and in locations that will not allow thorough compaction using rollers. The Engineer may require rolling using a trench roller on widened areas, in trenches, and in other limited areas.

Complete all compaction operations using breakdown rollers before the pavement temperature drops below 180°F, unless otherwise allowed. Compaction using a pneumatic or light finish roller operated in static mode is allowed for pavement temperatures above 160°F.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic, unless otherwise directed. Sprinkle the finished mat with water or limewater, when directed, to expedite opening the roadway to traffic.

4.9. **Acceptance Plan**. Payment adjustments for the material will be in accordance with Article 341.6., "Payment."

Sample and test the hot mix on a lot and sublot basis. Suspend production if the production payment factor shown in Section 341.6.1., "Production Payment Adjustment Factors," or the placement payment factor shown in Section 341.6.2., "Placement Payment Adjustment Factors," for two consecutive lots is below

1.000. Resume production once test results or other information indicates to the satisfaction of the Engineer that the next material produced or placed will result in payment factors of at least 1.000.

4.9.1. **Referee Testing**. The Materials and Tests Division is the referee laboratory. The Contractor may request referee testing if a "remove and replace" condition is determined based on the Engineer's test results, or if the differences between Contractor and Engineer test results exceed the maximum allowable difference in accordance with Table 11 and the differences cannot be resolved. The Contractor may also request referee testing if the Engineer's test results require suspension of production and the Contractor's test results are within specification limits. Make the request within 5 working days after receiving test results and cores from the Engineer. Referee tests will be performed only on the sublot in question and only for the tests in question. Allow 10 working days from the time the referee laboratory receives the samples for test results to be reported. The Department may require the Contractor to reimburse the Department for referee tests if more than three referee tests per project are required and the Engineer's test results are closer to the referee test results than the Contractor's test results.

The Materials and Tests Division will determine the laboratory-molded density based on the molded specific gravity and the maximum theoretical specific gravity of the referee sample. The in-place air voids will be determined based on the bulk specific gravity of the cores, as determined by the referee laboratory, and the Engineer's average maximum theoretical specific gravity for the lot. Except for "remove and replace" conditions, referee test results are final and will establish payment adjustment factors for the sublot in question. The Contractor may decline referee testing and accept the Engineer's test results when the placement payment adjustment factor for any sublot results in a "remove and replace" condition. Placement sublots subject to be removed and replaced will be further evaluated in accordance with Section 341.6.2.2., "Placement Sublots Subject to Removal and Replacement."

4.9.2. **Production Acceptance**.

4.9.2.1. **Production Lot**. A production lot consists of four equal sublots. The default quantity for Lot 1 is 1,000 ton; however, when requested by the Contractor, the Engineer may increase the quantity for Lot 1 to no more than 4,000 ton. The Engineer will select subsequent lot sizes based on the anticipated daily production such that approximately three–four sublots are produced each day. The lot size will be between 1,000 ton and 4,000 ton. The Engineer may change the lot size before the Contractor begins any lot.

If the optimum asphalt binder content for JMF2 is more than 0.5% lower than the optimum asphalt binder content for JMF1, the Engineer may perform or require the Contractor to perform Tex-226-F on Lot 1 to confirm the indirect tensile strength does not exceed 200 psi. Take corrective action to bring the mixture within specification compliance if the indirect tensile strength exceeds 200 psi, unless otherwise directed.

4.9.2.1.1. **Incomplete Production Lots**. If a lot is begun but cannot be completed, such as on the last day of production or in other circumstances deemed appropriate, the Engineer may close the lot. Adjust the payment for the incomplete lot in accordance with Section 341.6.1., "Production Payment Adjustment Factors." Close all lots within 5 working days unless otherwise allowed.

4.9.2.2. **Production Sampling**.

4.9.2.2.1. **Mixture Sampling**. The Engineer will perform or witness the sampling of production sublots from trucks at the plant in accordance with Tex-222-F The sampler will split each sample into three equal portions in accordance with Tex-200-F and label these portions as "Contractor," "Engineer," and "Referee." The Engineer will perform or witness the sample splitting and take immediate possession of the samples labeled "Engineer" and "Referee." The Engineer will maintain the custody of the samples labeled "Engineer" and "Referee" until the Department's testing is completed.

4.9.2.2.1.1. **Random Sample**. At the beginning of the project, the Engineer will select random numbers for all production sublots. Determine sample locations in accordance with Tex-225-F. Take one sample for each sublot at the randomly selected location. The Engineer will perform or witness the sampling of production sublots.

4.9.2.2.1.2. **Blind Sample**. For one sublot per lot, the Engineer will sample, split, and test a "blind" production sample instead of the random sample collected by the Contractor. The location of the Engineer's "blind" sample will not be disclosed to the Contractor before sampling. The Engineer's "blind" sample may be randomly selected in accordance with Tex-225-F for any sublot or selected at the discretion of the Engineer. The Engineer may sample and test an additional blind sample when the random sampling process does not result in obtaining a sample.

For one sublot per lot, the Contractor must obtain from the Engineer a "blind" production sample collected by the Engineer. If desired, the Contractor may witness the collection of blind samples. Test either the "blind" or the random sample; however, referee testing for the sublot (if applicable) will be based on a comparison of results from the "blind" sample.

4.9.2.2.2. **Asphalt Binder Sampling**. The Engineer will witness the Contractor obtain a 1-qt. sample of the asphalt binder for each lot of mixture produced. The Contractor will notify the Engineer when the sampling will occur. Obtain the sample at approximately the same time the mixture random sample is obtained. Sample from a port located immediately upstream from the mixing drum or pug mill and upstream from the introduction of any additives in accordance with Tex-500-C, Part II. Label the can with the corresponding lot and sublot numbers, producer name, producer facility, grade, District, date sampled, all applicable bills of lading (if available), and project information, including highway and CSJ number. The Engineer will retain these samples for 1 yr. The Engineer may also obtain independent samples. If obtaining an independent asphalt binder sample and upon request of the Contractor, the Engineer will split a sample of the asphalt binder with the Contractor.

At least once per project, the Engineer will collect split samples of each binder grade and source used. The Engineer will submit one split sample to the Materials and Tests Division to verify compliance with Item 300, and will retain the other split sample for 1 yr.

4.9.2.3. **Production Testing**. The Contractor and Engineer must perform production tests shown in Table 16. The Contractor has the option to verify the Engineer's test results on split samples provided by the Engineer. Determine compliance with operational tolerances shown in Table 11 for all sublots.

Take immediate corrective action if the Engineer's laboratory-molded density on any sublot is less than 95.0% or greater than 97.0% to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractor's corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

The Engineer may allow alternate methods for determining the asphalt binder content and aggregate gradation if the aggregate mineralogy is such that Tex-236-F, Part I does not yield reliable results. Provide evidence that results from Tex-236-F, Part I are not reliable before requesting permission to use an alternate method unless otherwise directed. Use the applicable test procedure as directed if an alternate test method is allowed.

Table 16
Production and Placement Testing Frequency

Description	Test Method	Min Contractor Testing Frequency	Min Engineer Testing Frequency
Individual % retained on #8 sieve and larger	Tex-200-F or Tex-236-F	1 per sublot	1 per 12 sublots[1]
Individual % retained on sieves smaller than #8 and larger than #200			
% passing #200 sieve			
Laboratory-molded density	Tex-207-F	–	1 per sublot[1]
Laboratory-molded bulk specific gravity			
In-place air voids			
VMA	Tex-204-F		
Segregation (density profile)	Tex-207-F, Part V	1 per sublot[2]	1 per project
Longitudinal joint density	Tex-207-F, Part VII	1 per sublot[3]	1 per project
Moisture content	Tex-212-F, Part II	When directed	1 per project
Theoretical maximum specific (Rice) gravity	Tex-227-F	–	1 per sublot[1]
Asphalt binder content	Tex-236-F	1 per sublot	1 per lot[1]
Thermal profile	Tex-244-F	1 per sublot[2]	1 per project
Hamburg wheel test	Tex-242-F	–	
Deleterious in RAS[4]	Tex-217-F, Part III	–	
Asphalt binder sampling and testing[4,5]	Tex-500-C, Part II	–	
Tack coat sampling and testing	Tex-500-C, Part III	–	
Boil test[6]	Tex-530-C	1 per lot	
Shear bond strength test[7]	Tex-249-F	–	

1. For production defined in Section 341.4.9.4., "Exempt Production," the Engineer will perform one test per day if 100 ton or more is produced. For exempt production, no testing is required when < 100 ton is produced.
2. To be performed in the presence of the Engineer when not using the thermal imaging system, unless otherwise approved.
3. To be performed in the presence of the Engineer.
4. Testing performed by the Materials and Tests Division or designated laboratory.
5. Sampling performed by the Contractor. The Engineer will witness sampling and retain the samples for 1 yr.
6. When shown on the plans.
7. Testing performed by the Materials and Tests Division or District for informational purposes on a sample obtained by the Contractor within the first four lots of the project.

4.9.2.4. **Operational Tolerances**. Control the production process within the operational tolerances shown in Table 11. When production is suspended, the Engineer will allow production to resume when test results or other information indicates the next mixture produced will be within the operational tolerances.

4.9.2.4.1. **Gradation**. Suspend operation and take corrective action if any aggregate is retained on the maximum sieve size shown in Table 8. A sublot is defined as out of tolerance if either the Engineer's or the Contractor's test results are out of operational tolerance. Suspend production when test results for gradation exceed the operational tolerances shown in Table 11 for three consecutive sublots on the same sieve or four consecutive sublots on any sieve, unless otherwise directed. The consecutive sublots may be from more than one lot.

4.9.2.4.2. **Asphalt Binder Content**. A sublot is defined as out of operational tolerance if either the Engineer's or the Contractor's test results exceed the values shown in Table 11. No production or placement payment adjustments greater than 1.000 will be paid for any sublot that is out of operational tolerance for asphalt binder content. Suspend production and shipment of the mixture if the Engineer's or the Contractor's asphalt binder content deviates from the current JMF by more than 0.5% for any sublot.

4.9.2.4.3. **VMAs**. The Engineer will determine the VMA for every sublot. For sublots when the Engineer does not determine asphalt binder content, the Engineer will use the asphalt binder content results from QC testing performed by the Contractor to determine VMA.

Take immediate corrective action if the VMA value for any sublot is less than the minimum VMA requirement for production shown in Table 8. Suspend production and shipment of the mixture if the Engineer's VMA results on two consecutive sublots are below the minimum VMA requirement for production shown in Table 8. No production or placement payment adjustments greater than 1.000 will be paid for any sublot that does not meet the minimum VMA requirement for production shown in Table 8 based on the Engineer's VMA determination.

Suspend production and shipment of the mixture if the Engineer's VMA result is more than 0.5% below the minimum VMA requirement for production shown in Table 8. In addition to suspending production, the Engineer may require removal and replacement or may allow the sublot to be left in place without payment.

4.9.2.4.4. **Hamburg Wheel Test**. The Engineer may perform a Hamburg wheel test on plant-produced mixture anytime during production. Suspend production until further Hamburg wheel tests meet the specified values when the production samples fail the Hamburg wheel test criteria shown in Table 10. The Engineer may require up to the entire sublot of any mixture failing the Hamburg wheel test to be removed and replaced at the Contractor's expense.

If the Department-approved laboratory's Hamburg wheel test on plant-produced mixture results in a "remove and replace" condition, the Contractor may request that the Materials and Tests Division determine the final disposition of the material in question by re-testing the failing material.

4.9.2.5. **Individual Loads of Hot Mix**. The Engineer may reject individual truckloads of hot mix. When a load of hot mix is rejected for reasons other than temperature, contamination, or excessive uncoated particles, the Contractor may request that the rejected load be tested. Make this request within 4 hr. of rejection. The Engineer will sample and test the mixture. If test results are within the operational tolerances shown in Table 11, payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load.

4.9.3. **Placement Acceptance**.

4.9.3.1. **Placement Lot**. A placement lot consists of four placement sublots. A placement sublot consists of the area placed during a production sublot.

4.9.3.1.1. **Lot 1 Placement**. Placement payment adjustments greater than 1.000 for Lot 1 will be in accordance with Section 341.6.2., "Placement Payment Adjustment Factors"; however, no placement adjustment less than 1.000 will be assessed for any sublot placed in Lot 1 when the in-place air voids are greater than or equal to 2.7% and less than or equal to 9.9%. Remove and replace any sublot with in-place air voids less than 2.7% or greater than 9.9%.

4.9.3.1.2. **Incomplete Placement Lots**. An incomplete placement lot consists of the area placed as described in Section 341.4.9.2.1.1., "Incomplete Production Lots," excluding areas defined in Section 341.4.9.3.1.4., "Miscellaneous Areas." Placement sampling is required if the random sample plan for production resulted in a sample being obtained from an incomplete production sublot.

4.9.3.1.3. **Shoulders, Ramps, Etc**. Shoulders, ramps, intersections, acceleration lanes, deceleration lanes, and turn lanes are subject to in-place air void determination and payment adjustments unless shown on the plans as not eligible for in-place air void determination. Intersections may be considered miscellaneous areas when determined by the Engineer.

4.9.3.1.4. **Miscellaneous Areas**. Miscellaneous areas include areas that typically involve significant handwork or discontinuous paving operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, spot level-up areas, pavement repair sections less than 300 ft., and other similar areas. Temporary detours are subject to in-place air void determination when shown on the plans. Miscellaneous areas also include level-ups and thin overlays when the layer thickness shown on the plans is less than the minimum untrimmed core height eligible for testing in accordance with Table 13. The specified layer thickness is based

on the rate of 110 lb. per square yard for each inch of pavement unless another rate is shown on the plans. When "Level Up" is listed as part of the bid item description, a payment adjustment factor of 1.000 will be assigned for all placement sublots as described in Article 341.6., "Payment." Miscellaneous areas are not eligible for random placement sampling locations. Compact miscellaneous areas in accordance with Section 341.4.8., "Compaction." Miscellaneous areas are not subject to in-place air void determination, thermal profiles testing, segregation (density profiles), or longitudinal joint density evaluations.

4.9.3.2. **Placement Sampling**. The Engineer will select random numbers for all placement sublots at the beginning of the project. The Engineer will provide the Contractor with the placement random numbers only immediately after the sublot is completed. Mark the roadway location at the completion of each sublot and record the station number. Determine one random sample location for each placement sublot in accordance with Tex-225-F. Adjust the random sample location by no more than necessary to achieve a 2-ft. clearance if the location is within 2 ft. of a joint or pavement edge.

Shoulders, ramps, intersections, acceleration lanes, deceleration lanes, and turn lanes are always eligible for selection as a random sample location; however, if a random sample location falls on one of these areas and the area is shown on the plans as not subject to in-place air void determination, cores will not be taken for the sublot and a 1.000 pay factor will be assigned to that sublot.

Provide the equipment and means to obtain and trim roadway cores onsite. Onsite is defined as in close proximity to where the cores are taken. Obtain the cores within 1 working day of the time the placement sublot is completed, unless otherwise approved. Obtain two 6-in. diameter cores side-by-side from within 1 ft. of the random location provided for the placement sublot. Mark the cores for identification, measure and record the untrimmed core height, and provide the information to the Engineer. The Engineer will witness the coring operation and measurement of the core thickness. Visually inspect each core and verify that the current paving layer is bonded to the underlying layer. Take corrective action if an adequate bond does not exist between the current and underlying layer to ensure that an adequate bond will be achieved during subsequent placement operations.

Trim the cores immediately after obtaining them from the roadway in accordance with Tex-251-F if the core heights meet the minimum untrimmed value in accordance with Table 13. Trim the cores onsite in the presence of the Engineer. Use a permanent marker or paint pen to record the lot and sublot numbers on each core, as well as the designation as Core A or Core B. The Engineer may require additional information to be marked on the core and may choose to sign or initial the core. The Engineer will take custody of the cores immediately after witnessing the trimming of the cores and will retain custody of the cores until the Department's testing is completed. Before turning the trimmed cores over to the Engineer, the Contractor may wrap the trimmed cores or secure them in a manner that will reduce the risk of possible damage occurring during transport by the Engineer. After testing, the Engineer will return the cores to the Contractor.

The Engineer may have the cores transported back to the Department's laboratory at the HMA plant via the Contractor's haul truck or other designated vehicle. In such cases where the cores will be out of the Engineer's possession during transport, the Engineer will use Department-provided security bags and the Protocol for Roadway Core Custody located on the Department's website to provide a secure means and process that protect the integrity of the cores during transport.

Decide whether to include the pair of cores in the air void determination for that sublot if the core height before trimming is less than the minimum untrimmed value shown in Table 13. Trim the cores in accordance with Tex-251-F before delivering to the Engineer if electing to have the cores included in the air void determination. If electing to not have the cores included in air void determination, inform the Engineer of the decision, and deliver untrimmed cores to the Engineer. The placement pay factor for the sublot will be 1.000 if cores will not be included in air void determination.

Instead of the Contractor trimming the cores onsite immediately after coring, the Engineer and the Contractor may mutually agree to have the trimming operations performed at an alternate location, such as a field laboratory or other similar location. In such cases, the Engineer will take possession of the cores immediately

after they are obtained from the roadway and will retain custody of the cores until testing is completed. Either the Department or Contractor representative may perform trimming of the cores. The Engineer will witness all trimming operations in cases where the Contractor representative performs the trimming operation.

Dry the core holes and tack the sides and bottom immediately after obtaining the cores. Fill the hole with the same type of mixture and properly compact the mixture. Repair core holes using other methods when approved.

4.9.3.3. **Placement Testing**. Perform placement tests in accordance with Table 16. After the Engineer returns the cores, the Contractor may test the cores to verify the Engineer's test results for in-place air voids. The allowable differences between the Contractor's and Engineer's test results are shown in Table 11.

4.9.3.3.1. **In-Place Air Voids**. The Engineer will measure in-place air voids in accordance with Tex-207-F and Tex-227-F. Before drying to a constant weight, cores may be pre-dried using a CoreDry or similar vacuum device to remove excess moisture. The Engineer will average the values obtained for all sublots in the production lot to determine the theoretical maximum specific gravity. The Engineer will use the average air void content for in-place air voids.

The Engineer will use the vacuum method to seal the core if required in accordance with Tex-207-F. The Engineer will use the test results from the unsealed core to determine the placement payment adjustment factor if the sealed core yields a higher specific gravity than the unsealed core. After determining the in-place air void content, the Engineer will return the cores and provide test results to the Contractor.

4.9.3.3.2. **Informational Shear Bond Strength Testing**. The Engineer will select one random sublot within the first four lots of the project for shear bond strength testing. Obtain full-depth cores in accordance with Tex-249-F unless the HMA is being placed directly on concrete pavement. Label the cores with lot and sublot numbers and provide to the Engineer. Inspector must use pertinent Department form to document the CSJ number, producer of the tack coat, mix type, and shot rate. The Engineer will ship the cores to the Materials and Tests Division or District laboratory for shear bond strength testing. Results from these tests will not be used for specification compliance.

4.9.3.3.3. **Segregation (Density Profile)**. Test for segregation using density profiles in accordance with Tex-207-F, Part V. Density profiles are not required and are not applicable when using a thermal imaging system. Density profiles are not applicable in areas described in Section 341.4.9.3.1.4., "Miscellaneous Areas."

Perform at least one density profile per sublot. Perform additional density profiles when any of the following conditions occur, unless otherwise approved:

- areas that are identified by either the Contractor or the Engineer with severe thermal segregation,
- any visibly segregated areas that exist,
- the paver stops due to lack of material being delivered to the paving operations and the temperature of the uncompacted mat before the initial breakdown rolling is less than the temperatures shown in Table 17.

Table 17
Min Uncompacted Mat Temperature Requiring Segregation Profile[1]

High-Temperature Binder Grade[2]	Min Temperature of Uncompacted Mat Allowed Before Initial Breakdown Rolling[3,4,5] (°F)
PG 64	<250
PG 70	<260
PG 76	<270

1. Applicable only to paver stops that occur due to lack of material being delivered to the paving operations and when not using a thermal imaging system.
2. The high-temperature binder grade refers to the high-temperature grade of the virgin asphalt binder used to produce the mixture.
3. The surface of the uncompacted mat must be measured using a handheld thermal camera or infrared thermometer.
4. Min uncompacted mat temperature requiring a segregation profile may be reduced 20°F if using a chemical WMA additive as a compaction aid, MTD with remixing capabilities, or paver hopper insert with remixing capabilities.
5. When using WMA, the Min uncompacted mat temperature requiring a segregation profile is 215°F.

Provide the Engineer with the density profile of every sublot in the lot within 1 working day of the completion of each lot. Report the results of each density profile in accordance with Section 341.4.2., "Reporting and Responsibilities."

The density profile is considered failing if it exceeds the tolerances shown in Table 18. When a thermal imaging system is not used, the Engineer will measure the density profile at least once per project. The Engineer's density profile results will be used when available. The Engineer may require the Contractor to remove and replace the area in question if the area fails the density profile and has surface irregularities as defined in Section 341.4.9.3.3.6., "Irregularities." The sublot in question may receive a production and placement payment adjustment greater than 1.000, if applicable, when the defective material is successfully removed and replaced.

Investigate density profile failures and take corrective actions during production and placement to eliminate the segregation. Suspend production if two consecutive density profiles fail unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

Table 18
Segregation (Density Profile) Acceptance Criteria

Mixture Type	Max Allowable Density Range (highest to lowest, pcf)	Max Allowable Density Range (average to lowest, pcf)
DG-B	8.0	5.0
DG-C, DG-D, and DG-F	6.0	3.0

4.9.3.3.4. **Longitudinal Joint Density**.

4.9.3.3.4.1. **Informational Tests**. Perform joint density evaluations while establishing the rolling pattern and verify that the joint density is no more than 3.0 pcf below the density taken at or near the center of the mat. Adjust the rolling pattern, if needed, to achieve the desired joint density. Perform additional joint density evaluations, at least once per sublot, unless otherwise directed.

4.9.3.3.4.2. **Record Tests**. Perform a joint density evaluation for each sublot at each pavement edge that is or will become a longitudinal joint. Joint density evaluations are not applicable in areas described in Section 341.4.9.3.1.4., "Miscellaneous Areas." Determine the joint density in accordance with Tex-207-F, Part VII. Record the joint density information and submit results on Department forms to the Engineer. The evaluation is considered failing if the joint density is more than 3.0 pcf below the density taken at the core random sample location and

the correlated joint density is less than 90.0%. The Engineer will make independent joint density verification at least once per project and may make independent joint density verifications at the random sample locations. The Engineer's joint density test results will be used when available.

Provide the Engineer with the joint density of every sublot in the lot within 1 working day of the completion of each lot. Report the results of each joint density in accordance with Section 341.4.2., "Reporting and Responsibilities."

Investigate joint density failures and take corrective actions during production and placement to improve the joint density. Suspend production if the evaluations on two consecutive sublots fail, unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

4.9.3.3.5. **Recovered Asphalt Dynamic Shear Rheometer (DSR)**. The Engineer may take production samples or cores from suspect areas of the project to determine recovered asphalt properties. Asphalt binders with an aging ratio greater than 3.5 do not meet the requirements for recovered asphalt properties and may be deemed defective when tested and evaluated by the Materials and Tests Division. The aging ratio is the DSR value of the extracted binder divided by the DSR value of the original unaged binder. Obtain DSR values in accordance with AASHTO T 315 at the specified high-temperature PG of the asphalt. The Engineer may require removal and replacement of the defective material at the Contractor's expense. The asphalt binder will be recovered for testing from production samples or cores in accordance with Tex-211-F.

4.9.3.3.6. **Irregularities**. Identify and correct irregularities, including segregation, rutting, raveling, flushing, fat spots, mat slippage, irregular color, irregular texture, roller marks, tears, gouges, streaks, uncoated aggregate particles, or broken aggregate particles. The Engineer may also identify irregularities, and in such cases, the Engineer will promptly notify the Contractor. If the Engineer determines that the irregularity will adversely affect pavement performance, the Engineer may require the Contractor to remove and replace (at the Contractor's expense) areas of the pavement that contain irregularities. The Engineer may also require the Contractor to remove and replace (at the Contractor's expense) areas where the mixture does not bond to the existing pavement.

If irregularities are detected, the Engineer may require the Contractor to immediately suspend operations or may allow the Contractor to continue operations for no more than 1 day while the Contractor is taking appropriate corrective action.

4.9.4. **Exempt Production**. The mixture may be deemed as exempt production when mutually agreed upon between the Engineer and the Contractor, or when shown on the plans. Exempt production may be used for the following conditions.

- Anticipated daily production is less than 500 ton.
- Total production for the project is less than 5,000 ton.
- Pavement repair sections are equal to or greater than 300 ft. For pavement repair sections less than 300 ft., refer to Section 341.4.9.3.1.4., "Miscellaneous Areas."

Exempt production is not eligible for referee testing. For exempt production, the Contractor is relieved of all production and placement QC and QA sampling and testing requirements, except for coring operations when required by the Engineer. When mutually agreed upon between the Engineer and the Contractor, production sampling will be allowed at the point of delivery. When 100 ton or more per day is produced, the Engineer must perform acceptance tests for production and placement in accordance with Table 16. If the specification requirements listed below are met, the production and placement pay factors are 1.000:

- produce, haul, place, and compact the mixture in compliance with the specification and as directed;
- control mixture production to yield a laboratory-molded density that is within ±1.0% of the target laboratory-molded density as tested by the Engineer;
- compact the mixture in accordance with Section 341.4.8., "Compaction;"

- when a thermal imaging system is not used, the Engineer may perform segregation (density profiles) and thermal profiles in accordance with the specification; and
- all other specification requirements.

4.9.5. **Ride Quality**. ~~Measure ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.~~ **The Contractor shall perform smoothness testing in transverse and longitudinal directions daily to verify that the construction processes are producing pavement with variances less than ¼ inch in 12 feet, identifying areas that may pond water which could lead to hydroplaning of aircraft. If the smoothness criteria is not met, appropriate changes and corrections to the construction process shall be made by the Contractor before construction continues.**

The Contractor may use a 12-foot (3.7 m) "straightedge, a rolling inclinometer meeting the requirements of ASTM E2133 or rolling external reference device that can simulate a 12-foot (3.7m) straightedge approved by the RPR. Straight-edge testing shall start with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. Testing shall be continuous across all joints. The surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between the two high points. If the rolling inclinometer or external reference device is used, the data may be evaluated using either the FAA profile program, ProFAA, or FHWA ProVal, using the 12-foot straightedge simulation function.

Smoothness readings shall not be made across grade changes or cross slope transitions. The transition between new and existing pavement shall be evaluated separately for conformance with the plans.

(1) Transverse measurements. Transverse measurements shall be taken for each day's production placed. Transverse measurements shall be taken perpendicular to the pavement centerline each 50 feet (15 m) or more often as determined by the RPR. The joint between lanes shall be tested separately to facilitate smoothness between lanes.

(2) Longitudinal measurements. Longitudinal measurements shall be taken for each day's production placed. Longitudinal tests shall be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet (6 m); and at the third points of paving lanes when widths of paving lanes are 20 ft (6 m) or greater. When placement abuts previously placed material the first measurement shall start with one half the length of the straight edge on the previously placed material.

Deviations on the final surface course in either the transverse or longitudinal direction that will trap water greater than 1/4 inch (6 mm) shall be corrected with diamond grinding per paragraph 401-4.16 or by removing and replacing the surface course to full depth. Grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. All areas in which diamond grinding has been performed shall be subject to the final pavement thickness tolerances specified in paragraph 401-6.1d(3). Areas that have been ground shall be sealed with a surface treatment in accordance with Item P-608. To avoid the surface treatment creating any conflict with runway or taxiway markings, it may be necessary to seal a larger area.

Control charts shall be kept to show area of each day's placement and the percentage of corrective grinding required. Corrections to production and placement shall be initiated when corrective grinding is required. If the Contractor's machines and/or methods produce significant areas that need corrective actions in excess of 10 percent of a day's production, production shall be stopped until corrective measures are implemented by the Contractor.

5. MEASUREMENT

5.1. **Dense-Graded HMA**. Hot mix will be measured by the ton of composite hot mix, which includes asphalt, aggregate, and additives. Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment."

~~5.2.~~ **Tack Coat**. Tack coat will be measured **by the square yard and paid separately.** ~~at the applied temperature by strapping the tank before and after road application and determining the net volume in gallons from the calibrated distributor. The Engineer will witness all strapping operations for volume determination. All tack, including emulsions, will be measured by the gallon applied.~~

The Engineer may allow the use of a metering device to determine asphalt volume used and application rate if the device is accurate within 1.5% of the strapped volume.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under Section 341.5.1., "Dense-Graded HMA," will be paid for at the unit price bid for "~~Dense-Graded Hot-Mix Asphalt~~ TX-341a Hot Mix Asphalt Surface Course (Taxiways), TX-341b Hot Mix Asphalt Surface Course (Runway) and TX-341c Hot Mix Asphalt Surface Course (Apron) " of the mixture type, SAC, and binder specified. These prices are full compensation for surface preparation, materials, placement, equipment, labor, tools, and incidentals.

The work performed and materials furnished in accordance with this Item and measured as provided under Section 341.5.2., "Tack Coat," will be paid for at the unit price bid for "Tack Coat" ~~of the tack coat provided~~. These prices are full compensation for materials, placement, equipment, labor, tools, and incidentals. Payment adjustments will be applied as determined in accordance with this Item; however, a payment adjustment factor of 1.000 will be assigned for all placement sublots for level-ups only when "Level Up" is listed as part of the bid item description. A payment adjustment factor of 1.000 will be assigned to all production and placement sublots when "Exempt" is listed as part of the bid item description, and all testing requirements are met.

Payment for each sublot, including applicable payment adjustments greater than 1.000, will be paid only for sublots when the Contractor supplies the Engineer with the required documentation for production and placement QC and QA, thermal profiles, segregation density profiles, and longitudinal joint densities in accordance with Section 341.4.2., "Reporting and Responsibilities." When a thermal imaging system is used, documentation is not required for segregation density profiles on individual sublots; however, the thermal imaging system automated reports described in Tex-244-F are required.

Trial batches will not be paid for unless they are included in pavement work approved by the Department.

Payment adjustment for ride quality will be determined in accordance with Item 585.

6.1. **Production Payment Adjustment Factors**. The production payment adjustment factor is based on the laboratory-molded density using the Engineer's test results. The bulk specific gravities of the samples from each sublot will be divided by the Engineer's maximum theoretical specific gravity for the sublot. The individual sample densities for the sublot will be averaged to determine the production payment adjustment factor in accordance with Table 19 for each sublot, using the deviation from the target laboratory-molded density in accordance with Table 9. The production payment adjustment factor for completed lots will be the average of the payment adjustment factors for the four sublots sampled within that lot.

Table 19
Production Payment Adjustment Factors for Laboratory-Molded Density[1]

Absolute Deviation from Target Laboratory-Molded Density	Production Payment Adjustment Factor (Target Laboratory-Molded Density)
0.0	1.050
0.1	1.050
0.2	1.050
0.3	1.044
0.4	1.038
0.5	1.031
0.6	1.025
0.7	1.019
0.8	1.013
0.9	1.006
1.0	1.000
1.1	0.965
1.2	0.930
1.3	0.895
1.4	0.860
1.5	0.825
1.6	0.790
1.7	0.755
1.8	0.720
>1.8	Remove and replace

1. If the Engineer's laboratory-molded density on any sublot is <95.0% or >97.0%, take immediate corrective action to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractor's corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

6.1.1. **Payment for Incomplete Production Lots**. Production payment adjustments for incomplete lots, described under Section 341.4.9.2.1.1., "Incomplete Production Lots," will be calculated using the average production payment factors from all sublots sampled.

A production payment factor of 1.000 will be assigned to any lot when the random sampling plan did not result in collection of any samples within the first sublot.

6.1.2. **Production Sublots Subject to Removal and Replacement**. If after referee testing the laboratory-molded density for any sublot results in a "remove and replace" condition as shown in Table 19, the Engineer may require removal and replacement or may allow the sublot to be left in place without payment. The Engineer may also accept the sublot in accordance with Section 5.3.1., "Acceptance of Defective or Unauthorized Work." Replacement material meeting the requirements of this Item will be paid for in accordance with this Section.

6.2. **Placement Payment Adjustment Factors**. The placement payment adjustment factor is based on in-place air voids using the Engineer's test results. The bulk specific gravities of the cores from each sublot will be divided by the Engineer's average maximum theoretical specific gravity for the lot. The individual core densities for the sublot will be averaged to determine the placement payment adjustment factor in accordance with Table 20 for each sublot that requires in-place air void measurement. A placement payment adjustment factor of 1.000 will be assigned to the entire sublot when the random sample location falls in an area shown on the plans as not subject to in-place air void determination. A placement payment adjustment factor of 1.000 will be assigned to quantities placed in areas described in Section 341.4.9.3.1.4., "Miscellaneous Areas." The placement payment adjustment factor for completed lots will be the average of the placement payment adjustment factors for up to four sublots within that lot.

Table 20
Placement Payment Adjustment Factors for In-Place Air Voids

In-Place Air Voids	Placement Pay Adjustment Factor	In-Place Air Voids	Placement Payment Adjustment Factor
<2.7	Remove and replace	6.4	1.042
2.7	0.710	6.5	1.040
2.8	0.740	6.6	1.038
2.9	0.770	6.7	1.036
3.0	0.800	6.8	1.034
3.1	0.830	6.9	1.032
3.2	0.860	7.0	1.030
3.3	0.890	7.1	1.028
3.4	0.920	7.2	1.026
3.5	0.950	7.3	1.024
3.6	0.980	7.4	1.022
3.7	0.998	7.5	1.020
3.8	1.002	7.6	1.018
3.9	1.006	7.7	1.016
4.0	1.010	7.8	1.014
4.1	1.014	7.9	1.012
4.2	1.018	8.0	1.010
4.3	1.022	8.1	1.008
4.4	1.026	8.2	1.006
4.5	1.030	8.3	1.004
4.6	1.034	8.4	1.002
4.7	1.038	8.5	1.000
4.8	1.042	8.6	0.998
4.9	1.046	8.7	0.996
5.0	1.050	8.8	0.994
5.1	1.050	8.9	0.992
5.2	1.050	9.0	0.990
5.3	1.050	9.1	0.960
5.4	1.050	9.2	0.930
5.5	1.050	9.3	0.900
5.6	1.050	9.4	0.870
5.7	1.050	9.5	0.840
5.8	1.050	9.6	0.810
5.9	1.050	9.7	0.780
6.0	1.050	9.8	0.750
6.1	1.048	9.9	0.720
6.2	1.046	>9.9	Remove and replace
6.3	1.044	–	–

6.2.1. **Payment for Incomplete Placement Lots**. Payment adjustments for incomplete placement lots described under Section 341.4.9.3.1.2., "Incomplete Placement Lots," will be calculated using the average of the placement payment factors from all sublots sampled and sublots where the random location falls in an area shown on the plans as not eligible for in-place air void determination.

If the random sampling plan results in production samples, but not in placement samples, the random core location and placement adjustment factor for the sublot will be determined by applying the placement random number to the length of the sublot placed.

If the random sampling plan results in placement samples, but not in production samples, no placement adjustment factor will apply for that sublot placed.

A placement payment adjustment factor of 1.000 will be assigned to any lot when the random sampling plan did not result in collection of any production samples.

6.2.2. **Placement Sublots Subject to Removal and Replacement**. If after referee testing the placement payment adjustment factor for any sublot results in a "remove and replace" condition as shown in Table 20, the Engineer will choose the location of two cores to be taken within 3 ft. of the original failing core location. The Contractor must obtain the cores in the presence of the Engineer. The Engineer will take immediate possession of the untrimmed cores and submit the untrimmed cores to the Materials and Tests Division, where they will be trimmed, if necessary, and tested for bulk specific gravity within 10 working days of receipt.

The bulk specific gravity of each core from each sublot will be divided by the Engineer's average maximum theoretical specific gravity for the lot. The individual core densities for the sublot will be averaged to determine the new payment adjustment factor of the sublot in question. If the new payment adjustment factor is 0.720 or greater, the new payment adjustment factor will apply to that sublot. If the new payment adjustment factor is less than 0.720, no payment will be made for the sublot. Remove and replace the failing sublot, or the Engineer may allow the sublot to be left in place without payment. The Engineer may also accept the sublot in accordance with Section 5.3.1., "Acceptance of Defective or Unauthorized Work." Replacement material meeting the requirements of this Item will be paid for in accordance with this Section.

~~6.3. **Total Adjusted Pay (TAP) Calculation**. TAP will be based on the applicable payment adjustment factors for production and placement for each lot.~~

~~*TAP = (A+B)/2*~~

~~where:~~
~~*A* = Bid price × production lot quantity × average payment adjustment factor for the production lot~~
~~*B* = Bid price × placement lot quantity × average payment adjustment factor for the placement lot + (bid price × quantity placed in miscellaneous areas × 1.000)~~

~~*Production lot quantity* = Quantity actually placed - quantity left in place without payment~~

~~*Placement lot quantity* = Quantity actually placed - quantity left in place without payment - quantity placed in miscellaneous areas~~

ITEM TX-351_FLEXIBLE PAVEMENT STRUCTURE REPAIR
Summary of Changes

1. Section 1 Description
    a. First sentence revised as follows:
        i. Repair localized sections of flexible pavement structure, including subgrade, base, and surfacing, as ~~shown on the plans~~ as directed by the Engineer during construction operations.

2. Section 5 Measurement
    a. First paragraph revised as follows:
        i. This Item will be measured by the square yard. Only those areas discovered during construction are included in this bid item. Specific locations shown on the plans for full depth replacement are paid for under separate line items. In areas where material is excavated, as directed, to depths greater than those specified on the plans, measurement will be made by dividing the actual depth of such area by the plan depth and then multiplying this figure by the area in square yard of work performed. Calculations for each repaired area will be rounded up to the nearest 1/10 sq. yd. At each repair location, the minimum area for payment purposes will be 1 sq. yd.

3. Section 6 Payment
    a. First paragraph revised as follows:
        i. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "~~Flexible Pavement Structure Repair~~ TX-351 Full Depth Spot Reconstruction (Flexible Quantity)" ~~of the specified depth~~. This price is full compensation for scarifying, removing, hauling, spreading, disposing of, and stockpiling existing pavement structure; removing objectionable or unstable material; furnishing and placing materials; maintaining completed section before surfacing; applying tack or prime coat; hauling, sprinkling, spreading, and compacting; and equipment, labor, tools, and incidentals.

Item 351
Flexible Pavement Structure Repair

1. DESCRIPTION

Repair localized sections of flexible pavement structure, including subgrade, base, and surfacing, as ~~shown on the plans~~ as directed by the Engineer during construction operations.

2. MATERIALS

Furnish materials unless otherwise shown on the plans. Provide materials of the type and grade as shown on the plans and in accordance with the following.

- Item 132, "Embankment"
- Item 204, "Sprinkling"
- Item 247, "Flexible Base"
- Item 260, "Lime Treatment (Road-Mixed)"
- Item 275, "Cement Treatment (Road-Mixed)"
- Item 276, "Cement Treatment (Plant-Mixed)"
- Item 292, "Asphalt Treatment (Plant-Mixed)"
- Item 310, "Prime Coat"
- Item 316, "Seal Coat"
- Item 330, "Limestone Rock Asphalt Pavement"
- Item 334, "Hot-Mix Cold-Laid Asphalt Concrete Pavement"
- Item 341, "Dense-Graded Hot-Mix Asphalt"
- Item 344, "Superpave Mixtures"

For asphalt concrete materials, Contractor testing and payment adjustment provisions will be waived unless otherwise shown on the plans.

3. EQUIPMENT

Furnish equipment in accordance with pertinent Items. Use of a motor grader will be permitted for asphalt concrete pavement unless otherwise shown on the plans.

4. WORK METHODS

Repair using one or more of the following operations as shown on the plans. For Contracts with callout work, begin physical repair within 24 hr. of notification unless otherwise shown on the plans. Cut neat vertical faces around the perimeter of the work area when removing pavement structure layers. Removed materials are the property of the Contractor unless otherwise shown on the plans. Dispose of removed material in conformance with federal, state, and local regulations. Provide a smooth line and grade conforming to the adjacent pavement.

4.1. **Removing Pavement Structure**. Remove adjacent soil and vegetation if necessary to prevent contamination of the repair area and place it in a windrow. Do not damage adjacent pavement structure during repair operations. Remove flexible pavement structure layers from work area if subgrade work is required.

4.2. **Preparing Subgrade**. Fill holes, ruts, and depressions using approved material. Wet, reshape, and compact the subgrade thoroughly as directed.

Remove unstable subgrade material to the depth directed and replace with an approved material where subgrade has failed.

4.3. **Mixing and Placing Base Material**. Place, spread, and compact material in conformance with the applicable Item to the required or directed depth. Pulverize bituminous material to a maximum dimension of 2-1/2 in., and uniformly mix with existing base to the depth shown on the plans when the material is to remain in pavement structure.

4.3.1. **Flexible Base**. Use existing base and add new flexible base as required in accordance with Item 247 and details shown on the plans to achieve required section.

4.3.2. **Lime-Stabilized Base**. Use existing base, add new flexible base, and stabilize with a minimum lime content of 3% by weight of the total mixture. Construct in accordance with Item 260 and details shown on the plans to achieve required section.

4.3.3. **Cement-Stabilized Base**. Use existing base, add flexible base, and stabilize with a minimum cement content of 4% by weight of the total mixture. Construct in accordance with Item 275 or Item 276 and details shown on the plans to achieve required section.

4.3.4. **Asphalt-Stabilized Base**. Place asphalt-stabilized base in accordance with Item 292 or Item 341 and details shown on the plans to achieve required section.

4.3.5. **Limestone Rock Asphalt**. Place in accordance with Item 330 and details shown on the plans to achieve required section.

4.4. **Curing Base**. Cure in conformance with the appropriate Item unless otherwise directed or approved. Maintain completed base sections until surfacing.

4.5. **Surfacing**. Apply surfacing to the completed base section using materials shown on the plans.

4.5.1. **Prime Coat**. Protect the compacted, finished, and cured flexible, lime-stabilized, or cement-stabilized base mixtures with a prime coat of the type and grade shown on the plans. Apply the prime coat at the rate shown on the plans.

4.5.2. **Surface Treatments**. Apply surface treatment with the type and grade of asphalt and aggregate as shown on the plans in accordance with Item 316.

4.5.3. **Asphalt Concrete Pavement**. Apply tack coat of the type and grade and at the rate shown on the plans unless otherwise directed. Construct in accordance with Item 330, Item 334, Item 341, or Item 344 to achieve required section.

4.6. **Finishing**. Regrade and compact disturbed topsoil. Clean roadway surface after repair operations.

4.7. **Ride Quality**. Use Surface Test Type A to determine the ride quality of the repaired areas, unless otherwise shown on the plans.

5. MEASUREMENT

This Item will be measured by the square yard. Only those areas discovered during construction are included in this bid item. Specific locations shown on the plans for full depth replacement are paid for under separate line items. In areas where material is excavated, as directed, to depths greater than those specified on the plans, measurement will be made by dividing the actual depth of such area by the plan depth and then multiplying this figure by the area in square yard of work performed. Calculations for each repaired area will be rounded up to the nearest 1/10 sq. yd. At each repair location, the minimum area for payment purposes will be 1 sq. yd.

The minimum quantity for Contracts with callout work is 5 sq. yd. per callout unless otherwise shown on the plans.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "~~Flexible Pavement Structure Repair~~ TX-351 Full Depth Spot Reconstruction (Flexible Quantity)" ~~of the specified depth~~. This price is full compensation for scarifying, removing, hauling, spreading, disposing of, and stockpiling existing pavement structure; removing objectionable or unstable material; furnishing and placing materials; maintaining completed section before surfacing; applying tack or prime coat; hauling, sprinkling, spreading, and compacting; and equipment, labor, tools, and incidentals.

ITEM TX-354 PLANING AND TEXTURING PAVEMENT
Summary of Changes

1. Section 3 Construction
    a. Paragraph 3.2 is revised to read as follows:
        i. **Profiling, grade correction, or surface correction.** The machine shall have a minimum width of 7 feet (2 m) and it shall be equipped with electronic grade control devices that will cut the surface to the grade specified. The tolerances shall be maintained within +0 inch and -1/4 inch (+0 mm and -6mm) of the specified grade. The machine must cut vertical edges and have a positive method of dust control. The machine must have the ability to remove the millings or cuttings from the pavement and load them into a truck.

2. Section 5 Payment
    a. The first paragraph is revised to read as follows:
        i. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "~~Planing and Texturing Asphalt Concrete Pavement," "Planing and Texturing Concrete Pavement," "Planing Asphalt Concrete Pavement," or "Planing Concrete Pavement~~ TX-354 Planing and Texturing Pavement " ~~of the depths specified~~ to the depth required.

Item 354
Planing and Texturing Pavement

1. DESCRIPTION

Plane, or plane and texture, existing asphalt concrete pavement, asphalt-stabilized base, or concrete pavement.

2. EQUIPMENT

The Engineer may require demonstration of the equipment's capabilities.

2.1. **Planing Machine**. Use planing machines that:

- have a minimum 6-ft. cutting width except for work areas less than 6 ft. wide;
- are self-propelled with enough power, traction, and stability to maintain an accurate depth of cut and slope;
- can cut in one continuous operation: 4 in. of asphalt concrete pavement, 1 in. of concrete pavement, or a combination of 2 in. of asphalt concrete pavement and 1/2 in. of concrete pavement;
- use dual longitudinal controls capable of operating on both sides automatically from any longitudinal grade reference, which includes string line, ski, mobile string line, or matching shoe;
- use transverse controls with an automatic system to control cross slope at a given rate;
- use integral loading and reclaiming devices to allow cutting, removal, and discharge of the material into a truck in one operation; and
- include devices to control dust created by the cutting action.

2.2. **Manual System**. Use a manual system that can achieve a uniform depth of cut, flush to all inlets, valve covers, manholes, and other appurtenances within the paved area. Use of a manual system is allowed for areas restricted to self-propelled access and for detail pavement removal.

2.3. **Sweeper**. Use a street sweeper to remove cuttings and debris from the planed or textured pavement unless otherwise approved. Equip the sweeper with a water tank, a dust control spray assembly, both a pick-up and a gutter broom, and a debris hopper.

3. CONSTRUCTION

3.1. **Grade Reference**. Place grade reference points at maximum intervals of 50 ft. in accordance with Item 5, "Control of the Work," when required. Use the control points to set the grade reference. Support the grade reference so the maximum deflection does not exceed 1/16 in. between supports.

3.2. **Profiling, grade correction, or surface correction.** The machine shall have a minimum width of 7 feet (2 m) and it shall be equipped with electronic grade control devices that will cut the surface to the grade specified. The tolerances shall be maintained within +0 inch and -1/4 inch (+0 mm and -6mm) of the specified grade. The machine must cut vertical edges and have a positive method of dust control. The machine must have the ability to remove the millings or cuttings from the pavement and load them into a truck.

3.3. **Planing and Texturing**. Vary the speed of the machine to leave a grid or other pattern type with discontinuous longitudinal reach. Remove the pavement surface for the length, depth, and width shown on the typical section and to the established line and grades. Remove pavement to vertical lines adjacent to curbs, gutters, inlets, manholes, or other obstructions. Do not damage appurtenances or underlying pavement. Provide a planed surface that has a uniform textured appearance and riding surface. Surface

should be free of gouges, continuous longitudinal grooves, ridges, oil film, and other imperfections of workmanship. Leave a uniform surface of concrete pavement free of asphalt materials when removing an asphalt concrete pavement overlay.

Provide a minimum texture depth of not less than 0.05 in. when an overlay on the planed pavement is not required. Stop planing operations when surface texture depth is not sufficient. Never damage armor joints and other appurtenances.

Provide a pavement surface that, after planing, has a smooth riding quality and is true to the established line, grade, and cross-section. Provide a pavement surface that does not vary more than 1/8 in. in 10 ft. Evaluate this criterion using a 10-ft. straightedge placed parallel to the centerline of the roadway. Deviations will be measured from the top of the texture. Correct any point in the surface not meeting this requirement.

Sweep pavement and gutter. Leave pavement and curb clean.

3.4. **Edge Treatments**. Slope vertical or near vertical longitudinal faces in the pavement surface for areas under traffic in conformance with the requirements on the plans at the end of the day. Taper transverse faces to provide an acceptable ride.

3.5. **Salvaged Materials**. The Contractor will retain ownership of planed materials unless otherwise shown on the plans. Stockpile salvaged materials at locations shown on the plans. Prepare the stockpile site by removing vegetation and trash and providing proper drainage. Keep salvaged paving material free of contamination during its removal, transportation, and storage. Place different types or qualities of salvaged asphalt paving material into separate stockpiles. Dispose of unsalvageable material in conformance with applicable federal, state, and local regulations.

4. MEASUREMENT

This Item will be measured by the square yard of surface area for each pavement type, including asphalt concrete pavement and concrete pavement. Measurement will be based on the depth shown for each bid item, within the limits shown on the plans, regardless of the number of passes required. Only one bid item for each pavement type will apply to any one location.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "~~Planing and Texturing Asphalt Concrete Pavement," "Planing and Texturing Concrete Pavement," "Planing Asphalt Concrete Pavement," or "Planing Concrete Pavement~~ TX-354 Planing and Texturing Pavement " ~~of the depths specified~~ to the depth required.

The planing of concrete pavement to remove all asphalt concrete pavement in accordance with Article 354.3., "Construction," will be subsidiary to the planing of asphalt concrete pavement of the depth shown on the plans.

This price is full compensation for removing all material to the depth shown; texturing the pavement surface when texturing is shown in the bid item description; loading, hauling, and unloading; stockpiling or disposing of material; sweeping; tapering or sloping longitudinal or transverse joints in accordance with Section 354.3.3., "Edge Treatments"; and equipment, labor, tools, and incidentals. Demonstration work to receive approval for use of equipment will not be paid for unless work is performed in accordance with the Contract and is accepted.

ITEM TX-464 REINFORCED CONCRETE PIPE
Summary of Changes

1. Section 5 Payment
    a. The first paragraph is revised as follows:
        i. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "TX-464a Reinforced Concrete Pipe (18 in., Class 5," ~~"Reinforced Concrete Pipe (Arch),"~~ or "Reinforced Concrete Pipe (Elliptical, 18 in. X 12 in., Class 5)" ~~of the size and D-load specified or of the size and class specified~~. This price is full compensation for constructing, furnishing, transporting, placing, and joining pipes; shaping the bed; cutting pipes on skew or slope; connecting to new or existing structures; breaking back, removing, and disposing of portions of the existing structure; replacing portions of the existing structure; cutting pipe ends on skew or slope; and equipment, labor, tools, and incidentals.
    b. The second paragraph is revised to read as follows:
        i. Protection methods for excavations, if required shall be considered incidental to this item. ~~greater than 5 ft. deep will be measured and paid for as required under Item 402, "Trench Excavation Protection," or Item 403, "Temporary Special Shoring." Excavation, shaping, bedding, and backfill will be paid for in accordance with Item 400. When jacking, boring, or tunneling is used at the Contractor's option, payment will be made under this Item. When jacking, boring, or tunneling is required, payment will be made under Item 476~~.

Item 464
Reinforced Concrete Pipe

1. DESCRIPTION

Furnish and install reinforced concrete pipe, materials for precast concrete pipe culverts, or precast concrete storm drain mains, laterals, stubs, and inlet leads.

2. MATERIALS

2.1. **Fabrication**. Multi-project fabrication plants, as defined in DMS-7305, "Fabrication and Qualification Procedure for Multi-Project Fabrication Plants of Precast Concrete Drainage Structures," must be approved by the Materials and Tests Division in accordance with DMS-7305 before furnishing precast reinforced concrete pipe for Department projects. The Department's MPL includes approved multi-project reinforced concrete pipe fabrication plants.

Furnish material and fabricate reinforced concrete pipe in accordance with DMS-7305.

2.2. **Design**.

2.2.1. **General**. The class and D-load equivalents are shown in Table 1. Furnish arch pipe in accordance with ASTM C506 and the dimensions shown in Table 2. Furnish horizontal elliptical pipe in accordance with ASTM C507 and the dimensions shown in Table 3. For arch pipe and horizontal elliptical pipe, the minimum height of cover required is 1 ft.

Table 1
Circular Pipe
ASTM C76 and ASTM C655

Class	D-Load
I	800
II	1,000
III	1,350
IV	2,000
V	3,000

Table 2
Arch Pipe

Design Size	Equivalent Diameter (in.)	Rise (in.)	Span (in.)
1	18	13-1/2	22
2	21	15-1/2	26
3	24	18	28-1/2
4	30	22-1/2	36-1/4
5	36	26-5/8	43-3/4
6	42	31-5/16	51-1/8
7	48	36	58-1/2
8	54	40	65
9	60	45	73
10	72	54	88

Table 3
Horizontal Elliptical Pipe

Design Size	Equivalent Diameter (in.)	Rise (in.)	Span (in.)
0	15	12	19
1	18	14	23
2	24	19	30
3	27	22	34
4	30	24	38
5	33	27	42
6	36	29	45
7	39	32	49
8	42	34	53
9	48	38	60
10	54	43	68

2.2.2. **Jacking, Boring, or Tunneling**. Design pipe for jacking, boring, or tunneling considering the specific installation conditions such as the soil conditions, installation methods, anticipated deflection angles, and jacking stresses. Provide design notes and drawings signed and sealed by a Texas licensed professional engineer when requested. Provide steel reinforcement in bell and spigot.

2.3. **Marking**. Furnish each section of reinforced concrete pipe marked with the following information in accordance with DMS-7305:

- class or D-load of pipe,
- ASTM designation,
- date of manufacture,
- pipe size,
- name or trademark of fabricator and plant location,
- designation “TX” for precast units fabricated in accordance with DMS-7305,
- designated fabricator’s approval stamp for each approved unit,
- pipe to be used for jacking and boring (when applicable), and
- designation “SR” for pipe meeting sulfate-resistant concrete plan requirements (when applicable).

Clearly mark one end of each section during the process of manufacture or immediately thereafter for pipe with elliptical reinforcement. Mark the pipe on the inside and outside of opposite walls to show the location of the top or bottom of the pipe as it should be installed unless the external shape of the pipe is such that the correct position of the top and bottom is obvious. Mark the pipe section by indenting or painting with waterproof paint.

2.4. **Inspection**. Provide access for inspection of the finished pipe at the project site before and during installation.

2.5. **Causes for Rejection**. Individual sections of pipe may be rejected for any of the conditions stated in the DMS-7305 Annex.

2.6. **Repairs**. Make repairs, if necessary, in accordance with the DMS-7305 Annex.

2.7. **Jointing Materials**. Use any of the following materials for the making of joints unless otherwise shown on the plans. Furnish a manufacturer’s certificate of compliance for all jointing materials except mortar.

2.7.1. **Mortar**. Provide mortar for joints that meets the requirements of Section 464.3.3., “Jointing.”

2.7.2. **Cold-Applied, Plastic Asphalt Sewer Joint Compound**. Provide a material that consists of natural or processed asphalt base, suitable volatile solvents, and inert filler. Ensure the consistency is such that the ends of the pipe can be coated with a layer of the compound up to 1/2 in. thick by trowel. Provide a joint

compound that cures to a firm, stiff plastic condition after application. Provide a material of a uniform mixture. Stir any small separation found in the container into a uniform mix before using.

Provide a material that meets the requirements shown in Table 4 when tested in accordance with Tex-526-C.

Table 4
Cold-Applied, Plastic Asphalt Sewer Joint Compound Material Requirements

Composition	Analysis
Asphalt base, 100%–% volatiles–% ash, % by weight	28–45
Volatiles, 212°F evaporation, 24 hr., % by weight	10–26
Mineral matter, determined as ash, % by weight	30–55
Consistency, cone penetration, 150 q, 5 sec., 77°F	150–275

2.7.3. **Rubber Gaskets**. Provide gaskets that conform to ASTM C1619 Class A or Class C. Meet the requirements of ASTM C443 for design of the pipe joints and permissible variations in dimensions.

2.7.4. **Pre-Formed Flexible Joint Sealants**. Pre-formed flexible joint sealants may be used for sealing joints of tongue-and-groove concrete pipe. Provide flexible joint sealants that meet the requirements of ASTM C990. Use flexible joint sealants that do not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength. Supply in extruded rope form of suitable cross-section. Provide a size of the pre-formed flexible joint sealant in conformance with the manufacturer's recommendations and large enough to properly seal the joint. Protect flexible joint sealants with a suitable wrapper able to maintain the integrity of the jointing material when the wrapper is removed.

3. CONSTRUCTION

3.1. **Excavation, Shaping, Bedding, and Backfill**. Excavate, shape, bed, and backfill in accordance with Item 400, "Excavation and Backfill for Structures," except where jacking, boring, or tunneling methods are permitted. Jack, bore, or tunnel the pipe in accordance with Item 476, "Jacking, Boring, or Tunneling Pipe or Box." Immediate backfilling is permitted if joints consist of materials other than mortar. Take special precautions in placing and compacting the backfill to avoid any movement of the pipe or damage to the joints. Do not use heavy earth-moving equipment to haul over the structure until at least 4 ft. of permanent or temporary compacted fill has been placed over the structure, unless otherwise shown on the plans or permitted in writing. Remove and replace pipe damaged by the Contractor at no expense to the Department.

3.2. **Laying Pipe**. Start the laying of pipe on the bedding at the outlet end with the spigot or tongue end pointing downstream and proceed toward the inlet end with the abutting sections properly matched, true to the established lines and grades unless otherwise authorized. Fit, match, and lay the pipe to form a smooth, uniform conduit. Cut cross trenches in the foundation to allow the barrel of the pipe to rest firmly on the bedding where bell-and-spigot pipe is used. Cut cross trenches no more than 2 in. larger than the bell ends of the pipe. Lower sections of pipe into the trench without damaging the pipe or disturbing the bedding and the sides of the trench. Carefully clean the ends of the pipe before the pipe is placed. Prevent earthen or bedding material from entering the pipe as it is laid. Lay the pipe in the trench, when elliptical pipe with circular reinforcing or circular pipe with elliptical reinforcing is used, so the markings for the top or bottom are not more than 5° from the vertical plane through the longitudinal axis of the pipe. Remove and re-lay, without extra compensation, pipe that is not in alignment or shows excessive settlement after laying.

Lay multiple lines of reinforced concrete pipe with the centerlines of the individual barrels parallel. Use the clear distances between outer surfaces of adjacent pipes shown in Table 5 unless otherwise shown on the plans. Use the equivalent diameter from Table 2 or Table 3 for arch pipe or horizontal elliptical pipe to determine the clear distance requirement shown in Table 5.

Table 5
Minimum Clear Distance Between Pipes

Equivalent Diameter	Min Clear Distance
18 in.	9 in.
24 in.	11 in.
30 in.	1 ft. 1 in.
36 in.	1 ft. 3 in.
42 in.	1 ft. 5 in.
48 in.	1 ft. 7 in.
54 in.	1 ft. 11 in.
60–84 in.	2 ft.

3.3. **Jointing**. Make available an appropriate rolling device similar to an automobile mechanic's "creeper" for conveyance through small-size pipe structures.

3.3.1. **Joints Sealed with Hydraulic Cement Mortar**. Use Type S mortar meeting the requirements of ASTM C270. Clean and wet the pipe ends before making the joint. Plaster the lower half of the bell or groove and the upper half of the tongue or spigot with mortar. Pack mortar into the joint from both inside and outside the pipe after the pipes are tightly jointed. Finish the inside smooth and flush with adjacent joints of pipe. Form a bead of semicircular cross-section over tongue-and-groove joints outside the pipe, extending at least 1 in. on each side of the joint. Form the mortar for bell-and-spigot joints to a 45° fillet between the outer edge of the bell and the spigot. Cure mortar joints by keeping the joints wet for at least 48 hr. or until the backfill has been completed, whichever is first. Place fill or backfill once the mortar jointing material has cured for at least 6 hr. Conduct jointing only when the atmospheric temperature is above 40°F. Protect mortared joints against freezing by backfilling or other approved methods for at least 24 hr.

Driveway culverts do not require mortar banding on the outside of the pipe.

Furnish pipes, with approval, that are large enough for a person to enter with the groove between 1/2 in. and 3/4 in. longer than the tongue. Such pipe may be laid and backfilled without mortar joints. Clean the space on the interior of the pipe between the end of the tongue and the groove of all foreign material, thoroughly wet and fill with mortar around the entire circumference of the pipe, and finish flush after the backfilling has been completed.

3.3.2. **Joints Using Cold-Applied, Plastic Asphalt Sewer Joint Compound**. Ensure both ends of the pipes are clean and dry. Trowel or otherwise place a 1/2-in. thick layer of the compound in the groove end of the pipe covering at least 2/3 of the joint face around the entire circumference. Shove home the tongue end of the next pipe with enough pressure to make a tight joint. Remove any excess mastic projecting into the pipe after the joint is made. Backfill after the joint has been inspected and approved.

3.3.3. **Joints Using Rubber Gaskets**. Make the joint assembly in conformance with the recommendations of the gasket manufacturer. Make joints watertight when using rubber gaskets. Backfill after the joint has been inspected and approved.

3.3.4. **Joints Using Pre-Formed Flexible Joint Sealants**. Install pre-formed flexible joint sealants in conformance with the manufacturer's recommendations. Place the joint sealer so no dirt or other deleterious materials contact the joint sealing material. Pull or push home the pipe with enough force to properly seal the joint. Remove any joint material pushed out into the interior of the pipe that would tend to obstruct the flow. Store pre-formed flexible joint sealants in an area warmed naturally or artificially to above 70°F in an approved manner when the atmospheric temperature is below 60°F. Apply flexible joint sealants to pipe joints immediately before placing pipe in trench, and connect pipe to previously laid pipe. Backfill after the joint has been inspected and approved.

3.4. **Connections and Stub Ends**. Make connections of concrete pipe to existing pipes, pipe storm drains, or storm drain appurtenances as shown on the plans.

Mortar or concrete the bottom of existing structures if necessary to eliminate any drainage pockets created by the connections. Repair any damage to the existing structure resulting from making the connections.

Make connections between concrete pipe and corrugated metal pipe with a suitable concrete collar and a minimum thickness of 4 in. unless otherwise shown on the plans.

Finish stub ends for connections to future work not shown on the plans by installing watertight plugs into the free end of the pipe.

Fill lift holes with concrete, mortar, or precast concrete plugs after the pipe is in place.

4. MEASUREMENT

This Item will be measured by the foot. Measurement will be made between the ends of the pipe barrel along the flow line, not including safety end treatments. Safety end treatments will be measured in accordance with Item 467, "Safety End Treatment." Pipe that will be jacked, bored, or tunneled will be measured in accordance with Item 476. Measurement of spurs, branches, or new connecting pipe will be made from the intersection of the flow line with the outside surface of the pipe into which it connects. Where inlets, headwalls, catch basins, manholes, junction chambers, or other structures are included in lines of pipe, the length of pipe tying into the structure wall will be included for measurement, but no other portion of the structure length or width will be included.

For multiple pipes, the measured length will be the sum of the lengths of the barrels.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Reinforced Concrete Pipe," "Reinforced Concrete Pipe (Arch)," or "Reinforced Concrete Pipe (Elliptical)" of the size and D-load specified or of the size and class specified. This price is full compensation for constructing, furnishing, transporting, placing, and joining pipes; shaping the bed; cutting pipes on skew or slope; connecting to new or existing structures; breaking back, removing, and disposing of portions of the existing structure; replacing portions of the existing structure; cutting pipe ends on skew or slope; and equipment, labor, tools, and incidentals.

Protection methods for excavations greater than 5 ft. deep will be measured and paid for as required under Item 402, "Trench Excavation Protection," or Item 403, "Temporary Special Shoring." Excavation, shaping, bedding, and backfill will be paid for in accordance with Item 400. When jacking, boring, or tunneling is used at the Contractor's option, payment will be made under this Item. When jacking, boring, or tunneling is required, payment will be made under Item 476.

ITEM TX- 467 SAFETY END TREATMENT
Summary of Changes

1. Section 2 Materials
    a. Paragraph 2.2 Fabrication – removed requirements for riprap as follows:
        i. precast safety end treatment (SET) units. ~~Provide riprap only if the plans specifically require it for this alternative.~~

2. Section 3 Construction
    a. Paragraph 3.1 General second sentence is deleted in full:
        i. ~~Provide riprap on all prefabricated metal end sections.~~

3. Section 4 Measurement
    a. Second paragraph is deleted in full:
        i. ~~Pipe runners or pipe runner assemblies installed or replaced on existing structure will be measured by each installed or replaced on each structure end.~~

4. Section 5 Payment
    a. First paragraph revised as follows:
        i. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for TX-467a Safety End Treatment (Type II, 18 IN.) and TX-467b Safety End Treatment (Type II, 18 IN. x 12 IN.) ~~the various designations of "Safety End Treatment" specified as follows:~~
            1. ~~"SET (Type I) (Barrel Span) (Wall Height) (Slope, Horizontal:Vertical) (Orientation, Cross or Parallel)";~~
            2. ~~"SET (Type I) (Pipe Diameter or Design) (Slope, Horizontal:Vertical) (Orientation, Cross or Parallel)";~~
            3. ~~"SET (Type II) (Pipe Diameter or Design) (Pipe Material) (Slope, Horizontal:Vertical) (Orientation, Cross or Parallel)";~~
            4. ~~"SET (Pipe Runner)"; and~~
            5. ~~"SET (Pipe Runner Assembly)."~~

Item 467
Safety End Treatment

1. DESCRIPTION

Furnish, construct, and install safety end treatments for drainage structures, or install or replace pipe runners or pipe runner assemblies on existing drainage structures.

2. MATERIALS

2.1. **General**. Furnish materials in accordance with the following.

- Item 420, “Concrete Substructures”
- Item 421, “Hydraulic Cement Concrete”
- Item 432, “Riprap”
- Item 440, “Reinforcement for Concrete”
- Item 442, “Metal for Structures”
- Item 445, “Galvanizing”
- Item 460, “Corrugated Metal Pipe”
- Item 464, “Reinforced Concrete Pipe”

Use Class C concrete for cast-in-place and precast concrete units unless otherwise shown on the plans. Furnish cast-in-place or precast safety end treatments unless otherwise shown on the plans. Furnish Class B concrete for concrete riprap unless otherwise shown on the plans. Provide galvanized steel for prefabricated metal end sections in accordance with Item 460.

Furnish pipe runners in accordance with the following:

- ASTM A1085;
- ASTM A53, Type E or S, Grade B;
- ASTM A500, Grade B; or
- API 5L, Grade X42.

Furnish plates and angles in accordance with ASTM A36. Furnish nuts and bolts in accordance with ASTM A307. Galvanize pipes, plates, angles, nuts, and bolts in accordance with Item 445.

2.2. **Fabrication**. Fabricate cast-in-place concrete units and precast units in accordance with Item 420. Provide either prefabricated metal end sections or mitered corrugated metal pipe (CMP) when specified for the pipe structure unless otherwise shown on the plans.

Provide one of the following when reinforced concrete pipe (RCP) is specified for the pipe structure, unless otherwise shown on the plans:

- mitered RCP, or
- precast safety end treatment (SET) units. ~~Provide riprap only if the plans specifically require it for this alternative.~~

2.2.1. **SET Types**.

2.2.1.1. **Type I**. Provide Type I SET consisting of reinforced concrete headwalls or wingwalls and pipe runners as shown on the plans when required.

2.2.1.2. **Type II**. Provide Type II SET as shown on the plans consisting of the following:

- CMP or RCP mitered to the proper slope, concrete riprap, and pipe runners, when required;
- prefabricated metal end sections, concrete riprap, and pipe runners, when required; or
- precast SET units, concrete riprap, when required, and pipe runners, when required.

2.2.2. **Lifting Holes**. Provide no more than four lifting holes in each section for precast units. Lifting holes may be cast, cut into fresh concrete after form removal, or drilled. Provide lifting holes large enough for adequate lifting devices based on the size and weight of the section. The maximum hole diameter is 3 in. at the inside surface of the wall and 4 in. at the outside surface. Cut no more than one longitudinal wire or two circumferential wires per layer of reinforcing steel when locating lift holes. Repair spalled areas around lifting holes.

2.2.3. **Marking**. Clearly mark the following on each precast unit, mitered CMP, mitered RCP, or metal end section before shipment from the casting or fabrication yard:

- the date of manufacture,
- the name or trademark of the manufacturer, and
- the type and size designation.

2.2.4. **Storage and Shipment**. Store precast units on a level surface. Do not place any loads on precast units until the design strength is reached. Do not ship units until design strength requirements have been met.

2.2.5. **Causes for Rejection**. Precast units may be rejected for not meeting any one of the specification requirements. Individual units may also be rejected for fractures or cracks passing through the wall or surface defects indicating honeycombed or open texture surfaces. Remove rejected units from the project and replace with acceptable units meeting the requirements of this Item.

2.2.6. **Defects and Repairs**. Occasional imperfections in manufacture or accidental damage sustained during handling may be repaired in accordance with the Department's *Concrete Repair Manual*. The repaired units will be acceptable if they conform to the requirements of this Item and the repairs are sound and properly finished and cured in conformance with pertinent specifications. Repair damaged galvanizing in accordance with Section 445.3.4., "Repairs."

3. CONSTRUCTION

3.1. **General**. Remove portions of existing structures in accordance with Section 420.4.8., "Extending Existing Substructures." Drill, dowel, and grout in accordance with Item 420. Furnish concrete riprap in accordance with Item 432.

~~Provide riprap on all prefabricated metal end sections.~~

3.2. **Excavation, Shaping, Bedding, and Backfill**. Excavate, shape, bed, and backfill in accordance with Item 400, "Excavation and Backfill for Structures." Take special precautions in placing and compacting the backfill to avoid any movement or damage to the units. Bed precast units on foundations of firm and stable material accurately shaped to conform to the bases of the units.

3.3. **Placement of Precast Units**. Provide adequate means to lift and place the precast units. Fill lifting holes with mortar or concrete and cure. Precast concrete or mortar plugs may be used.

3.4. **Connections**. Make connections to new or existing structures as shown on the plans. Furnish jointing material in accordance with Item 464.

Also remove a length of the existing pipe from the headwall to the joint when removing existing headwalls as shown on the plans or as approved. Re-lay the removed pipe if approved, or furnish and lay a length of new pipe.

3.5. **Install or Replace Pipe Runners or Assemblies**. Install or replace individual pipe runners or pipe runner assemblies on existing drainage structures as shown on the plans.

4. MEASUREMENT

SETs of all types will be measured by each barrel of each structure end.

~~Pipe runners or pipe runner assemblies installed or replaced on existing structure will be measured by each installed or replaced on each structure end.~~

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for TX-467a Safety End Treatment (Type II, 18 IN.) and TX-467b Safety End Treatment (Type II, 18 IN. x 12 IN.) ~~the various designations of "Safety End Treatment" specified as follows:~~

- ~~"SET (Type I) (Barrel Span) (Wall Height) (Slope, Horizontal:Vertical) (Orientation, Cross or Parallel)";~~
- ~~"SET (Type I) (Pipe Diameter or Design) (Slope, Horizontal:Vertical) (Orientation, Cross or Parallel)";~~
- ~~"SET (Type II) (Pipe Diameter or Design) (Pipe Material) (Slope, Horizontal:Vertical) (Orientation, Cross or Parallel)";~~
- ~~"SET (Pipe Runner)"; and~~
- ~~"SET (Pipe Runner Assembly)."~~

For payment purposes, the wingwall heights of Type I SETs for box culverts will be rounded to the nearest foot.

This price is full compensation for constructing, furnishing, transporting, and installing the end treatments; pipe runners, or pipe runner assemblies, connecting to existing structure; breaking back, removing and disposing of portions of the existing structure, removing and disposing of existng pipe runner or pipe runner assemblies, and replacing portions of the existing structure as required to make connections; excavation and backfill; furnishing concrete, reinforcing steel, CMP or RCP, and pipe runners; and concrete riprap, nuts, bolts, plates, angles, equipment, labor, tools, and incidentals.

The removal and re-laying of existing pipe or the furnishing of new pipe to replace existing pipe will not be paid for directly, but will be subsidiary to this Item.

The mitered length of CMP or RCP that is a part of the SET (Type II) will not be paid for directly, but will be subsidiary to this Item. The limits for payment for pipe will be as shown on the plans and paid for in accordance with the pertinent bid item.

The limits of riprap to be included in the unit price bid for each SET will be shown on the plans. Any riprap placed beyond the limits shown will be paid for in accordance with Item 432. Riprap between multiple precast SET units will be required as shown on the plans and is included in the unit price bid for SET.

When precast SETs are provided as an option to mitered RCP, riprap aprons will not be required unless shown on the plans. The plans will show the limits of the riprap to be included with the precast SET for payment.

ITEM TX-506_TEMPORARY EROSION, SEDIMENTATION, AND ENVIRONMENTAL CONTROLS
Summary of Changes

1. Section 4 Construction
    a) Paragraph 4.4.10 – Vertical Tracking is revised as follows:
        i. **Vertical Tracking**. Perform vertical tracking on slopes to temporarily stabilize soil. Provide equipment with a track undercarriage capable of producing a linear soil impression measuring at least 12 in. long × 2–4 in. wide × 1/2–2 in. deep. Do not exceed 12 in. between track impressions. Install continuous linear track impressions where the 12-in. length impressions are perpendicular to the slope. Vertical tracking is required on projects where soil disturbing activities have occurred, unless otherwise approved.

2. Section 5 Measurement
    a. Section 5 is removed except as follows:
        i. ~~Rock Filter Dams. Installation or removal of rock filter dams will be measured by the foot or by the cubic yard. The measured volume will include sandbags, when used.~~ Erosion Control will be measured by the Lump Sum to furnish, install, maintain, and remove erosion control devices and features as shown on plans and as required by the specifications.
            ~~1. Linear Measurement. When rock filter dams are measured by the foot, measurement will be along the centerline of the top of the dam.~~
            ~~2. Volume Measurement. When rock filter dams are measured by the cubic yard, measurement will be based on the volume of rock computed by the method of average end areas.~~
                ~~*a. Installation. Measurement will be made in final position.*~~
                ~~*b. Removal. Measurement will be made at the point of removal.*~~
        ~~ii. Temporary Pipe Slope Drains. Temporary pipe slope drains will be measured by the foot.~~
        ~~iii. Temporary Paved Flumes. Temporary paved flumes will be measured by the square yard of surface area. The measured area will include the energy dissipater at the flume outlet.~~
        ~~iv. Construction Exits. Construction exits will be measured by the square yard of surface area.~~
        ~~v. Earthwork for Erosion and Sediment Control.~~
            ~~1. Equipment and Labor Measurement. Equipment and labor used will be measured by the actual number of hours the equipment is operated and the labor is engaged in the work.~~
            ~~2. Volume Measurement.~~
                ~~*a. In Place.*~~
                    ~~i. Excavation. Excavation will be measured by the cubic yard in its original position and the volume computed by the method of average end areas.~~
                    ~~ii. Embankment. Embankment will be measured by the cubic yard in its final position by the method of average end areas. The volume of embankment will be determined between:~~
            ~~3. the original ground surfaces or the surface upon which the embankment is to be constructed for the feature and~~
            ~~4. the lines, grades, and slopes of the accepted embankment for the feature.~~
                ~~*a. In Vehicles. Excavation and embankment quantities will be combined and paid for under "Earthwork (Erosion and Sediment Control, In Vehicle)." Excavation will be measured by the cubic yard in vehicles at the point of removal. Embankment will be measured by the cubic yard in vehicles measured at the point of delivery. Shrinkage or swelling factors will not be considered in determining the calculated quantities.*~~
        ~~vi. Construction Perimeter Fence. Construction perimeter fence will be measured by the foot.~~

vii. Sandbags for Erosion Control. Sandbags will be measured as each sandbag or by the foot along the top of sandbag berms or dams.

viii. Temporary Sediment Control Fence. Installation or removal of temporary sediment control fence will be measured by the foot.

ix. Biodegradable Erosion Control Logs. Installation or removal of biodegradable erosion control logs will be measured by the foot along the centerline of the top of the control logs.

x. Vertical Tracking. Vertical tracking will not be measured or paid for directly, but will be subsidiary to this Item.

3. Section 6 Payment
   a. Section 6 is removed except as follows:

The following will not be paid for directly, but will be subsidiary to pertinent Items:

erosion control measures for Contractor project specific locations (PSLs) inside and outside the right of way (e.g., construction and haul roads, field offices, equipment and supply areas, plants, and material sources);

removal of litter, unless a separate pay item is shown on the plans;

repair to devices and features damaged by Contractor operations;

added measures and maintenance needed due to negligence, carelessness, lack of maintenance, and failure to install permanent controls;

removal and reinstallation of devices and features needed for the convenience of the Contractor;

finish grading and dressing upon removal of the device; and

minor adjustments including but not limited to plumbing posts, reattaching fabric, minor grading to maintain slopes on an erosion embankment feature, or moving small numbers of sandbags.

Stabilization of disturbed areas will be paid for under pertinent Items except vertical tacking, which will be subsidiary.

Furnishing and installing pipe for outfalls associated with sediment traps and ponds will not be paid for directly, but will be subsidiary to the excavation and embankment under this Item.

Rock Filter Dams. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid as follows. Erosion Control will be paid by the Lump Sum to furnish, install, maintain, and remove erosion control devices and features as shown on plans and as required by the specifications.

Installation. Installation will be paid for as "Rock Filter Dams (Install)" of the type and slope as specified. This price is full compensation for furnishing and operating equipment, finish backfill and grading, lacing, proper disposal, labor, materials, tools, and incidentals.

Removal. Removal will be paid for as "Rock Filter Dams (Remove)." This price is full compensation for furnishing and operating equipment, proper disposal, labor, materials, tools, and incidentals.

When the Engineer directs that the rock filter dam installation or portions thereof be replaced, payment will be made at the unit price bid for "Rock Filter Dams (Remove)" and for "Rock Filter Dams (Install)" of the type specified. This price is full compensation for furnishing and operating equipment, finish backfill and grading, lacing, proper disposal, labor, materials, tools, and incidentals.

Temporary Pipe Slope Drains. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Temporary Pipe Slope Drains" of the size specified. This price is full compensation for furnishing materials, removal and disposal, furnishing and operating equipment, labor, tools, and incidentals.

Removal of temporary pipe slope drains will not be paid for directly, but will be subsidiary to the installation Item. When the Engineer directs that the pipe slope drain installation or portions thereof be replaced, payment will be made at the unit price bid for "Temporary Pipe Slope Drains" of the size specified, which is full compensation for the removal and reinstallation of the pipe drain.

Earthwork required for the pipe slope drain installation, including construction of the sediment trap, will be measured and paid for under "Earthwork for Erosion and Sediment Control."

Riprap concrete or stone, when used as an energy dissipater or as a stabilized sediment trap, will be measured and paid for in accordance with Item 432.

Temporary Paved Flumes. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Temporary Paved Flume (Install)" or "Temporary Paved Flume (Remove)." This price is full

compensation for furnishing and placing materials, removal and disposal, equipment, labor, tools, and incidentals.

When the Engineer directs that the paved flume installation or portions thereof be replaced, payment will be made at the unit prices bid for "Temporary Paved Flume (Remove)" and "Temporary Paved Flume (Install)." These prices are full compensation for the removal and replacement of the paved flume and for equipment, labor, tools, and incidentals.

Earthwork required for the paved flume installation, including construction of a sediment trap, will be measured and paid for under "Earthwork for Erosion and Sediment Control."

Construction Exits. Contractor required construction exits from off right of way locations or on right of way PSLs will not be paid for directly, but will be subsidiary to pertinent Items.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" for construction exits needed on right of way access to work areas required by the Department will be paid for at the unit price bid for "Construction Exits (Install)" of the type specified or "Construction Exits (Remove)." This price is full compensation for furnishing and placing materials, excavating, removal and disposal, cleaning vehicles, labor, tools, and incidentals.

When the Engineer directs that a construction exit or portion thereof be removed and replaced, payment will be made at the unit prices bid for "Construction Exit (Remove)" and "Construction Exit (Install)" of the type specified. These prices are full compensation for the removal and replacement of the construction exit and for equipment, labor, tools, and incidentals.

Construction of sediment traps used in conjunction with the construction exit will be measured and paid for under "Earthwork for Erosion and Sediment Control."

Earthwork for Erosion and Sediment Control.

Initial Earthwork for Erosion and Sediment Control. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Excavation (Erosion and Sediment Control, In Place)," "Embankment (Erosion and Sediment Control, In Place)," "Excavation (Erosion and Sediment Control, In Vehicle)," "Embankment (Erosion and Sediment Control, (In Vehicle)," or "Earthwork (Erosion and Sediment Control, In Vehicle)."

This price is full compensation for excavation and embankment, including hauling; disposal of material not used elsewhere on the project; embankments including furnishing material from approved sources and construction of erosion control features; and equipment, labor, tools, and incidentals.

Sprinkling and rolling required by this Item will not be paid for directly, but will be subsidiary to this Item.

Maintenance Earthwork for Erosion and Sediment Control for Cleaning and Restoring Control Measures. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid under a Contractor Force Account Item from invoice provided to the Engineer.

This price is full compensation for excavation, embankment, and re-grading, including dewatering for removal of accumulated sediment, and the removal of accumulated sediment in various erosion control installations as directed, hauling, and disposal of material not used elsewhere on the project; excavation for construction of erosion control features; embankments, including furnishing material from approved sources and construction of erosion control features; and equipment, labor, tools, and incidentals.

Earthwork needed to remove and obliterate erosion control features will not be paid for directly, but will be subsidiary to pertinent Items unless otherwise shown on the plans.

Sprinkling and rolling required by this Item will not be paid for directly, but will be subsidiary to this Item.

Construction Perimeter Fence. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Construction Perimeter Fence." This price is full compensation for furnishing and placing the fence; digging, fence posts, wire, and flagging; removal and disposal; and materials, equipment, labor, tools, and incidentals.

Removal of construction perimeter fence will not be paid for directly, but will be subsidiary to the installation Item. When the Engineer directs that the perimeter fence installation or portions thereof be removed and replaced, payment will be made at the unit price bid for "Construction Perimeter

~~Fence," which is full compensation for the removal and reinstallation of the construction perimeter fence.~~

~~**Sandbags for Erosion Control.** Sandbags will be paid for at the unit price bid for "Sandbags for Erosion Control" (of the height specified when measurement is by the foot). This price is full compensation for materials, placing sandbags, removal and disposal, equipment, labor, tools, and incidentals.~~

~~Removal of sandbags will not be paid for directly, but will be subsidiary to the installation Item. When the Engineer directs that the sandbag installation or portions thereof be replaced, payment will be made at the unit price bid for "Sandbags for Erosion Control," which is full compensation for the reinstallation of the sandbags.~~

~~**Temporary Sediment Control Fence**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid as follows.~~

~~**Installation**. Installation will be paid for as "Temporary Sediment Control Fence (Install)." This price is full compensation for furnishing and operating equipment, finish backfill and grading, lacing, proper disposal, labor, materials, tools, and incidentals.~~

~~**Removal**. Removal will be paid for as "Temporary Sediment Control Fence (Remove)." This price is full compensation for furnishing and operating equipment, proper disposal, labor, materials, tools, and incidentals.~~

~~**Biodegradable Erosion Control Logs**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid as follows.~~

~~**Installation**. Installation will be paid for as "Biodegradable Erosion Control Logs (Install)" of the size specified. This price is full compensation for furnishing and operating equipment, finish backfill and grading, staking, proper disposal, labor, materials, tools, and incidentals.~~

~~**Removal**. Removal will be paid for as "Biodegradable Erosion Control Logs (Remove)." This price is full compensation for furnishing and operating equipment, proper disposal, labor, materials, tools, and incidentals.~~

~~**Vertical Tracking**. Vertical tracking will not be measured or paid for directly, but will be subsidiary to this Item.~~

Erosion Control will be paid for by the Lump Sum to furnish, install, maintain, and remove erosion control devices and features as shown on the plans and required by the specifications.

i. .

Item 506

Temporary Erosion, Sedimentation, and Environmental Controls

1. DESCRIPTION

Install, maintain, and remove erosion, sedimentation, and environmental control measures to prevent or reduce the discharge of pollutants and protect environmental resources in accordance with the Stormwater Pollution Prevention Plan (SWP3) and environmental layout shown on the plans. Comply with Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit (CGP) TXR150000 requirements. Control measures are defined as Best Management Practices (BMPs) used to prevent or reduce the discharge of pollutants and measures to protect environmental resources. Control measures include, but are not limited to, rock filter dams, temporary pipe slope drains, temporary paved flumes, construction exits, earthwork for erosion control, pipe, construction perimeter fence, sandbags, temporary sediment control fence, biodegradable erosion control logs, vertical tracking, temporary or permanent seeding, and other measures. Erosion and sediment control devices must be selected from the Erosion Control Approved Products List. Perform work in a manner to prevent degradation of receiving waters, protect environmental resources, facilitate project construction, and comply with applicable federal, state, and local regulations. Ensure the installation and maintenance of control measures are performed in conformance with the manufacturer's or designer's specifications.

2. MATERIALS

Furnish materials in accordance with the following.

- Item 161, "Compost"
- Item 432, "Riprap"
- Item 556, "Pipe Underdrains"

2.1. **Rock Filter Dams**.

2.1.1. **Aggregate**. Furnish aggregate with approved hardness, durability, cleanliness, and resistance to crumbling, flaking, and eroding. Provide the following.

- **Types 1, 2, and 4 Rock Filter Dams**. Use 3–6-in. aggregate.
- **Type 3 Rock Filter Dams**. Use 4–8-in. aggregate.

2.1.2. **Wire**. Provide minimum 20-gauge galvanized wire for the steel wire mesh and tie wires for Types 2 and 3 rock filter dams. Type 4 dams require:

- a double-twisted, hexagonal weave with a nominal mesh opening of 2-1/2 × 3-1/4 in.,
- minimum 0.0866-in. steel wire for netting,
- minimum 0.1063-in. steel wire for selvages and corners, and
- minimum 0.0866 in. for binding or tie wire.

2.1.3. **Sandbag Material**. Furnish sandbags meeting Section 506.2.8., "Sandbags," except that any gradation of aggregate may be used to fill the sandbags.

2.2. **Temporary Pipe Slope Drains**. Provide corrugated metal pipe, polyvinyl chloride (PVC) pipe, flexible tubing, watertight connection bands, grommet materials, prefabricated fittings, and flared entrance sections as shown on the plans. Recycled and other materials meeting these requirements are allowed if approved.

Furnish concrete in accordance with Item 432.

2.3. **Temporary Paved Flumes**. Furnish asphalt concrete, hydraulic cement concrete, or other comparable non-erodible material as shown on the plans. Provide rock or rubble with a minimum diameter of 6 in. and a maximum volume of 1/2 cu. ft. for the construction of energy dissipaters.

2.4. **Construction Exits**. Provide materials as shown on the plans and in accordance with this Section.

2.4.1. **Rock Construction Exit**. Provide crushed aggregate for long- and short-term construction exits. Furnish aggregates that are clean, hard, durable, and free of adherent coatings such as salt, alkali, dirt, clay, loam, shale, soft or flaky materials, and organic and injurious matter. Use 4–8-in. aggregate for Type 1. Use 2–4-in. aggregate for Type 3.

2.4.2. **Timber Construction Exit**. Furnish No. 2 quality or better railroad ties and timbers for long-term construction exits, free of large and loose knots and treated to control rot. Fasten timbers using nuts and bolts or lag bolts, of at least 1/2 in. diameter, unless otherwise shown on the plans or allowed. Provide plywood or pressed wafer board at least 1/2 in. thick for short-term exits.

2.4.3. **Foundation Course**. Provide a foundation course consisting of flexible base, bituminous concrete, hydraulic cement concrete, or other materials as shown on the plans or directed.

2.5. **Embankment for Erosion Control**. Provide rock, loam, clay, topsoil, or other earth materials that will form a stable embankment to meet the intended use.

2.6. **Pipe**. Provide pipe outlet material in accordance with Item 556 and as shown on the plans.

2.7. **Construction Perimeter Fence**.

2.7.1. **Posts**. Provide essentially straight wood or steel posts that are at least 60 in. long. Furnish soft wood posts with a minimum diameter of 3 in. or use nominal 2 × 4-in. boards. Furnish hardwood posts with a minimum cross-section of 1-1/2 × 1-1/5 in. Furnish T- or L-shaped steel posts with a minimum weight of 1.25 lb. per foot.

2.7.2. **Fence**. Provide orange construction fencing as approved.

2.7.3. **Fence Wire**. Provide 14-gauge or larger galvanized smooth or twisted wire. Provide 16-gauge or larger tie wire.

2.7.4. **Flagging**. Provide brightly colored flagging that is fade-resistant and at least 3/4 in. wide to provide maximum visibility both day and night.

2.7.5. **Staples**. Provide staples with a crown at least 1/2 in. wide and legs at least 1/2 in. long.

2.7.6. **Used Materials**. Previously used materials meeting the applicable requirements may be used if approved.

2.8. **Sandbags**. Provide sandbag material of polypropylene, polyethylene, or polyamide woven fabric with a minimum unit weight of 4 oz. per square yard, a Mullen burst-strength exceeding 300 psi, and an ultraviolet (UV) stability exceeding 70%.

Use natural coarse sand or manufactured sand meeting the gradation shown in Table 1 to fill sandbags. Filled sandbags must be 24–30 in. long, 16–18 in. wide, and 6–8 in. thick.

Table 1
Sand Gradation

Sieve Size	Retained (% by Weight)
#4	Maximum 3%
#100	Minimum 80%
#200	Minimum 95%

Aggregate may be used instead of sand for situations where sandbags are not adjacent to traffic. The aggregate size must not exceed 3/8 in.

2.9. **Temporary Sediment Control Fence**. Provide a net-reinforced fence using woven geotextile fabric. Logos visible to the traveling public will not be allowed.

2.9.1. **Fabric**. Provide fabric materials in accordance with DMS-6230, "Temporary Sediment Control Fence Fabric."

2.9.2. **Posts**. Provide essentially straight wood or steel posts with a minimum length of 48 in., unless otherwise shown on the plans. Furnish soft wood posts at least 3 in. in diameter or use nominal 2 × 4-in. boards. Furnish hardwood posts with a minimum cross-section of 1-1/2 × 1-1/2 in. Furnish T- or L-shaped steel posts with a minimum weight of 1.25 lb. per foot.

2.9.3. **Net Reinforcement**. Provide net reinforcement of at least 12.5-gauge (Standard Wire Gauge) galvanized welded wire mesh, with a maximum opening size of 2 × 4 in., at least 24 in. wide, unless otherwise shown on the plans.

2.9.4. **Staples**. Provide staples with a crown at least 3/4 in. wide and legs 1/2 in. long.

2.9.5. **Used Materials**. Use recycled material meeting the applicable requirements if approved.

2.10. **Biodegradable Erosion Control Logs**.

2.10.1. **Core Material**. Furnish core material that is biodegradable or recyclable. Use compost, mulch, aspen excelsior wood fibers, chipped site vegetation, agricultural rice or wheat straw, coconut fiber, 100% recyclable fibers, or any other acceptable material unless specifically shown on the plans. Permit no more than 5% of the material to escape from the containment mesh. Furnish compost in accordance with Item 161.

2.10.2. **Containment Mesh**. Furnish containment mesh that is 100% biodegradable, photodegradable, or recyclable, such as burlap, twine, UV photodegradable plastic, polyester, or any other acceptable material.

Furnish biodegradable or photodegradable containment mesh when log will remain in place as part of a vegetative system.

Furnish recyclable containment mesh for temporary installations.

2.10.3. **Size**. Furnish biodegradable erosion control logs with diameters as shown on the plans or as directed. Stuff containment mesh densely so logs do not deform.

3. QUALIFICATIONS, TRAINING, AND EMPLOYEE REQUIREMENTS

3.1. **Contractor Responsible Person Environmental (CRPE) Qualifications and Responsibilities**. Provide and designate in writing at the preconstruction conference a CRPE and alternate CRPE who have overall responsibility for managing environmental compliance. The CRPE will implement stormwater and erosion control practices, oversee and observe stormwater control measure monitoring and management, oversee environmental compliance requirements, and monitor the project site daily and produce daily monitoring reports as long as there are BMPs in place or soil disturbing activities are evident to ensure compliance with the SWP3 and TPDES CGP TXR150000. Take required training in accordance with Section 7.7.4.4, "Training."

Maintain daily monitor reports and make them available within 24 hr. upon request. During time suspensions when work is not occurring or on Contract non-work days, daily inspections are not required unless a rain event has occurred. The CRPE will provide recommendations on how to improve the effectiveness of control measures. Attend the Department's preconstruction conference for the project.

Ensure training is completed in accordance with Section 7.7.4.4., "Training," by all applicable personnel before employees work on the project. Document, maintain, and make available within 24 hr. of a request, a list, signed by the CRPE, of all applicable Contractor and subcontractor employees who have completed the training. Include the employee's name, the training course name, and the date the employee completed the training.

3.2. **Contractor Superintendent Qualifications and Responsibilities**. Provide a superintendent who is competent, has experience with and knowledge of stormwater management, and is knowledgeable of the requirements and the conditions of the TPDES CGP TXR150000. The superintendent will manage and oversee the day-to-day operations and activities at the project site, work with the CRPE to provide effective stormwater management at the project site, represent and act on behalf of the Contractor, and attend the Department's preconstruction conference for the project. Take training as required in Section 7.7.4.4., "Training."

4. CONSTRUCTION

4.1. **Contractor Responsibilities**. Implement the SWP3 for the project site in accordance with the plans and specifications, TPDES CGP TXR150000, and as directed. Coordinate stormwater management with all other work on the project. Develop and implement an SWP3 for project-specific material supply plants within and outside the Department's right of way in conformance with the specific or general stormwater permit requirements. Prevent water pollution from stormwater associated with construction activity from entering any surface water or private property on or adjacent to the project site.

4.2. **Implementation**. The CRPE, or alternate CRPE, must be accessible by telephone and able to respond to project-related stormwater management or other environmental emergencies 24 hr. per day.

4.2.1. **Commencement**. Implement the SWP3 as shown on the plans and as directed. Contractor-proposed recommendations for changes will be allowed as approved. Conform to the established guidelines in the TPDES CGP TXR150000 to make changes. Do not implement changes until approval has been received and changes have been incorporated into the plans. Minor adjustments to meet field conditions are allowed and will be recorded in the SWP3.

4.2.2. **Phasing**. Implement control measures before the commencement of activities that result in soil disturbance. Phase and minimize the soil disturbance to the areas shown on the plans. Coordinate temporary control measures with permanent control measures and all other work activities on the project to assure economical, effective, safe, and continuous water pollution prevention. Provide control measures that are appropriate to the construction means, methods, and sequencing allowed by the Contract. Exercise precaution throughout the life of the project to prevent pollution of ground waters and surface waters. Schedule and perform clearing and grubbing operations so that stabilization measures will follow immediately thereafter if project conditions permit. Bring all grading sections to final grade as soon as possible and implement temporary and permanent control measures at the earliest time possible. Implement temporary control measures when required by TPDES CGP TXR150000 or otherwise necessitated by project conditions.

Do not prolong final grading and shaping. Preserve vegetation where possible throughout the project, and minimize clearing, grubbing, and excavation within stream banks, bed, and approach sections.

4.3. **General**.

4.3.1. **Temporary Alterations or Control Measure Removal**. Altering or removal of control measures is allowed when control measures are restored within the same working day.

4.3.2. **Stabilization**. Initiate stabilization for disturbed areas no more than 14 days after the construction activities in that portion of the site have temporarily or permanently ceased. Establish a uniform vegetative cover or use another stabilization practice in accordance with TPDES CGP TXR150000.

4.3.3. **Finished Work**. Remove and dispose of all temporary control measures upon acceptance of vegetative cover or other stabilization practice unless otherwise directed. Complete soil disturbing activities and establish a uniform perennial vegetative cover. A project will not be considered for acceptance until a vegetative cover of 70% density of existing adjacent undisturbed areas is obtained or equivalent permanent stabilization is obtained in accordance with TPDES CGP TXR150000. The Engineer may accept the work before vegetative cover of 70% density of existing adjacent undisturbed areas. An exception will be allowed in arid areas as defined in TPDES CGP TXR150000.

4.3.4. **Restricted Activities and Required Precautions**. Do not discharge onto the ground or into surface waters any pollutants such as chemicals, raw sewage, fuels, lubricants, coolants, hydraulic fluids, bitumens, or any other petroleum product. Operate and maintain equipment onsite to prevent actual or potential water pollution. Manage, control, and dispose of litter onsite such that no adverse impacts to water quality occur. Prevent dust from creating a potential or actual unsafe condition, public nuisance, or condition endangering the value, utility, or appearance of any property. Wash out concrete trucks only as described in TPDES CGP TXR150000. Use appropriate controls to minimize the offsite transport of suspended sediments and other pollutants if it is necessary to pump or channel standing water (i.e., dewatering). Immediately address chemical and hydrocarbon spills caused by the Contractor. Keep a spill kit onsite. Prevent discharges that would contribute to a violation of Edwards Aquifer Rules, water quality standards, the impairment of a listed water body, or other state or federal law.

4.4. **Installation, Maintenance, and Removal Work**. Perform work in accordance with the SWP3, in conformance with manufacturers' guidelines, and in accordance with TPDES CGP TXR150000. Install and maintain the integrity of temporary erosion and sedimentation control devices to accumulate silt and debris until soil disturbing activities are completed and permanent erosion control features are in place, or the disturbed area has been adequately stabilized as approved.

The Department will inspect and document the condition of the control measures at the frequency shown on the plans and will provide the Construction SWP3 Field Inspection and Maintenance Reports to the Contractor. Make corrections as soon as possible before the next anticipated rain event or within 7 calendar days after being able to enter the worksite for each control measure. The only acceptable reason for not accomplishing the corrections within the timeframe specified is when site conditions are considered "too wet to work." Take immediate action if a correction is deemed critical as directed. When corrections are not made within the established timeframe, all work will cease on the project and time charges will continue while the control measures are brought into compliance. Commence work once the Engineer reviews and documents the project is in compliance. Commencing work does not release the Contractor of the liability for noncompliance with the SWP3, the plans, or TPDES CGP TXR150000.

The Engineer may limit the disturbed area if the Contractor cannot control soil erosion and sedimentation resulting from the Contractor's operations. Implement additional controls as directed.

Remove devices upon approval or as directed. Finish-grade and dress the area upon removal. Stabilize disturbed areas in accordance with TPDES CGP TXR150000, and as shown on the plans or directed. Materials removed are considered consumed by the project. Retain ownership of stockpiled material and remove it from the project when new installations or replacements are no longer required.

4.4.1. **Rock Filter Dams for Erosion Control**. Remove trees, brush, stumps, and other objectionable material that may interfere with the construction of rock filter dams. Place sandbags as a foundation when required or at the Contractor's option.

Place the aggregate to the lines, height, and slopes specified, without undue voids for Types 1, 2, 3, and 5. Place the aggregate on the mesh and then fold the mesh at the upstream side over the aggregate and secure it to itself on the downstream side using wire ties, or hog rings for Type 2 and Type 3, or as directed.

Place rock filter dams perpendicular to the flow of the stream or channel unless otherwise directed. Construct filter dams in accordance with the following criteria unless otherwise shown on the plans.

4.4.1.1. **Type 1 (Non-Reinforced)**.

- **Height**. At least 18 in. measured vertically from existing ground to top of filter dam.
- **Top Width**. At least 2 ft.
- **Slopes**. No steeper than 2:1.

4.4.1.2. **Type 2 (Reinforced)**.

- **Height**. At least 18 in. measured vertically from existing ground to top of filter dam.
- **Top Width**. At least 2 ft.
- **Slopes**. No steeper than 2:1.

4.4.1.3. **Type 3 (Reinforced)**.

- **Height**. At least 36 in. measured vertically from existing ground to top of filter dam.
- **Top Width**. At least 2 ft.
- **Slopes**. No steeper than 2:1.

4.4.1.4. **Type 4 (Sack Gabions)**. Unfold sack gabions and smooth out kinks and bends. Connect the sides by lacing in a single-loop-double-loop pattern on 4–5-in. spacing for vertical filling. Pull the end lacing rod at one end until tight, wrap around the end, and twist four times. Fill with stone at the filling end, pull the rod tight, cut the wire with approximately 6 in. remaining, and twist wires four times.

Place the sack flat in a filling trough, fill with stone, connect sides, and secure ends as described above for horizontal filling.

Lift and place without damaging the gabion. Shape sack gabions to existing contours.

4.4.1.5. **Type 5**. Provide rock filter dams as shown on the plans.

4.4.2. **Temporary Pipe Slope Drains**. Install pipe with a slope as shown on the plans or as directed. Construct embankment for the drainage system in 8-in. lifts to the required elevations. Hand-tamp the soil around and under the entrance section to the top of the embankment as shown on the plans or as directed. Form the top of the embankment or earth dike over the pipe slope drain at least 1 ft. higher than the top of the inlet pipe at all points. Secure the pipe with hold-downs or hold-down grommets spaced at most 10 ft. on center. Construct the energy dissipaters or sediment traps as shown on the plans or as directed. Construct the sediment trap using concrete or rubble riprap in accordance with Item 432, when shown on the plans.

4.4.3. **Temporary Paved Flumes**. Construct paved flumes as shown on the plans or as directed. Provide excavation and embankment (including compaction of the subgrade) of material to the dimensions shown on the plans unless otherwise indicated. Install a rock or rubble riprap energy dissipater, constructed from the materials specified above, to a minimum depth of 9 in. at the flume outlet to the limits shown on the plans or as directed.

4.4.4. **Construction Exits**. Prevent traffic from crossing or exiting the construction site or moving directly onto a public roadway, alley, sidewalk, parking area, or other right of way areas other than at the location of construction exits when tracking conditions exist. Construct exits for either long- or short-term use.

4.4.4.1. **Long-Term**. Place the exit over a foundation course as required. Grade the foundation course or compacted subgrade to direct runoff from the construction exits to a sediment trap as shown on the plans or as directed. Construct exits with a width of at least 14 ft. for one-way and 20 ft. for two-way traffic for the full width of the exit, or as directed.

4.4.4.1.1. **Type 1**. Construct to a depth of at least 8 in. using crushed aggregate as shown on the plans or as directed.

4.4.4.1.2. **Type 2**. Construct using railroad ties and timbers as shown on the plans or as directed.

4.4.4.2. **Short-Term**.

4.4.4.2.1. **Type 3**. Construct using crushed aggregate, plywood, or wafer board. This type of exit may be used for daily operations where long-term exits are not practical.

4.4.4.2.2. **Type 4**. Construct as shown on the plans or as directed.

4.4.5. **Earthwork for Erosion Control**. Perform excavation and embankment operations to minimize erosion and to remove collected sediments from other erosion control devices.

4.4.5.1. **Excavation and Embankment for Erosion Control Features**. Place earth dikes, swales, or combinations of both along the low crown of daily lift placement, or as directed, to prevent runoff spillover. Place swales and dikes at other locations as shown on the plans or as directed to prevent runoff spillover or to divert runoff. Construct cuts with the low end blocked with undisturbed earth to prevent erosion of hillsides. Construct sediment traps at drainage structures in conjunction with other erosion control measures as shown on the plans or as directed.

Create a sediment basin, where required, providing 3,600 cu. ft. of storage per acre drained, or equivalent control measures for drainage locations that serve an area with 10 or more disturbed acres at one time, not including offsite areas.

4.4.5.2. **Excavation of Sediment and Debris**. Remove sediment and debris when accumulation affects the performance of the devices, after a rain, and when directed.

4.4.6. **Construction Perimeter Fence**. Construct, align, and locate fencing as shown on the plans or as directed.

4.4.6.1. **Installation of Posts**. Embed posts 18 in. deep or adequately anchor in rock, with a spacing of 8–10 ft.

4.4.6.2. **Wire Attachment**. Attach the top wire to the posts at least 3 ft. from the ground. Attach the lower wire midway between the ground and the top wire.

4.4.6.3. **Flag Attachment**. Attach flagging to both wire strands midway between each post. Use flagging at least 18 in. long. Tie flagging to the wire using a square knot.

4.4.7. **Sandbags for Erosion Control**. Construct a berm or dam of sandbags that will intercept sediment-laden stormwater runoff from disturbed areas, create a retention pond, detain sediment, and release water in sheet flow. Fill each bag with sand so that at least the top 6 in. of the bag is unfilled to allow for proper tying of the open end. Place the sandbags with their tied ends in the same direction. Offset subsequent rows of sandbags 1/2 the length of the preceding row. Place a single layer of sandbags downstream as a secondary debris trap. Place additional sandbags as necessary or as directed for supplementary support to berms or dams of sandbags or earth.

4.4.8. **Temporary Sediment Control Fence**. Provide temporary sediment control fence near the downstream perimeter of a disturbed area to intercept sediment from sheet flow. Incorporate the fence into erosion control measures used to control sediment in areas of higher flow. Install the fence as shown on the plans, in accordance with this Section, or as directed.

4.4.8.1. **Installation of Posts**. Embed posts at least 18 in. deep or adequately anchor, if in rock, with a spacing of 6--8 ft., and install on a slight angle toward the runoff source.

4.4.8.2. **Fabric Anchoring**. Dig trenches along the uphill side of the fence to anchor 6–8 in. of fabric. Provide a minimum trench cross-section of 6 × 6 in. Place the fabric against the side of the trench and align approximately 2 in. of fabric along the bottom in the upstream direction. Backfill the trench, then hand-tamp.

4.4.8.3. **Fabric and Net Reinforcement Attachment**. Attach the reinforcement to wooden posts using staples, or to steel posts using T-clips, in at least four places equally spaced unless otherwise shown on the plans. Sewn vertical pockets may be used to attach reinforcement to end posts. Fasten the fabric to the top strand of reinforcement using hog rings or cord every 15 in. or less.

4.4.8.4. **Fabric and Net Splices**. Locate splices at a fence post with a minimum lap of 6 in. attached in at least six places equally spaced unless otherwise shown on the plans. Do not locate splices in concentrated flow areas.

Requirements for installation of used temporary sediment control fence include the following:

- fabric with minimal or no visible signs of biodegradation (weak fibers),
- fabric without excessive patching (more than one patch every 15–20 ft.),
- posts without bends, and
- backing without holes.

4.4.9. **Biodegradable Erosion Control Logs**. Install biodegradable erosion control logs near the downstream perimeter of a disturbed area to intercept sediment from sheet flow. Incorporate the biodegradable erosion control logs into the erosion measures used to control sediment in areas of higher flow. Install, align, and locate the biodegradable erosion control logs as specified below, as shown on the plans, or as directed.

Secure biodegradable erosion control logs in a method adequate to prevent displacement resulting from normal rain events, to prevent damage to the logs, and as approved, such that flow is not allowed under the logs. Temporarily removing and replacing biodegradable erosion logs to facilitate daily work is allowed at the Contractor's expense.

4.4.10. **Vertical Tracking**. Perform vertical tracking on slopes to temporarily stabilize soil. Provide equipment with a track undercarriage capable of producing a linear soil impression measuring at least 12 in. long × 2–4 in. wide × 1/2–2 in. deep. Do not exceed 12 in. between track impressions. Install continuous linear track impressions where the 12-in. length impressions are perpendicular to the slope. Vertical tracking is required on projects where soil disturbing activities have occurred, unless otherwise approved.

4.5. **Monitoring and Documentation**. Monitor the control measures daily as long as there are BMPs in place or soil disturbing activities are evident to ensure compliance with the SWP3 and TPDES CGP TXR150000. During time suspensions when work is not occurring or contract non-work days, daily inspections are not required unless a rain event has occurred. Monitoring will consist of, but is not limited to, observing, inspecting, and documenting site locations with control measures and discharge points to provide maintenance and inspection of controls in accordance with the SWP3. Keep written records of daily monitoring. Document in the daily monitoring report the control measure condition, the date of inspection, required corrective actions, the responsible person for making the corrections, and the date corrective actions were completed. Maintain records of all monitoring reports at the project site or at an approved place. Provide copies within 7 days. Together, the CRPE and an Engineer's representative will complete the Construction Stage Gate Checklist periodically as directed.

5. MEASUREMENT

5.1. **~~Rock Filter Dams~~**. ~~Installation or removal of rock filter dams will be measured by the foot or by the cubic yard. The measured volume will include sandbags, when used.~~ Erosion Control will be measured by the Lump Sum to furnish, install, maintain, and remove erosion control devices and features as shown on plans and as required by the specifications.

~~5.1.1. **Linear Measurement**. When rock filter dams are measured by the foot, measurement will be along the centerline of the top of the dam.~~

~~5.1.2. **Volume Measurement**. When rock filter dams are measured by the cubic yard, measurement will be based on the volume of rock computed by the method of average end areas.~~

5.1.2.1. **Installation**. Measurement will be made in final position.

5.1.2.2. **Removal**. Measurement will be made at the point of removal.

5.2. **Temporary Pipe Slope Drains**. Temporary pipe slope drains will be measured by the foot.

5.3. **Temporary Paved Flumes**. Temporary paved flumes will be measured by the square yard of surface area. The measured area will include the energy dissipater at the flume outlet.

5.4. **Construction Exits**. Construction exits will be measured by the square yard of surface area.

5.5. **Earthwork for Erosion and Sediment Control**.

5.5.1. **Equipment and Labor Measurement**. Equipment and labor used will be measured by the actual number of hours the equipment is operated and the labor is engaged in the work.

5.5.2. **Volume Measurement**.

5.5.2.1. **In Place**.

5.5.2.1.1. **Excavation**. Excavation will be measured by the cubic yard in its original position and the volume computed by the method of average end areas.

5.5.2.1.2. **Embankment**. Embankment will be measured by the cubic yard in its final position by the method of average end areas. The volume of embankment will be determined between:

- the original ground surfaces or the surface upon which the embankment is to be constructed for the feature and
- the lines, grades, and slopes of the accepted embankment for the feature.

5.5.2.2. **In Vehicles**. Excavation and embankment quantities will be combined and paid for under "Earthwork (Erosion and Sediment Control, In Vehicle)." Excavation will be measured by the cubic yard in vehicles at the point of removal. Embankment will be measured by the cubic yard in vehicles measured at the point of delivery. Shrinkage or swelling factors will not be considered in determining the calculated quantities.

5.6. **Construction Perimeter Fence**. Construction perimeter fence will be measured by the foot.

5.7. **Sandbags for Erosion Control**. Sandbags will be measured as each sandbag or by the foot along the top of sandbag berms or dams.

5.8. **Temporary Sediment Control Fence**. Installation or removal of temporary sediment control fence will be measured by the foot.

5.9. **Biodegradable Erosion Control Logs**. Installation or removal of biodegradable erosion control logs will be measured by the foot along the centerline of the top of the control logs.

5.10. **Vertical Tracking**. Vertical tracking will not be measured or paid for directly, but will be subsidiary to this Item.

6. PAYMENT

The following will not be paid for directly, but will be subsidiary to pertinent Items:

- erosion control measures for Contractor project-specific locations (PSLs) inside and outside the right of way (e.g., construction and haul roads, field offices, equipment and supply areas, plants, and material sources);
- removal of litter, unless a separate pay item is shown on the plans;

- repair to devices and features damaged by Contractor operations;
- added measures and maintenance needed due to negligence, carelessness, lack of maintenance, and failure to install permanent controls;
- removal and reinstallation of devices and features needed for the convenience of the Contractor;
- finish grading and dressing upon removal of the device; and
- minor adjustments including but not limited to plumbing posts, reattaching fabric, minor grading to maintain slopes on an erosion embankment feature, or moving small numbers of sandbags.

Stabilization of disturbed areas will be paid for under pertinent Items except vertical tacking, which will be subsidiary.

Furnishing and installing pipe for outfalls associated with sediment traps and ponds will not be paid for directly, but will be subsidiary to the excavation and embankment under this Item.

6.1. **Rock Filter Dams**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid as follows. Erosion Control will be paid by the Lump Sum to furnish, install, maintain, and remove erosion control devices and features as shown on plans and as required by the specifications.

6.1.1. **Installation**. Installation will be paid for as "Rock Filter Dams (Install)" of the type and slope as specified. This price is full compensation for furnishing and operating equipment, finish backfill and grading, lacing, proper disposal, labor, materials, tools, and incidentals.

6.1.2. **Removal**. Removal will be paid for as "Rock Filter Dams (Remove)." This price is full compensation for furnishing and operating equipment, proper disposal, labor, materials, tools, and incidentals.

When the Engineer directs that the rock filter dam installation or portions thereof be replaced, payment will be made at the unit price bid for "Rock Filter Dams (Remove)" and for "Rock Filter Dams (Install)" of the type specified. This price is full compensation for furnishing and operating equipment, finish backfill and grading, lacing, proper disposal, labor, materials, tools, and incidentals.

6.2. **Temporary Pipe Slope Drains**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Temporary Pipe Slope Drains" of the size specified. This price is full compensation for furnishing materials, removal and disposal, furnishing and operating equipment, labor, tools, and incidentals.

Removal of temporary pipe slope drains will not be paid for directly, but will be subsidiary to the installation Item. When the Engineer directs that the pipe slope drain installation or portions thereof be replaced, payment will be made at the unit price bid for "Temporary Pipe Slope Drains" of the size specified, which is full compensation for the removal and reinstallation of the pipe drain.

Earthwork required for the pipe slope drain installation, including construction of the sediment trap, will be measured and paid for under "Earthwork for Erosion and Sediment Control."

Riprap concrete or stone, when used as an energy dissipater or as a stabilized sediment trap, will be measured and paid for in accordance with Item 432.

6.3. **Temporary Paved Flumes**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Temporary Paved Flume (Install)" or "Temporary Paved Flume (Remove)." This price is full compensation for furnishing and placing materials, removal and disposal, equipment, labor, tools, and incidentals.

When the Engineer directs that the paved flume installation or portions thereof be replaced, payment will be made at the unit prices bid for "Temporary Paved Flume (Remove)" and "Temporary Paved Flume (Install)." These prices are full compensation for the removal and replacement of the paved flume and for equipment, labor, tools, and incidentals.

Earthwork required for the paved flume installation, including construction of a sediment trap, will be measured and paid for under "Earthwork for Erosion and Sediment Control."

6.4. **Construction Exits**. Contractor-required construction exits from off right of way locations or on right of way PSLs will not be paid for directly, but will be subsidiary to pertinent Items.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" for construction exits needed on right of way access to work areas required by the Department will be paid for at the unit price bid for "Construction Exits (Install)" of the type specified or "Construction Exits (Remove)." This price is full compensation for furnishing and placing materials, excavating, removal and disposal, cleaning vehicles, labor, tools, and incidentals.

When the Engineer directs that a construction exit or portion thereof be removed and replaced, payment will be made at the unit prices bid for "Construction Exit (Remove)" and "Construction Exit (Install)" of the type specified. These prices are full compensation for the removal and replacement of the construction exit and for equipment, labor, tools, and incidentals.

Construction of sediment traps used in conjunction with the construction exit will be measured and paid for under "Earthwork for Erosion and Sediment Control."

6.5. **Earthwork for Erosion and Sediment Control**.

6.5.1. **Initial Earthwork for Erosion and Sediment Control**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Excavation (Erosion and Sediment Control, In Place)," "Embankment (Erosion and Sediment Control, In Place)," "Excavation (Erosion and Sediment Control, In Vehicle)," "Embankment (Erosion and Sediment Control, (In Vehicle)," or "Earthwork (Erosion and Sediment Control, In Vehicle)."

This price is full compensation for excavation and embankment, including hauling; disposal of material not used elsewhere on the project; embankments including furnishing material from approved sources and construction of erosion control features; and equipment, labor, tools, and incidentals.

Sprinkling and rolling required by this Item will not be paid for directly, but will be subsidiary to this Item.

6.5.2. **Maintenance Earthwork for Erosion and Sediment Control for Cleaning and Restoring Control Measures**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid under a Contractor Force Account Item from invoice provided to the Engineer.

This price is full compensation for excavation, embankment, and re-grading, including dewatering for removal of accumulated sediment, and the removal of accumulated sediment in various erosion control installations as directed, hauling, and disposal of material not used elsewhere on the project; excavation for construction of erosion control features; embankments, including furnishing material from approved sources and construction of erosion control features; and equipment, labor, tools, and incidentals.

Earthwork needed to remove and obliterate erosion control features will not be paid for directly, but will be subsidiary to pertinent Items unless otherwise shown on the plans.

Sprinkling and rolling required by this Item will not be paid for directly, but will be subsidiary to this Item.

6.6. **Construction Perimeter Fence**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Construction Perimeter Fence." This price is full compensation for furnishing and placing the fence; digging, fence posts, wire, and flagging; removal and disposal; and materials, equipment, labor, tools, and incidentals.

Removal of construction perimeter fence will not be paid for directly, but will be subsidiary to the installation Item. When the Engineer directs that the perimeter fence installation or portions thereof be removed and

replaced, payment will be made at the unit price bid for "Construction Perimeter Fence," which is full compensation for the removal and reinstallation of the construction perimeter fence.

6.7. **Sandbags for Erosion Control**. Sandbags will be paid for at the unit price bid for "Sandbags for Erosion Control" (of the height specified when measurement is by the foot). This price is full compensation for materials, placing sandbags, removal and disposal, equipment, labor, tools, and incidentals.

Removal of sandbags will not be paid for directly, but will be subsidiary to the installation Item. When the Engineer directs that the sandbag installation or portions thereof be replaced, payment will be made at the unit price bid for "Sandbags for Erosion Control," which is full compensation for the reinstallation of the sandbags.

6.8. **Temporary Sediment Control Fence**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid as follows.

6.8.1. **Installation**. Installation will be paid for as "Temporary Sediment-Control Fence (Install)." This price is full compensation for furnishing and operating equipment, finish backfill and grading, lacing, proper disposal, labor, materials, tools, and incidentals.

6.8.2. **Removal**. Removal will be paid for as "Temporary Sediment-Control Fence (Remove)." This price is full compensation for furnishing and operating equipment, proper disposal, labor, materials, tools, and incidentals.

6.9. **Biodegradable Erosion Control Logs**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid as follows.

6.9.1. **Installation**. Installation will be paid for as "Biodegradable Erosion Control Logs (Install)" of the size specified. This price is full compensation for furnishing and operating equipment, finish backfill and grading, staking, proper disposal, labor, materials, tools, and incidentals.

6.9.2. **Removal**. Removal will be paid for as "Biodegradable Erosion Control Logs (Remove)." This price is full compensation for furnishing and operating equipment, proper disposal, labor, materials, tools, and incidentals.

6.10. **Vertical Tracking**. Vertical tracking will not be measured or paid for directly, but will be subsidiary to this Item.

Erosion Control will be paid for by the Lump Sum to furnish, install, maintain, and remove erosion control devices and features as shown on the plans and required by the specifications.

Item ST-P-311 Pavement Fabric

DESCRIPTION

311-1.1 This item shall consist of furnishing and installing a paving mat on an existing pavement surface in the construction areas as shown on the plans.

MATERIALS

311-2.1 Paving mat shall be constructed of continuous high strength fiberglass fibers embedded between two spun bond polyester textiles conforming to the following test methods and physical properties.

Property	Test Method	Units	Type I
Mass per Unit Area	ASTM D5261	oz/yd²	4.0
Wide Width Tensile Strength, MD	ASTM D5035	lbs/in	45
Wide Width Tensile Strength, CD	ASTM D5035	lbs/in	45
Wide Width Elongation, MD	ASTM D5035	%	≤ 5.0
Melting Point	ASTM D276	°F	>446
Asphalt Retention	ASTM D6140	gal/yd²	0.21
Shrinkage	Tex-616-J	%	0

STORAGE

311-3.1 Paving mat rolls shall be furnished with suitable wrapping to protect against moisture and extended ultraviolet exposure prior to placement.

311-3.2 Each roll shall be tagged or labeled with the name of the product and manufacturer. All rolls shall be tagged or labeled with the width, length, and unique roll number for quality tracking purposes. The tag or label shall be securely fastened to the outside of the roll.

311-3.3 Rolls shall be stored and handled in a manner to prevent damage.

311-3.4 After unloading, inspect rolls for defects and damage.

311-3.5 Paving mat shall be stored according to the manufacturer's recommendations in a dry covered condition, free from dust, dirt and moisture.

311.3.6 Rolls shall be stored off ground, protected from precipitation, ultraviolet radiation, strong chemicals, sparks and flames, temperatures in excess of 71 °C (160 °F) and other environmental conditions that could cause damage to paving mat.

CONSTRUCTION METHODS

311-4.1 Pavement Preparation

a. Before applying binder, cracks greater than 6 mm (0.25 inch) shall be filled as directed by the engineer, pot holes and depressions in existing pavement shall be repaired as directed by the Engineer.

b. Immediately prior to placing binder, paving mat, and asphalt concrete surfacing, the pavement shall be cleaned of loose and extraneous materials such as, but not limited to, vegetation, sand, dirt, gravel and water.

c. If finish or profile milling has been performed, a leveling course is typically not required prior to placement of paving mat. This will depend on the smoothness of the surface created during the milling operation and the specific interlayer material being placed. The milling equipment and operation shall have the capability to;

    1) Remove asphalt concrete a minimum depth of 6 mm (0.25 inch)

    2) Provide a surface relief (distance between ridges) of no more than 6 mm (0.25 inch)

    3) Maintain a 6 mm (0.25 inch) grade tolerance over the surface (transverse and longitudinally)

    4) There shall be no more than 6 mm (0.25 inch) vertical height variation between planed and un-planed surface at inside edge of conform and taper mills

    5) If Cold Planning is performed, a leveling course is required prior to placement of paving mat.

d. A leveling course is required over all Portland cement concrete pavements prior to placement of paving mat.

311-4.2 Asphalt Cement Tack Coat Installation

a. Apply tack coat as required to saturate paving mat at a rate between 0.45 to 0.67 l/m^2 (0.10 to 0.15 gal/yd^2), based on relative porosity of existing pavement, ambient temperature, and specified tack coat.

b. Apply tack coat by distributor truck in smooth, uniform manner at temperature below 149 degrees C (300 degrees F). Spray application approximately 30 cm (1 inch) wider than width of paving mat.

c. Asphaltic emulsion shall not be substituted for paving asphalt binder for paving mats.

d. All traffic shall be kept off the tack coat.

311-4.3 Paving Mat Installation

a. Provide a manufacturer's representative at project site during the first day of installation of the paving mat. Provide manufacturer at least 2 weeks notice prior to installation.

b. The paving mat shall be installed with the use of a mechanical tractor specially equipped truck mounted fabric installer, or manually.

c. If manual laydown methods are used, the paving mat shall be unrolled, aligned, and placed in increments of approximately 9.0 m (30 ft).

d. The paving mat shall be aligned and placed with no wrinkles that lap.

e. Keep the material flat and wrinkle-free. The paving mat installation may require hand brooming. Hand brooming is necessary to eliminate ripples that may occur during installation.

f. For sharp curves, cut material, realign and lap in the direction of the placement of the asphalt overlay.

g. Paving mat shall be lapped 5-10 cm (2 to 4 inches) longitudinally to any adjacent paving mat material.

h. All paving mat applied shall be transversely lapped 5-10 cm (2 to 4 inches) in the direction of the placement of the asphalt overlay.

i. At paving mat overlaps, both the binder and the mat shall overlap previously placed mat by the same amount.

j. If the paving mat wrinkles during installation, and the height of the wrinkle is 1.6 cm (5/8 inches) or more, the wrinkle shall be cut and then lapped in the direction of paving.

k. Pneumatic rolling equipment shall be permitted on the paving mat after placement. If excess binder is present, the exposed binder may be covered lightly with sand to protect the paving mat from damage.

l. Turning of the paving equipment and other vehicles shall be gradual and kept to a minimum to avoid damage to the paving mat. If excessive turning cannot be eliminated then small quantities of asphalt concrete are permitted to be broadcast onto the paving mat.

m. Paving mat shall not be exposed to public traffic or kept to a minimum except where deemed necessary by the Engineer. At the discretion of the Engineer, traffic may be allowed to cross the mat under traffic control after the Contractor has placed a small quantity of asphalt concrete or sand over the paving mat.

n. Surface and ambient temperature during fabric installation shall be warm enough to allow adequate "tack" from the asphalt binder to hold the paving mat in place. A minimum temperature for application of most asphalt cement binders is approximately 10°C (50°F) and rising however the temperature shall not be below the project specifications except as waived by the Engineer.

311-4.4 Hot Mix Overlay

The asphalt overlay shall be constructed per the requirements of asphalt specifications and will be paid under that item.

As required by the Engineer, a small quantity of asphalt concrete may be broadcast over the paving mat in order to prevent the mat from being damaged by construction equipment.

The paving mat must be paved over on the day of placement.

METHOD OF MEASUREMENT

311-5.1 Pavement Fabric shall be measured by the number of square yards of area covered measured in its final position. Pay quantities will be computed to the neat lines staked by the Contractor in accordance with the plans or as directed by the Engineer. Measurement will not include the lapping of transverse or longitudinal joints.

BASIS OF PAYMENT

311-6.1 Payment shall be made at the contract unit price per square yard for Pavement Fabric. The price shall be full compensation for furnishing all materials, for all preparation and placing the materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

ST-P-311-6.1 Pavement Fabric, per Square Yard.

END OF ITEM ST-P-311

Item P-101 Preparation/Removal of Existing Pavements

DESCRIPTION

101-1 This item shall consist of preparation of existing pavement surfaces for overlay, surface treatments, removal of existing pavement, and other miscellaneous items. The work shall be accomplished in accordance with these specifications and the applicable plans.

EQUIPMENT AND MATERIALS

101-2 All equipment and materials shall be specified here and in the following paragraphs or approved by the Resident Project Representative (RPR). The equipment shall not cause damage to the pavement to remain in place.

CONSTRUCTION

101-3.1 Removal of existing pavement.

The Contractor's removal operation shall be controlled to not damage adjacent pavement structure, and base material, cables, utility ducts, pipelines, or drainage structures which are to remain under the pavement.

a. Asphalt pavement removal. Asphalt pavement to be removed shall be cut to the full depth of the asphalt pavement around the perimeter of the area to be removed.

b. Repair or removal of Base, Subbase, and/or Subgrade. All failed material including surface, base course, subbase course, and subgrade shall be removed and repaired as shown on the plans or as directed by the RPR. Materials and methods of construction shall comply with the applicable sections of these specifications. Any damage caused by Contractor's removal process shall be repaired at the Contractor's expense.

101-3.2 Preparation of joints and cracks prior to overlay/surface treatment. Remove all vegetation and debris from cracks to a minimum depth of 1 inch (25 mm). If extensive vegetation exists, treat the specific area with a concentrated solution of a water-based herbicide approved by the RPR. Fill all cracks greater than 1/4 inch (6 mm) wide) with a crack sealant per ASTM D6690. The crack sealant, preparation, and application shall be compatible with the surface treatment/overlay to be used. To minimize contamination of the asphalt with the crack sealant, underfill the crack sealant a minimum of 1/8 inch (3 mm), not to exceed ¼ inch (6 mm). Any excess joint or crack sealer shall be removed from the pavement surface.

Cracks and joints may be filled with a mixture of emulsified asphalt and aggregate. The aggregate shall consist of limestone, volcanic ash, sand, or other material that will cure to form a hard substance. The combined gradation shall be as shown in the following table.

Gradation

Sieve Size	Percent Passing
No. 4 (4.75 mm)	100
No. 8 (2.36 mm)	90-100
No. 16 (1.18 mm)	65-90
No. 30 (600 µm)	40-60
No. 50 (300 µm)	25-42
No. 100 (150 µm)	15-30
No. 200 (75 µm)	10-20

Up to 3% cement can be added to accelerate the set time. The mixture shall not contain more than 20% natural sand without approval in writing from the RPR.

The proportions of asphalt emulsion and aggregate shall be determined in the field and may be varied to facilitate construction requirements. Normally, these proportions will be approximately one part asphalt emulsion to five parts aggregate by volume. The material shall be poured or placed into the joints or cracks and compacted to form a voidless mass. The joint or crack shall be filled to within +0 to -1/8 inches (+0 to -3 mm) of the surface. Any material spilled outside the width of the joint shall be removed from the pavement surface prior to constructing the overlay.

101-3.3 Removal of Foreign Substances/contaminates prior to overlay. Removal of foreign substances/contaminates from existing pavement that will affect the bond of the new treatment shall consist of removal of rubber, fuel spills, oil, crack sealer, at least 90% of paint, and other foreign substances from the surface of the pavement. Areas that require removal are designated on the plans and as directed by the RPR in the field during construction.

Chemicals, high-pressure water, heater scarifier (asphaltic concrete only),or sandblasting may be used. If chemicals are used, they shall comply with the state's environmental protection regulations. Removal methods used shall not cause major damage to the pavement, or to any structure or utility within or adjacent to the work area. Major damage is defined as changing the properties of the pavement, removal of asphalt causing the aggregate to ravel, or removing pavement over 1/8 inch (3 mm) deep. If it is deemed by the RPR that damage to the existing pavement is caused by operational error, such as permitting the application method to dwell in one location for too long, the Contractor shall repair the damaged area without compensation and as directed by the RPR.

Removal of foreign substances shall not proceed until approved by the RPR. Water used for high-pressure water equipment shall be provided by the Contractor at the Contractor's expense. No material shall be deposited on the pavement shoulders. All waste shall be disposed of in a proper manner off-site.

101-3.4 Cleaning prior to sealing. Immediately before sealing, joints shall be cleaned by removing any remaining laitance and other foreign material. Allow sufficient time to dry out joints prior to sealing.
Joint surfaces will be surface-dry prior to installation of sealant.

101-3.5 Joint sealant. Joint material and installation will be in accordance with Item TX-300.

101-3.6 Preparation of Cracks in Flexible Pavement prior to sealing. Prior to application of sealant material, clean and dry the joints of all scale, dirt, dust, old sealant, curing compound, moisture and other foreign matter. The Contractor shall demonstrate, in the presence of the RPR, that the method used cleans the cracks and does not damage the pavement.

METHOD OF MEASUREMENT

101-4.1 Lump sum. No separate measurement for payment will be made. The work covered by this section shall be considered as a subsidiary obligation of the Contractor and covered under the other contract items.

BASIS OF PAYMENT

101-5.1 Payment. No separate payment will be made for this item The work covered by this section shall be considered as a subsidiary obligation of the Contractor and covered under the other contract items.

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5380-6	Guidelines and Procedures for Maintenance of Airport Pavements.

ASTM International (ASTM)

ASTM D6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

END OF ITEM P-101

Item P-620 Runway and Taxiway Marking

DESCRIPTION

620-1.1 This item shall consist of the preparation and painting of numbers, markings, and stripes on the surface of runways, taxiways, and aprons, in accordance with these specifications and at the locations shown on the plans, or as directed by the Resident Project Representative (RPR). The terms "paint" and "marking material" as well as "painting" and "application of markings" are interchangeable throughout this specification.

MATERIALS

620-2.1 Materials acceptance. The Contractor shall furnish manufacturer's certified test reports, for materials shipped to the project. The certified test reports shall include a statement that the materials meet the specification requirements. This certification along with a copy of the paint manufacturer's surface preparation; marking materials, including adhesion, flow promoting and/or floatation additive; and application requirements must be submitted and approved by the Resident Project Representative (RPR) prior to the initial application of markings. The reports can be used for material acceptance or the RPR may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the RPR upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers that are easily quantifiable for inspection by the RPR.

620-2.2 Marking materials.

Table 1. Marking Materials

Paint[1]				Glass Beads[2]	
Type	**Color**	**Fed Std. 595 Number**	**Application Rate Maximum**	**Type**	**Application Rate Minimum**
Waterborne Type I*	Yellow	33538 or 33655	115 ft²/gal	Type III, Gradation A	10 lb/gal
Waterborne Type I*	White	37925	115 ft²/gal	Type III, Gradation A	10 lb/gal
Waterborne Type I*	Blacck	37038	115 ft²/gal	Not Used	N/A
Temporary Marking Waterborne	All	See Above	230 ft²/gal	None	None

[1] See paragraph 620-2.2a

[2] See paragraph 620-2.2b

a. Paint. Paint shall be waterborne in accordance with the requirements of this paragraph. Paint colors shall comply with Federal Standard No. 595.

Paint Color	Fed Std. No 595 Color Number
White	37925
Yellow	33538 or 33655
Black	37038

Waterborne. Paint shall meet the requirements of Federal Specification TT-P-1952F, Type I. The non-volatile portion of the vehicle for all paint types shall be composed of a 100% acrylic polymer as determined by infrared spectral analysis.

b. Reflective media. Glass beads for white and yellow paint shall meet the requirements for Federal Specification TT-B-1325D Type III.

Glass beads shall be treated with all compatible coupling agents recommended by the manufacturers of the paint and reflective media to ensure adhesion and embedment.

CONSTRUCTION METHODS

620-3.1 Weather limitations. Painting shall only be performed when the surface is dry, and the ambient temperature and the pavement surface temperature meet the manufacturer's recommendations in accordance with paragraph 620-2.1. Painting operations shall be discontinued when the ambient or surface temperatures do not meet the manufacturer's recommendations. Markings shall not be applied when the wind speed exceeds 10 mph unless windscreens are used to shroud the material guns. Markings shall not be applied when weather conditions are forecasts to not be within the manufacturers' recommendations for application and dry time.

620-3.2 Equipment. Equipment shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, a bead dispensing machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.

The mechanical marker shall be an atomizing spray-type or airless type marking machine with automatic glass bead dispensers suitable for application of traffic paint. It shall produce an even and uniform film thickness and appearance of both paint and glass beads at the required coverage and shall apply markings of uniform cross-sections and clear-cut edges without running or spattering and without over spray. The marking equipment for both paint and beads shall be calibrated daily.

620-3.3 Preparation of surfaces. Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other contaminates that would reduce the bond between the paint and the pavement. Use of any chemicals or impact abrasives during surface preparation shall be approved in advance by the RPR. After the cleaning operations, sweeping, blowing, or rinsing with pressurized water shall be performed to ensure the surface is clean and free of grit or other debris left from the cleaning process.

a. Preparation of new pavement surfaces. The area to be painted shall be cleaned by broom, blower, water blasting, or by other methods approved by the RPR to remove all contaminants, including PCC curing compounds, minimizing damage to the pavement surface.

b. Preparation of pavement to remove existing markings. Existing pavement markings shall be removed by rotary grinding, water blasting, or by other methods approved by the RPR minimizing damage to the pavement surface. The removal area may need to be larger than the area of the markings to eliminate ghost markings. After removal of markings on asphalt pavements, apply a fog seal or seal coat to 'block out' the removal area to eliminate 'ghost' markings.

c. Preparation of pavement markings prior to remarking. Prior to remarking existing markings, loose existing markings must be removed minimizing damage to the pavement surface, with a method approved by the RPR. After removal, the surface shall be cleaned of all residue or debris.

Prior to the application of markings, the Contractor shall certify in writing that the surface is dry and free from dirt, grease, oil, laitance, or other foreign material that would prevent the bond of the paint to the pavement or existing markings. This certification along with a copy of the paint manufactures application and surface preparation requirements must be submitted to the RPR prior to the initial application of markings.

620-3.4 Layout of markings. The proposed markings shall be laid out in advance of the paint application. The locations of markings to receive glass beads shall be shown on the plans.

620-3.5 Application. A period of 30 days shall elapse between placement of surface course or seal coat and application of the permanent paint markings. Paint shall be applied at the locations and to the dimensions and spacing shown on the plans. Paint shall not be applied until the layout and condition of the surface has been approved by the RPR.

The edges of the markings shall not vary from a straight line more than 1/2 inch (12 mm) in 50 feet (15 m), and marking dimensions and spacing shall be within the following tolerances:

Marking Dimensions and Spacing Tolerance

Dimension and Spacing	Tolerance
36 inch (910 mm) or less	±1/2 inch (12 mm)
greater than 36 inch to 6 feet (910 mm to 1.85 m)	±1 inch (25 mm)
greater than 6 feet to 60 feet (1.85 m to 18.3 m)	±2 inch (50 mm)
greater than 60 feet (18.3 m)	±3 inch (76 mm)

The paint shall be mixed in accordance with the manufacturer's instructions and applied to the pavement with a marking machine at the rate shown in Table 1. The addition of thinner will not be permitted.

Glass beads shall be distributed upon the marked areas at the locations shown on the plans to receive glass beads immediately after application of the paint. A dispenser shall be furnished that is properly designed for attachment to the marking machine and suitable for dispensing glass beads. Glass beads shall be applied at the rate shown in Table 1. Glass beads shall not be applied to black paint or green paint. Glass beads shall adhere to the cured paint or all marking operations shall cease until corrections are made. Different bead types shall not be mixed. Regular monitoring of glass bead embedment and distribution should be performed.

620-3.6 Application--preformed thermoplastic airport pavement markings.

Preformed thermoplastic pavement markings not used.

620-3.7 Control strip. Prior to the full application of airfield markings, the Contractor shall prepare a control strip in the presence of the RPR. The Contractor shall demonstrate the surface preparation method and all striping equipment to be used on the project. The marking equipment must achieve the prescribed application rate of paint and population of glass beads (per Table 1) that are properly embedded and evenly distributed across the full width of the marking. Prior to acceptance of the control strip, markings must be evaluated during darkness to ensure a uniform appearance.

620-3.8 Retro-reflectance. Reflectance shall be measured with a portable retro-reflectometer meeting ASTM E1710 (or equivalent). A total of 6 reading shall be taken over a 6 square foot area with 3 readings taken from each

direction. The average shall be equal to or above the minimum levels of all readings which are within 30% of each other.

Minimum Retro-Reflectance Values

Material	Retro-reflectance mcd/m^2/lux		
	White	Yellow	Red
Initial Type I	300	175	35
Initial Type III	600	300	35
Initial Thermoplastic	225	100	35
All materials, remark when less than[1]	100	75	10

[1] 'Prior to remarking determine if removal of contaminants on markings will restore retro-reflectance

620-3.9 Protection and cleanup. After application of the markings, all markings shall be protected from damage until dry. All surfaces shall be protected from excess moisture and/or rain and from disfiguration by spatter, splashes, spillage, or drippings. The Contractor shall remove from the work area all debris, waste, loose reflective media, and by-products generated by the surface preparation and application operations to the satisfaction of the RPR. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and federal environmental statutes and regulations.

METHOD OF MEASUREMENT

620-4.1a The quantity of markings shall be paid for shall be measured by the number of square feet of painting**.**

620-4.1d The quantity of temporary markings to be incidental to the permanent marking**.**

BASIS OF PAYMENT

620-5.1 This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item complete in place and accepted by the RPR in accordance with these specifications.

620-5.1a Payment for markings shall be made at the contract price for the number of square feet of painting.

Payment will be made under:

Item P-620a	Reflectorized Pavement Marking (White) per square foot
Item P-620b	Reflectorized Pavement Marking (Yellow) per square foot
Item P-620c	Pavement Marking (Black) per square foot

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D476	Standard Classification for Dry Pigmentary Titanium Dioxide Products
ASTM D968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1652	Standard Test Method for Epoxy Content of Epoxy Resins
ASTM D2074	Standard Test Method for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D2240	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D7585	Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments
ASTM E303	Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester
ASTM E1710	Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
ASTM E2302	Standard Test Method for Measurement of the Luminance Coefficient Under Diffuse Illumination of Pavement Marking Materials Using a Portable Reflectometer
ASTM G154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

Code of Federal Regulations (CFR)

40 CFR Part 60, Appendix A-7, Method 24	Determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings
29 CFR Part 1910.1200	Hazard Communication

Federal Specifications (FED SPEC)

FED SPEC TT-B-1325D	Beads (Glass Spheres) Retro-Reflective
FED SPEC TT-P-1952F	Paint, Traffic and Airfield Marking, Waterborne
FED STD 595	Colors used in Government Procurement

Commercial Item Description

A-A-2886B	Paint, Traffic, Solvent Based

Advisory Circulars (AC)

AC 150/5340-1	Standards for Airport Markings
AC 150/5320-12	Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces

END OF ITEM P-620

Item P-640 Aircraft Tiedown Anchor

DESCRIPTION

222-1.1 This item covers the requirements for installing aircraft tiedown anchors in conformance with the design and dimensions shown on the plans. The construction shall include the foundation and the reinforced concrete steel anchor bars. All anchors shall be cast in place after the pavement has been placed.

MATERIALS

640-2.1 CONCRETE. Concrete shall conform to Item TX-421, Hydraulic Cement Concrete, of these Technical Specifications.

640-2.2 REINFORCED CONCRETE STEEL ANCHOR BARS. Reinforced concrete steel anchor bars for the tiedown anchors shall be size No. 5, Grade 40 steel, conforming to the requirements of ASTM A615 or AASHTO M 31. The anchor bars shall be zinc-coated in accordance with ASTM A123 or AASHTO M 111.

CONSTRUCTION METHODS

640-3.1 GENERAL. The aircraft tiedown anchors shall be constructed in accordance with the details on the Plans and as specified herein using new materials. The pavement section shall be cored to the depth shown on the plans for installation of the tiedown anchors.

METHOD OF MEASUREMENT

640-4.1 Aircraft tiedown anchors shall be measured by the unit of each, complete in place.

BASIS OF PAYMENT

640-5.1 Payment will be made at the contract unit price per each for the aircraft tiedown anchors. This price shall be full compensation for furnishing all materials and for removal of existing tiedowns, preparation, excavation, placement of the steel and concrete, clean-up and disposal of excavated material, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

P-640 Aircraft Tie-Down Anchor - Each

END OF ITEM P-640

Item L-101 Airport Rotating Beacons

DESCRIPTION

101-1.1 This item shall consist of removal of existing beacon; furnishing and installing new airport rotating beacons. The work shall include mounting, leveling, wiring, painting, maintaining, and testing of the beacon. In addition, this item also includes all materials and incidentals necessary to place the beacon in a serviceable condition (as a completed unit) to the satisfaction of the RPR. This item shall include a mounting platform if specified in the plans.

EQUIPMENT AND MATERIALS

101-2.1 General.

a. Airport lighting equipment and materials covered by advisory circulars (ACs) shall be certified in AC 150/5345-53, Airport Lighting Equipment Certification Program (ALECP) and listed in the ALECP Addendum.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the RPR.

c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials that are per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the RPR) and replaced with materials, that are per these specifications, at the Contractor's cost.

d. All materials and equipment used to construct this item shall be submitted to the RPR for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly mark each copy to identify the products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components or electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that accrue directly or indirectly from late submissions or resubmissions of submittals.

e. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the Contract Documents plans and specifications. The Contractor's submittals shall be in an electronic pdf file format, tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

f. All equipment and materials furnished and installed in this section shall be guaranteed against defects in materials and workmanship for at least twelve (12) months from the date of final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

101-2.2 Beacon. The beacon shall be a LED Type L-801A Class 1 beacon meeting the requirements of AC 150/5345-12, Specification for Airport and Heliport Beacons.

101-2.3 Beacon installation. Installation shall be as shown on the plans. Provide two lamp sets as spares.

101-2.4 Panel boards and breakers. Panel boards and breakers shall conform to the requirements of Federal Specification W-P-115, Panel, Power Distribution.

101-2.5 Weatherproof cabinets. The weatherproof cabinets shall conform to National Electrical Manufacturers Association Standards (NEMA) and shall be constructed of steel not less than No. 16 United States Standard (USS) gauge.

101-2.6 Electrical wire. For ratings up to 600 volts, moisture and heat resistant thermoplastic wire conforming to Commercial Item Description A-A-59544A Type THWN-2 shall be used. The wires shall be the type, size, number of conductors, and voltage shown in the plans or in the proposal.

101-2.7 Conduit. Rigid steel conduit and fittings shall be per Underwriters Laboratories Standards 6, 514B, and 1242.

101-2.8 Paint.

a. Priming paint for non-galvanized metal surfaces shall be a high solids alkyd primer compatible with the manufacturer's recommendations for the intermediate or topcoat.

b. Priming paint for galvanized metal surfaces shall be a zinc-rich epoxy primer paint per MIL-DTL-24441/19C, Formula 159, Type III. Use MIL-24441 thinner per paint manufacturer's recommendations.

c. Orange paint for the body and the finish coats on metal and wood surfaces shall consist of a ready-mixed non-fading paint meeting the requirements of Master Painter's Institute (MPI) Reference #9 (gloss). The color shall be per Federal Standard 595, International Orange Number 12197.

d. White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint per the Master Painter's Institute, Reference #9, Exterior Alkyd, Gloss, volatile organic content (VOC) Range E2.

e. Priming paint for wood surfaces shall be mixed on the job by thinning the above-specified orange or white paint with 1/2 pint (0.24 liter (l)) of raw linseed oil to each gallon (liter).

CONSTRUCTION METHODS

101-3.1. Placing the beacon. The beacon shall be mounted as shown in the plans.

101-3.2 Hoisting and mounting. The beacon shall be hoisted to the mounting platform by using suitable slings and hoisting tackle. Before fastening the beacon to the mounting platform, the mounting holes shall be checked for correct spacing. Beacon base or mounting legs shall not be strained or forced out of position to fit incorrect spacing of mounting holes. The beacon base shall be raised first, set in position, and bolted in place. The drum shall then be raised and assembled to the base.

101-3.3 Leveling. After the beacon has been mounted, it shall be accurately leveled following the manufacturer's instructions. The leveling shall be checked in the presence of the RPR and shall be to the RPR's satisfaction.

101-3.4 Servicing. Before placing the beacon in operation, the Contractor shall check the manufacturer's manual for proper servicing requirements. Follow the manufacturer's servicing instructions for each size of beacon.

101-3.5 Beam adjustment. After the beacon has been mounted and leveled, the elevation of the beam shall be adjusted. The final beam adjustments shall be made at night so that results can be readily observed. The beams shall be adjusted to the elevation directed by the RPR or as shown in the plans. See AC 150/5340-30 for additional information about airport beacon beam adjustment.

101-3.6 Beacon mounting platform. Where the beacon is to be mounted at a location other than the beacon tower and where a special mounting platform is required, the construction of the mounting platform and any necessary lightning protection equipment shall be per the details shown in the plans.

101-3.7 Wiring. The Contractor shall furnish all necessary labor and materials and shall make complete above ground electrical connections per the wiring diagram furnished with the project plans. The electrical installation shall conform to the requirements of the latest edition of National Fire Protection Association, NFPA-70, National Electrical Code (NEC).

If underground cable for the power feed from the transformer vault to the beacon site and duct for this cable installation is required, the cable, ground rods and duct shall be installed as shown on the plans.

If shown on the plans, the Contractor shall connect the tell-tale relay mechanism in the beacon to energize the tower obstruction light circuit when failure of the beacon service (primary) lamp occurs.

If lightning protection is specified in the plans, it shall be installed per Item L-103, Airport Beacon Towers, paragraph 103-2.3.

101-3.8 Panel and cabinet. If shown on the plans, the Contractor shall furnish and install at the top of the beacon tower or mounting platform a circuit-breaker panel consisting of four 15-ampere breakers mounted in a weather-proof cabinet to provide separate protection for the circuits to the beacon lamps, motor, obstruction lights, and other equipment. The cabinet shall be located on the side of the beacon platform as shown on the plans or as directed by the RPR.

101-3.9 Conduit. All exposed wiring shall be run in not less than 3/4 inch (19 mm) galvanized rigid steel conduit. Outdoor rated, liquid-tight, flexible metal conduit may be used for final connection at the beacon equipment. No conduit shall be installed on top of a beacon platform floor. All conduits shall be installed to provide for drainage. If mounted on a steel beacon tower, the conduit shall be fastened to the tower members with Wraplock® straps (or equivalent), clamps, or approved fasteners, spaced approximately 5 feet (1.5 m) apart. The conduit shall be fastened to wooden structures with galvanized pipe straps and with galvanized wood screws not less than No. 8 or less than 1-1/4 inches (32 mm) long. There shall be at least two fastenings for each 10 feet (3 m) length.

101-3.10 Booster transformer. Not used.

101-3.11 Photoelectric control. If shown in the plans or specified in the job specifications, the Contractor shall furnish and install an automatic control switch at the location indicated in the plans. The switch shall be a photoelectric type. It shall be a standard commercially available unit that will energize when the illumination on a vertical surface facing North decreases to 25 to 35 foot-candles (269 to 377 lux). The photoelectric switch should de-energize when the illumination rises to 50 to 60 foot-candles (538 to 646 lux). The photoelectronic switch shall be installed, connected, and adjusted per the manufacturer's instructions.

101-3.12 Obstruction lights. Unless otherwise specified, the Contractor shall install on the top of the beacon tower or mounting platform two LED L-810 obstruction lights on opposite corners. These lights shall be mounted on conduit extensions to a height of not less than 4 inches (100 mm) above the top of the beacon.

101-3.13 Painting. If construction of a wooden mounting platform is stipulated in the proposal as part of this item, all wooden parts of the platform shall be given one priming coat of white or aviation-orange paint after fabrication but before erection and one body and one finish coat of international-orange paint after erection. Steel mounting platforms shall be given one priming coat of corrosion-inhibiting primer before erection and one body and one finish coat of international-orange paint after erection. All equipment installed under this contract and exposed to the weather shall be given one body and one finish coat of international-orange (per Federal Standard 595, Number 12197) or white paint as required. This shall include the beacon (except glass surfaces), beacon base, breaker

cabinet, all conduit, and transformer cases. It shall not include lightning protection system air terminals or obstruction light globes.

Apply the paint uniformly at the proper consistency. The finished paint shall be free from sags, holidays, and smears. Each coat of paint shall be given ample time to dry and harden before the next coat of paint is applied. A minimum of three (3) days shall be allowed for drying on wood surfaces, and a minimum of four (4) days shall be allowed for drying on metal surfaces. Painting shall not be performed in cold, damp, foggy, dusty, or frosty atmospheres, or when the air temperature is below 40°F (4°C), nor started when the weather forecast indicates such conditions for the day.

All surfaces shall be cleaned before painting. The surfaces shall be dry and free from scale, grease, rust, dust, and dirt. All knots in wood surfaces shall be covered with shellac immediately before applying the priming coat of paint. Nail holes and permissible imperfections shall be filled with putty. The ready-mixed paint shall be thinned for the priming and body coats per the manufacturer's recommendations. In the absence of such recommendations, the following shall apply:

a. Body coats (for both wood and steel surfaces) - add 1/2 pint (0.24 liter) of turpentine to each gallon (liter) of ready-mixed paint for body coats.

b. Finish coats (for both wood and steel surfaces) the ready-mixed paint shall be used as it comes from the container for finish coats.

101-3.14 Testing. The beacon installation shall be fully tested as a completed unit prior to acceptance. These tests shall include operation of the lamp-changer and performing insulation resistance and voltage readings. The insulation resistance to ground of the beacon power supply circuit shall be not less than 100 megohms when measured ungrounded. The Contractor must furnish testing equipment. Tests shall be conducted in the presence of the RPR and shall be to the RPR's satisfaction.

METHOD OF MEASUREMENT

101-4.1 The quantity to be paid for shall be the number of beacons installed as completed units in place, accepted, and ready for operation.

BASIS OF PAYMENT

101-5.1 Payment will be made at the contract unit price for each completed and accepted job. This price shall be full compensation for removal of existing beacon; furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item L-101a	Remove L-801A Airport Rotating Beacon - per each
Item L-101b	Install LED L-801A Airport Rotating Beacon - per each

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5345-7	Specification for L-824 Underground Cable for Airport Lighting Circuits

AC 150/5345-12	Specification for Airport and Heliport Beacons
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-53	Airport Lighting Equipment Certification Program
AC 150/5390-2	Heliport Design

Commercial Item Description

A-A-59544A	Cable and Wire, Electrical (Power, Fixed Installation)

Federal Specification (FED SPEC)

FED SPEC W-P-115	Panel, Power Distribution

Federal Standard (FED STD)

FED STD 595	Colors Used in Government Procurement

Master Painter Institute (MPI)

MPI Reference #9	Alkyd, Exterior, Gloss (MPI Gloss Level 6)

Mil Spec

MIL-DTL-24441C/19C	Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III

National Fire Protection Association (NFPA)

NFPA-70	National Electric Code (NEC)
NFPA-780	Standard for the Installation of Lightning Protection Systems

Underwriters Laboratories (UL)

UL Standard 6	Electrical Rigid Metal Conduit – Steel
UL Standard 514B	Conduit, Tubing, and Cable Fittings
UL Standard 1242	Electrical Intermediate Metal Conduit - Steel

END OF ITEM L-101

Item L-103 Airport Beacon Towers

DESCRIPTION

103-1.1 This item shall consist of removal of existing beacon tower and furnishing and installing an airport beacon tower of the type shown in the plans, per these specifications. This work shall include the clearing of the site, erection of the tower, installation of lightning protection, painting, and all incidentals necessary to place it in operating condition as a completed unit to the satisfaction of the RPR. See advisory circular (AC) 150/5340-30 for additional installation information about airport beacon towers.

EQUIPMENT AND MATERIALS

103-2.1 General.

a. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the RPR.

b. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the RPR) and replaced with materials, that are per these specifications, at the Contractor's cost.

c. All materials and equipment used to construct this item shall be submitted to the RPR for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals to components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

d. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the plans and specifications. The Contractor's submittals shall be in an electronic pdf file format, tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for at least twelve (12) months from the date of final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

103-2.2 Tower. The beacon tower shall be a tipdown beacon pole**.**

103-2.3 Lightning protection. Lightning protection shall comply with NFPA-780, Standard for the Installation of Lightning Protection Systems. All materials shall comply with NFPA 780 Class II material requirements regardless of the tower height.

103-2.4 Paint.

a. Priming paint for galvanized steel towers shall be zinc dust-zinc oxide primer paint per MIL-DTL-24441C/19B. Use MIL-24441 thinner per paint manufacturer's recommendations.

b. Priming paint for non-galvanized steel towers shall be a high solids alkyd primer per the Master Painter's Institute (MPI), Reference #9, Exterior Alkyd, Gloss.

c. Orange paint for the body and the finish coats on metal and wood surfaces shall consist of a ready-mixed non-fading paint MPI Reference #9 (gloss). The color shall be per Federal Standards 595, International Orange Number 12197.

d. White paint for a steel tower shall be ready-mixed paint per MPI #8.

CONSTRUCTION METHODS

103-3.1 Clearing and grading. The site on which the beacon tower is to be erected shall be cleared and leveled. All trees and brush shall be removed from the area within a distance of 25 feet (7.5 m) from the tower or as called for in the plans. Stumps shall be removed to a depth of 18 inches (0.5 m) below finished grade and the excavation filled with earth and tamped. If a transformer vault or other structure is included as part of the installation, the area shall be cleared to a distance of 25 feet (7.5 m) from these structures. The ground near the tower shall be leveled to permit the operation of mowing machines. The leveling shall extend at least 2 feet (60 cm) outside the tower legs. All debris removed from the tower site shall be disposed of by the Contractor to the satisfaction of the RPR and per federal, state, or local regulations.

103-3.2 Excavation and fill. Excavation for the tower footings shall be carried to a minimum of 4 inches (100 mm) below the footing depth. The excess excavation below the footing depth shall then be backfilled with gravel or crushed stone and compacted to the required level. The footing plates shall be installed, and a thickness of not less than 18 inches (0.5 m) of the same gravel or crushed stone shall be placed immediately above the footing plates in layers of not over 6 inches (150 mm). Each layer above the footing plates shall be thoroughly tamped in place. The remainder of the backfill may be of excavated earth placed in layers not to exceed 6 inches (150 mm). Each layer shall be thoroughly compacted by tamping.

Where solid rock is encountered, which prevents the carrying of the foundation legs to the required depth but which is of sufficient strength to use hold-down bolts, the tower anchor posts shall be cut off at the required length and the hold-down bolts shall be installed as indicated in the plans with the approval of the RPR. Each tower leg shall be anchored to the rock by means of two 7/8-inch (22 mm) diameter by 3 feet (1 m) long expansion or split bolts and shall be grouted with neat Portland cement into holes drilled into the natural rock. Except as required for rock foundations, the footing members shall not be cut off or shortened. If excavated material is of such consistency that it will not readily compact when backfilled, the RPR may order the excavation backfilled with concrete or other suitable material.

The concrete footing for tubular beacon towers shall be installed per the manufacturer's recommendations. Portions of the footing in the topsoil layer shall not be included in the footing height.

103-3.3 Erection. Tower erection as shown on the plans and detailed erection drawings furnished by the manufacturer shall be strictly followed during construction. All towers shall be erected in sections from the ground up unless otherwise specified. For final assembly, all bolts and fastenings shall be installed, and the structure shall be plumb, true, square, and level. Nuts shall be taken up to a firm bearing after which the bolts shall, if necessary, be cut to proper length to protrude three full threads. Approved locknuts shall be placed on each bolt over the regular nut. Ladder bolts shall be inserted with the head to the outer face of the tower. Diagonal, leg, and handrail bolts shall be installed with nuts on the outer face of the tower, unless otherwise specified. Bent parts shall be straightened before erection without damage to the protective coating. Surfaces abraded or bared of protective coating shall be painted with the proper priming paint per these specifications.

The Contractor shall install the ladder on the side of the tower adjacent to the driveway or most accessible approach to the tower. Tubular beacon towers shall be erected per the manufacturer's recommendations. The safety cable shall be located on the side of the tower adjacent to the driveway or most accessible approach to the tower.

103-3.4 Lightning protection. The Contractor shall furnish and install a Class II lightning protection system in accordance with NFPA 780. Ground rods and underground cables shall be installed in accordance with the plans.

Down-conductor cables shall be securely fastened to the surface of the tower leg at 5 feet (1.5 m) intervals with suitable bronze fasteners having bronze or noncorrosive metal bolts. Sharp turns or bends in the down conductor will not be permitted.

All connections of cable to cable, cable to air terminals, and cable to ground plates or rods shall be made with solderless connectors or noncorrosive metal approved by the RPR and shall be of substantial construction.

The down-conductor cable shall be securely attached to ground rods or plates placed at least 2 feet (60 cm) away from the tower foundations. The ground rod shall be driven into the ground so that the top is at least 6 inches (150 mm) below grade. The down-conductor shall be firmly attached to the ground plate or rod by means of an exothermic weld only. Plates shall be embedded in an area of permanent moisture.

The complete lightning protection installation shall be accomplished to the satisfaction of the RPR. The resistance to ground of any part of the lightning protection system shall not exceed 25 ohms. If a single rod grounding electrode has a resistance to earth of over 25 ohms, then install one supplemental rod not less than 10 feet from the first rod. If desired resistance to ground levels are still not achieved, see FAA-STD-019 for guidance on the application of coke breeze.

103-3.5 Painting. The Contractor shall furnish all materials and labor for painting the beacon tower. The color scheme for the steel tower shall be as shown in the plans.

a. Parts to be painted. Tower parts (except those parts to be exposed to earth) shall not be treated or primed before erection. All tower parts placed below ground level or within 12 inches (300 mm) above ground level shall be given two coats of approved asphalt paint.

Apply the proper consistency of paint uniformly. The finished paint shall be free from sags, holidays, and smears. Division lines between colors shall be sharply defined. Each coat of paint shall be given ample time to dry and harden before the next coat is applied. A minimum of four (4) days shall be allowed for drying on metal surfaces. Painting shall not be done in cold, damp, foggy, or dusty atmospheres, or when air temperature is below 40°F (4°C), nor started when the weather forecast indicates such conditions for the day.

All surfaces shall be cleaned before painting. The surfaces shall be dry and free from scale, grease, rust, dust, and dirt when paint is applied.

The number of coats of paint applied shall be per the following instructions:

b. Steel towers, galvanized. One priming coat of zinc dust-zinc oxide primer after erection and one body and one finish of white or orange paint (as required by the color scheme) shall be applied after erection.

c. Steel towers, not galvanized. One priming coat of corrosion-inhibiting primer and one body and one finish coat of white or orange paint (as required by the color scheme) shall be applied after erection.

The above specified orange and white ready-mixed paints shall be thinned for the body coats per the manufacturer's recommendations. In the absence of such recommendations, the following shall apply:

d. Body coats. Add not more than 1/2 pint (0.24 liters) of turpentine to each gallon (liter) of ready-mixed paint for body coats.

e. Finish coats. The ready-mixed paint shall be used as it comes from the container for finish coats.

METHOD OF MEASUREMENT

103-4.1 The quantity to be paid for under this item shall be the number of airport beacon towers installed as completed units in place, accepted, and ready for operation.

BASIS OF PAYMENT

103 5.1 Payment will be made at the contract unit price for each completed and accepted job. This price shall be full compensation for of removal of existing beacon tower; furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item L-103a	Remove Beacon Tower – per each
Item L-103b	Install Tip-Down Beacon Pole – per each

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5340-30	Installation and Design Details for Airport Visual Aids

Master Painter's Institute (MPI)

MPI Reference #8	Alkyd, Exterior, Flat (MPI Gloss Level 1)
MPI Reference #9	Alkyd, Exterior, Gloss (MPI Gloss Level 6)

Federal Standard (FED STD)

FED STD 595	Colors Used in Government Procurement

Mil Standard

MIL-DTL-24441C/19B	Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III

National Fire Protection Association (NFPA)

NFPA-780	Standard for the Installation of Lightning Protection Systems

END OF ITEM L-103

ITEM L-107 AIRPORT WIND CONES
Summary of Changes

Section 107-2.6 Revised to read as follows:

a) The concrete for foundations shall be proportioned, placed, and cured per Item ~~P-610~~TX-421, ~~Concrete for Miscellaneous Structures~~Hydraulic Cement Concrete.

Item L-107 Airport Wind Cones

DESCRIPTION

107-1.1 This item shall consist of removal of existing airport wind cones; furnishing and installing an airport wind cone per these specifications and per the dimensions, design, and details shown in the plans.

The work shall include the furnishing and installation of a support for mounting the wind cone, the specified interconnecting wire, and a concrete foundation. The item shall also include all cable connections, conduit and conduit fittings, the furnishing and installation of all lamps, ground rod and ground connection, the testing of the installation, and all incidentals necessary to place the wind cone in operation (as a completed unit) to the satisfaction of the RPR.

EQUIPMENT AND MATERIALS

107-2.1 General.

a. Airport lighting equipment and materials covered by advisory circulars (ACs) shall be certified in AC 150/5345-53, Airport Lighting Equipment Certification Program (ALECP) and listed in the ALECP Addendum.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the RPR.

c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the RPR) and replaced with materials that comply with these specifications, at the Contractor's cost.

d. All materials and equipment used to construct this item shall be submitted to the RPR for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

e. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the plans and specifications. The Contractor's submittals shall be in electronic pdf format, tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures, that do not meet the system design and the standards and codes, specified in this document.

f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for at least twelve (12) months from the date of final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

107-2.2 Wind cones. The wind cone assembly shall be LED Type L-807, Style B, Size 2.

107-2.3 Electrical wire and cable. Cable rated up to 5,000 volts in conduit shall conform to AC 150/5345-7, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits. For ratings up to 600 volts, moisture and heat resistant thermoplastic wire conforming to Commercial Item Description A-A-59544A Type THWN-2 shall be used. The wires shall be of the type, size, number of conductors, and voltage shown in the plans or in the proposal.

107-2.4 Conduit. Rigid steel conduit and fittings shall conform to the requirements of Underwriters Laboratories Standards 6, 514B, and 1242.

107-2.5 Plastic conduit (for use below grade only). Plastic conduit and fittings shall be per the following:

- UL 514B covers W-C-1094 - Conduit fittings all types, Classes 1 thru 3 and 6 thru 10
- UL 514C covers W-C-1094 - all types, Class 5 junction box and cover in plastic (polyvinyl chloride (PVC))
- UL 651 covers W-C-1094 - Rigid PVC Conduit, types I and II, Class 4
- UL 651A covers W-C-1094 - Rigid PVC Conduit and high-density polyethylene (HDPE) Conduit type III and Class 4

Underwriters Laboratories Standard UL-651 shall be one of the following, as shown in the plans:

a. Type I–Schedule 40 PVC suitable for underground use either direct-buried or encased in concrete.

b. Type II–Schedule 40 PVC suitable for either above ground or underground use.

Plastic conduit adhesive shall be a solvent cement manufactured specifically for the purpose of gluing the type of plastic conduit and fitting.

107-2.6 Concrete. The concrete for foundations shall be proportioned, placed, and cured per Item TX-421, Hydraulic Cement Concrete.

107-2.7 Paint.

a. Priming paint for non-galvanized metal surfaces shall be a high solids alkyd primer compatible with the manufacturer's recommendations for the intermediate or topcoat.

b. Priming paint for galvanized metal surfaces shall be zinc dust-zinc oxide primer paint conforming to MIL-DTL-24441C/19B. Use MIL-24441 thinner per paint manufacturer's recommendations.

c. Orange paint for the body and the finish coats on metal and wood surfaces shall consist of a ready-mixed non-fading paint per Master Painter's Institute (MPI) Reference #9 (gloss). The color shall be per Federal Standards 595, International Orange, Number 12197.

d. White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to the MPI, Reference #9, Exterior Alkyd, Gloss.

e. Priming paint for wood surfaces shall be mixed on the job by thinning the above specified aviation-orange or white paint by adding 1/2 pint (0.24 liter) of raw linseed oil to each gallon (liter).

CONSTRUCTION METHODS

107-3.1 Installation. The hinged support or hinged pole shall be installed on a concrete foundation per the plans.

107-3.2 Support pole erection. The Contractor shall erect the pole on the foundation following the manufacturer's requirements and erection details. The pole shall be level and secure.

107-3.3 Electrical connection. The Contractor shall furnish all labor and materials and shall make complete electrical connections per the wiring diagram furnished with the project plans. The electrical installation shall conform to the requirements of the latest edition of National Fire Protection Association, NFPA-70, National Electric Code (NEC).

Underground cable and duct for cable installation shall be installed in accordance with Item L-108, Underground Power Cables for Airports, and Item L-110, Airport Underground Electrical Duct Banks and Conduits in locations as shown on the plans.

107-3.4 Booster transformer. Not used.

107-3.5 Ground connection and ground rod. The Contractor shall furnish and install a ground rod, grounding cable, and ground clamps for grounding the "A" frame of the 12-foot (3.7-m) assembly or pipe support of the 8-foot (2.4-m) support near the base. The ground rod shall be of the type, diameter and length specified in Item L-108, Underground Power Cable for Airports. The ground rod shall be driven into the ground adjacent to the concrete foundation (minimum distance from foundation of 2 feet (60 cm)) so that the top is at least 6 inches (150 mm) below grade. The grounding cable shall consist of No. 6 American wire gauge (AWG) minimum stranded copper wire or larger and shall be firmly attached to the ground rod by exothermic welding. If an exothermic weld is not possible, connections to the grounding bus shall be made by using connectors approved for direct burial in soil or concrete per UL 467. The other end of the grounding cable shall be securely attached to a leg of the frame or to the base of the pipe support with non-corrosive metal and shall be of substantial construction. The resistance to ground shall not exceed 25 ohms. If a single rod grounding electrode has a resistance to earth of over 25 ohms, then install one supplemental rod not less than 10 feet from the first rod. If desired resistance to ground levels are still not achieved, see FAA-STD-019 for guidance on the application of coke breeze.

107-3.6 Painting. Three coats of paint shall be applied (one prime, one body, and one finish) to all exposed material installed under this item except the fabric cone, obstruction light globe, and lamp reflectors. The wind cone assembly, if already painted upon receipt, shall be given one finish coat of paint in lieu of the three coats specified above. The paint shall be per MPI Reference #9 (gloss). The color shall be per Federal Standard 595, International Orange, Number 12197.

107-3.7 Light sources. The Contractor shall furnish and install lamps per the manufacturer's instruction book.

107-3.8 Chain and padlock. The Contractor shall furnish and install a suitable operating chain for lowering and raising the hinged top section. The chain shall be attached to the pole support in a manner to prevent the light fixture assembly from striking the ground in the lowered position.

A padlock shall also be furnished by the Contractor on the 8-foot (2.4-m) wind cone for securing the hinged top section to the fixed lower section. Keys for the padlock shall be delivered to the RPR.

107-3.9 Segmented circle. The segmented circle shall be constructed as shown on the Plans.

METHOD OF MEASUREMENT

107-4.1 The quantity to be paid shall be the number of wind cones installed as completed units in place, accepted, and ready for operation.

107-4.2 The quantity of segmented circle airport marker systems to be paid for shall be the number of systems installed as completed units in place, accepted, and ready for operation.

BASIS OF PAYMENT

107-5.1 Payment will be made at the contract unit price for each completed and accepted job. This price shall be full compensation for removal of existing airport wind cones; furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

107-5.2 Payment will be made at the contract unit price for each segmented circle airport marker system. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item L-107a	Remove L-807 Primary Wind Cone -- per Each
Item L-107b	Remove Segmented Circle -- per Each
Item L-107c	Install LED L-807 Primary Wind Cone -- per Each
Item L-107d	Install Segmented Circle -- per Each

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5340-5	Segmented Circle Airport Marker System
AC 150/5340-30	Design and Installation Details for airport Visual Aids
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-27	Specification for Wind Cone Assemblies
AC 150/5345-53	Airport Lighting Equipment Certification Program

Commercial Item Description

A-A-59544	Cable and Wire, Electrical (Power, Fixed Installation)

Federal Standard (FED STD)

FED STD 595	Colors Used in Government Procurement

Master Painter's Institute (MPI)

MPI Reference #9	Alkyd, Exterior, Gloss (MPI Gloss Level 6)

Mil Standard

MIL-DTL-24441C/19B	Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III

Underwriters Laboratories (UL)

UL Standard 6	Electrical Rigid Metal Conduit – Steel
UL Standard 514B	Conduit, Tubing, and Cable Fittings
UL Standard 514C	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL Standard 651	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings

UL Standard 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit
UL Standard 1242	Electrical Intermediate Metal Conduit - Steel

National Fire Protection Association (NFPA)

NFPA-70	National Electric Code (NEC)

END OF ITEM L-107

ITEM L-108 UNDERGROUND POWER CABLE FOR AIRPORTS
Summary of Changes

Section 18-2.6 revised to read as follows:

a) The concrete for foundations shall be proportioned, placed, and cured per Item ~~P-610~~TX-421, ~~Concrete for Miscellaneous Structures~~Hydraulic Cement Concrete.

Item L-108 Underground Power Cable for Airports

DESCRIPTION

108-1.1 This item shall consist of furnishing and installing power cables that are direct buried and furnishing and/or installing power cables within conduit or duct banks per these specifications at the locations shown on the plans. It includes excavation and backfill of trench for direct-buried cables only. Also included are the installation of counterpoise wires, ground wires, ground rods and connections, cable splicing, cable marking, cable testing, and all incidentals necessary to place the cable in operating condition as a completed unit to the satisfaction of the RPR. This item shall not include the installation of duct banks or conduit, trenching and backfilling for duct banks or conduit, or furnishing or installation of cable for FAA owned/operated facilities.

EQUIPMENT AND MATERIALS

108-2.1 General.

a. Airport lighting equipment and materials covered by advisory circulars (AC) shall be approved under the Airport Lighting Equipment Certification Program per AC 150/5345-53, current version.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification, when requested by the RPR.

c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the RPR) and replaced with materials that comply with these specifications at the Contractor's cost.

d. All materials and equipment used to construct this item shall be submitted to the RPR for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

e. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the plans and specifications. The Contractor's submittals shall be electronically submitted in pdf format. The RPR reserves the right to reject any and all equipment, materials, or procedures that do not meet the system design and the standards and codes, specified in this document.

f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for at least twelve (12) months from the date of final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner. The Contractor shall maintain a minimum insulation resistance in accordance with paragraph 108-3.10e with isolation transformers connected in new circuits and new segments of existing circuits through the end of the contract warranty period when tested in accordance with AC 150/5340-26, *Maintenance Airport Visual Aid Facilities*, paragraph 5.1.3.1, Insulation Resistance Test.

108-2.2 Cable. Underground cable for airfield lighting facilities (runway and taxiway lights and signs) shall conform to the requirements of AC 150/5345-7, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits latest edition. Conductors for use on 6.6 ampere primary airfield lighting series circuits shall be single conductor, seven strand, #8 American wire gauge (AWG), L-824 Type C, 5,000 volts, non-shielded, with cross-linked polyethylene insulation. Conductors for use on 20 ampere primary airfield lighting series circuits shall be single conductor, seven strand, #6 AWG, L-824 Type C, 5,000 volts, non-shielded, with cross-linked polyethylene insulation. L-824 conductors for use on the L-830 secondary of airfield lighting series circuits shall be sized in accordance with the manufacturer's recommendations. All other conductors shall comply with FAA and National Electric Code (NEC) requirements. Conductor sizes noted above shall not apply to leads furnished by manufacturers on airfield lighting transformers and fixtures.

Wire for electrical circuits up to 600 volts shall comply with Specification L-824 and/or Commercial Item Description A-A-59544A and shall be type THWN-2, 75°C for installation in conduit and RHW-2, 75°C for direct burial installations. Conductors for parallel (voltage) circuits shall be type and size and installed in accordance with NFPA-70, National Electrical Code.

Unless noted otherwise, all 600-volt and less non-airfield lighting conductor sizes are based on a 75°C, THWN-2, 600-volt insulation, copper conductors, not more than three single insulated conductors, in raceway, in free air. The conduit/duct sizes are based on the use of THWN-2, 600-volt insulated conductors. The Contractor shall make the necessary increase in conduit/duct sizes for other types of wire insulation. In no case shall the conduit/duct size be reduced. The minimum power circuit wire size shall be #12 AWG.

Conductor sizes may have been adjusted due to voltage drop or other engineering considerations. Equipment provided by the Contractor shall be capable of accepting the quantity and sizes of conductors shown in the Contract Documents. All conductors, pigtails, cable step-down adapters, cable step-up adapters, terminal blocks and splicing materials necessary to complete the cable termination/splice shall be considered incidental to the respective pay items provided.

Cable type, size, number of conductors, strand and service voltage shall be as specified in the Contract Document.

108-2.3 Bare copper wire (counterpoise, bare copper wire ground and ground rods). Wire for counterpoise or ground installations for airfield lighting systems shall be No. **6** AWG bare solid copper wire for counterpoise and/or No. 6 AWG insulated stranded for grounding bond wire per ASTM B3 and ASTM B8, and shall be bare copper wire . For voltage powered circuits, the equipment grounding conductor shall comply with NEC Article 250.

Ground rods shall be copper-clad steel. The ground rods shall be of the length and diameter specified on the plans, but in no case be less than 10 feet (2.54 m) long and 3/4 inch (19 mm) in diameter.

108-2.4 Cable connections. In-line connections or splices of underground primary cables shall be of the type called for on the plans, and shall be one of the types listed below. No separate payment will be made for cable connections.

a. The cast splice. A cast splice, employing a plastic mold and using epoxy resin equivalent to that manufactured by 3M™ Company, "Scotchcast" Kit No. 82-B, or an approved equivalent, used for potting the splice is acceptable.

b. The field-attached plug-in splice. Field attached plug-in splices shall be installed as shown on the plans. The Contractor shall determine the outside diameter of the cable to be spliced and furnish appropriately sized connector kits and/or adapters. Tape or heat shrink tubing with integral sealant shall be in accordance with the manufacturer's requirements. Primary Connector Kits manufactured by Amerace, "Super Kit", Integro "Complete Kit", or approved equal is acceptable.

c. The factory-molded plug-in splice. Specification for L-823 Connectors, Factory-Molded to Individual Conductors, is acceptable.

d. The taped or heat-shrink splice. Taped splices employing field-applied rubber, or synthetic rubber tape covered with plastic tape is acceptable. The rubber tape should meet the requirements of ASTM D4388 and the plastic tape should comply with Military Specification MIL-I-24391 or Commercial Item Description A-A-55809. Heat shrinkable tubing shall be heavy-wall, self-sealing tubing rated for the voltage of the wire being spliced and suitable for direct-buried installations. The tubing shall be factory coated with a thermoplastic adhesive-sealant that will adhere to the insulation of the wire being spliced forming a moisture- and dirt-proof seal. Additionally, heat shrinkable tubing for multi-conductor cables, shielded cables, and armored cables shall be factory kits that are designed for the application. Heat shrinkable tubing and tubing kits shall be manufactured by Tyco Electronics/ Raychem Corporation, Energy Division, or approved equivalent.

In all the above cases, connections of cable conductors shall be made using crimp connectors using a crimping tool designed to make a complete crimp before the tool can be removed. All L-823/L-824 splices and terminations shall be made per the manufacturer's recommendations and listings.

All connections of counterpoise, grounding conductors and ground rods shall be made by the exothermic process or approved equivalent, except that a light base ground clamp connector shall be used for attachment to the light base. All exothermic connections shall be made per the manufacturer's recommendations and listings.

108-2.5 Splicer qualifications. Every airfield lighting cable splicer shall be qualified in making airport cable splices and terminations on cables rated at or above 5,000 volts AC. The Contractor shall submit to the RPR proof of the qualifications of each proposed cable splicer for the airport cable type and voltage level to be worked on. Cable splicing/terminating personnel shall have a minimum of three (3) years continuous experience in terminating/splicing medium voltage cable.

108-2.6 Concrete. Concrete shall be proportioned, placed, and cured per Item TX-421,Hydraulic Cement Concrete.

108-2.7 Flowable backfill. Flowable material used to backfill trenches for power cable trenches shall conform to the requirements of Item P-153, Controlled Low Strength Material.

108-2.8 Cable identification tags. Cable identification tags shall be made from a non-corrosive material with the circuit identification stamped or etched onto the tag. The tags shall be of the type as detailed on the plans.

108-2.9 Tape. Electrical tapes shall be Scotch™ Electrical Tapes –Scotch™ 88 (1-1/2 inch (38 mm) wide) and Scotch™ 130C® linerless rubber splicing tape (2-inch (50 mm) wide), as manufactured by the Minnesota Mining and Manufacturing Company (3M™), or an approved equivalent.

108-2.10 Electrical coating. Electrical coating shall be Scotchkote™ as manufactured by 3M™, or an approved equivalent.

108-2.11 Existing circuits. Whenever the scope of work requires connection to an existing circuit, the existing circuit's insulation resistance shall be tested, in the presence of the RPR. The test shall be performed per this item and prior to any activity that will affect the respective circuit. The Contractor shall record the results on forms acceptable to the RPR. When the work affecting the circuit is complete, the circuit's insulation resistance shall be checked again, in the presence of the RPR. The Contractor shall record the results on forms acceptable to the RPR. The second reading shall be equal to or greater than the first reading or the Contractor shall make the necessary repairs to the existing circuit to bring the second reading above the first reading. All repair costs including a complete replacement of the L-823 connectors, L-830 transformers and L-824 cable, if necessary, shall be borne by the Contractor. All test results shall be submitted in the Operation and Maintenance (O&M) Manual.

108-2.12 Detectable warning tape. Plastic, detectable, American Public Works Association (APWA) Red (electrical power lines, cables, conduit and lighting cable) with continuous legend tape shall be polyethylene film with a metalized foil core and shall be 3-6 inches (75-150 mm) wide. Detectable tape is incidental to the respective bid

item. Detectable warning tape for communication cables shall be orange. Detectable warning tape color code shall comply with the APWA Uniform Color Code.

CONSTRUCTION METHODS

108-3.1 General. The Contractor shall install the specified cable at the approximate locations indicated on the plans. Unless otherwise shown on the plans, all cable required to cross under pavements expected to carry aircraft loads shall be installed in concrete encased duct banks. Cable shall be run without splices, from fixture to fixture.

Cable connections between lights will be permitted only at the light locations for connecting the underground cable to the primary leads of the individual isolation transformers. The Contractor shall be responsible for providing cable in continuous lengths for home runs or other long cable runs without connections unless otherwise authorized in writing by the RPR or shown on the plans.

In addition to connectors being installed at individual isolation transformers, L-823 cable connectors for maintenance and test points shall be installed at locations shown on the plans. Cable circuit identification markers shall be installed on both sides of the L-823 connectors installed and on both sides of slack loops where a future connector would be installed.

Provide not less than 3 feet (1 m) of cable slack on each side of all connections, isolation transformers, light units, and at points where cable is connected to field equipment. Where provisions must be made for testing or for future above grade connections, provide enough slack to allow the cable to be extended at least one foot (30 cm) vertically above the top of the access structure. This requirement also applies where primary cable passes through empty light bases, junction boxes, and access structures to allow for future connections, or as designated by the RPR.

Primary airfield lighting cables installed shall have cable circuit identification markers attached on both sides of each L-823 connector and on each airport lighting cable entering or leaving cable access points, such as manholes, hand holes, pull boxes, junction boxes, etc. Markers shall be of sufficient length for imprinting the cable circuit identification legend on one line, using letters not less than 1/4 inch (6 mm) in size. The cable circuit identification shall match the circuits noted on the construction plans.

108-3.2 Installation in duct banks or conduits. This item includes the installation of the cable in duct banks or conduit per the following paragraphs. The maximum number and voltage ratings of cables installed in each single duct or conduit, and the current-carrying capacity of each cable shall be per the latest version of the National Electric Code, or the code of the local agency or authority having jurisdiction.

The Contractor shall make no connections or splices of any kind in cables installed in conduits or duct banks.

Unless otherwise designated in the plans, where ducts are in tiers, use the lowest ducts to receive the cable first, with spare ducts left in the upper levels. Check duct routes prior to construction to obtain assurance that the shortest routes are selected and that any potential interference is avoided.

Duct banks or conduits shall be installed as a separate item per Item L-110, Airport Underground Electrical Duct Banks and Conduit. The Contractor shall run a mandrel through duct banks or conduit prior to installation of cable to ensure that the duct bank or conduit is open, continuous and clear of debris. The mandrel size shall be compatible with the conduit size. The Contractor shall swab out all conduits/ducts and clean light bases, manholes, etc., interiors immediately prior to pulling cable. Once cleaned and swabbed, the light bases and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, light bases, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be re-cleaned at the Contractor's expense. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the RPR of any blockage in the existing ducts.

The cable shall be installed in a manner that prevents harmful stretching of the conductor, damage to the insulation, or damage to the outer protective covering. The ends of all cables shall be sealed with moisture-seal tape providing moisture-tight mechanical protection with minimum bulk, or alternately, heat shrinkable tubing before pulling into the conduit and it shall be left sealed until connections are made. Where more than one cable is to be installed in a conduit, all cable shall be pulled in the conduit at the same time. The pulling of a cable through duct banks or conduits may be accomplished by hand winch or power winch with the use of cable grips or pulling eyes. Maximum pulling tensions shall not exceed the cable manufacturer's recommendations. A non-hardening cable-pulling lubricant recommended for the type of cable being installed shall be used where required.

The Contractor shall submit the recommended pulling tension values to the RPR prior to any cable installation. If required by the RPR, pulling tension values for cable pulls shall be monitored by a dynamometer in the presence of the RPR. Cable pull tensions shall be recorded by the Contractor and reviewed by the RPR. Cables exceeding the maximum allowable pulling tension values shall be removed and replaced by the Contractor at the Contractor's expense.

The manufacturer's minimum bend radius or NEC requirements (whichever is more restrictive) shall apply. Cable installation, handling and storage shall be per manufacturer's recommendations. During cold weather, particular attention shall be paid to the manufacturer's minimum installation temperature. Cable shall not be installed when the temperature is at or below the manufacturer's minimum installation temperature. At the Contractor's option, the Contractor may submit a plan, for review by the RPR, for heated storage of the cable and maintenance of an acceptable cable temperature during installation when temperatures are below the manufacturer's minimum cable installation temperature.

Cable shall not be dragged across base can or manhole edges, pavement or earth. When cable must be coiled, lay cable out on a canvas tarp or use other appropriate means to prevent abrasion to the cable jacket.

108-3.3 Installation of direct-buried cable in trenches. Unless otherwise specified, the Contractor shall not use a cable plow for installing the cable. Cable shall be unreeled uniformly in place alongside or in the trench and shall be carefully placed along the bottom of the trench. The cable shall not be unreeled and pulled into the trench from one end. Slack cable sufficient to provide strain relief shall be placed in the trench in a series of S curves. Sharp bends or kinks in the cable shall not be permitted.

Where cables must cross over each other, a minimum of 3 inches (75 mm) vertical displacement shall be provided with the topmost cable depth at or below the minimum required depth below finished grade.

a. Trenching. Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored. Trenches for cables may be excavated manually or with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of surface is disturbed. Graders shall not be used to excavate the trench with their blades. The bottom surface of trenches shall be essentially smooth and free from coarse aggregate. Unless otherwise specified, cable trenches shall be excavated to a minimum depth of 18 inches (0.5 m) below finished grade per NEC Table 300.5, except as follows:

- When off the airport or crossing under a roadway or driveway, the minimum depth shall be 36 inches (91 cm) unless otherwise specified.
- Minimum cable depth when crossing under a railroad track, shall be 42 inches (1 m) unless otherwise specified.

The Contractor shall excavate all cable trenches to a width not less than 6 inches (150 mm). Unless otherwise specified on the plans, all cables in the same location and running in the same general direction shall be installed in the same trench.

When rock is encountered, the rock shall be removed to a depth of at least 3 inches (75 mm) below the required cable depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4-inch (6.3 mm) sieve. Flowable backfill material may alternatively be used.

Duct bank or conduit markers temporarily removed for trench excavations shall be replaced as required.

It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Where existing active cables cross proposed installations, the Contractor shall ensure that these cables are adequately protected. Where crossings are unavoidable, no splices will be allowed in the existing cables, except as specified on the plans. Installation of new cable where such crossings must occur shall proceed as follows:

(1) Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely no damage has occurred.

(2) Trenching, etc., in cable areas shall then proceed, with approval of the RPR, with care taken to minimize possible damage or disruption of existing cable, including careful backfilling in area of cable.

In the event that any previously identified cable is damaged during the course of construction, the Contractor shall be responsible for the complete repair or replacement.

b. Backfilling. After the cable has been installed, the trench shall be backfilled. The first layer of backfill in the trench shall encompass all cables ; be 3 inches (75 mm) deep, loose measurement; and shall be either earth or sand containing no mineral aggregate particles that would be retained on a 1/4-inch (6.3 mm) sieve. This layer shall not be compacted. The second layer shall be 5 inches (125 mm) deep, loose measurement, and shall contain no particles that would be retained on a one inch (25.0 mm) sieve. The remaining third and subsequent layers of backfill shall not exceed 8 inches (20 cm) of loose measurement and be excavated or imported material and shall not contain stone or aggregate larger than 4 inches (100 mm) maximum diameter.

The second and subsequent layers shall be thoroughly tamped and compacted to at least the density of the adjacent material. If the cable is to be installed in locations or areas where other compaction requirements are specified (under pavements, embankments, etc.) the backfill compaction shall be to a minimum of 100 percent of ASTM D1557.

Trenches shall not contain pools of water during backfilling operations. The trench shall be completely backfilled and tamped level with the adjacent surface, except that when turf is to be established over the trench, the backfilling shall be stopped at an appropriate depth consistent with the type of turfing operation to be accommodated. A proper allowance for settlement shall also be provided. Any excess excavated material shall be removed and disposed of per the plans and specifications.

Underground electrical warning (caution) tape shall be installed in the trench above all direct-buried cable. Contractor shall submit a sample of the proposed warning tape for acceptance by the RPR. If not shown on the plans, the warning tape shall be located 6 inches (150 mm) above the direct-buried cable or the counterpoise wire if present. A 3-6 inch (75 - 150 mm) wide polyethylene film detectable tape, with a metalized foil core, shall be installed above all direct buried cable or counterpoise. The tape shall be of the color and have a continuous legend as indicated on the plans. The tape shall be installed 8 inches (200 mm) minimum below finished grade.

c. Restoration. Following restoration of all trenching near airport movement surfaces, the Contractor shall visually inspect the area for foreign object debris (FOD) and remove any that is found. Where soil and sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by work shall be restored to its original condition. The restoration shall include the seeding as shown on the plans. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. When trenching is through paved areas, restoration shall be equal to existing conditions. If the cable is to be installed in locations or areas where other compaction requirements are specified (under pavements, embankments, etc.) the backfill compaction shall be to a minimum of 100 percent of ASTM D1557**.** Restoration shall be considered incidental to the pay item of which it is a component part.

108-3.4 Cable markers for direct-buried cable. The location of direct buried circuits shall be marked by a concrete slab marker, 2 feet (60 cm) square and 4-6 inch (10 - 15 cm) thick, extending approximately one inch (25 mm) above the surface. Each cable run from a line of lights and signs to the equipment vault shall be marked at approximately every 200 feet (61 m) along the cable run, with an additional marker at each change of direction of cable run. All other direct-buried cable shall be marked in the same manner. Cable markers shall be installed directly above the cable. The Contractor shall impress the word "CABLE" and directional arrows on each cable marking slab. The letters

shall be approximately 4 inches (100 mm) high and 3 inches (75 mm) wide, with width of stroke 1/2 inch (12 mm) and 1/4 inch (6 mm) deep. Stencils shall be used for cable marker lettering; no hand lettering shall be permitted.

At the location of each underground cable connection/splice, except at lighting units, or isolation transformers, a concrete marker slab shall be installed to mark the location of the connection/splice. The Contractor shall impress the word “SPLICE” on each slab. The Contractor also shall impress additional circuit identification symbols on each slab as directed by the RPR. All cable markers and splice markers shall be painted international orange. Paint shall be specifically manufactured for uncured exterior concrete. After placement, all cable or splice markers shall be given one coat of high-visibility aviation orange paint as approved by the RPR. Furnishing and installation of cable markers is incidental to the respective cable pay item.

108-3.5 Splicing. Connections of the type shown on the plans shall be made by experienced personnel regularly engaged in this type of work and shall be made as follows:

a. Cast splices. These shall be made by using crimp connectors for jointing conductors. Molds shall be assembled, and the compound shall be mixed and poured per the manufacturer’s instructions and to the satisfaction of the RPR.

b. Field-attached plug-in splices. These shall be assembled per the manufacturer’s instructions. These splices shall be made by plugging directly into mating connectors. The joint where the connectors come together shall be finished by one of the following methods: (1) wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches (38 mm) on each side of the joint (2) Covered with heat shrinkable tubing with integral sealant extending at least 1-1/2 inches (38 mm) on each side of the joint or (3) On connector kits equipped with water seal flap; roll-over water seal flap to sealing position on mating connector.

c. Factory-molded plug-in splices. These shall be made by plugging directly into mating connectors. The joint where the connectors come together shall be finished by one of the following methods: (1) Wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches (38 mm) on each side of the joint. (2) Covered with heat shrinkable tubing with integral sealant extending at least 1-1/2 inches (38 mm) on each side of the joint. or (3) On connector kits so equipped with water seal flap; roll-over water seal flap to sealing position on mating connector.

d. Taped or heat-shrink splices. A taped splice shall be made in the following manner:

Bring the cables to their final position and cut so that the conductors will butt. Remove insulation and jacket allowing for bare conductor of proper length to fit compression sleeve connector with 1/4 inch (6 mm) of bare conductor on each side of the connector. Prior to splicing, the two ends of the cable insulation shall be penciled using a tool designed specifically for this purpose and for cable size and type. Do not use emery paper on splicing operation since it contains metallic particles. The copper conductors shall be thoroughly cleaned. Join the conductors by inserting them equidistant into the compression connection sleeve. Crimp conductors firmly in place with crimping tool that requires a complete crimp before tool can be removed. Test the crimped connection by pulling on the cable. Scrape the insulation to assure that the entire surface over which the tape will be applied (plus 3 inches (75 mm) on each end) is clean. After scraping, wipe the entire area with a clean lint-free cloth. Do not use solvents.

Apply high-voltage rubber tape one-half lapped over bare conductor. This tape should be tensioned as recommended by the manufacturer. Voids in the connector area may be eliminated by highly elongating the tape, stretching it just short of its breaking point. The manufacturer's recommendation for stretching tape during splicing shall be followed. Always attempt to exactly half-lap to produce a uniform buildup. Continue buildup to 1-1/2 times cable diameter over the body of the splice with ends tapered a distance of approximately one inch (25 mm) over the original jacket. Cover rubber tape with two layers of vinyl pressure-sensitive tape one-half lapped. Do not use glyptol or lacquer over vinyl tape as they react as solvents to the tape. No further cable covering or splice boxes are required.

Heat shrinkable tubing shall be installed following manufacturer's instructions. Direct flame heating shall not be permitted unless recommended by the manufacturer. Cable surfaces within the limits of the heat-shrink application shall be clean and free of contaminates prior to application.

e. Assembly. Surfaces of equipment or conductors being terminated or connected shall be prepared in accordance with industry standard practice and manufacturer's recommendations. All surfaces to be connected shall be thoroughly cleaned to remove all dirt, grease, oxides, nonconductive films, or other foreign material. Paints and other nonconductive coatings shall be removed to expose base metal. Clean all surfaces at least 1/4 inch (6.4 mm) beyond all sides of the larger bonded area on all mating surfaces. Use a joint compound suitable for the materials used in the connection. Repair painted/coated surface to original condition after completing the connection.

108-3.6 Bare counterpoise wire installation for lightning protection and grounding. If shown on the plans or included in the job specifications, bare solid #6 AWG copper counterpoise wire shall be installed for lightning protection of the underground cables. The RPR shall select one of two methods of lightning protection for the airfield lighting circuit based upon sound engineering practice and lightning strike density.

a. Equipotential. The counterpoise size is as shown on the plans. The equipotential method is applicable to all airfield lighting systems; i.e. runway, taxiway, apron – touchdown zone, centerline, edge, threshold and approach lighting systems. The equipotential method is also successfully applied to provide lightning protection for power, signal and communication systems. The light bases, counterpoise, etc – all components - are bonded together and bonded to the vault power system ground loop/electrode.

Counterpoise wire shall be installed in the same trench for the entire length of buried cable, conduits and duct banks that are installed to contain airfield cables. The counterpoise is centered over the cable/conduit/duct to be protected.

The counterpoise conductor shall be installed no less than 8 inches (200 mm) minimum or 12 inches (300 mm) maximum above the raceway or cable to be protected, except as permitted below:

(1) The minimum counterpoise conductor height above the raceway or cable to be protected shall be permitted to be adjusted subject to coordination with the airfield lighting and pavement designs.

(2) The counterpoise conductor height above the protected raceway(s) or cable(s) shall be calculated to ensure that the raceway or cable is within a 45-degree area of protection, (45 degrees on each side of vertical creating a 90 degree angle).

The counterpoise conductor shall be bonded to each metallic light base, mounting stake, and metallic airfield lighting component.

All metallic airfield lighting components in the field circuit on the output side of the constant current regulator (CCR) or other power source shall be bonded to the airfield lighting counterpoise system.

All components rise and fall at the same potential; with no potential difference, no damaging arcing and no damaging current flow.

See AC 150/5340-30, Design and Installation Details for Airport Visual Aids and NFPA 780, Standard for the Installation of Lightning Protection Systems, Chapter 11, for a detailed description of the Equipotential Method of lightning protection.

Reference FAA STD-019E, Lightning and Surge Protection, Grounding Bonding and Shielding Requirements for Facilities and Electronic Equipment, Part 4.1.1.7.

b. Isolation. Not used.

c. Common Installation requirements. When a metallic light base is used, the grounding electrode shall be bonded to the metallic light base or mounting stake with a No. 6 AWG bare, annealed or soft drawn, solid copper conductor.

When a nonmetallic light base is used, the grounding electrode shall be bonded to the metallic light fixture or metallic base plate with a No. 6 AWG bare, annealed or soft drawn, solid copper conductor.

Grounding electrodes may be rods, ground dissipation plates, radials, or other electrodes listed in the NFPA 70 (NEC) or NFPA 780.

Where raceway is installed by the directional bore, jack and bore, or other drilling method, the counterpoise conductor shall be permitted to be installed concurrently with the directional bore, jack and bore, or other drilling method raceway, external to the raceway or sleeve.

The counterpoise wire shall also be exothermically welded to ground rods installed as shown on the plans but not more than 500 feet (150 m) apart around the entire circuit. The counterpoise system shall be continuous and terminate at the transformer vault or at the power source. It shall be securely attached to the vault or equipment external ground ring or other made electrode-grounding system. The connections shall be made as shown on the plans and in the specifications.

Where an existing airfield lighting system is being extended or modified, the new counterpoise conductors shall be interconnected to existing counterpoise conductors at each intersection of the new and existing airfield lighting counterpoise systems.

d. Parallel Voltage Systems. Provide grounding and bonding in accordance with NFPA 70, National Electrical Code.

108-3.7 Counterpoise installation above multiple conduits and duct banks. Counterpoise wires shall be installed above multiple conduits/duct banks for airfield lighting cables, with the intent being to provide a complete area of protection over the airfield lighting cables. When multiple conduits and/or duct banks for airfield cable are installed in the same trench, the number and location of counterpoise wires above the conduits shall be adequate to provide a complete area of protection measured 45 degrees each side of vertical.

Where duct banks pass under pavement to be constructed in the project, the counterpoise shall be placed above the duct bank. Reference details on the construction plans.

108-3.8 Counterpoise installation at existing duct banks. When airfield lighting cables are indicated on the plans to be routed through existing duct banks, the new counterpoise wiring shall be terminated at ground rods at each end of the existing duct bank where the cables being protected enter and exit the duct bank. The new counterpoise conductor shall be bonded to the existing counterpoise system.

108-3.9 Exothermic bonding. Bonding of counterpoise wire shall be by the exothermic welding process or equivalent method accepted by the RPR. Only personnel experienced in and regularly engaged in this type of work shall make these connections.

Contractor shall demonstrate to the satisfaction of the RPR, the welding kits, materials and procedures to be used for welded connections prior to any installations in the field. The installations shall comply with the manufacturer's recommendations and the following:

a. All slag shall be removed from welds.

b. Using an exothermic weld to bond the counterpoise to a lug on a galvanized light base is not recommended unless the base has been specially modified. Consult the manufacturer's installation directions for proper methods of bonding copper wire to the light base. See AC 150/5340-30 for galvanized light base exception.

c. If called for in the plans, all buried copper and weld material at weld connections shall be thoroughly coated with 6 mm of 3M™ Scotchkote™, or approved equivalent, or coated with coal tar Bitumastic® material to prevent surface exposure to corrosive soil or moisture.

108-3.10 Testing. The Contractor shall furnish all necessary equipment and appliances for testing the airport electrical systems and underground cable circuits before and after installation. The Contractor shall perform all tests in the presence of the RPR. The Contractor shall demonstrate the electrical characteristics to the satisfaction of the RPR. All costs for testing are incidental to the respective item being tested. For phased projects, the tests must be completed by phase. The Contractor must maintain the test results throughout the entire project as well as during the warranty period that meet the following:

a. Earth resistance testing methods shall be submitted to the RPR for approval. Earth resistance testing results shall be recorded on an approved form and testing shall be performed in the presence of the RPR. All such testing shall be at the sole expense of the Contractor.

b. Should the counterpoise or ground grid conductors be damaged or suspected of being damaged by construction activities the Contractor shall test the conductors for continuity with a low resistance ohmmeter. The conductors shall be isolated such that no parallel path exists and tested for continuity. The RPR shall approve of the test method selected. All such testing shall be at the sole expense of the Contractor.

After installation, the Contractor shall test and demonstrate to the satisfaction of the RPR the following:

c. That all affected lighting power and control circuits (existing and new) are continuous and free from short circuits.

d. That all affected circuits (existing and new) are free from unspecified grounds.

e. That the insulation resistance to ground of all new non-grounded high voltage series circuits or cable segments is not less than 50 megohms. Verify continuity of all series airfield lighting circuits prior to energization.

f. That the insulation resistance to ground of all new non-grounded conductors of new multiple circuits or circuit segments is not less than 100 megohms.

g. That all affected circuits (existing and new) are properly connected per applicable wiring diagrams.

h. That all affected circuits (existing and new) are operable. Tests shall be conducted that include operating each control not less than 10 times and the continuous operation of each lighting and power circuit for not less than 1/2 hour.

i. That the impedance to ground of each ground rod does not exceed 25 ohms prior to establishing connections to other ground electrodes. The fall-of-potential ground impedance test shall be used, as described by American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81, to verify this requirement. As an alternate, clamp-on style ground impedance test meters may be used to satisfy the impedance testing requirement. Test equipment and its calibration sheets shall be submitted for review and approval by the RPR prior to performing the testing.

Two copies of tabulated results of all cable tests performed shall be supplied by the Contractor to the RPR. Where connecting new cable to existing cable, insulation resistance tests shall be performed on the new cable prior to connection to the existing circuit.

There are no approved “repair” procedures for items that have failed testing other than complete replacement.

METHOD OF MEASUREMENT

108-4.1 Cable or counterpoise wire installed in trench, duct bank or conduit shall be measured by the number of linear feet (meters) installed and grounding connectors, and trench marking tape ready for operation, and accepted

as satisfactory. Separate measurement shall be made for each cable or counterpoise wire installed in trench, duct bank or conduit. The measurement for this item shall not include additional quantities required for slack.

108-4.2 Cable or counterpoise wire installed in trench, duct bank or conduit shall be measured by the number of linear feet (meters) installed and grounding connectors, and trench marking tape ready for operation, and accepted as satisfactory. Separate measurement shall be made for each cable or counterpoise wire installed in trench, duct bank or conduit. The measurement for this item shall not include additional quantities required for slack.

108-4.3 No separate payment will be made for ground rods.

BASIS OF PAYMENT

108-5.1 Payment will be made at the contract unit price for trenching, cable and bare counterpoise wire installed in trench (direct-buried), or cable and equipment ground installed in duct bank or conduit, in place by the Contractor and accepted by the RPR. This price shall be full compensation for furnishing all materials and for all preparation and installation of these materials, and for all labor, equipment, tools, and incidentals, including ground rods and ground connectors and trench marking tape, necessary to complete this item.

Payment will be made under:

Item L-108a	Install #8 AWG, L-824C, 5000V Wire – per linear foot
Item L-108b	Install #6 AWG, Bare Copper Counterpoise including Ground Rods and Terminations – per linear foot

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5340-26	Maintenance of Airport Visual Aid Facilities
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-53	Airport Lighting Equipment Certification Program

Commercial Item Description

A-A-59544A	Cable and Wire, Electrical (Power, Fixed Installation)
A-A-55809	Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic

ASTM International (ASTM)

ASTM B3	Standard Specification for Soft or Annealed Copper Wire
ASTM B8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes

ASTM D4388	Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes

Mil Spec

MIL-PRF-23586F	Performance Specification: Sealing Compound (with Accelerator), Silicone Rubber, Electrical
MIL-I-24391	Insulation Tape, Electrical, Plastic, Pressure Sensitive

National Fire Protection Association (NFPA)

NFPA-70	National Electrical Code (NEC)
NFPA-780	Standard for the Installation of Lightning Protection Systems

American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

ANSI/IEEE STD 81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

Federal Aviation Administration Standard

FAA STD-019E	Lightning and Surge Protection, Grounding Bonding and Shielding Requirements for Facilities and Electronic Equipment

END OF ITEM L-108

ITEM L-109 AIRPORT TRANSFORMER VAULT AND VAULT EQUIPMENT – Summary of Changes

Section 109-3.2 revised to read as follows:

a) The concrete for foundations shall be proportioned, placed, and cured per Item ~~P-610~~TX-421, ~~Concrete for Miscellaneous Structures~~Hydraulic Cement Concrete.

Item L-109 Airport Transformer Vault and Vault Equipment

DESCRIPTION

109-1.1 This item shall consist of removing an existing airport transformer vault and equipment and; constructing an airport transformer vault or a prefabricated metal housing per these specifications and per the design and dimensions shown in the plans. This work shall also include the installation of conduits in the floor and foundation, painting and lighting of the vault or metal housing, and the furnishing of all incidentals that are necessary to produce a completed unit. Included as a separate part under this item or as a separate item where an existing vault is to be used shall be the furnishing of all vault equipment, wiring, electrical buses, cable, conduit, potheads, and grounding systems. This work shall also include the painting of equipment and conduit; the marking and labeling of equipment and the labeling or tagging of wires; the testing of the installation; and the furnishing of all incidentals necessary to place it in operating condition as a completed unit to the satisfaction of the RPR.

EQUIPMENT AND MATERIALS

109-2.1 General.

a. Airport lighting equipment and materials covered by advisory circulars (AC) shall be certified in AC 150/5345-53, Airport Lighting Equipment Certification Program (ALECP) and listed in the ALECP Addendum.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the RPR.

c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the RPR) and replaced with materials that comply with these specifications at the Contractor's cost.

d. All materials and equipment used to construct this item shall be submitted to the RPR for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

e. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the plans and specifications. The Contractor's submittals shall be provided in electronic pdf format, tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

CONSTRUCTION OF VAULT AND PREFABRICATED METAL HOUSING

109-3.1 Electrical vault building. The electrical vault building must comply with NEC Article 110.31, Enclosure for Electrical Installations, Item (A) Electrical Vaults. Construct the building of materials having adequate structural strength for the conditions and installed location, has a minimum fire rating of two or three hours as determined by the authority having jurisdiction (AHJ), and is bullet resistant to minimum UL 752 Level 4.

109-3.2 Concrete. Concrete shall be proportioned, placed, and cured per Item TX-421, Hydraulic Cement Concrete.

109-3.3 Precast concrete structures. Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another RPR approved third party certification program. Precast concrete structures shall conform to ASTM C478.

109-3.4 Reinforcing steel. Reinforcing steel bars shall be intermediate or structural grade deformed-type bars and shall be per ASTM A615.

109-3.5 Brick. Brick shall be per ASTM C62, Grade SW.

109-3.6 Rigid steel conduit. Rigid steel conduit and fittings shall be per Underwriters Laboratories Standards 6 and 514B.

109-3.7 Plastic Conduit and fittings. Plastic Conduit and fittings shall conform to the requirements of UL-651 and UL-654 schedule 40 polyvinyl chloride (PVC) suitable for use above or below ground.

109-3.8 Lighting. Vault or metal-housing light fixtures shall be of a vapor-proof type.

109-3.9 Outlets. Convenience outlets shall be heavy-duty duplex units designed for industrial service.

109-3.10 Switches. Vault or metal-housing light switches shall be single-pole switches.

109-3.11 Paint.

a. Priming paint for non-galvanized metal surfaces shall be a high solids alkyd primer compatible with the manufacturer's recommendations for the intermediate or topcoat.

b. White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to the Master Painter's Institute (MPI), Reference #9, Exterior Alkyd, Gloss.

c. Priming paint for wood surfaces shall be mixed on the job by thinning the specified white paint by adding 1/2 pint (0.24 liter) of raw linseed oil to each gallon (liter).

d. Paint for the floor, ceiling, and inside walls shall be per Porter Paint Company 69, 71, and 79 or equivalent. Walls and ceiling shall be light gray and the floor shall be medium gray.

e. The roof coating shall be hot asphalt material per ASTM D2823. Asbestos-free roof coating per ASTM D4479 may be substituted if required by local codes.

109-3.12 Ground bus. Ground bus shall be 1/8 $\times$ 3/4 inch (3 $\times$ 19 mm) minimum copper bus bar.

109-3.13 Square duct. Duct shall be square similar to that manufactured by the Square D Company (or equivalent), or the Trumbull Electric Manufacturing Company (or equivalent). The entire front of the duct on each section shall consist of hinged or removable cover for ready access to the interior. The cross-section of the duct shall be not less than 4 $\times$ 4 inch (100 $\times$ 100 mm) except where otherwise shown in the plans.

109-3.14 Ground rods. Ground rods shall be in accordance with Item L-108.

109-3.15 Vault prefabricated metal housing. The prefabricated metal housing shall be a commercially available unit.

109-3.16 FAA-approved equipment. Certain items of airport lighting equipment installed in vaults are covered by individual ACs listed below:

AC 150/5345-3	Specification for L-821, Panels for Remote Control of Airport Lighting
AC 150/5345-5	Circuit Selector Switch
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-10	Specification for Constant Current Regulators and Regulator Monitors
AC 150/5345-13	Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits.
AC 150/5345-49	Specification for L-854, Radio Control Equipment
AC 150/5345-56	Specification for L-890 Airport Lighting Control and Monitoring System (ALCMS)

109-3.17 Other electrical equipment. Distribution transformers, oil switches, cutouts, relays, terminal blocks, transfer relays, circuit breakers, and all other regularly used commercial items of electrical equipment not covered by FAA equipment specifications and ACs shall conform to the applicable rulings and standards of the Institute of Electrical and Electronic Engineers (IEEE) or the National Electrical Manufacturers Association (NEMA). When specified, test reports from a testing laboratory indicating that the equipment meets the specifications shall be supplied. In all cases, equipment shall be new and a first-grade product. This equipment shall be supplied in the quantities required for the specific project and shall incorporate the electrical and mechanical characteristics specified in the proposal and plans. Equipment selected and installed by the Contractor shall maintain the interrupting current rating of the existing systems or specified rating whichever is greater.

109-3.18 Wire. Wire (in conduit) rated up to 5,000 volts shall be per AC 150/5345-7, Specification for L-824 Underground Electrical Cables for Airport Lighting Circuits. For ratings up to 600 volts, moisture and heat resistant thermoplastic wire conforming to Commercial Item Description A-A-59544A Type THWN-2 shall be used. The wires shall be of the type, size, number of conductors, and voltage shown in the plans or in the proposal.

a. Control circuits. Unless otherwise indicated on the plans, wire shall be not less than No. 12 American wire gauge (AWG) and shall be insulated for 600 volts. If telephone control cable is specified, No. 19 AWG telephone cable per ANSI/Insulated Cable Engineers Association (ICEA) S-85-625 specifications shall be used.

b. Power circuits.

(1) 600 volts maximum – Wire shall be No. 6 AWG or larger and insulated for at least 600 volts.

(2) 3,000 volts maximum – Wire shall be No. 6 AWG or larger and insulated for at least 3,000 volts.

(3) Over 3,000 volts-Wire shall be No. 6 AWG or larger and insulated for at least the circuit voltage.

109-3.19 Short circuit / coordination / device evaluation / arc flash analysis. The Contractor shall, based upon the equipment provided, include as a part of the submittal process the electrical system "Short Circuit / Coordination / Device evaluation / Arc Flash Analysis". The analysis shall be performed by the equipment manufacturer and submitted in a written report. The analysis shall be signed and sealed by a registered professional Engineer from the state in which the project is located. The analysis shall comply with NFPA-70E and IEEE 1584.

The analysis will include: one line diagrams, short circuit analysis, coordination analysis, equipment evaluation, arc flash analysis and arc flash labels containing at a minimum, equipment name, voltage/current rating, available incident energy and flash protection boundary.

The selected firms field service Engineer shall perform data gathering for analysis completion and device settings, perform device setting as recommended by the analysis and will furnish and install the arc flash labels. The

components worst case incident energy will be considered the available arc flash energy at that specific point in the system. Submit three written copies and one electronic copy of the report.

CONSTRUCTION METHODS

CONSTRUCTION OF VAULT AND PREFABRICATED METAL HOUSING

109-4.1 General. The Contractor shall construct the transformer vault or prefabricated metal housing at the location indicated in the plans. Vault construction shall be reinforced concrete, concrete masonry, or brick wall as specified. The metal housing shall be prefabricated equipment enclosure to be supplied in the size specified. The mounting pad or floor details, installation methods, and equipment placement are shown in the plans. Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another engineer approved third party certification program.

The Contractor shall clear, grade, and seed the area around the vault or metal housing for a minimum distance of 10 feet (3 m) on all sides. The slope shall be not less than 1/2 inch per foot (12 mm per 0.3 m) away from the vault or metal housing in all directions.

The vault shall provide adequate protection against weather elements, including rain, wind-driven dust, snow, ice and excessive heat. The vault shall have sufficient filtered ventilation, to assure that the interior room temperatures and conditions do not exceed the recommended limits of the electrical equipment to be installed in the vault. The Contractor is responsible for contacting the manufacturer of the equipment to be installed to obtain environmental limitations of the equipment to be installed. Refer to the electrical vault detail plan sheets for construction requirements. The prefabricated building shall include roof, walls and floor in accordance with the details and these specifications.

109-4.2 Foundation and walls.

a. Reinforced concrete construction. The Contractor shall construct the foundation and walls per the details shown in the plans. Unless otherwise specified, internal ties shall be of the mechanical type so that when the forms are removed the ends of the ties shall be at least one inch (25 mm) beneath the concrete surface; the holes shall be plugged and finished to prevent discoloration. Reinforcing steel shall be placed, as shown in the drawings, and secured in position to prevent displacement during the concrete placement.

The external surfaces of the concrete shall be thoroughly worked during the placing operation to force all coarse aggregate from the surface. Thoroughly work the mortar against the forms to produce a smooth finish free from air pockets and honeycomb.

The surface film of all pointed surfaces shall be removed before setting occurs. As soon as the pointing has set sufficiently, the entire surface inside and outside of the vault shall be thoroughly wet with water and rubbed with a No. 16 carborundum stone, or equivalent quality abrasive, bringing the surface to a paste. All form marks and projections shall be removed. The surface produced shall be smooth and dense without pits or irregularities. The materials which have been ground into a paste during the rubbing process shall be spread or brushed uniformly over the entire surface (except the interior surfaces that are to be painted shall have all paste removed by washing before painting) and permitted to reset. Final exterior finish shall be obtained by rubbing with No. 30 carborundum stone, or an equivalent quality abrasive. The surface shall be rubbed until the entire surface is smooth and uniform in color.

b. Brick and concrete construction. When this type of construction is specified, the foundation shall be concrete conforming to the details shown in the plans. The outer edge of the foundation at the floor level shall be beveled 1-1/2 inches (38 mm) at 45 degrees. Brick walls shall be 8 inches (200 mm) thick, laid in running bond with every sixth course a header course. Brick shall be laid in cement mortar (one part masonry cement and 3 parts sand) with full mortar bed and shoved joints. All joints shall be completely filled with mortar, and facing brick shall be back-parged

with mortar as work progresses. All joints shall be 3/8 inch (9 mm) thick, exterior joints tooled concave, and interior joints struck flush. Both interior and exterior brick surfaces shall be cleaned and nail holes, cracks and other defects filled with mortar. When specified, a nonfading mineral pigment mortar coloring shall be added to the mortar. Steel reinforcing bars, 3/8 inch (9 mm) in diameter and 12 inches (300 mm) long, shall be set vertically in the center of the brick wall on not more than 2 feet (60 cm) centers to project 2-1/2 inches (60 mm) into the concrete roof slab. Lintels for supporting the brickwork over doors, windows, and louvers shall consist of two 4 × 3 × 3/8 inch (100 × 75 × 9 mm) steel angles. Lintels shall be painted with one coat of corrosion-inhibiting primer before installation, and all exposed parts shall be painted similar to doors and window sash after installation.

Window sills may be concrete poured in place or precast concrete as indicated in the plans. All exposed surfaces shall have a rubbed finish as specified under reinforced concrete construction. After completion, all interior and exterior faces of walls shall be scrubbed with a solution of muriatic acid and water in the proportions of not less than one part acid to 10 parts of water. All traces of efflorescence, loose mortar, and mortar stain shall be removed, and the walls washed down with clear water.

c. Concrete masonry construction. When this type of construction is specified, the foundation shall be concrete conforming to the details shown in the plans. The concrete masonry units shall be standard sizes and shapes and shall conform to ASTM C90 and shall include the closures, jambs, and other shapes required by the construction as shown in the plans. Standard construction practice shall be followed for this type of work including mortar, joints, reinforcing steel for extensions into roof slab, etc. Plaster for interior walls, if specified, shall be Portland cement plaster.

109-4.3 Roof. The roof shall be reinforced concrete as shown in the plans. Reinforcing steel shall be placed as shown in the drawing and secured in position to prevent displacement during the pouring of the concrete. The concrete shall be poured monolithically and shall be free of honeycombs and voids. The surface shall have a steel-troweled finish and shall be sloped as shown in the drawing. The underside of the roof slab shall be finished in the same manner as specified for walls.

One brush or mop coat of hot asphalt roof coating shall be applied to the top surface of the roof slab. The asphalt material shall be heated to within the range specified by the manufacturer and immediately applied to the roof. The finished coat shall be continuous over the roof surface and free from holidays and blisters. Smears and dribbles of asphalt on the roof edges and building walls shall be removed.

109-4.4 Floor. Construct building foundation in accordance with the details shown in the plans. The floor shall be reinforced concrete as shown in the drawings. When present, all sod, roots, refuse, and other perishable material shall be removed from the area under the floor to a depth of 8 inches (200 mm), unless a greater depth is specified in the invitation for bids. This area shall be backfilled with materials consisting of sand, cinders, gravel, or stone. Fill shall be placed in layers not to exceed 4 inches (100 mm) and shall be thoroughly compacted by tamping or rolling. A layer of building paper shall be placed over the fill prior to placing concrete. The floor surfaces shall have a steel-troweled finish. The floor shall be level unless a drain is specified, in which case the floor shall be pitched 1/4 inch (6 mm) per foot downward toward the drain. A 1/4-inch (6-mm) asphalt felt expansion joint shall be placed between floor and foundation walls. The floor shall be poured monolithically and shall be free of honeycombs and voids.

109-4.5 Floor drain. If shown in the plans, a floor drain and dry well shall be installed in the center of the floor of the equipment room. The dry well shall be excavated 4 × 4 feet (1.2 × 1.2 m) square and to a depth of 4 feet (1.2 m) below the finished floor elevation and shall be backfilled to the elevation of the underside of the floor with gravel - which shall all pass a 2-inch (50 mm) mesh sieve and shall all be retained on a 1/4-inch (6.3 mm) mesh sieve. The gravel backfill shall be placed in 6 inch (150 mm) maximum layers, and the entire surface of each layer shall be tamped either with a mechanical tamper or with a hand tamper weighing not less than 25 pounds (11 kg) and having a face area of not more than 36 square inches (232 square cm) nor less than 16 square inches (103 square cm). The drain inlet shall be set flush in the concrete floor. The drain shall have a clear opening of not less than 8 inches (200 mm) in diameter.

109-4.6 Conduits in floor and foundation. Conduits shall be installed in the floor and through the foundation walls per the details shown in the plans. All underground conduit shall be painted with an asphalt compound. Conduit shall be installed with a coupling or metal conduit adapter flush with the top of the floor. All incoming conduit shall be closed with a pipe plug to prevent the entrance of foreign material during construction. Space conduit entrances shall be left closed.

109-4.7 Doors. Doors shall be metal-clad fireproof Class A (three (3) hour rated) doors conforming to requirements of the National Electrical Code (NEC) and local electrical codes. Panic bar exit hardware shall be installed per NEC requirements. Refer to the new electrical vault detail plan sheets for construction requirements.

109-4.8 Painting. The floor, ceiling, and inside walls of concrete construction shall first be given a hardening treatment, after which the Contractor shall apply two coats of paint as specified below, except that interior face brick walls need not be painted. The hardening treatment shall consist of applying two coats of either a commercial floor hardener or a solution made by dissolving 2 pounds (0.9 kg) of magnesium fluorosilicate or zinc sulfate crystals in one gallon (liter) of water. Each coat shall be allowed to dry at least 48 hours before the next application. After the second treating coat has dried, the surfaces shall be brushed clean of all crystals and thoroughly washed with clear water. Paint for walls and ceiling shall be a light gray color approved by the RPR. The floor paint shall be a medium gray color approved by the RPR. Before painting, the surfaces shall be dry and clean. The first coat shall be thinned by adding 2/3-quart (0.63 liters) of spar varnish and 1/3-quart (0.31 liters) of turpentine to each gallon (liter) of paint. The second coat shall be applied without thinning. All doors, lintels, and windows shall be cleaned to remove any rust or foreign material and shall be given one body and one finish coat of white paint. Bare metal surfaces shall be given a prime coat of corrosion-inhibiting primer prior to the body and finish coats.

109-4.9 Lights and switches. The Contractor shall furnish and install a minimum of two duplex convenience outlets in the vault room. Where a control room is specified, at least two duplex outlets shall be installed.

INSTALLATION OF EQUIPMENT IN VAULT OR PREFABRICATED METAL HOUSING

109-5.1 General. The Contractor shall furnish, install, and connect all equipment, equipment accessories, conduit, cables, wires, buses, grounds, and support necessary to ensure a complete and operable electrical distribution center for the airport lighting system as specified herein and shown in the plans. When specified, an emergency power supply and transfer switch shall be provided and installed.

The equipment installation and mounting shall comply with the requirements of the National Electrical Code and local code agency having jurisdiction. All electrical work shall comply with the NEC and local code agency having jurisdiction including the separation of under 600V work from 5,000V work."

109-5.2 Power supply equipment. Transformers, regulators, booster transformers, and other power supply equipment items shall be furnished and installed at the location shown in the plans or as directed by the RPR. The power supply equipment shall be set on steel "H" sections, "I" beams, channels, or concrete blocks to provide a minimum space of 1-1/2 inch (38 mm) between the equipment and the floor. The equipment shall be placed so as not to obstruct the oil-sampling plugs of the oil-filled units; and name-plates shall, so far as possible, not be obscured.

If specified in the plans and specifications, equipment for an alternate power source or an emergency power generator shall be furnished and installed. The alternate power supply installation shall include all equipment, accessories, an automatic changeover switch, and all necessary wiring and connections. The emergency power generator set shall be the size and type specified.

109-5.3 Switchgear and panels. Oil switches, fused cutouts, relays, transfer switches, panels, panel boards, and other similar items shall be furnished and installed at the location shown in the plans or as directed by the RPR. Wall or ceiling mounted items shall be attached to the wall or ceiling with galvanized bolts of not less than 3/8-inch (9 mm) diameter engaging metal expansion shields or anchors in masonry or concrete vaults.

109-5.4 Duct and conduit. The Contractor shall furnish and install square-type exposed metallic ducts with hinged covers for the control circuits in the vault. These shall be mounted along the walls behind all floor-mounted equipment and immediately below all wall-mounted equipment. The hinged covers shall be placed to open from the front side with the hinges at the front bottom.

Wall brackets for square ducts shall be installed at all joints 2 feet (60 cm) or more apart with intermediate brackets as specified. Conduit shall be used between square ducts and equipment or between different items of equipment when the equipment is designed for conduit connection. When the equipment is not designed for conduit connection, conductors shall enter the square-type control duct through insulating bushings in the duct or on the conduit risers.

109-5.5 Wiring and connections. The Contractor shall make all necessary electrical connections in the vault per the wiring diagrams furnished and as directed by the RPR. In wiring to the terminal blocks, the Contractor shall leave sufficient extra length on each control lead to make future changes in connections at the terminal block. This shall be accomplished by running each control lead the longest way around the box to the proper terminal. Leads shall be neatly laced in place.

109-5.6 Marking and labeling. All equipment, control wires, terminal blocks, etc., shall be tagged, marked, or labeled as specified below:

a. Wire identification. The Contractor shall furnish and install self-sticking wire labels or identifying tags on all control wires at the point where they connect to the control equipment or to the terminal blocks. Wire labels, if used, shall be of the self-sticking preprinted type and of the manufacturer's recommended size for the wire involved. Identification -markings designated in the plans shall be followed. Tags, if used, shall be of fiber not less than 3/4 inch (19 mm) in diameter and not less than 1/32 inch (1 mm) thick. Identification markings designated in the plans shall be stamped on tags by means of small tool dies. Each tag shall be securely tied to the proper wire by a nonmetallic cord.

b. Labels. The Contractor shall stencil identifying labels on the cases of regulators, breakers, and distribution and control relay cases with white oil paint as designated by the RPR. The letters and numerals shall be not less than one inch (25 mm) in height and shall be of proportionate width. The Contractor shall also mark the correct circuit designations per the wiring diagram on the terminal marking strips, which are a part of each terminal block.

METHOD OF MEASUREMENT

109-6.1 The quantity of vaults to be paid for under this item shall consist of the number of vaults constructed in place and accepted as a complete unit.

109-6.2 The quantity of prefabricated metal housings to be paid for under this item shall consist of the number of housings constructed in place and accepted as a complete unit.

109-6.3 The quantity of equipment to be paid for under this item shall consist of all equipment installed, connected and accepted as a complete unit ready for operation within an existing vault or prefabricated metal housing.

BASIS OF PAYMENT

109-7.1 Payment will be made at the contract unit price for each completed and accepted vault or prefabricated metal housing equipment installation. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item L-109a	Remove Airfield Lighting Vault – per lump sum
Item L-109b	Install Prefab. Airfield Lighting Vault – per lump sum
Item L-109c	Install L-829 Constant Current Regulator, Ferroresonant Type– per each

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-3	Specification for L-821, Panels for Remote Control of Airport Lighting
AC 150/5345-5	Circuit Selector Switch
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-10	Specification for Constant Current Regulators and Regulator Monitors
AC 150/5345-13	Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits
AC 150/5345-49	Specification L-854, Radio Control Equipment;
AC 150/5345-53	Airport Lighting Equipment Certification Program

American National Standards Institute / Insulated Cable Engineers Association (ANSI/ICEA)

ANSI/ICEA S-85-625	Standard for Telecommunications Cable Aircore, Polyolefin Insulated, Copper Conductor Technical Requirements

ASTM International (ASTM)

ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C62	Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C90	Standard Specification for Loadbearing Concrete Masonry Units
ASTM D2823	Standard Specification for Asphalt Roof Coatings, Asbestos Containing
ASTM D4479	Standard Specification for Asphalt Roof Coatings – Asbestos-Free

Commercial Item Description (CID)

A-A 59544	Cable and Wire, Electrical (Power, Fixed Installation) Institute of Electrical and Electronic Engineers (IEEE)
IEEE 1584	Guide for Performing Arc-Flash Hazard Calculations

Master Painter's Institute (MPI)

MPI Reference #9	Alkyd, Exterior, Gloss (MPI Gloss Level 6)

Underwriters Laboratories (UL)

UL Standard 6	Electrical Rigid Metal Conduit – Steel

UL Standard 514B	Conduit, Tubing, and Cable Fittings
UL Standard 514C	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL Standard 651	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL Standard 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit

National Fire Protection Association (NFPA)

NFPA-70	National Electrical Code (NEC)
NFPA-70E	Standard for Electrical Safety in the Workplace
NFPA-780	Standard for the Installation of Lightning Protection Systems

END OF ITEM L-109

ITEM L-110 AIRPORT UNDERGROUND ELECTRICAL DUCT BANKS AND CONDUITS – Summary of Changes

Section 110-2.6 revised to read as follows:

a) The concrete for foundations shall be proportioned, placed, and cured per Item ~~P-610~~TX-421, ~~Concrete for Miscellaneous Structures~~Hydraulic Cement Concrete.

Item L-110 Airport Underground Electrical Duct Banks and Conduits

DESCRIPTION

110-1.1 This item shall consist of underground electrical conduits and duct banks (single or multiple conduits encased in concrete or buried in sand) installed per this specification at the locations and per the dimensions, designs, and details shown on the plans. This item shall include furnishing and installing of all underground electrical duct banks and individual and multiple underground conduits and removal of existing duct banks. It shall also include all turfing trenching, backfilling, removal, and restoration of any paved or turfed areas; concrete encasement, mandrelling, pulling lines, duct markers, plugging of conduits, and the testing of the installation as a completed system ready for installation of cables per the plans and specifications. This item shall also include furnishing and installing conduits and all incidentals for providing positive drainage of the system. Verification of existing ducts is incidental to the pay items provided in this specification.

EQUIPMENT AND MATERIALS

110-2.1 General.

a. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the RPR.

b. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications and acceptable to the RPR. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the RPR and replaced with materials, that comply with these specifications, at the Contractor's cost.

c. All materials and equipment used to construct this item shall be submitted to the RPR for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in project that accrue directly or indirectly from late submissions or resubmissions of submittals.

d. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the plans and specifications. The Contractor's submittals shall be electronically submitted in pdf format, tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes specified in this document.

e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

110-2.2 Steel conduit. Rigid galvanized steel (RGS) conduit and fittings shall be hot dipped galvanized inside and out and conform to the requirements of Underwriters Laboratories Standards 6, 514B, and 1242. All RGS conduits or RGS elbows installed below grade, in concrete, permanently wet locations or other similar environments shall be

painted with a 10-mil thick coat of asphaltum sealer or shall have a factory-bonded polyvinyl chloride (PVC) cover. Any exposed galvanizing or steel shall be coated with 10 mils of asphaltum sealer. When using PVC coated RGS conduit, care shall be exercised not to damage the factory PVC coating. Damaged PVC coating shall be repaired per the manufacturer's written instructions. In lieu of PVC coated RGS, corrosion wrap tape shall be permitted to be used where RGS is in contact with direct earth."

110-2.3 Plastic conduit. Plastic conduit and fittings-shall conform to the following requirements:

- UL 514B covers W-C-1094-Conduit fittings all types, classes 1 thru 3 and 6 thru 10.
- UL 514C covers W-C-1094- all types, Class 5 junction box and cover in plastic (PVC).
- UL 651 covers W-C-1094-Rigid PVC Conduit, types I and II, Class 4.
- UL 651A covers W-C-1094-Rigid PVC Conduit and high-density polyethylene (HDPE) Conduit type III and Class 4.

Underwriters Laboratories Standards UL-651 and Article 352 of the current National Electrical Code shall be one of the following, as shown on the plans:

a. Type I–Schedule 40 and Schedule 80 PVC suitable for underground use either direct-buried or encased in concrete.

b. Type II–Schedule 40 PVC suitable for either above ground or underground use.

c. Type III – Schedule 80 PVC suitable for either above ground or underground use either direct-buried or encased in concrete.

d. Type III –HDPE pipe, minimum standard dimensional ratio (SDR) 11, suitable for placement with directional boring under pavement.

The type of solvent cement shall be as recommended by the conduit/fitting manufacturer.

110-2.4 Split conduit. Split conduit shall be pre-manufactured for the intended purpose and shall be made of steel or plastic.

110-2.5 Conduit spacers. Conduit spacers shall be prefabricated interlocking units manufactured for the intended purpose. They shall be of double wall construction made of high grade, high density polyethylene complete with interlocking cap and base pads. They shall be designed to accept No. 4 reinforcing bars installed vertically.

110-2.6 Concrete. Concrete shall be proportioned, placed, and cured per Item TX-421, Hydraulic Cement Concrete.

110-2.7 Precast concrete structures. Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another RPR approved third party certification program. Precast concrete structures shall conform to ASTM C478.

110-2.8 Flowable backfill. Flowable material used to back fill conduit and duct bank trenches shall conform to the requirements of Item P-153, Controlled Low Strength Material.

110-2.9 Detectable warning tape. Plastic, detectable, American Public Works Association (APWA) red (electrical power lines, cables, conduit and lighting cable), orange (telephone/fiber optic cabling) with continuous legend magnetic tape shall be polyethylene film with a metallized foil core and shall be 3-6 inches (75-150 mm) wide. Detectable tape is incidental to the respective bid item.

CONSTRUCTION METHODS

110-3.1 General. The Contractor shall install underground duct banks and conduits at the approximate locations indicated on the plans. The RPR shall indicate specific locations as the work progresses, if required to differ from the plans. Duct banks and conduits shall be of the size, material, and type indicated on the plans or specifications. Where no size is indicated on the plans or in the specifications, conduits shall be not less than 2 inches (50 mm) inside diameter or comply with the National Electrical Code based on cable to be installed, whichever is larger. All duct bank and conduit lines shall be laid so as to grade toward access points and duct or conduit ends for drainage. Unless shown otherwise on the plans, grades shall be at least 3 inches (75 mm) per 100 feet (30 m). On runs where it is not practicable to maintain the grade all one way, the duct bank and conduit lines shall be graded from the center in both directions toward access points or conduit ends, with a drain into the storm drainage system. Pockets or traps where moisture may accumulate shall be avoided. Under pavement, the top of the duct bank shall not be less than 18 inches (0.5 m) below the subgrade; in other locations, the top of the duct bank or underground conduit shall be be not less than 18 inches (0.5 m) below finished grade.

The Contractor shall mandrel each individual conduit whether the conduit is direct-buried or part of a duct bank. An iron-shod mandrel, not more than 1/4 inch (6 mm) smaller than the bore of the conduit shall be pulled or pushed through each conduit. The mandrel shall have a leather or rubber gasket slightly larger than the conduit hole.

The Contractor shall swab out all conduits/ducts and clean base can, manhole, pull boxes, etc., interiors immediately prior to pulling cable. Once cleaned and swabbed the light bases, manholes, pull boxes, etc., and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, base cans, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be recleaned at the Contractor's expense. All accessible points shall be kept closed when not installing cable. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the RPR of any blockage in the existing ducts.

For pulling the permanent wiring, each individual conduit, whether the conduit is direct-buried or part of a duct bank, shall be provided with a 200-pound (90 kg) test polypropylene pull rope. The ends shall be secured and sufficient length shall be left in access points to prevent it from slipping back into the conduit. Where spare conduits are installed, as indicated on the plans, the open ends shall be plugged with removable tapered plugs, designed for this purpose.

All conduits shall be securely fastened in place during construction and shall be plugged to prevent contaminants from entering the conduits. Any conduit section having a defective joint shall not be installed. Ducts shall be supported and spaced apart using approved spacers at intervals not to exceed 5 feet (1.5 m).

Unless otherwise shown on the plans, concrete encased duct banks shall be used when crossing under pavements expected to carry aircraft loads, such as runways, taxiways, taxilanes, ramps and aprons. When under paved shoulders and other paved areas, conduit and duct banks shall be encased using flowable fill for protection.

All conduits within concrete encasement of the duct banks shall terminate with female ends for ease in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored.

Trenches for conduits and duct banks may be excavated manually or with mechanical trenching equipment unless in pavement, in which case they shall be excavated with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Blades of graders shall not be used to excavate the trench.

When rock is encountered, the rock shall be removed to a depth of at least 3 inches (75 mm) below the required conduit or duct bank depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4-inch (6.3 mm) sieve. Flowable backfill may alternatively be used

Underground electrical warning (Caution) tape shall be installed in the trench above all underground duct banks and conduits in unpaved areas. Contractor shall submit a sample of the proposed warning tape for approval by the RPR. If not shown on the plans, the warning tape shall be located 6 inches above the duct/conduit or the counterpoise wire if present.

Joints in plastic conduit shall be prepared per the manufacturer's recommendations for the particular type of conduit. Plastic conduit shall be prepared by application of a plastic cleaner and brushing a plastic solvent on the outside of the conduit ends and on the inside of the couplings. The conduit fitting shall then be slipped together with a quick one-quarter turn twist to set the joint tightly. Where more than one conduit is placed in a single trench, or in duct banks, joints in the conduit shall be staggered a minimum of 2 feet (60 cm).

Changes in direction of runs exceeding 10 degrees, either vertical or horizontal, shall be accomplished using manufactured sweep bends.

Whether or not specifically indicated on the drawings, where the soil encountered at established duct bank grade is an unsuitable material, as determined by the RPR, the unsuitable material shall be removed per Item P-152 and replaced with suitable material. Additional duct bank supports shall be installed, as approved by the RPR.

All excavation shall be unclassified and shall be considered incidental to Item L-110. Dewatering necessary for duct installation, and erosion per federal, state, and local requirements is incidental to Item L-110.

Unless otherwise specified, excavated materials that are deemed by the RPR to be unsuitable for use in backfill or embankments shall be removed and disposed of offsite.

Any excess excavation shall be filled with suitable material approved by the RPR and compacted per Item P-152.

It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Where existing active cables) cross proposed installations, the Contractor shall ensure that these cables are adequately protected. Where crossings are unavoidable, no splices will be allowed in the existing cables, except as specified on the plans. Installation of new cable where such crossings must occur shall proceed as follows:

a. Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely no damage has occurred

b. Trenching, etc., in cable areas shall then proceed with approval of the RPR, with care taken to minimize possible damage or disruption of existing cable, including careful backfilling in area of cable.

In the event that any previously identified cable is damaged during the course of construction, the Contractor shall be responsible for the complete repair.

110-3.2 Duct banks. Unless otherwise shown in the plans, duct banks shall be installed so that the top of the concrete envelope is not less than 18 inches (0.5 m) below the bottom of the base or stabilized base course layers where installed under runways, taxiways, aprons, or other paved areas, and not less than 18 inches (0.5 m) below finished grade where installed in unpaved areas.

Unless otherwise shown on the plans, duct banks under paved areas shall extend at least 3 feet (1 m) beyond the edges of the pavement or 3 feet (1 m) beyond any under drains that may be installed alongside the paved area. Trenches for duct banks shall be opened the complete length before concrete is placed so that if any obstructions are encountered, provisions can be made to avoid them. Unless otherwise shown on the plans, all duct banks shall be placed on a layer of concrete not less than 3 inches (75 mm) thick prior to its initial set. The Contractor shall space

the conduits not less than 3 inches (75 mm) apart (measured from outside wall to outside wall). All such multiple conduits shall be placed using conduit spacers applicable to the type of conduit. As the conduit laying progresses, concrete shall be placed around and on top of the conduits not less than 3 inches (75 mm) thick unless otherwise shown on the plans. All conduits shall terminate with female ends for ease of access in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Conduits forming the duct bank shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of 6 inches (150 mm) to anchor the assembly into the earth prior to placing the concrete encasement. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at 5-foot (1.5-m) intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the RPR for review prior to use.

When specified, the Contractor shall reinforce the bottom side and top of encasements with steel reinforcing mesh or fabric or other approved metal reinforcement. When directed, the Contractor shall supply additional supports where the ground is soft and boggy, where ducts cross under roadways, or where shown on the plans. Under such conditions, the complete duct structure shall be supported on reinforced concrete footings, piers, or piles located at approximately 5-foot (1.5-m) intervals.

All pavement surfaces that are to have ducts installed therein shall be neatly saw cut to form a vertical face. All excavation shall be included in the contract with price for the duct.

Install a plastic, detectable, color as noted, 3 to 6 inches (75 to 150 mm) wide tape, 8 inches (200 mm) minimum below grade above all underground conduit or duct lines not installed under pavement. Utilize the 3-inch (75-mm) wide tape only for single conduit runs. Utilize the 6-inch (150-mm) wide tape for multiple conduits and duct banks. For duct banks equal to or greater than 24 inches (600 mm) in width, utilize more than one tape for sufficient coverage and identification of the duct bank as required.

When existing cables are to be placed in split duct, encased in concrete, the cable shall be carefully located and exposed by hand tools. Prior to being placed in duct, the RPR shall be notified so that he may inspect the cable and determine that it is in good condition. Where required, split duct shall be installed as shown on the drawings or as required by the RPR.

110-3.3 Conduits without concrete encasement. Trenches for single-conduit lines shall be not less than 6 inches (150 mm) nor more than 12 inches (300 mm) wide. The trench for 2 or more conduits installed at the same level shall be proportionately wider. Trench bottoms for conduits without concrete encasement shall be made to conform accurately to grade so as to provide uniform support for the conduit along its entire length.

Unless otherwise shown on the plans, a layer of fine earth material, at least 4 inches (100 mm) thick (loose measurement) shall be placed in the bottom of the trench as bedding for the conduit. The bedding material shall consist of soft dirt, sand or other fine fill, and it shall contain no particles that would be retained on a 1/4-inch (6.3 mm) sieve. The bedding material shall be tamped until firm. Flowable backfill may alternatively be used.

Unless otherwise shown on plans, conduits shall be installed so that the tops of all conduits within the Airport's secured area where trespassing is prohibited are at least 18 inches (0.5 m) below the finished grade. Conduits outside the Airport's secured area shall be installed so that the tops of the conduits are at least 24 inches (60 cm) below the finished grade per National Electric Code (NEC), Table 300.5.

When two or more individual conduits intended to carry conductors of equivalent voltage insulation rating are installed in the same trench without concrete encasement, they shall be spaced not less than 3 inches (75 mm) apart (measured from outside wall to outside wall) in a horizontal direction and not less than 6 inches (150 mm) apart in a vertical direction. Where two or more individual conduits intended to carry conductors of differing voltage insulation rating are installed in the same trench without concrete encasement, they shall be placed not less than 3

inches (75 mm) apart (measured from outside wall to outside wall) in a horizontal direction and lot less than 6 inches (150 mm) apart in a vertical direction.

Trenches shall be opened the complete length between normal termination points before conduit is installed so that if any unforeseen obstructions are encountered, proper provisions can be made to avoid them.

Conduits shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of 6 inches (150 mm) to anchor the assembly into the earth while backfilling. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at 5-foot (1.5-m) intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the RPR for review prior to use.

110-3.4 Markers. The location of each end and of each change of direction of conduits and duct banks shall be marked by a concrete slab marker 2 feet (60 cm) square and 4 - 6 inches (100 - 150 mm) thick extending approximately one inch (25 mm) above the surface. The markers shall also be located directly above the ends of all conduits or duct banks, except where they terminate in a junction/access structure or building. Each cable or duct run from a line of lights and signs to the equipment vault must be marked at approximately every 200 feet (61 m) along the cable or duct run, with an additional marker at each change of direction of cable or duct run.

The Contractor shall impress the word “DUCT” or “CONDUIT” on each marker slab. Impression of letters shall be done in a manner, approved by the RPR, for a neat, professional appearance. All letters and words must be neatly stenciled. After placement, all markers shall be given one coat of high-visibility orange paint, as approved by the RPR. The Contractor shall also impress on the slab the number and size of conduits beneath the marker along with all other necessary information as determined by the RPR. The letters shall be 4 inches (100 mm) high and 3 inches (75 mm) wide with width of stroke 1/2 inch (12 mm) and 1/4 inch (6 mm) deep or as large as the available space permits. Furnishing and installation of duct markers is incidental to the respective duct pay item.

110-3.5 Backfilling for conduits. For conduits, 8 inches (200 mm) of sand, soft earth, or other fine fill (loose measurement) shall be placed around the conduits ducts and carefully tamped around and over them with hand tampers. The remaining trench shall then be backfilled and compacted per Item P-152 except that material used for back fill shall be select material not larger than 4 inches (100 mm) in diameter.

Flowable backfill may alternatively be used.

Trenches shall not contain pools of water during back filling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of per instructions issued by the RPR.

110-3.6 Backfilling for duct banks. After the concrete has cured, the remaining trench shall be backfilled and compacted per Item P-152 “Excavation and Embankment” except that the material used for backfill shall be select material not larger than 4 inches (100 mm) in diameter. In addition to the requirements of Item P-152, where duct banks are installed under pavement, one moisture/density test per lift shall be made for each 250 linear feet (76 m) of duct bank or one work period’s construction, whichever is less.

Flowable backfill may alternatively be used.

Trenches shall not contain pools of water during backfilling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of per instructions issued by the RPR.

110-3.7 Restoration. Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the work shall be restored to its original condition. The restoration shall include seeding as shown on the plans. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. All restoration shall be considered incidental to the respective L-110 pay item. Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD), and remove any such FOD that is found. This FOD inspection and removal shall be considered incidental to the pay item of which it is a component part.

110-3.8 Ownership of removed cable. The Contractor shall obtain ownership of all removed cable.

METHOD OF MEASUREMENT

110-4.1 Underground conduits and duct banks shall be measured by the linear feet (meter) of conduits and duct banks installed, including encasement, locator tape, trenching and backfill with designated material, and restoration, and for drain lines, the termination at the drainage structure, all measured in place, completed, and accepted. Separate measurement shall be made for the various types and sizes.

BASIS OF PAYMENT

110-5.1 Payment will be made at the contract unit price per linear foot for each type and size of conduit and duct bank completed and accepted, including trench and backfill with the designated material, and, for drain lines, the termination at the drainage structure. This price shall be full compensation for removal and disposal of existing duct banks and conduits as shown on the plans, furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item per the provisions and intent of the plans and specifications.

Payment will be made under:

Item L-110a	Install 1-2" Sch 40 PVC Conduit, Direct Earth Buried (DEB) - per linear foot
Item L-110b	Install 1-2" Sch 40 PVC Conduit, Concrete Encased (CE) - per linear foot
Item L-110c	Install 1-2" HDPE Conduit, Directionally Bored - per linear foot

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circular (AC)

AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-53	Airport Lighting Equipment Certification Program

ASTM International (ASTM)

ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

National Fire Protection Association (NFPA)

NFPA-70	National Electrical Code (NEC)

Underwriters Laboratories (UL)

UL Standard 6	Electrical Rigid Metal Conduit - Steel
UL Standard 514B	Conduit, Tubing, and Cable Fittings
UL Standard 514C	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL Standard 1242	Electrical Intermediate Metal Conduit Steel
UL Standard 651	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL Standard 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit

END OF ITEM L-110

ITEM L-115 ELECTRICAL MANHOLES AND JUNCTION STRUCTURES
Summary of Changes

1) Section 115-2.2 first sentence revised to read as follows:
   a) The concrete for foundations shall be proportioned, placed, and cured per Item ~~P-610~~TX-421, ~~Concrete for Miscellaneous Structures~~Hydraulic Cement Concrete.

2) Section 115-2.6 revised to read as follows:
   a) The concrete for foundations shall be proportioned, placed, and cured per Item ~~P-610~~TX-421, ~~Concrete for Miscellaneous Structures~~Hydraulic Cement Concrete.

3) Section 115-3.2 second sentence revised to read as follows:
   a) The concrete and construction methods shall conform to the requirements specified in Item ~~P-610~~TX-421.

Item L-115 Electrical Manholes and Junction Structures

DESCRIPTION

115-1.1 This item shall consist of electrical manholes and junction structures (hand holes, pull boxes, junction cans, etc.) installed per this specification, at the indicated locations and conforming to the lines, grades and dimensions shown on the plans or as required by the RPR. This item shall include the installation of each electrical manhole and/or junction structures with all associated excavation, backfilling, sheeting and bracing, concrete, reinforcing steel, ladders, appurtenances, testing, dewatering and restoration of surfaces to the satisfaction of the RPR, including removal of existing manholes and junction structures as shown on the plans.

EQUIPMENT AND MATERIALS

115-2.1 General.

a. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when so requested by the RPR.

b. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the RPR) and replaced with materials that comply with these specifications at the Contractor's cost.

c. All materials and equipment used to construct this item shall be submitted to the RPR for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

d. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the plans and specifications**.** The Contractor's submittals shall be electronically submitted in pdf format, tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from the date of final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

115-2.2 Concrete structures. Concrete shall be proportioned, placed, and cured per Item TX-421, Hydraulic Cement Concrete. Cast-in-place concrete structures shall be as shown on the plans.

115-2.3 Precast concrete structures. Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another engineer approved third party certification program. Provide precast concrete structures where shown on the plans.

Precast concrete structures shall be an approved standard design of the manufacturer. Precast units shall have mortar or bitumastic sealer placed between all joints to make them watertight. The structure shall be designed to withstand H20 traffic loads, unless otherwise shown on the plans. Openings or knockouts shall be provided in the structure as detailed on the plans.

Threaded inserts and pulling eyes shall be cast in as shown on the plans.

If the Contractor chooses to propose a different structural design, signed and sealed shop drawings, design calculations, and other information requested by the RPR shall be submitted by the Contractor to allow for a full evaluation by the RPR. The RPR shall review per the process defined in the General Provisions.

115-2.4 Junction boxes. Junction boxes shall be L-867 Class 1 (non-load bearing) or L-868 Class 1 (load bearing) airport light bases that are encased in concrete. The light bases shall have a L-894 blank cover, gasket, and stainless steel hardware. All bolts, studs, nuts, lock washers, and other similar fasteners used for the light fixture assemblies must be fabricated from 316L (equivalent to EN 1.4404), 18-8, 410, or 416 stainless steel. If 18-8, 410, or 416 stainless steel is utilized it shall be passivated and be free from any discoloration. Covers shall be 3/8-inch (9-mm) thickness for L-867 and 3/4-inch (19-mm) thickness for L-868. All junction boxes shall be provided with both internal and external ground lugs.

115-2.5 Mortar. The mortar shall be composed of one part of cement and two parts of mortar sand, by volume. The cement shall be per the requirements in ASTM C150, Type I. The sand shall be per the requirements in ASTM C144. Hydrated lime may be added to the mixture of sand and cement in an amount not to exceed 15% of the weight of cement used. The hydrated lime shall meet the requirements of ASTM C206. Water shall be potable, reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product.

115-2.6 Concrete. All concrete used in structures shall conform to the requirements of TX-421, Hydraulic Cement Concrete.

115-2.7 Frames and covers. The frames shall conform to one of the following requirements:

a. ASTM A48	Gray iron castings
b. ASTM A47	Malleable iron castings
c. ASTM A27	Steel castings
d. ASTM A283, Grade D	Structural steel for grates and frames
e. ASTM A536	Ductile iron castings
f. ASTM A897	Austempered ductile iron castings

All castings specified shall withstand a H20 traffic loads.

All castings or structural steel units shall conform to the dimensions shown on the plans and shall be designed to support the loadings specified.

Each frame and cover unit shall be provided with fastening members to prevent it from being dislodged by traffic, but which will allow easy removal for access to the structure.

All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A123.

Each cover shall have the word “ELECTRIC” or other approved designation cast on it. Each frame and cover shall be as shown on the plans or approved equivalent. No cable notches are required.

Each manhole shall be provided with a "DANGER -- PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER" safety warning sign as detailed in the Contract Documents and in accordance with OSHA 1910.146 (c)(2).

115-2.8 Ladders. Ladders, if specified, shall be galvanized steel or as shown on the plans.

115-2.9 Reinforcing steel. All reinforcing steel shall be deformed bars of new billet steel meeting the requirements of ASTM A615, Grade 60.

115-2.10 Bedding/special backfill. Bedding or special backfill shall be as shown on the plans.

115-2.11 Flowable backfill. Flowable material used to backfill shall conform to the requirements of Item P-153, Controlled Low Strength Material.

115-2.12 Cable trays. Cable trays shall be of galvanized steel**.** Cable trays shall be located as shown on the plans.

115-2.13 Plastic conduit. Plastic conduit shall comply with Item L-110, Airport Underground Electrical Duct Banks and Conduits.

115-2.14 Conduit terminators. Conduit terminators shall be pre-manufactured for the specific purpose and sized as required or as shown on the plans.

115-2.15 Pulling-in irons. Pulling-in irons shall be manufactured with 7/8-inch (22 mm) diameter hot-dipped galvanized steel or stress-relieved carbon steel roping designed for concrete applications (7 strand, 1/2-inch (12 mm) diameter with an ultimate strength of 270,000 psi (1862 MPa)). Where stress-relieved carbon steel roping is used, a rustproof sleeve shall be installed at the hooking point and all exposed surfaces shall be encapsulated with a polyester coating to prevent corrosion.

115-2.16 Ground rods. Ground rods shall be one piece, copper or copper clad steel. The ground rods shall be of the length and diameter specified on the plans, but in no case shall they be less than 8 feet (2.4 m) long nor less than 5/8 inch (16 mm) in diameter.

CONSTRUCTION METHODS

115-3.1 Unclassified excavation. It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Damage to utility lines, through lack of care in excavating, shall be repaired or replaced to the satisfaction of the RPR without additional expense to the Owner.

The Contractor shall perform excavation for structures and structure footings to the lines and grades or elevations shown on the plans or as staked by the RPR. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown.

All excavation shall be unclassified and shall be considered incidental to Item L-115. Dewatering necessary for structure installation and erosion per federal, state, and local requirements is incidental to Item L-115.

Boulders, logs and all other objectionable material encountered in excavation shall be removed. All rock and other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped or serrated, as directed by the RPR. All seams, crevices, disintegrated rock and thin strata shall be removed. When concrete is to rest on a surface other than rock, special care shall be taken not to disturb the bottom of the excavation. Excavation to final grade shall not be made until just before the concrete or reinforcing is to be placed.

The Contractor shall provide all bracing, sheeting and shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheeting and shoring shall be included in the unit price bid for the structure.

Unless otherwise provided, bracing, sheeting and shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall be effected in a manner that will not disturb or mar finished masonry. The cost of removal shall be included in the unit price bid for the structure.

After each excavation is completed, the Contractor shall notify the RPR. Structures shall be placed after the RPR has approved the depth of the excavation and the suitability of the foundation material.

Prior to installation the Contractor shall provide a minimum of 6 inches (150 mm) of sand or a material approved by the RPR as a suitable base to receive the structure. The base material shall be compacted and graded level and at proper elevation to receive the structure in proper relation to the conduit grade or ground cover requirements, as indicated on the plans.

115-3.2 Concrete structures. Concrete structures shall be built on prepared foundations conforming to the dimensions and form indicated on the plans. The concrete and construction methods shall conform to the requirements specified in Item TX-421. Any reinforcement required shall be placed as indicated on the plans and shall be approved by the RPR before the concrete is placed.

115-3.3 Precast unit installations. Precast units shall be installed plumb and true. Joints shall be made watertight by use of sealant at each tongue-and-groove joint and at roof of manhole. Excess sealant shall be removed and severe surface projections on exterior of neck shall be removed.

115-3.4 Placement and treatment of castings, frames and fittings. All castings, frames and fittings shall be placed in the positions indicated on the Plans or as directed by the RPR and shall be set true to line and to correct elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place and position before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

Field connections shall be made with bolts, unless indicated otherwise. Welding will not be permitted unless shown otherwise on the approved shop drawings and written approval is granted by the casting manufacturer. Erection equipment shall be suitable and safe for the workman. Errors in shop fabrication or deformation resulting from handling and transportation that prevent the proper assembly and fitting of parts shall be reported immediately to the RPR and approval of the method of correction shall be obtained. Approved corrections shall be made at Contractor’s expense.

Anchor bolts and anchors shall be properly located and built into connection work. Bolts and anchors shall be preset by the use of templates or such other methods as may be required to locate the anchors and anchor bolts accurately.

Pulling-in irons shall be located opposite all conduit entrances into structures to provide a strong, convenient attachment for pulling-in blocks when installing cables. Pulling-in irons shall be set directly into the concrete walls of the structure.

115-3.5 Installation of ladders. Ladders shall be installed such that they may be removed if necessary. Mounting brackets shall be supplied top and bottom and shall be cast in place during fabrication of the structure or drilled and grouted in place after erection of the structure.

115-3.6 Removal of sheeting and bracing. In general, all sheeting and bracing used to support the sides of trenches or other open excavations shall be withdrawn as the trenches or other open excavations are being refilled. That portion of the sheeting extending below the top of a structure shall be withdrawn, unless otherwise directed, before more than 6 inches (150 mm) of material is placed above the top of the structure and before any bracing is removed.

Voids left by the sheeting shall be carefully refilled with selected material and rammed tight with tools especially adapted for the purpose or otherwise as may be approved.

The RPR may direct the Contractor to delay the removal of sheeting and bracing if, in his judgment, the installed work has not attained the necessary strength to permit placing of backfill.

115-3.7 Backfilling. After a structure has been completed, the area around it shall be backfilled in horizontal layers not to exceed 6 inches (150 mm) in thickness measured after compaction to the density requirements in Item P-152. Each layer shall be deposited all around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans or as directed by the RPR.

Backfill shall not be placed against any structure until approval is given by the RPR. In the case of concrete, such approval shall not be given until tests made by the laboratory under supervision of the RPR establish that the concrete has attained sufficient strength to provide a factor of safety against damage or strain in withstanding any pressure created by the backfill or the methods used in placing it.

Where required, the RPR may direct the Contractor to add, at his own expense, sufficient water during compaction to assure a complete consolidation of the backfill. The Contractor shall be responsible for all damage or injury done to conduits, duct banks, structures, property or persons due to improper placing or compacting of backfill.

115-3.8 Connection of duct banks. To relieve stress of joint between concrete-encased duct banks and structure walls, reinforcement rods shall be placed in the structure wall and shall be formed and tied into duct bank reinforcement at the time the duct bank is installed.

115-3.9 Grounding. A ground rod shall be installed in the floor of all concrete structures so that the top of rod extends 6 inches (150 mm) above the floor. The ground rod shall be installed within one foot (30 cm) of a corner of the concrete structure. Ground rods shall be installed prior to casting the bottom slab. Where the soil condition does not permit driving the ground rod into the earth without damage to the ground rod, the Contractor shall drill a 4-inch (100 mm) diameter hole into the earth to receive the ground rod. The hole around the ground rod shall be filled throughout its length, below slab, with Portland cement grout. Ground rods shall be installed in precast bottom slab of structures by drilling a hole through bottom slab and installing the ground rod. Bottom slab penetration shall be sealed watertight with Portland cement grout around the ground rod.

A grounding bus of 4/0 bare stranded copper shall be exothermically bonded to the ground rod and loop the concrete structure walls. The ground bus shall be a minimum of one foot (30 cm) above the floor of the structure and separate from other cables. No. 2 American wire gauge (AWG) bare copper pigtails shall bond the grounding bus to all cable trays and other metal hardware within the concrete structure. Connections to the grounding bus shall be exothermic. If an exothermic weld is not possible, connections to the grounding bus shall be made by using connectors approved for direct burial in soil or concrete per UL 467. Hardware connections may be mechanical, using a lug designed for that purpose.

115-3.10 Cleanup and repair. After erection of all galvanized items, damaged areas shall be repaired by applying a liquid cold-galvanizing compound per MIL-P-21035. Surfaces shall be prepared and compound applied per the manufacturer's recommendations.

Prior to acceptance, the entire structure shall be cleaned of all dirt and debris.

115-3.11 Restoration. After the backfill is completed, the Contractor shall dispose of all surplus material, dirt and rubbish from the site. The Contractor shall restore all disturbed areas equivalent to or better than their original condition. All sodding, grading and restoration shall be considered incidental to the respective Item L-115 pay item.

The Contractor shall grade around structures as required to provide positive drainage away from the structure.

Areas with special surface treatment, such as roads, sidewalks, or other paved areas shall have backfill compacted to match surrounding areas, and surfaces shall be repaired using materials comparable to original materials.

Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD), and remove any such FOD that is found. This FOD inspection and removal shall be considered incidental to the pay item of which it is a component part.

After all work is completed, the Contractor shall remove all tools and other equipment, leaving the entire site free, clear and in good condition.

115-3.12 Inspection. Prior to final approval, the electrical structures shall be thoroughly inspected for conformance with the plans and this specification. Any indication of defects in materials or workmanship shall be further investigated and corrected. The earth resistance to ground of each ground rod shall not exceed 25 ohms. Each ground rod shall be tested using the fall-of-potential ground impedance test per American National Standards Institute / Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81. This test shall be performed prior to establishing connections to other ground electrodes.

115-3.13 Manhole elevation adjustments. The Contractor shall adjust the tops of existing manholes in areas designated in the Contract Documents to the new elevations shown. The Contractor shall be responsible for determining the exact height adjustment required to raise or lower the top of each manhole to the new elevations. The existing top elevation of each manhole to be adjusted shall be determined in the field and subtracted/added from the proposed top elevation.

The Contractor shall remove/extend the existing top section or ring and cover on the manhole structure or manhole access. The Contractor shall install precast concrete sections or grade rings of the required dimensions to adjust the manhole top to the new proposed elevation or shall cut the existing manhole walls to shorten the existing structure, as required by final grades. The Contractor shall reinstall the manhole top section or ring and cover on top and check the new top elevation.

The Contractor shall construct a concrete slab around the top of adjusted structures located in graded areas that are not to be paved. The concrete slab shall conform to the dimensions shown on the plans.

115-3.14 Duct extension to existing ducts. Where existing concrete encased ducts are to be extended, the duct extension shall be concrete encased plastic conduit. The fittings to connect the ducts together shall be standard manufactured connectors designed and approved for the purpose. The duct extensions shall be installed according to the concrete encased duct detail and as shown on the plans.

METHOD OF MEASUREMENT

115-4.1 Electrical manholes and junction structures shall be measured by each unit completed in place and accepted. The following items shall be included in the price of each unit: All required excavation and dewatering:; sheeting and bracing; all required backfilling with on-site materials; restoration of all surfaces and finished grading and turfing; all required connections; temporary cables and connections; and ground rod testing

115-4.2 Manhole elevation adjustments shall be measured by the completed unit installed, in place, completed, and accepted. Separate measurement shall not be made for the various types and sizes.

BASIS OF PAYMENT

115-5.1 The accepted quantity of electrical manholes and junction structures will be paid for at the Contract unit price per each, complete and in place. This price shall be full compensation for furnishing all materials and for all

preparation, excavation, backfilling and placing of the materials, furnishing and installation of appurtenances and connections to duct banks and other structures as may be required to complete the item as shown on the plans and for all labor, equipment, tools and incidentals necessary to complete the structure.

115-5.2 Payment shall be made at the contract unit price for manhole elevation adjustments. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary, including but not limited to, spacers, concrete, rebar, dewatering, excavating, backfill, topsoil, sodding and pavement restoration, where required, to complete this item as shown in the plans and to the satisfaction of the RPR.

Payment will be made under:

Item L-115a Install New L-867 Junction Box - Per Each

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

American National Standards Institute / Insulated Cable Engineers Association (ANSI/ICEA)

ANSI/IEEE STD 81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

Advisory Circular (AC)

AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-42	Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-53	Airport Lighting Equipment Certification Program

Commercial Item Description (CID)

A-A 59544	Cable and Wire, Electrical (Power, Fixed Installation)

ASTM International (ASTM)

ASTM A27	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A47	Standard Specification for Ferritic Malleable Iron Castings
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A123	Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
ASTM A283	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A536	Standard Specification for Ductile Iron Castings

ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A897	Standard Specification for Austempered Ductile Iron Castings
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C206	Standard Specification for Finishing Hydrated Lime

FAA Engineering Brief (EB)

EB #83	In Pavement Light Fixture Bolts

Mil Spec

MIL-P-21035	Paint High Zinc Dust Content, Galvanizing Repair

National Fire Protection Association (NFPA)

NFPA-70	National Electrical Code (NEC)

END OF ITEM L-115

Item L-125 Installation of Airport Lighting Systems

DESCRIPTION

125-1.1 This item shall consist of airport lighting systems furnished and installed in accordance with this specification, the referenced specifications, and the applicable advisory circulars (ACs). The systems shall be installed at the locations and in accordance with the dimensions, design, and details shown in the plans. This item shall include the furnishing of all equipment, materials, services, and incidentals necessary to place the systems in operation as completed units to the satisfaction of the RPR.

EQUIPMENT AND MATERIALS

125-2.1 General.

a. Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specifications shall be certified under the Airport Lighting Equipment Certification Program in accordance with AC 150/5345-53, current version. FAA certified airfield lighting shall be compatible with each other to perform in compliance with FAA criteria and the intended operation. If the Contractor provides equipment that does not performs as intended because of incompatibility with the system, the Contractor assumes all costs to correct the system for to operate properly.

b. Manufacturer's certifications shall not relieve the Contractor of their responsibility to provide materials in accordance with these specifications and acceptable to the RPR. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the RPR and replaced with materials, which do comply with these specifications, at the sole cost of the Contractor.

c. All materials and equipment used shall be submitted to the RPR for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Clearly mark each copy to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be clearly made with arrows or circles (highlighting is not acceptable). The Contractor shall be responsible for delays in the project accruing directly or indirectly from late submissions or resubmissions of submittals.

d. The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the plans and specifications. The Contractor's submittals shall be submitted electronic PDF format, tabbed by specification section. The RPR reserves the right to reject any or all equipment, materials or procedures, which, in the RPR’s opinion, does not meet the system design and the standards and codes, specified herein.

e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

All LED light fixtures, with the exception of obstruction lighting (AC 150/5345-43) must be warranted by the manufacturer for a minimum of 4 years after date of installation inclusive of all electronics.” Obstruction lighting warranty is set by the individual manufacturer.

EQUIPMENT AND MATERIALS

125-2.2 Conduit/Duct. Conduit shall conform to Specification Item L-110 Airport Underground Electrical Duct Banks and Conduits.

125-2.3 Cable and Counterpoise. Cable and Counterpoise shall conform to Item L-108 Underground Power Cable for Airports.

125-2.4 Tape. Rubber and plastic electrical tapes shall be Scotch Electrical Tape Numbers 23 and 88 respectively, as manufactured by 3M Company or an approved equal.

125-2.5 Cable Connections. Cable Connections shall conform to Item L-108 Installation of Underground Cable for Airports.

125-2.6 Retroreflective Markers. Retroreflective markers shall be type L-853 and shall conform to the requirements of AC 150/5345-39.

125-2.7 Runway and Taxiway Lights. Runway and taxiway lights shall conform to the requirements of AC 150/5345-46. Lamps shall be of size and type indicated, or as required by fixture manufacturer for each lighting fixture required under this contract. Filters shall be of colors conforming to the specification for the light concerned or to the standard referenced.

Lights

Type	Class	Mode	Style	Option	Base	Filter	Transformer	Notes
L-861 LED	**2**	**2**			**L-867B**	**W/Y**	**Per Manufacturer**	**No Arctic Kit**
L-861E LED	**2**	**2**			**L-867B**	**G/R**	**Per Manufacturer**	**No Arctic Kit**

125-2.8 Runway and Taxiway Signs. Runway and Taxiway Guidance Signs should conform to the requirements of AC 150/5345-44.

Signs

Type	Size	Style	Class	Mode	Notes
L-858 LED	**1**	**2**	**1**	**2**	

125-2.9 Runway End Identifier Light (REIL). The REIL fixtures shall meet the requirements of AC 150/5345-51, LED Type L-849I, Style E**.**

125-2.10 Precision Approach Path Indicator (PAPI). The light units for the PAPI shall meet the requirements of AC 150/5345-28, LED Type L-881, Style A Class I.

125-2.11 Circuit Selector Cabinet. Not used.

125-2.12 Light Base and Transformer Housings. Light Base and Transformer Housings should conform to the requirements of AC 150/5345-42. Light bases shall be Type L-867, Class 1A, Size B shall be provided as indicated or as required to accommodate the fixture or device installed thereon. Base plates, cover plates, and adapter plates shall be provided to accommodate various sizes of fixtures.

125-2.13 Isolation Transformers. Isolation Transformers shall be Type L-83, size as required for each installation. Transformer shall conform to AC 150/5345-47.

INSTALLATION

125-3.1 Installation. The Contractor shall furnish, install, connect and test all equipment, accessories, conduit, cables, wires, buses, grounds and support items necessary to ensure a complete and operable airport lighting system as specified here and shown in the plans.

The equipment installation and mounting shall comply with the requirements of the National Electrical Code and state and local code agencies having jurisdiction.

The Contractor shall install the specified equipment in accordance with the applicable advisory circulars and the details shown on the plans.

125-3.2 Testing. All lights shall be fully tested by continuous operation for not less than 24 hours as a completed system prior to acceptance. The test shall include operating the constant current regulator in each step not less than 10 times at the beginning and end of the 24-hour test. The fixtures shall illuminate properly during each portion of the test.

125-3.3 Shipping and Storage. Equipment shall be shipped in suitable packing material to prevent damage during shipping. Store and maintain equipment and materials in areas protected from weather and physical damage. Any equipment and materials, in the opinion of the RPR, damaged during construction or storage shall be replaced by the Contractor at no additional cost to the owner. Painted or galvanized surfaces that are damaged shall be repaired in accordance with the manufacturer's recommendations.

125-3.4 Elevated and In-pavement Lights. Water, debris, and other foreign substances shall be removed prior to installing fixture base and light.

A jig or holding device shall be used when installing each light fixture to ensure positioning to the proper elevation, alignment, level control, and azimuth control. Light fixtures shall be oriented with the light beams parallel to the runway or taxiway centerline and facing in the required direction. The outermost edge of fixture shall be level with the surrounding pavement. Surplus sealant or flexible embedding material shall be removed. The holding device shall remain in place until sealant has reached its initial set.

METHOD OF MEASUREMENT

125-4.1 Reflective markers will be measured by the number installed as completed units in place, ready for operation, and accepted by the RPR. Runway and taxiway lights will be measured by the number of each type installed as completed units in place, ready for operation, and accepted by the RPR. Guidance signs will be measured by the number of each type and size installed as completed units, in place, ready for operation, and accepted by the

RPR. Runway End Identifier Lights shall be measured by each system installed as a completed unit in place, ready for operation, and accepted by the RPR.

Precision Approach Path Indicator shall be measured by each system installed as a completed unit, in place, ready for operation, and accepted by the RPR. Abbreviated Precision Approach Path Indicator shall be measured by each system installed as a completed unit, in place, ready for operation, and accepted by the RPR.

BASIS OF PAYMENT

125-5.1 Payment will be made at the Contract unit price for each complete runway or taxiway light, guidance sign, reflective marker, runway end identification light, precision approach path indicator, or abbreviated precision approach path indicator installed by the Contractor and accepted by the RPR. This payment will be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools and incidentals necessary to complete this item.

Payment will be made under:

L-125a	Remove Runway Edge Light – per each
L-125b	Remove Runway Threshold Light – per each
L-125c	Remove PAPI System – per each
L-125d	Remove REIL System – per each
L-125e	Remove Guidance Sign – per each
L-125f	Remove Retroreflective Marker – per each
L-125g	Install L-861 LED Runway Edge Light On New Base – per each
L-125h	Install L-861E LED Runway Threshold Light On New Base – per each
L-125i	Install LED L-881 PAPI System – per each
L-125j	Install LED L-849 REIL System – per each
L-125k	Install LED L-858 Lighted Guidance Sign On New Concrete Pad, Size 1 – per each
L-125l	Install Retroreflective Marker – per each

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5340-18	Standards for Airport Sign Systems
AC 150/5340-26	Maintenance of Airport Visual Aid Facilities
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-5	Circuit Selector Switch
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors

AC 150/5345-28	Precision Approach Path Indicator (PAPI) Systems
AC 150/5345-39	Specification for L-853, Runway and Taxiway Retroreflective Markers
AC 150/5345-42	Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories
AC 150/5345-44	Specification for Runway and Taxiway Signs
AC 150/5345-46	Specification for Runway and Taxiway Light Fixtures
AC 150/5345-47	Specification for Series to Series Isolation Transformers for Airport Lighting Systems
AC 150/5345-51	Specification for Discharge-Type Flashing Light Equipment
AC 150/5345-53	Airport Lighting Equipment Certification Program

Engineering Brief (EB)

EB No. 67	Light Sources Other than Incandescent and Xenon for Airport and Obstruction Lighting Fixtures

END OF ITEM L-125

GEOTECHNICAL REPORT

Rodriguez Engineering Laboratories

Construction Materials Engineering Testing

Geotechnical Investigation for

Ennis Municipal Airport

F41 2024 Runway Widening, Taxiway Extension & Airfield Electrical

TxDOT CSJ No. 2411ENNIS

Ellis, Texas

Submitted to:

Thomas Hart, P.E.

Project Manager

Woolpert

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REVISED

July 1, 2025

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Geotechnical Investigation for
Ennis Municipal Airport
Ellis, Texas

1. INTRODUCTION

Woolpert retained Rodriguez Engineering Laboratories LLC (REL) to perform a geotechnical investigation at Ennis Municipal Airport in Ellis, Texas.

2. PURPOSE OF STUDY

This investigation aims to determine the engineering properties of the in-situ subsurface soils for the proposed airfield pavement improvements at the Ennis Municipal Airport. The pavement improvements include the widening of Runway 16-34 and the extension of the taxiway. The scope of work for the field geotechnical investigation includes drilling boreholes, cutting HMAC cores, collecting DCP data, excavating test pits, collecting representative soils, base, and HMAC samples to perform the appropriate laboratory tests, and performing a Falling Weight Deflectometer (FWD) test. The objective is to submit a summary of the field and laboratory test results and provide pavement section recommendations for the given aircraft design information using the most current FAARFIELD pavement computer program. The results of this geotechnical investigation are summarized in this report.

3. SUBSURFACE INVESTIGATION

The subsurface investigation was performed under the supervision of Jose Melendez, P.E. Octaviano Avitia performed the drilling, logging, and field inspection. The drilling operations included excavating two (2) test pits to the subgrade depth, obtaining thirty-two (32) HMAC cores, performing six (6) DCP tests, and advancing seventeen (17) bores to 5 feet, nine (9) bores to 10 feet and seven (7) bores to 2 feet. Samples of the HMAC pavement structure were taken by coring. Then, DCP tests were performed on selected boreholes, followed by the collection of soil samples using an auger through the total depth of each borehole. The approximate boring depths were initiated from existing pavement or ground elevations at the locations approved by Woolpert. Upon completion, the boreholes were adequately backfilled.

Appendix C contains a map of the borehole locations. Appendix E includes the DCP test results and analysis. Appendix A contains information on each borehole and the laboratory results for Moisture Content, Atterberg Limits, Sieve Analysis, and Unified Soil Classification. The borings were drilled with a Giddings trailer-mounted drill rig with a six-inch diameter flight auger at the selected locations.

4. FIELD AND LABORATORY TESTING

4.1 Field Testing

The field test results obtained during the exploration were performed by experienced field personnel and monitored by the geotechnical engineer. The following field test procedure determined the parameters:

- Field description of the material was determined by the Practice for Description and Identification of Soils (Visual-Manual Procedure) (ASTM D 2488).

The data can be found in Appendix A.

- The estimated strength of in-situ soils under existing field conditions was determined by the standard test method for Use of the Dynamic Cone Penetrometer (DCP) in Shallow Pavement Applications (ASTM D 6951).

The data can be found in Appendix E.

4.2 Laboratory Testing

The representative asphalt and soil samples obtained during the exploration were sealed at the site and transported to the laboratory. A testing program was conducted on the sealed samples to aid in the classification and evaluation of the engineering properties required for analysis. The laboratory tests were performed by experienced laboratory technicians and monitored by the geotechnical engineer. The following laboratory tests determined the parameters:

- Potential volumetric shrinkage characteristics of the cohesive soils were determined by the Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils (ASTM D 4318).

- Material gradation for soil classification was determined by the Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) (ASTM D 2487).

- Material moisture content was determined by the Standard Test Method for Laboratory Determination of Water Content of Soil and Rock by Mass (ASTM D 2216).

The data can be found in Appendix A.

- The Moisture-Density relationship of the natural subgrade and base soils and lime-treated subgrade soils was determined by the standard test method for Laboratory

Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3(600 kN-m/m^3)) (ASTM D 698).

- An index of strength and deflection characteristics of the natural subgrade and base soils and lime treated subgrade soils was determined by performing the Standard Test Method for CBR of Laboratory-Compacted Soils (ASTM D 1883 & ASTM D 3668-78).

The data can be found in Appendix B.

- The Stabilization of the Subgrade was determined by the Standard Specification for Determining the Stabilization Ability of Lime by Soil pH (Tex-121-E, Part III).

The data can be found in Appendix F.

- The pH of the subgrade material was determined by the Standard Test Method for Determining Soil pH (Tex-128-E).

- The Soluble Sulfate Content was determined by the Standard Test Method for Sulfate Content in Soils Colorimetric Method (Tex-145-E).

The data can be found in Table 2 of this report.

- The resistance of aggregate in flexible base material to disintegration in the presence of water was determined by the Standard Test Method for Resistance to Degradation by Wet Ball Mill Method (Tex-116-E).

- The percentage of deleterious material of coarse aggregate was determined by the Standard Test Method for Deleterious Material of Coarse and Fine Aggregate (Tex-413-A).

The data can be found in Table 5 of this report.

5. SITE AND SUBSURFACE CONDITIONS

5.1 Site Conditions

Ennis Municipal Airport is approximately three (3) miles west of downtown Ennis, Texas. The area's topography is generally flat.

The Geological Atlas of Texas (Dallas Sheet) published by the Bureau of Economic Geology at the University of Texas at Austin indicates that the general geology of the area is Wolfe City Formation (Kwc) from the Upper Cretaceous period. Kwc consists of marl, sand, sandstone, and mudstone. In Navarro County, the marl is sandy and silty, interbedded with

thin sandstone beds and massive sandstone; it is medium gray in color. Northward, it grades into an upper unit of fine-grained sand and silt that is calcareous and medium yellowish gray, and a lower unit of calcareous mudstone that is dark gray and weathers to medium gray. Marine megafossils are present. Thickness ranges from 75 to 300 feet and decreases northward.

Appendix C includes a geological map of the area and a site map of the boring locations.

5.2 Subsurface Conditions

Borings to depth generally advanced easily; the material sampled varied from non-plastic silty sand and gravel, lean clay, to fatty Clay with high plasticity. The subsurface stratigraphy, as determined by the exploration, is shown in detail in the boring logs in Appendix A.

No groundwater was encountered during drilling operations. However, the short-term field observations generally do not accurately evaluate the subsurface water levels. Any groundwater elevation provided is representative of the conditions of the day and the specific location where the data was taken. The groundwater elevation may fluctuate due to time, climatic conditions, and construction activities.

6. SUMMARY OF TEST RESULTS

The following is a summary of test results obtained from the field borings information and laboratory tests of the representative soil samples.

6.1 Summary of Subgrade Materials Test Results

Soil classifications for the subgrade materials encountered are presented in Table 1.

Table 1. Summary of Soil Parameters

Boring No.	Depth	Soil Classification	Moisture Content (%)	Atterberg Limits		Sieve Analysis Percent Passing		
				LL	PI	#4	#40	#200
1	1.1' – 2.5'	Brown, Poorly Graded SAND with Silt and Gravel (SP-SM)	5.2	16	3	65.6	18.9	10.0
	2.5' – 4.0'	Dark Brown, Fat CLAY with Sand (CH)	21.0	59	39	99.8	95.2	83.7
	4.0' – 5.0'	Brown, Fat CLAY (CH)	20.7	57	41	99.9	98.3	90.4
2	1.2' – 4.0'	Dark Brown, Poorly Graded GRAVEL with Sand (GP)	4.2	Non-Plastic		44.3	10.7	3.8

Boring No.	Depth	Soil Classification	Moisture Content (%)	Atterberg Limits		Sieve Analysis Percent Passing		
				LL	PI	#4	#40	#200
	4.0' – 5.0'	Dark Brown, Fat CLAY (CH)	23.6	54	38	99.9	98.0	89.5
3	1.5' – 4.0'	Very Dark Gray, Poorly Graded GRAVEL with Sand (GP)	7.3	Non-Plastic		19.1	3.3	1.4
	4.0' – 5.0'	Very Dark Gray, Lean CLAY with Sand (CL)	22.3	43	27	99.8	98.9	73.4
4	1.0' – 4.0'	Gray, Sandy Lean CLAY (CL)	20.7	36	23	99.8	97.3	65.6
	4.0' – 5.0'	Gray, Sandy Fat CLAY (CH)	20.4	53	38	96.8	93.6	69.5
5	1.0' – 4.0'	Gray, Sandy Lean CLAY (CL)	23.4	40	23	99.5	97.1	68.3
	4.0' – 5.0'	Gray, Fat CLAY with Sand (CH)	23.7	53	38	98.7	97.3	70.8
6	1.2' – 2.5'	Dark Brown, Fat CLAY (CH)	25.9	66	51	99.6	96.1	86.7
	2.5' – 5.0'	Brown, Fat CLAY (CH)	24.9	68	53	99.4	97.7	91.6
7	0.9' – 2.5'	Dark Brown, Fat CLAY (CH)	24.0	57	44	99.1	95.2	85.3
	2.5' – 5.0'	Dark Brown, Fat CLAY (CH)	24.4	81	69	99.5	97.3	89.7
8	1.2' – 2.5'	Dark Brown, Fat CLAY with Sand (CH)	28.8	61	43	99.6	91.7	76.0
	2.5' – 5.0'	Brown, Fat CLAY (CH)	27.1	63	50	99.7	97.7	89.9
9	1.1' – 2.5'	Brown, Silty SAND (SM)	27.5	Non-Plastic		88.3	41.4	15.7
	2.5' – 5.0'	Dark Brown, Fat CLAY with Sand (CH)	24.7	57	46	99.2	97.6	82.4
10	1.1' – 2.5'	Dark Brown, Sandy Fat CLAY (CH)	29.8	71	55	96.8	81.2	67.4
	2.5' – 5.0'	Brown, Fat CLAY (CH)	23.5	61	44	99.8	95.5	88.8
11	1.0' - 2.5'	Very Dark Gray, Fat CLAY with Sand (CH)	32.1	70	45	98.9	86.7	74.2
	2.5' – 5.0'	Brown, Fat CLAY with Sand (CH)	25.3	92	77	99.7	95.2	83.8
12	1.2' – 2.5'	Dark Brown, SILT (ML)	22.5	Non-Plastic		99.7	97.8	86.0
	2.5' – 5.0'	Dark Brown, Fat CLAY with Sand (CH)	23.0	52	40	95.6	91.4	76.4

Boring No.	Depth	Soil Classification	Moisture Content (%)	Atterberg Limits		Sieve Analysis Percent Passing		
				LL	PI	#4	#40	#200
13	1.2' – 2.5'	Dark Brown, SILT with Sand (ML)	26.9	Non-Plastic		99.7	94.3	79.3
	2.5' – 5.0'	Dark Brown, Fat CLAY with Sand (CH)	20.0	55	44	98.4	96.2	84.0
14	1.1' - 2.5'	Dark Brown, Lean CLAY (CL)	28.6	49	35	99.6	97.0	86.5
	2.5' – 5.0'	Dark Brown, Lean CLAY (CL)	23.9	49	40	99.9	97.8	85.3
15	1.1' – 2.5'	Dark Brown, Lean CLAY with Sand (CL)	24.7	46	34	98.5	93.0	74.0
	2.5' – 5.0'	Dark Brown, Fat CLAY (CH)	22.9	58	47	99.1	97.2	85.1
16	1.0' – 1.5'	Brown, Clay with Sand	-	50	36	-	-	-
17	1.0' - 3.5'	Very Dark Gray, Sandy Lean CLAY (CL)	18.2	30	16	99.2	96.6	56.7
	3.5' – 5.0'	Very Dark Gray, Sandy Fat CLAY (CH)	21.8	55	41	99.9	99.2	68.0
19	0.3' – 1.1'	Dark Brown, Fat CLAY with Sand (CH)	29.8	54	41	97.9	91.7	76.7
	1.1' – 2.0'	Very Dark Gray, Fat CLAY (CH)	4.7	63	50	99.2	98.4	90.8
20	0.3' – 0.9'	Dark Brown, Lean CLAY with Sand (CL)	26.8	46	34	98.4	91.3	71.2
	0.9' – 2.0'	Very Dark Gray, Lean CLAY with Sand (CL)	22.2	46	34	99.7	98.7	83.0
21	0.3' – 0.8'	Brown, Clayey SAND (SC)	29.0	42	24	92.5	75.1	30.0
	0.8' – 2.0'	Very Dark Gray, Sandy Lean CLAY (CL)	19.7	41	30	99.7	98.3	63.8
22	0.3' – 0.75'	Brown, Poorly Graded SAND with Clay and Gravel (or Silty Clay and Gravel) (SP-SC)	22.8	52	34	75.5	34.9	7.1
	0.75' – 2.0'	Brown, Clayey SAND with Gravel (SC)	14.0	26	14	82.3	59.3	28.5
23	0.25' – 0.8'	Brown, Sandy Lean CLAY (CL)	26.4	41	27	96.8	82.9	59.7
	0.8' – 2.0'	Dark Brown, Fat CLAY with Sand (CH)	24.6	55	43	98.4	93.8	82.1
24	0.3' – 1.1'	Dark Brown, Fat CLAY (CH)	27.7	67	57	99.2	97.4	87.9
	1.1' – 2.0'	Dark Brown, Fat CLAY (CH)	28.1	65	54	99.0	97.3	85.4

Boring No.	Depth	Soil Classification	Moisture Content (%)	Atterberg Limits		Sieve Analysis Percent Passing		
				LL	PI	#4	#40	#200
25	0.3' – 2.5'	Gray, Fat CLAY with Sand (CH)	26.5	58	40	97.6	90.3	76.3
	2.5' – 5.0'	Brown, Fat CLAY with Sand (CH)	22.1	55	39	99.1	94.0	81.3
	5.0' – 7.5'	Yellowish Brown, Fat CLAY (CH)	21.3	53	35	98.8	95.8	85.5
	7.5' – 10.0'	Yellowish Brown, Fat CLAY (CH)	20.3	53	37	99.0	97.1	87.2
26	0.3' – 1.0'	Dark Brown, Sandy Fat CLAY (CH)	26.2	51	40	93.6	86.9	69.0
	1.0' – 2.5'	Dark Brown, Lean CLAY with Sand (CL)	22.4	47	36	99.7	98.8	81.1
	2.5' – 5.0'	Dark Brown, Fat CLAY with Sand (CH)	26.1	64	52	99.7	98.8	84.2
	5.0' – 7.5'	Dark Brown, Fat CLAY (CH)	29.0	59	47	99.7	99.3	88.4
	7.5' – 10.0'	Dark Brown, Fat CLAY (CH)	25.7	66	53	99.1	97.0	86.4
27	1.0' – 2.5'	Brown, Fat CLAY with Sand (CH)	19.9	55	42	99.7	98.9	72.3
	2.5' – 5.0'	Brown, Lean CLAY with Sand (CL)	18.3	48	37	99.7	97.2	71.3
	5.0' – 7.5'	Brown, Sandy Fat CLAY (CH)	18.4	50	38	98.9	96.9	66.8
	7.5' – 10.0'	Brown, Sandy Lean CLAY (CL)	19.6	45	36	98.9	96.8	64.0
28	0.3' – 0.9'	Brown, Clayey SAND with Gravel (SC)	27.0	50	28	83.3	40.7	13.8
	0.9' – 2.5'	Brown, Fat CLAY with Sand (CH)	20.3	55	44	100	98.8	70.2
	2.5' – 5.0'	Brown, Fat CLAY with Sand (CH)	19.9	53	38	99.4	97.2	73.0
	5.0' – 7.5'	Brown, Fat CLAY with Sand (CH)	18.4	51	37	99.6	97.2	71.1
	7.5' – 10.0'	Brown, Sandy Lean CLAY (CL)	18.0	49	37	99.0	91.9	66.6
29	0.3' – 1.0'	Brown, Sandy Lean CLAY (CL)	26.4	49	36	96.1	85.3	60.6
	1.0' – 2.5'	Brown, Fat CLAY with Sand (CH)	21.4	52	41	99.8	98.2	80.8
	2.5' – 5.0'	Brown, Fat CLAY with Sand (CH)	21.4	63	52	91.4	95.6	75.8
	5.0' – 7.5'	Brown, Sandy Fat CLAY (CH)	24.0	54	43	92.7	87.6	69.8

Boring No.	Depth	Soil Classification	Moisture Content (%)	Atterberg Limits		Sieve Analysis Percent Passing		
				LL	PI	#4	#40	#200
	7.5' – 10.0'	Yellowish Brown, Fat CLAY (CH)	25.8	61	47	98.3	93.2	85.3
30	0.17' – 0.6'	Dark Brown, Fat CLAY with Sand (CH)	23.0	65	53	97.9	94.2	83.1
	0.6' – 1.5'	Dark Brown, Fat CLAY (CH)	27.2	72	60	98.3	95.7	87.0
31	1.2' – 2.5'	Very Dark Grayish Brown, Sandy Fat CLAY (CH)	22.6	55	44	98.1	93.2	69.3
	2.5' – 5.0'	Brown, Fat CLAY with Sand (CH)	21.1	66	55	95.7	93.0	71.0
	5.0' – 7.5'	Brown, Sandy Lean CLAY (CL)	16.7	47	36	99.0	94.7	69.4
	7.5' – 10.0'	Brown, Sandy Fat CLAY (CH)	19.6	53	42	99.7	98.3	65.3
32	0.3' – 1.0'	Dark Brown, Fat CLAY with Sand (CH)	18.6	55	43	100	99.7	74.9
	1.0' – 2.5'	Dark Brown, Sandy Lean CLAY (CL)	2.2	20	10	99.2	97.6	67.5
	2.5' – 5.0'	Dark Brown, Fat CLAY with Sand (CH)	21.1	63	52	96.1	94.5	70.5
	5.0' – 7.5'	Dark Brown, Fat CLAY with Sand (CH)	18.5	60	49	99.8	98.4	72.2
	7.5' – 10.0'	Brown, Fat CLAY with Sand (CH)	21.0	61	49	99.5	98.2	74.1
33	0.3' – 2.5'	Dark Brown, Sandy Lean CLAY (CL)	17.1	36	24	100	99.6	63.4
	2.5' – 5.0'	Brown, Fat CLAY with Sand (CH)	17.3	65	55	99.0	95.0	73.8
	5.0' – 7.5'	Brown, Fat CLAY with Sand (CH)	21.0	60	49	99.3	98.5	75.4
	7.5' – 10.0'	Brown, Fat CLAY with Sand (CH)	19.2	61	48	99.5	98.3	74.1

6.2 Laboratory CBR Value, Subgrade

Soil classification for the subgrade material used on the CBR test is presented in Table 2.

Table 2. Soil Properties for Subgrade CBR Samples.

CBR No.	Soil Classification	Atterberg Limits		Moisture Content	Material Passing (%)			Soluble Sulfate Content (Avg)		Soil pH Value
		LL	PI	(%)	#4	#40	#200	PPM	%	
1	Dark Gray, Sandy Silt	44	10	14.0	85.4	68.6	50.2	2360	0.236	8.4
2	Dark Gray, Sandy Silt	49	21	18.5	94.9	80.2	62.9	1260	0.126	9.1
3	Fat Clay with Sand	52	38	15.3	99.4	97.9	71.3	2640	0.264	8.5

The laboratory CBR values in Table 3 are based on a 95% maximum dry density (ASTM D-698) compaction level and a 96-hour soaking period.

Table 3. Subgrade CBR Results.

CBR No.	Sample Location	Laboratory Compacted – Soaked CBR	Maximum Dry Density (PCF)	Optimum Moisture (%)	Maximum Percent Swell Measured
1	Runway 16-34 at 32°19'40.94"N; 96°39'47.79"W	6.4	103.7	19.5	0.2
2	Parallel Taxiway at 32°19'53.96"N; 96°39'55.21"W	4.2	90.7	25.0	0.4
3	Proposed Taxiway at 32°19'32.52"N; 96°39'45.10"W	2.6	105.0	19.2	0.1
3 w/Lime	Boring 33 with 5% Lime	23.5	100.9	22.3	0.5

The CBR and Proctor Data are shown in Appendix B.

6.3 Laboratory Results of Existing Base

Table 4 shows the soil classification and soluble sulfate content results for the existing base material sampled in the Runway area.

Table 4. Soil Classification and Soluble Sulfate Content of Base from Test Pits.

Location	Soil Classification	Liquid Limit	Plasticity Index	Moisture Content (%)	Material Passing No. 4 (%)	Material Passing No. 40 (%)	Material Passing No. 200 (%)	Soluble Sulfate Content (Avg.)	
								ppm	%
TP1	Light Brown, Silty Sand with Gravel	17	3	4.6	59.6	23.1	10.0	120	0.012

Location	Soil Classification	Liquid Limit	Plasticity Index	Moisture Content (%)	Material Passing No. 4 (%)	Material Passing No. 40 (%)	Material Passing No. 200 (%)	Soluble Sulfate Content (Avg.)	
								ppm	%
TP2	Light Brown, Poorly Graded Gravel with Silt and Sand	NP	NP	7.6	49.3	34.1	6.9	180	0.018

The table below summarizes the laboratory test results for base material samples collected from the test pits. It includes the Wet Ball Mill values, soil binder increase, and the percentage of deleterious material retained on the sieve for each location.

Table 5. Wet Ball Mill, Soil Binder Increase, and Deleterious Material Content for Base Materials from the Test Pits

Location	Wet Ball Mill Value	Soil Binder Increase	%Deleterious Material Retained on the Sieve
TP1	25	5	0.0
TP2	22	3	0.0

6.4 Summary of Existing Pavement Structure

Table 6 is a summary of the existing pavement structure and soil classification of the encountered base material:

Table 6. Summary of Pavement Thickness.

Boring No.	Location	Pavement Thickness		Properties of Existing Base			
		Asphalt (in)	Base (in)	Soil Group Symbol	Soil Classification	LL	PI
B1	32°20'5.40" N 96°39'57.15" W	6-1/2	7-1/2	GP	Dark Brown, Poorly Graded GRAVEL with Sand	Non-Plastic	
B2	32°19'56.03" N 96°39'53.64" W	9-7/8	4-1/8	GP	Dark Brown, Poorly Graded GRAVEL with Sand	24	8
B3	32°19'46.64" N 96°39'50.10" W	9	8-1/2	SP	Dark Brown, Poorly Graded SAND with Gravel	Non-Plastic	
B4	32°19'37.26" N 96°39'46.20" W	6-3/4	5-1/4	GM	Light Brown, Silty GRAVEL with Sand	Non-Plastic	
B5	32°19'28.60" N 96°39'42.75" W	5-1/2	6-1/2	GM	Light Brown, Silty GRAVEL with Sand	Non-Plastic	
B6	32°20'4.42" N 96°39'59.45" W	4-1/2	9	-	Brown, Silty Sand with Gravel	-	-
B7	32°19'57.41" N 96°39'56.61" W	5	6	SC	Dark Brown, Clayey SAND with Gravel	25	13

Boring No.	Location	Pavement Thickness		Properties of Existing Base			
		Asphalt (in)	Base (in)	Soil Group Symbol	Soil Classification	LL	PI
B8	32°19'50.46" N 96°39'53.77" W	6-7/8	6-5/8	GP - GC	Brown, Poorly Graded GRAVEL with Clay and Sand (or Silty Clay and Sand)	18	6
B9	32°19'43.42" N 96°39'51.08" W	5	8	GP - GM	Brown, Poorly Graded GRAVEL with Silt and Sand	Non-Plastic	
B10	32°20'5.19" N 96°39'58.84" W	6-3/4	6-/4	GP - GC	Brown, Poorly Graded GRAVEL with Clay and Sand (or Silty Clay and Sand)	17	6
B11	32°19'57.69" N 96°39'55.90" W	4-7/8	6-5/8	GM	Brown, Silty GRAVEL with Sand	Non-Plastic	
B12	32°19'39.64" N 96°39'51.29" W	2-3/4	11-1/4	GP - GC	Brown, Poorly Graded GRAVEL with Clay and Sand (or Silty Clay and Sand)	20	9
B13	32°19'40.10" N 96°39'52.46" W	2-1/2	11	GP - GC	Brown, Poorly Graded GRAVEL with Clay and Sand (or Silty Clay and Sand)	15	6
B14	32°19'40.48" N 96°39'50.57" W	3-1/4	9-3/4	GP - GC	Brown, Poorly Graded GRAVEL with Clay and Sand (or Silty Clay and Sand)	18	6
B15	32°19'40.84" N 96°39'51.78" W	3-3/8	9-5/8	GC	Brown, Clayey GRAVEL with Sand	20	10
B16	32°19'37.30" N 96°39'48.66" W	4-1/2	7	SC	Brown, Clayey SAND with Gravel	17	9
B17	32°19'28.23" N 96°39'44.70" W	5	7	SP	Very Dark Gray, Poorly Graded SAND with Gravel	Non-Plastic	
B18	32°19'40.01" N 96°39'48.88" W	4-3/4	6	SP - SM	Brown, Poorly Graded SAND with Silt and Gravel	Non-Plastic	
B19	32°19'59.75" N 96°39'54.65" W	3-7/8	-	-	-	-	-
B20	32°19'46.45" N 96°39'49.43" W	3-1/4	-	-	-	-	-
B21	32°19'33.86" N 96°39'44.52" W	3-5/8	-	-	-	-	-
B22	32°19'34.22" N 96°39'45.39" W	3-1/2	-	-	-	-	-
B23	32°19'48.22" N 96°39'50.85" W	3	-	-	-	-	-
B24	32°20'2.26" N 96°39'56.41" W	3-5/8	-	-	-	-	-
B25A	32°20'4.63" N 96°39'56.39" W	3-3/4	-	-	-	-	-
B26	32°19'48.91" N 96°39'50.40" W	3-1/4	-	-	-	-	-

Boring No.	Location	Pavement Thickness		Properties of Existing Base			
		Asphalt (in)	Base (in)	Soil Group Symbol	Soil Classification	LL	PI
B27	32°19'31.45" N 96°39'43.56" W	3-1/4	6-1/4	SM	Light Brown, Silty SAND	Non-Plastic	
B28	32°19'30.42" N 96°39'43.92" W	3	-	-	-	-	-
B29	32°19'43.54" N 96°39'49.04" W	3-3/8	-	-	-	-	-
B30	32°19'52.78" N 96°39'52.66" W	2	-	-	-	-	-
B31	32°19'34.94" N 96°39'46.82" W	9-1/4	5-3/4	GM	Brown, Silty GRAVEL with Sand	Non-Plastic	
B32	32°19'32.52" N 96°39'46.18" W	4	-	-	-	-	-
TP 1	32°19'40.94"N 96°39'47.79"W	6-3/4	6-3/4	SM	Light Brown, Silty SAND with Gravel	17	3
TP 2	32°19'53.96"N 96°39'55.21"W	6-1/2	7-1/2	GP - GM	Light Brown, Poorly Graded GRAVEL with Silt and Sand	Non-Plastic	

Base samples were obtained from boring locations using the drilling method. However, drilling with an auger through the base layer may cause degradation of the coarse aggregate. Therefore, the gradation and plasticity test results of base samples obtained from borings by drilling may vary from those of the in-place base material.

6.5 Summary of DCP Test Results

Dynamic Cone Penetrometer (DCP) was used to estimate the in-situ CBR values of the sub-surface soils at depths up to 33.6 inches using a 17.6-lb (8kg) hammer with a 0.79-inch (20 mm) 60-degree angled disposable Cone Tip attached to the end of a drive rod. The DCP testing started on the base beneath the asphalt pavement layer at the borehole numbers below. The DCP tests followed the FAA-AC150/5320-6G and ASTM D6951. Results are presented in Appendix D and summarized in Table 7, which includes a summary of the DCP Test results.

Table 7. Summary of Layer Thickness and CBR Results from DCP.

Location	Soil Layer	Depth (in)	DCP CBR
TP 1	1	7.5 – 13.8	28.8
	2	13.8 – 17.4	22.6
	3	17.4 – 32.0	3.6

Location	Soil Layer	Depth (in)	DCP CBR
TP 2	1	7.0 – 12.3	18.7
	2	12.3 – 24.2	6.2
	3	24.2 – 34.8	9.7
B11	1	5.0 – 10.4	39.0
	2	10.4 – 12.8	17.8
	3	12.8 – 15.1	101.3
	4	15.1 – 33.7	12.3
B13	1	3.0 – 8.1	95.6
	2	8.1 – 17.2	12.9
	3	17.2 – 33.5	7.9
B26	1	3.5 – 27.0	2.3
B33	1	4.0 – 37.1	0.8

The CBR values above were derived from the DCP common correlation for All Soils [CBR=292/(DCP*25.4)^1.12], except CL soils with CBR less than ten and CH, in the AC 150/5320-6G Section 5.2.4.4.2. The DCP tests were performed to obtain the estimated strength of in-situ soils under existing field conditions (e.g., moisture, temperature, etc.) during testing. Changing moisture conditions due to weather (arid or wet) will significantly affect the strength of the soil. Moist conditions will tend to provide weaker soil strength results than dry conditions. Most of the soil encountered during our geotechnical investigation was relatively wet condition.

6.6 Summary of FWD Testing

The Dynatest Falling Weight Deflectometer (FWD) was used to measure pavement deflections along Runway 16-34. Data collection began at the south end of the runway and progressed northward. Testing was conducted in six longitudinal passes, with measurements taken at 200-foot intervals within each pass. Cross-section deflection measurements were collected at offsets of 6 feet and 18 feet to both the left and right of the runway centerline.

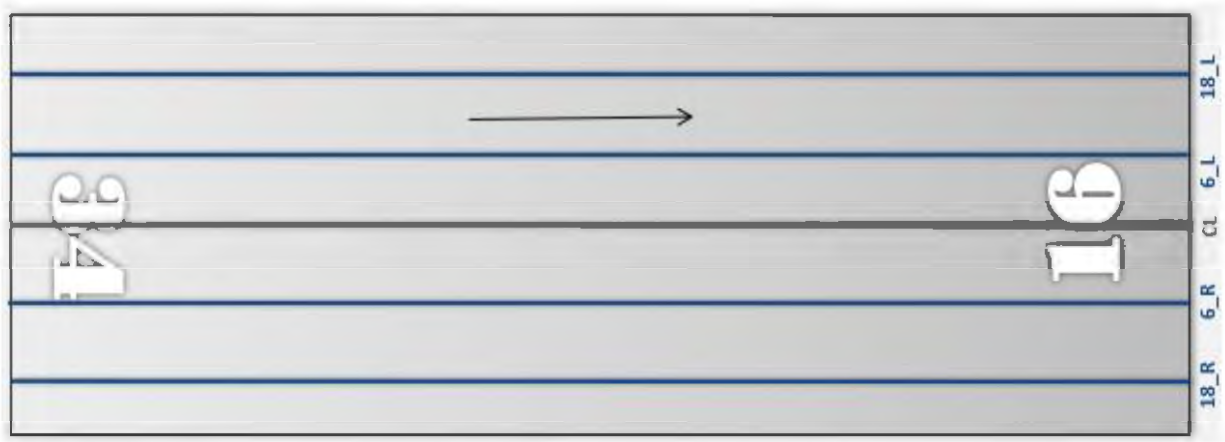


Figure 1. Diagram of FWD testing.

Deflection measurements from Sensor W1 (Figure 2) show a clear trend in pavement response along the evaluated section. Deflection values range from approximately 10 to 35 mils, with the highest readings concentrated near the southern end (stations 00+00 to ~05+00), where several points exceed 30 mils. This indicates relatively lower structural stiffness in that portion of the pavement. Beyond this area, deflections generally stabilize within a narrower range of 10 to 25 mils, suggesting more uniform and structurally sound pavement conditions throughout the remainder of the section.

While some localized variability is observed, especially between stations 10+00 and 30+00, the overall deflection levels are within an acceptable range for a flexible pavement system. A few isolated peaks may reflect potential soft spots or areas of early-stage deterioration. No widespread structural concerns are evident.

Deflection data from Sensor W7 (Figure 3), which reflects subgrade response, indicates generally consistent performance across the evaluated section. Most deflection values fall within the range of 1.0 to 2.5 mils, with occasional peaks slightly above 2.5 mils and a few dips closer to 1.0 mil. There is no indication of widespread subgrade distress; however, deflections are slightly higher in the first 500 feet (near station 00+00), which may suggest slightly weaker subgrade support in that area.

Overall, the subgrade deflection pattern shows a stable and uniform stiffness profile, with only minor variability across the stations. These results align with expectations for a flexible pavement system under moderate loading and do not indicate any critical deficiencies in subgrade support.

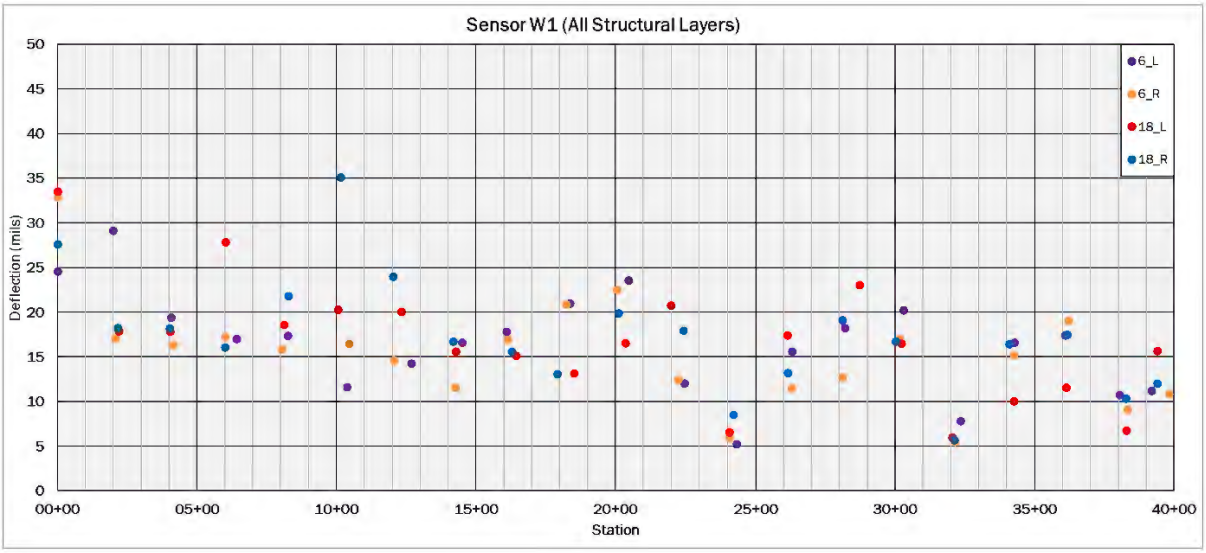


Figure 2. Normalized FWD Deflections - Sensor 1

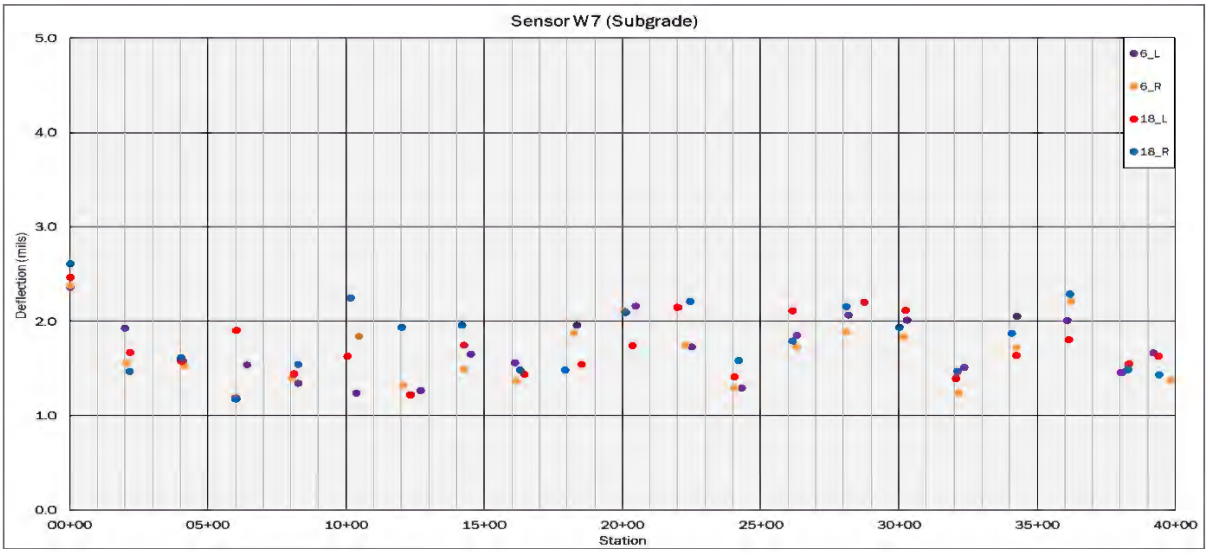


Figure 3. Normalized FWD Deflections - Sensor 7

7. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based upon the data obtained from the borings, field, and laboratory testing of the soil samples, the project information provided to us by Woolpert, and experience with similar soils and site conditions.

7.1 FWD Test Results and Analysis

The FWD values, along with thickness, field, and laboratory test results, were used to analyze the deflections and to determine the back-calculated modulus of each pavement

layer. This was done using Modulus 7.0 software. The output of this analysis is included in Appendix D.

The investigation used non-destructive FWD field-testing to determine the structural capacity of the pavement given the conditions (moisture, temperature, and others) during the time the testing occurred. Changing moisture conditions due to weather (arid or wet) will greatly affect the pavement's structural strength. Wet conditions in the pavement structure will tend to test weaker than dry conditions. Similarly, temperature affects the modulus of primarily the asphalt layer, during cold weather (below 77°F) the asphalt will stiffen causing the modulus to increase and as result the FWD surface deflections will decrease.

Due to shallow bedrock calculated by the software in some locations (average depth of 60 inches), two analyses were conducted: one using the bedrock depth calculated by the software and another assuming a constant depth of 200 inches. The base and subgrade moduli were determined based on both the error per sensor and the corresponding subgrade and base moduli values. Outliers were removed from the analysis, and the results are presented in Tables 8 and 9.

Table 8. Summary of Backcalculated Moduli of Base and Subgrade.

Runway		Taxiway	
Base Modulus (ksi)		Base Modulus (ksi)	
FWD - 06-Lt	26.9	FWD - 06-Lt	20.9
FWD - 06-Rt	25.3	FWD - 06-Rt	24.8
FWD - 18-Lt	24.8		
FWD - 18-Rt	27.7		
Avg	**26.2**	**Avg**	**22.9**
Runway		**Taxiway**	
Subgrade CBR		Subgrade CBR	
FWD - 06-Lt	8.1	FWD - 06-Lt	6
FWD - 06-Rt	8.5	FWD - 06-Rt	6.8
FWD - 18-Lt	8.2		
FWD - 18-Rt	7.7		
Avg	**8.1**	**Avg**	**6.4**

Table 9. Summary of Backcalculated Moduli of Surface.

Calculated Surface Moduli (ksi)	
Runway	
FWD - 06-Lt	589
FWD - 06-Rt	610
FWD - 18-Lt	531
FWD - 18-Rt	514
Avg	**561**
Taxiway	
FWD - 06-Lt	470
FWD - 06-Rt	578
Avg	**524**

7.2 Recommended E Value, Subgrade

Two laboratory CBR tests were performed on the subgrade material sampled from the Test Pits on Runway 6-24. The Resilient Moduli of the Subgrade (E Value) was obtained using laboratory CBR values, and the following correlation is shown in the FAA Advisory Circular 150/5320-6G Section 2.3.9.8:

E = 1500 * CBR

As recommended by the FAA, one standard deviation below the mean subgrade strength was selected as the design CBR value. The mean subgrade strengths were derived from the CBR determined by FWD and the Laboratory CBR Test results. Table 10 summarizes the recommended design values.

Table 10. Recommended Design Values.

CBR/Bore No.	Sample Location	Backcalculated CBR_{FWD}	Laboratory Subgrade CBR at 95%
CBR No. 1	Test Pit 1 (Runway)	-	6.4
CBR No. 2	Test Pit 2 (Taxiway)	-	4.2
CBR No. 3	Boring No. 33 (Infield)		2.6
CBR Runway	Average FWD Results for all passes	8.9	-
CBR Taxiway	Average FWD Results for all passes	6.4	
Average		5.7	
Standard Deviation (STD)		2.4	
Average - STD		3.3	
Design CBR		**3.3**	
Design E (psi)		**4,947**	

Both the lab and FWD results indicate that the material characteristics of Runway and Taxiway are similar. Considering the FAA's conservative approach of subtracting one standard deviation from the average to determine the design CBR for the subgrade, the same design CBR value can be used for both sections of the runway.

The infield CBR is significantly lower than the other measured values; therefore, the infield CBR will be used as the design value for developing pavement sections for the taxiway extension and connector taxiway construction.

Due to the low Infield CBR values, chemical stabilization is required, as per FAA guidance. Lime treatment may be used as a stabilization method; the amount of lime needed to stabilize the subgrade sample obtained during our investigation was 5-6%.

7.3 Aircraft Design Parameters

Based on the information provided by Woolpert, we understand that flexible pavement section recommendations are desired for the proposed pavement, using the fleet mix shown in Table 11. The Eurocopter EC-135 was excluded from the fleet mix, as pavement design for helicopters is outside the scope of this project.

Our recommendations are based on the FAA's *Airport Pavement Design and Evaluation* guidance (Advisory Circular 150/5320-6G), using a design CBR value of 3.3 for the existing runway and taxiway, and 3.0 for the taxiway extension and connector taxiway. The analysis also incorporates aircraft information provided by Woolpert. Due to the use of lime treatment, the subgrade CBR value of 2.6 was increased to 3.0 for pavement design purposes. As the type of aircraft and annual departures significantly influence pavement thickness, any modifications to the design parameters outlined below should be accompanied by a new pavement analysis.

Because not all Woolpert aircraft included in the provided list were available for use in the FAARFIELD 2.1 Software, similar aircraft (from the General Aviation section of the FAARFIELD Software) were substituted using the Gear Type, Gross Weight, Annual Depurates, and Percent Annual Growth as provided.

Table 11. Summary of Aircraft Fleet Mix.

Aircraft	FAARFIELD Aircraft Name Used	Gross Weight (lbs)	Gear Configuration	Departures (TAF Factored)	ANNUAL GROWTH
BE33 - Beech Bonanza 33	Beech Bonanza F33A	3412	S	60	3%
BE35 - Beech Bonanza 35	Beech Bonanza F33A	3412	S	210	3%

Aircraft	FAARFIELD Aircraft Name Used	Gross Weight (lbs)	Gear Configuration	Departures (TAF Factored)	ANNUAL GROWTH
BE36 - Beech Bonanza 36	Beech Bonanza F33A	3412	S	120	3%
C172 - Cessna Skyhawk 172/Cutlass	Cessna Skyhawk 172	2558	S	600	3%
P28A - Piper Cherokee	P28A - Piper Cherokee	2500	S	270	3%
PA46 - Piper Malibu	PA46 - Piper Malibu	4118	S	30	3%
S22T - Cirrus SR-22 Turbo	S-5	5000	S	270	3%
T210 - Cessna T210M	S-5	5000	S	30	3%
BE20 - Beech 200 Super King	BE20 - Beech 200 Super King	12590	D	900	3%
C425 - Cessna 425 Corsair	S-10	10000	S	270	3%
EC35 - Eurocopter EC-135	Not Included		Not Included	60	3%
M20T - Turbo Mooney M20K	Beech Bonanza F33A	3412	S	870	3%
RV7 - Experimental RV-7	S-3	3000	S	30	3%
SR20 - Cirrus SR-20	S-3	3000	S	30	3%
PA34 - Piper PA-34 Seneca	PA34 - Piper PA-34 Seneca	4570	S	30	3%
B36T - Allison 36 Turbine Bonanza	Beech Bonanza F33A	3412	S	30	3%
BE9L - Beech King Air 90	Beechcraft King Air C90	9710	S	420	3%
P46T - Piper Malibu Meridian	PA-46-350P Malibu Mirage	4118	S	60	3%
C208 - Cessna 208 Caravan	Cessna 208B Grand Caravan	8750	S	30	3%
C150 - Cessna 150	S-3	3000	S	30	3%
C182 - Cessna Skylane 182	Cessna Skylane 182	3110	S	120	3%
RV4 - Experimental	S-3	3000	S	30	3%
B350 - Beech Super King Air 350	Beech Super King Air 350	15100	D	30	3%
AEST - Piper Aero Star	S-5	5000	S	60	3%
BE30 - Raytheon 300 Super King Air	D-15	15000	D	120	3%

Aircraft	FAARFIELD Aircraft Name Used	Gross Weight (lbs)	Gear Configuration	Departures (TAF Factored)	ANNUAL GROWTH
SR22 - Cirrus SR 22	S-3	3000	S	90	3%
PC12 - Pilatus PC-12	S-10	10000	S	30	3%
BE58 - Beech 58	S-5	5000	S	90	3%
C180 - Cessna 180	S-3	3000	S	30	3%
M20P - Mooney M-20C Ranger	S-3	3000	S	60	3%
PA44 - Piper Seminole	S-5	5000	S	30	3%
SF50 - Cirrus Vision SF50	S-5	5000	S	90	3%
SW3 - Fairchild Swearingen SA-226T/TB Merlin 3	D-15	15000	D	30	3%
BE55 - Beech Baron 55	Beech Baron 55	5424	S	60	3%
M600 - Piper PA-46 M600	PA-46-350P Malibu Mirage	4118	S	30	3%
TBM9 - Socata TBM	S-10	10000	S	30	3%
PA30 - Piper PA-30	S-5	5000	S	30	3%
PA32 - Piper Cherokee Six	S-5	5000	S	30	3%

7.4 Pavement Section Recommendations

The FAA's Airport Pavement Design and Evaluation (Advisory Circular 150/5320-6G) and FAARFIELD software were used to develop the pavement recommendations, incorporating the parameters and aircraft information provided by the client. A design subgrade modulus (ESG) of 4,500 psi (CBR = 3) was used for the taxiway extension, while a CBR value of 3.3 was used for the existing pavement rehabilitation design.

Existing Pavement Rehabilitation:

Based on field coring, the observed cracking appears to extend nearly the full depth of the asphalt layer, although the crack width decreases at deeper depths. This condition presents a risk of reflection cracking if a standard mill-and-overlay is performed without additional mitigation measures. Considering the relatively light aircraft fleet (less than 30,000 lbs), a full-depth mill may not be necessary in all areas.

To achieve an effective balance between durability and project budget, it is recommended to take additional cores specifically within cracked areas to confirm crack depths before finalizing the milling depth. A 4-inch mill and replacement with 4 inches of new HMA can be considered, provided the cracks do not extend deeper than this depth in the majority of areas. Where deeper cracks or localized edge cracking and swelling are present, full-depth patching shall be performed prior to the overlay.

Due to varying construction practices across different areas of the airport, existing HMA layers have inconsistent thicknesses, with individual lifts ranging from approximately 1.5 inches to 2 inches. To prevent lamination and potential slippage between asphalt layers after the overlay, the milling depth should be carefully selected to either terminate at the interface between two HMA lifts or remain sufficiently above or below these interfaces.
If the existing asphalt thickness is less than 4 inches, full-depth milling and resurfacing should be performed. Where full-depth milling is not performed, a minimum of 1.5 to 2 inches of existing asphalt should remain in place to preserve the integrity of the underlying base and prevent damage during milling operations.

To further reduce the risk of reflection cracking, the use of a stress-absorbing interlayer such as GlassGrid or a SAMI shall be considered between the milled surface and the new overlay, particularly in areas with known cracking patterns.

Additionally, the presence of edge cracking and localized swelling in certain areas suggests underlying subgrade movement, likely due to the fatty clay soils with high plasticity index (PI) present at the site. These soils are prone to shrink-swell behavior, which can contribute to pavement distress, particularly along the edges where moisture variations are more pronounced. As part of the rehabilitation approach, it will be important to address drainage to minimize moisture fluctuations near pavement edges and to perform localized full-depth patching where swelling or severe edge cracking is evident.

The overlay design considered the minimum required combined base and HMA thickness; however, in the taxiway, some areas show less than 12 inches of total pavement structure. In these areas, if full-depth milling and resurfacing are required, a 5-inch HMA overlay should be used.

Taxiway Extension & Runway Widening - New Construction:

The new construction of the taxiway, connector extension, and runway widening will include lime treatment of the subgrade to a minimum depth of 12 inches, 6.5 inches of P-209 crushed aggregate base, and 4 inches of P-401 HMAC surface course.

4" FAA Item P-401
HMAC Surface Course

6.5" FAA Item P-209
Crushed Aggregate Base

12" Lime-Treated Subgrade

A mill, notch, and tie-in approach should be utilized where the widening meets the existing pavement, positioning the construction joint as far from wheel paths as practical to reduce longitudinal cracking risk. A stair-step or stepped joint detail should be employed at the widening interface to improve compaction quality, minimize reflective cracking, and support effective load transfer across the joint.

After lime treatment, Type II geogrid reinforcement should be placed over the treated subgrade within the widening areas to enhance stability and control potential movement.

To maintain a consistent surface across the existing runway, widening, and extension, it is recommended that 4 inches of new HMA be placed across the full width of the runway and extension areas during resurfacing.

To further reduce the risk of reflective cracking along the widening joints, the use of a stress-absorbing membrane interlayer (SAMI) or geotextile over the widening joint prior to overlay should be considered. Additionally, the final HMA overlay joint should be offset by 6–12 inches from the underlying vertical interface to improve joint impermeability and minimize water infiltration.

Pavement widening practices will follow the guidance provided in Section 5.2 (Pavement Widening) of the TxDOT Pavement Manual to ensure proper tie-in and performance of the widened sections.

7.5 General Pavement Recommendations

Areas containing unsuitable materials (with vegetable or organic matter) should be removed to avoid differential settlements due to the decomposition of these materials. The unacceptable materials shall be disposed of in authorized areas or, if approved, used for embankment slopes to support vegetation.

After full-depth milling and removal of the HMA pavement, proof rolling should be conducted using a vibratory roller (10–12 ton) or a smooth drum roller in static mode to evaluate the stability and uniformity of the existing base before placing HMA. Any areas exhibiting excessive deflection, rutting, or movement should be repaired. The repairs may consist of replacing the unstable material with crushed aggregate Base, Item P-209, to

the required depth and/or by reworking the existing base and recompacting to a minimum of 100% Standard Proctor Density (ASTM D698). The moisture content of the material during compaction shall be within ±2% of the optimum moisture content.

All undercutting and grading of existing subgrades shall comply with the requirements of FAA Item P-152. The excavated areas may be refilled with suitable material obtained from the grading operations or borrow areas and compacted to a minimum of 95% of Standard Proctor Density ASTM D698. The moisture content of the material during placement shall be within ±2% of the optimum moisture content.

If embankment is utilized for lower areas, it should comply with the requirements of FAA Item P-152. Compact the material to a minimum of 95% of Standard Proctor Density ASTM D698, and the moisture content of the material during placement shall be within ±2% of the optimum moisture content. For non-cohesive material, the top 6" of the embankment should be compacted to 100% maximum density. The material should be placed in successive horizontal layers of not less than six (6) inches nor more than 12 inches of compacted thickness for the entire width of the cross-section. The compaction of side slopes should be parallel to the long direction of the side slopes. Pieces over 4 inches will not be allowed on the upper 6-inch course. The embankment should extend at least 5 feet from the pavement edge.

Subgrade preparation shall comply with the requirements of FAA Item P-152. Compact the material to a minimum of 95% of Standard Proctor Density ASTM D698, and the moisture content of the material during placement shall be within ±2% of the optimum moisture content.

Subgrade material having a plasticity index (PI) exceeding 20 should be stabilized with lime slurry to a minimum depth of 10 inches. Subgrade material having a PI of 20 or less should be stabilized using cement to a minimum depth of 10 inches. Geo-synthetics may be utilized for non-cohesive subgrade material.

Three subgrade samples were analyzed for Sulfate Content, and results ranged from 1260 ppm to 2640 ppm by weight of dry soil. Suppose lime, cement, or other calcium-based additives are used for stabilization; the subgrade should be analyzed for sulfate content during construction and after cut/fill operations from samples obtained every 500 feet before stabilization. The following recommendations for soil containing sulfate shall be followed if lime stabilization is used.

The TxDOT Treatment Guidelines for Soils and Base in Pavement Structures (*) suggests that soils with:

- Sulfate levels of 3000 ppm or less pose a low potential for sulfate heave if stabilized with lime, provided it's appropriately mixed with adequate moisture.

Traditional treatment can be used for these soils, with a minimum of 24 hours of mellowing recommended.

- Sulfate levels of 3000 ppm to 7000 ppm or less can be successfully treated with lime if care is taken to follow good construction practices, following "modified treatment" with extended mellowing time and additional moisture. The mellowing time and moisture content required for a specific soil can be estimated during the mix design process. The mellowing time is usually not less than seven days. If after seven days of mellowing, the sulfate content still exceeds 3000 ppm, continue to mellow the mixture and measure the sulfate content until it's below 3000 ppm. Treatment with cement **is not** recommended.
- Sulfate levels of more than 7000 ppm. Treatment with lime or cement **is not** recommended. High-sulfate soil should be replaced with low-sulfate soil.

If a lime-treated subgrade is used, it shall comply with the requirements of FAA Item P-155 (slurry-lime). The percentage (based on the dry weight of the soil) of lime required to stabilize the subgrade samples obtained during our investigation was 5% to 6%; however, if, during construction, after cut/fill operations, other types of subgrade materials or soils with higher plasticity indexes are encountered, additional testing should be performed to determine the required lime to stabilize the final subgrade material. Compact the material to a minimum of 95% of Standard Proctor Density (ASTM D-698), and the moisture content of the mixture at the start of the compaction shall not be below nor more than 2% of the optimum moisture. The lime-treated subgrade should extend at least 9 feet from the pavement edge. The lime-treated subgrade works as a moisture barrier, helping to minimize changes in water content under the pavement structure and thus helping to reduce cracking.

Geogrid should conform to TxDOT Departmental Material Specification (DMS) 6240, Geogrid for Base/Embankment Reinforcement Type 2, when tested with TxDOT standard test procedure Tex-621-J. If approved, Tensar Geogrid TriAx-TX5 may be used. The geogrid shall be placed between the compacted subgrade and crushed aggregate base material. The subgrade shall be proof-rolled after compaction and before the geogrid and base material placement. Geogrid will also provide long-term material separation, thus helping to avoid contaminating the base material with the subgrade. Place the geogrid according to the manufacturer's recommendations.

If a subbase course is used, it shall comply with the requirements of FAA Item P-154. Compact the material to a minimum of 100% of Standard Proctor Density ASTM D698, and the moisture content of the material during placement shall be within ±2% of the optimum moisture content. Subbase material should extend 2 feet from the pavement edge.

The crushed aggregate base shall comply with the requirements of FAA Item P-209. Compact the material to a minimum of 100% of the maximum dry density as determined by the Standard Proctor Density ASTM D698. The material's moisture content during placement shall not be below or 1½ percentage points above the optimum moisture content. The base material should extend 2 feet from the pavement edge. Topsoil should be placed over the base extension to protect the base from excess water penetration and to prevent erosion.

HMAC Pavement shall comply with the requirements of FAA specification Item P-401 (Plant Mix Bituminous Pavements) for 3/4" maximum nominal size aggregate, 50-blow or 50-gyrations compaction. Mix complying with this specification has sufficient asphalt to better resist oxidation and age hardening to which pavements receiving intermittent traffic are susceptible.

A prime coat shall be uniformly applied to the aggregate base before placing hot-mix asphalt. The surface shall be clean, dry, and free of loose material before application. The prime coat shall be applied at an appropriate rate to achieve uniform coverage, considering the surface texture. It shall be allowed to break and become tacky before proceeding with asphalt placement.

A tack coat shall be applied between all successive lifts of hot-mix asphalt to promote bonding between layers. Each layer shall receive a uniform application of track on a clean surface before placement of the next lift. Application rate shall be adjusted based on surface condition and texture to achieve uniform coverage. The tack coat shall be allowed to break before placing the next asphalt layer.

Care should be taken to slope the site to prevent water ponding around or on the pavement structure during and after construction. Poor drainage may cause premature pavement failure; creating positive drainage from the pavement structure is recommended. Once completed, the ground surface should slope away from the pavement and have enough topsoil to grow vegetative cover to prevent erosion.

It should be known that the extensive use of a vibratory roller or heavy construction equipment might wick the groundwater through the soil and into the surface, causing pumping during construction. The continuous passing of construction equipment and heavily loaded vehicles through these areas may cause the subgrade to be unstable. Usually, the heaviest load that the subgrade will experience is likely that of the construction equipment. Using alternate routes for equipment and heavy loads may help minimize any possible issues with pumping. If this problem arises, using the vibratory roller or heavy construction equipment may need to be limited, and the conditions may need to be evaluated.

It was also determined that the topsoil encountered during our investigation could be excavated using conventional earth-moving equipment (ripper, trencher, backhoe). However, rock hammers or blasting may be required if bedrock is encountered.

(*) *TxDOT Treatment Guidelines for Soils and Base in Pavement Structures.*

8. LIMITATIONS

This investigation followed accepted geotechnical engineering practice for the exclusive use of Woolpert in preparing the pavement design, construction, drawings, and specifications for the proposed new pavement at the Ennis Municipal Airport. The responsibility of others specializing in those areas is to verify subsurface conditions to determine the difficulty of excavation, dewatering, trafficability, etc. Our geotechnical scope of work for this site did not include an environmental assessment or chemical testing and analysis of the property's air, water, and subsurface soils. This report is not intended to determine construction means and methods and may be misleading if used. Suppose any changes in these structures' nature, design, or locations are made from those assumed herein; in that case, the conditions and recommendations in this report shall not be considered valid until the changes are reviewed and the conclusions are verified in writing.

9. APPENDIX

Appendix A:

Bore Log Data

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 1

Project: Ennis Municipal Airport
Location: Runway 16-34 at 32°20'5.40"N; 96°39'57.15"W
Date Drilled: 4/30/2025

Boring Depth: 5 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
0.5		C-1	6-1/2" HMAC		C												0.5
1.0		B1S1	7-1/2" BASE. Dark Brown, Poorly Graded GRAVEL with Sand	GP	A	5.9	Non-Plastic		100.0	100.0	99.2	74.1	49.4	24.4	2.5	0.6	1.0
1.5		B1S2	Brown, Poorly Graded SAND with Silt and Gravel	SP - SM	A	5.2	16	3	100.0	100.0	100.0	78.5	65.6	49.7	18.9	10.0	1.5
2.0																	2.0
2.5																	2.5
3.0		B1S3	Dark Brown, Fat CLAY with Sand	CH	A	21.0	59	39	100.0	100.0	100.0	100.0	99.8	98.5	95.2	83.7	3.0
3.5																	3.5
4.0																	4.0
4.5		B1S4	Brown, Fat CLAY	CH	A	20.7	57	41	100.0	100.0	100.0	100.0	99.9	99.5	98.3	90.4	4.5
5.0																	5.0

Boring terminated at 5 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 2

Project: Ennis Municipal Airport
Location: Runway 16-34 at 32°19'56.03"N; 96°39'53.64"W
Date Drilled: 4/30/2025

Boring Depth: 5 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
0.5		C-2	9-7/8" HMAC		C												0.5
1.0		B2S1	4-1/8" BASE. Dark Brown, Poorly Graded GRAVEL with Sand	GP	A	9.7	24	8	100.0	98.4	93.3	58.4	25.2	9.8	3.8	2.3	1.0
1.5		B2S2	Dark Brown, Poorly Graded GRAVEL with Sand	GP	A	4.2	Non-Plastic		100.0	100.0	100.0	74.2	44.3	23.9	10.7	3.8	1.5
2.0																	2.0
2.5																	2.5
3.0																	3.0
3.5																	3.5
4.0																	4.0
4.5		B2S3	Dark Brown, Fat CLAY	CH	A	23.6	54	38	100.0	100.0	100.0	100.0	99.9	99.2	98.0	89.5	4.5
5.0																	5.0

Boring terminated at 5 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 3

Project: Ennis Municipal Airport
Location: Runway 16-34 at 32°19'46.64"N; 96°39'50.10"W
Date Drilled: 4/30/2025

Boring Depth: 5 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
0.5		C-3	9" HMAC (Only 6" of the core was retrieved. The bottom 3" of the core was broken apart and was not retrieved by the core bit)		C												0.5
1.0 – 1.5		B3S1	8-1/2" BASE. Dark Brown, Poorly Graded SAND with Gravel	SP	A	4.7	Non-Plastic		100.0	96.4	93.6	75.6	51.5	30.7	9.6	1.1	1.0 – 1.5
2.0 – 4.0		B3S2	Very Dark Gray, Poorly Graded GRAVEL with Sand	GP	A	7.3	Non-Plastic		100.0	87.8	77.3	40.3	19.1	7.6	3.3	1.4	2.0 – 4.0
4.5 – 5.0		B3S3	Very Dark Gray, Lean CLAY with Sand	CL	A	22.3	43	27	100.0	100.0	100.0	100.0	99.8	99.6	98.9	73.4	4.5 – 5.0

Boring terminated at 5 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 4

Project: Ennis Municipal Airport
Location: Runway 16-34 at 32°19'37.26"N; 96°39'46.20"W
Date Drilled: 4/30/2025

Boring Depth: 5 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
0.5		C-4	6-3/4" HMAC		C												0.5
1.0		B4S1	5-1/4" BASE. Light Brown, Silty GRAVEL with Sand	GM	A	7.0	Non-Plastic		100.0	85.0	75.0	48.5	37.1	28.1	18.8	12.7	1.0
4.0		B4S2	Gray, Sandy Lean CLAY	CL	A	20.7	36	23	100.0	100.0	100.0	100.0	99.5	98.7	97.3	65.6	4.0
5.0		B4S3	Gray, Sandy Fat CLAY	CH	A	20.4	53	38	100.0	100.0	100.0	97.9	96.8	95.4	93.6	69.5	5.0

Boring terminated at 5 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 5

Project: Ennis Municipal Airport
Location: Runway 16-34 at 32°19'28.60"N; 96°39'42.75"W
Date Drilled: 4/30/2025

Boring Depth: 5 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-5	5-1/2" HMAC (Only 3-1/2" of the core was retrieved. The bottom 2" of the core was broken apart and was not retrieved by the core bit)		C												
0.5		B5S1	6-1/2" BASE. Light Brown, Silty GRAVEL with Sand	GM	A	8.4	Non-Plastic		100.0	92.7	89.4	67.3	55.4	45.9	30.0	19.4	0.5
1.0																	1.0
		B5S2	Gray, Sandy Lean CLAY	CL	A	23.4	40	23	100.0	100.0	100.0	100.0	99.5	98.7	97.1	68.3	
1.5																	1.5
2.0																	2.0
2.5																	2.5
3.0																	3.0
3.5																	3.5
4.0																	4.0
		B5S3	Gray, Fat CLAY with Sand	CH	A	23.7	53	38	100.0	100.0	100.0	99.7	98.7	98.1	97.3	70.8	
4.5																	4.5
5.0																	5.0

Boring terminated at 5 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 6

Project: Ennis Municipal Airport
Location: Parallel Taxiway at 32°20'4.42"N; 96°39'59.45"W
Date Drilled: 5/21/2025

Boring Depth: 5 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-6	4-1/2" HMAC		C												
0.5		B6S1	9" BASE. Brown, Silty Sand with Gravel	-	A	4.7	-	-	100.0	100.0	98.8	64.7	34.5	26.5	18.5	11.1	0.5
1.0																	1.0
1.5		B6S2	Dark Brown, Fat CLAY	CH	A	25.9	66	51	100.0	100.0	100.0	99.7	99.6	98.6	96.1	86.7	1.5
2.0																	2.0
2.5																	2.5
3.0		B6S3	Brown, Fat CLAY	CH	A	24.9	68	53	100.0	100.0	100.0	99.6	99.4	98.8	97.7	91.6	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Boring terminated at 5 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 7

Project: Ennis Municipal Airport
Location: Parallel Taxiway at 32°19'57.41"N; 96°39'56.61"W
Date Drilled: 5/21/2025

Boring Depth: 5 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-7	5" HMAC		C												
0.5		B7S1	6" BASE. Dark Brown, Clayey SAND with Gravel	SC	A	8.6	25	13	100.0	100.0	97.4	78.4	70.1	60.4	39.4	25.4	0.5
1.0		B7S2	Dark Brown, Fat CLAY	CH	A	24.0	57	44	100.0	100.0	100.0	100.0	99.1	97.9	95.2	85.3	1.0
1.5																	1.5
2.0																	2.0
2.5																	2.5
		B7S3	Dark Brown, Fat CLAY	CH	A	24.4	81	69	100.0	100.0	100.0	99.7	99.5	98.9	97.3	89.7	
3.0																	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Boring terminated at 5 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 8

Project: Ennis Municipal Airport
Location: Parallel Taxiway at 32°19'50.46"N; 96°39'53.77"W
Date Drilled: 5/21/2025

Boring Depth: 5 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
0.5		C-8	6-7/8" HMAC		C												0.5
1.0		B8S1	6-5/8" BASE. Brown, Poorly Graded GRAVEL with Clay and Sand (or Silty Clay and Sand)	GP - GC	A	6.8	18	6	100.0	84.9	77.0	51.2	38.7	31.7	25.0	11.2	1.0
1.5		B8S2	Dark Brown, Fat CLAY with Sand	CH	A	28.8	61	43	100.0	100.0	100.0	100.0	99.6	97.0	91.7	76.0	1.5
2.0																	2.0
2.5																	2.5
3.0		B8S3	Brown, Fat CLAY	CH	A	27.1	63	50	100.0	100.0	100.0	100.0	99.7	99.2	97.7	89.9	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Boring terminated at 5 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 9

Project: Ennis Municipal Airport
Location: Parallel Taxiway at 32°19'43.42"N; 96°39'51.08"W
Date Drilled: 5/21/2025

Boring Depth: 5 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-9	5" HMAC		C												
0.5		B9S1	8" BASE. Brown, Poorly Graded GRAVEL with Silt and Sand	GP - GM	A	7.5	Non-Plastic		100.0	44.1	42.9	28.3	21.7	18.4	15.1	6.5	0.5
1.0																	1.0
1.5		B9S2	Brown, Silty SAND	SM	A	27.5	Non-Plastic		100.0	100.0	100.0	97.1	88.3	67.9	41.4	15.7	1.5
2.0																	2.0
2.5																	2.5
3.0		B9S3	Dark Brown, Fat CLAY with Sand	CH	A	24.7	57	46	100.0	100.0	100.0	99.4	99.2	98.6	97.6	82.4	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Boring terminated at 5 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 10

Project: Ennis Municipal Airport
Location: Connector Taxiway at 32°20'5.19"N; 96°39'58.84"W
Date Drilled: 5/21/2025

Boring Depth: 5 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
0.5		C-10	6-3/4" HMAC		C												0.5
1.0		B10S1	6-1/4" BASE. Brown, Poorly Graded GRAVEL with Clay and Sand (or Silty Clay and Sand)	GP - GC	A	4.6	17	6	100.0	100.0	100.0	64.5	49.1	34.6	18.1	10.8	1.0
1.5		B10S2	Dark Brown, Sandy Fat CLAY	CH	A	29.8	71	55	100.0	100.0	100.0	99.5	96.8	91.7	81.2	67.4	1.5
2.0																	2.0
2.5																	2.5
3.0		B10S3	Brown, Fat CLAY	CH	A	23.5	61	44	100.0	100.0	100.0	100.0	99.8	98.6	95.5	88.8	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Boring terminated at 5 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 11

Project: Ennis Municipal Airport
Location: Connector Taxiway at 32°19'57.69"N; 96°39'55.90"W
Date Drilled: 5/21/2025

Boring Depth: 5 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-11	4-7/8" HMAC		C												
0.5		B11S1	6-5/8" BASE. Brown, Silty GRAVEL with Sand	GM	A	7.4	Non-Plastic		100.0	88.2	80.4	59.0	45.9	37.5	30.1	14.6	0.5
1.0																	1.0
1.5		B11S2	Very Dark Gray, Fat CLAY with Sand	CH	A	32.1	70	45	100.0	100.0	100.0	100.0	98.9	95.0	86.7	74.2	1.5
2.0																	2.0
2.5																	2.5
3.0		B11S3	Brown, Fat CLAY with Sand	CH	A	25.3	92	77	100.0	100.0	100.0	99.8	99.7	99.3	95.2	83.8	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Boring terminated at 5 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 12

Project: Ennis Municipal Airport
Location: Apron at 32°19'39.64"N; 96°39'51.29"W
Date Drilled: 5/21/2025

Boring Depth: 5 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-12	2-3/4" HMAC		C												
0.5		B12S1	11-1/4" BASE. Brown, Poorly Graded GRAVEL with Clay and Sand (or Silty Clay and Sand)	GP - GC	A	6.4	20	9	100.0	77.9	69.1	39.8	24.2	17.6	14.4	6.5	0.5
1.0																	1.0
1.5		B12S2	Dark Brown, SILT	ML	A	22.5	Non-Plastic		100.0	100.0	100.0	99.9	99.7	99.0	97.8	86.0	1.5
2.0																	2.0
2.5																	2.5
3.0		B12S3	Dark Brown, Fat CLAY with Sand	CH	A	23.0	52	40	100.0	100.0	100.0	97.1	95.6	93.7	91.4	76.4	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Boring terminated at 5 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 13

Project: Ennis Municipal Airport
Location: Apron at 32°19'40.10"N; 96°39'52.46"W
Date Drilled: 5/21/2025

Boring Depth: 5 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-13	2-1/2" HMAC		C												
0.5		B13S1	11" BASE. Brown, Poorly Graded GRAVEL with Clay and Sand (or Silty Clay and Sand)	GP - GC	A	6.8	15	6	100.0	90.1	82.5	54.1	39.3	29.1	21.7	9.8	0.5
1.0																	1.0
1.5		B13S2	Dark Brown, SILT with Sand	ML	A	26.9	Non-Plastic		100.0	100.0	100.0	100.0	99.7	98.0	94.3	79.3	1.5
2.0																	2.0
2.5																	2.5
3.0		B13S3	Dark Brown, Fat CLAY with Sand	CH	A	20.0	55	44	100.0	100.0	100.0	99.4	98.4	97.5	96.2	84.0	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Boring terminated at 5 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 14

Project: Ennis Municipal Airport
Location: Apron at 32°19'40.48"N; 96°39'50.57"W
Date Drilled: 5/21/2025

Boring Depth: 5 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-14	3-1/4" HMAC		C												
0.5		B14S1	9-3/4" BASE. Brown, Poorly Graded GRAVEL with Clay and Sand (or Silty Clay and Sand)	GP - GC	A	8.4	18	6	100.0	85.4	78.9	56.6	43.5	31.8	23.3	10.5	0.5
1.0																	1.0
1.5		B14S2	Dark Brown, Lean CLAY	CL	A	28.6	49	35	100.0	100.0	100.0	100.0	99.6	98.7	97.0	86.5	1.5
2.0																	2.0
2.5																	2.5
3.0		B14S3	Dark Brown, Lean CLAY	CL	A	23.9	49	40	100.0	100.0	100.0	100.0	99.9	99.0	97.8	85.3	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Boring terminated at 5 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 15

Project: Ennis Municipal Airport
Location: Apron at 32°19'40.48"N; 96°39'51.78"W
Date Drilled: 5/21/2025

Boring Depth: 5 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-15	3-3/8" HMAC		C												
0.5		B15S1	9-5/8" BASE. Brown, Clayey GRAVEL with Sand	GC	A	11.4	20	10	100.0	96.2	90.1	64.1	49.0	38.9	29.5	14.9	0.5
1.0																	1.0
1.5		B15S2	Dark Brown, Lean CLAY with Sand	CL	A	24.7	46	34	100.0	100.0	100.0	99.7	98.5	96.4	93.0	74.0	1.5
2.0																	2.0
2.5																	2.5
3.0		B15S3	Dark Brown, Fat CLAY	CH	A	22.9	58	47	100.0	100.0	100.0	99.7	99.1	98.4	97.2	85.1	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Boring terminated at 5 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 16

Project: Ennis Municipal Airport
Location: Parallel Taxiway at 32°19'37.30"N; 96°39'48.66"W
Date Drilled: 5/21/2025

Boring Depth: 1.5 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-16	4-1/2" HMAC		C												
0.5		B16S1	7" BASE. Brown, Clayey SAND with Gravel	SC	A	3.6	17	9	100.0	100.0	100.0	95.7	83.0	54.2	34.7	15.1	0.5
1.0		B16S2	Brown, Clay with Sand	-	A	-	50	36	-	-	-	-	-	-	-	-	1.0
1.5			Boring terminated at 1.5 ft due to auger refusal. No groundwater was encountered.														1.5
2.0																	2.0
2.5																	2.5
3.0																	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 17

Project: Ennis Municipal Airport
Location: Extended area West of Runway 34-End at 32°19'28.23"N; 96°39'44.70"W
Date Drilled: 5/21/2025

Boring Depth: 5 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-17	5" HMAC		C												
0.5		B17S1	7" BASE. Very Dark Gray, Poorly Graded SAND with Gravel	SP	A	4.8	Non-Plastic		100.0	100.0	100.0	91.3	51.4	22.0	7.5	1.1	0.5
1.0																	1.0
		B17S2	Very Dark Gray, Sandy Lean CLAY	CL	A	18.2	30	16	100.0	100.0	100.0	99.6	99.2	98.0	96.6	56.7	
1.5																	1.5
2.0																	2.0
2.5																	2.5
3.0																	3.0
3.5																	3.5
		B17S3	Very Dark Gray, Sandy Fat CLAY	CH	A	21.8	55	41	100.0	100.0	100.0	100.0	99.9	99.6	99.2	68.0	
4.0																	4.0
4.5																	4.5
5.0																	5.0

Boring terminated at 5 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 18

Project: Ennis Municipal Airport
Location: Connector Taxiway at 32°19'40.01"N; 96°39'48.88"W
Date Drilled: 5/21/2025

Boring Depth: 0.9 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-18	4-3/4" HMAC		C												
0.5		B18S1	6" BASE. Brown, Poorly Graded SAND with Silt and Gravel	SP - SM	A	7.7	Non-Plastic		100.0	100.0	94.7	81.5	67.9	48.8	29.6	10.7	0.5
1.0			Boring terminated at 0.9 ft due to auger refusal. No groundwater was encountered.														1.0
1.5																	1.5
2.0																	2.0
2.5																	2.5
3.0																	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 19

Project: Ennis Municipal Airport
Location: Runway Shoulder at 32°19'59.75"N; 96°39'54.65"W
Date Drilled: 5/22/2025

Boring Depth: 2 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-19	3-7/8" HMAC		C												
0.5		B19S1	Dark Brown, Fat CLAY with Sand	CH	A	29.8	54	41	100.0	100.0	100.0	98.7	97.9	96.3	91.7	76.7	0.5
1.0																	1.0
		B19S2	Very Dark Gray, Fat CLAY	CH	A	4.7	63	50	100.0	100.0	100.0	99.4	99.2	99.0	98.4	90.8	
1.5																	1.5
2.0																	2.0
			Boring terminated at 2 ft. No groundwater was encountered.														
2.5																	2.5
3.0																	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 20

Project: Ennis Municipal Airport
Location: Runway Shoulder at 32°19'46.54"N; 96°39'49.43"W
Date Drilled: 5/22/2025

Boring Depth: 2 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-20	3-1/4" HMAC		C												
0.5		B20S1	Dark Brown, Lean CLAY with Sand	CL	A	26.8	46	34	100.0	100.0	100.0	99.7	98.4	95.9	91.3	71.2	0.5
1.0		B20S2	Very Dark Gray, Lean CLAY with Sand	CL	A	22.2	46	34	100.0	100.0	100.0	100.0	99.7	99.3	98.7	83.0	1.0
1.5																	1.5
2.0			*Boring terminated at 2 ft. No groundwater was encountered.*														2.0
2.5																	2.5
3.0																	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 21

Project: Ennis Municipal Airport
Location: Runway Shoulder at 32°19'33.86"N; 96°39'44.52"W
Date Drilled: 5/22/2025

Boring Depth: 2 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-21	3-5/8" HMAC		C												
0.5		B21S1	Brown, Clayey SAND	SC	A	29.0	42	24	100.0	100.0	97.8	94.8	92.5	88.3	75.1	30.0	0.5
1.0		B21S2	Very Dark Gray, Sandy Lean CLAY	CL	A	19.7	41	30	100.0	100.0	100.0	100.0	99.7	99.2	98.3	63.8	1.0
1.5																	1.5
2.0			*Boring terminated at 2 ft. No groundwater was encountered.*														2.0
2.5																	2.5
3.0																	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 22

Project: Ennis Municipal Airport
Location: Runway Shoulder at 32°19'34.22"N; 96°39'45.39"W
Date Drilled: 5/22/2025

Boring Depth: 2 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-22	3-1/2" HMAC		C												
0.5		B22S1	Brown, Poorly Graded SAND with Clay and Gravel (or Silty Clay and Gravel)	SP - SC	A	22.8	52	34	100.0	94.1	92.2	87.5	75.5	57.8	34.9	7.1	0.5
1.0		B22S2	Brown, Clayey SAND with Gravel	SC	A	14.0	26	14	100.0	100.0	98.0	90.9	82.3	71.7	59.3	28.5	1.0
1.5																	1.5
2.0			*Boring terminated at 2 ft. No groundwater was encountered.*														2.0
2.5																	2.5
3.0																	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 23

Project: Ennis Municipal Airport
Location: Runway Shoulder at 32°19'48.22"N; 96°39'50.85"W
Date Drilled: 5/22/2025

Boring Depth: 2 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-23	3" HMAC		C												
0.5		B23S1	Brown, Sandy Lean CLAY	CL	A	26.4	41	27	100.0	100.0	100.0	99.2	96.8	92.9	82.9	59.7	0.5
1.0		B23S2	Dark Brown, Fat CLAY with Sand	CH	A	24.6	55	43	100.0	100.0	100.0	100.0	98.4	96.3	93.8	82.1	1.0
1.5																	1.5
2.0			*Boring terminated at 2 ft. No groundwater was encountered.*														2.0
2.5																	2.5
3.0																	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 24

Project: Ennis Municipal Airport
Location: Runway Shoulder at 32°20'2.26"N; 96°39'56.41"W
Date Drilled: 5/22/2025

Boring Depth: 2 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-24	3-5/8" HMAC		C												
0.5		B24S1	Dark Brown, Fat CLAY	CH	A	27.7	67	57	100.0	100.0	100.0	100.0	99.2	98.7	97.4	87.9	0.5
1.0																	1.0
		B24S2	Dark Brown, Fat CLAY	CH	A	28.1	65	54	100.0	100.0	100.0	99.3	99.0	98.8	97.3	85.4	
1.5																	1.5
2.0																	2.0
			Boring terminated at 2 ft. No groundwater was encountered.														
2.5																	2.5
3.0																	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 25

Project: Ennis Municipal Airport
Location: Runway Shoulder at 32°20'4.64"N; 96°39'56.57"W
Date Drilled: 5/1/2025

Boring Depth: 10 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		NS	*Top Soil with Vegetation*														
1.0		B25S1	Gray, Fat CLAY with Sand	CH	A	26.5	58	40	100.0	100.0	100.0	99.3	97.6	95.3	90.3	76.3	1.0
2.0																	2.0
3.0		B25S2	Brown, Fat CLAY with Sand	CH	A	22.1	55	39	100.0	100.0	100.0	99.9	99.1	97.4	94.0	81.3	3.0
4.0																	4.0
5.0																	5.0
6.0		B25S3	Yellowish Brown, Fat CLAY	CH	A	21.3	53	35	100.0	100.0	100.0	99.4	98.8	97.8	95.8	85.5	6.0
7.0																	7.0
8.0		B25S4	Yellowish Brown, Fat CLAY	CH	A	20.3	53	37	100.0	100.0	100.0	99.2	99.0	98.2	97.1	87.2	8.0
9.0																	9.0
10.0																	10.0

Boring terminated at 10 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 26

Project: Ennis Municipal Airport
Location: Runway Shoulder at 32°19'48.91"N; 96°39'50.40"W
Date Drilled: 5/22/2025

Boring Depth: 10 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-26	3-1/4" HMAC		C												
1.0		B26S1	Dark Brown, Sandy Fat CLAY	CH	A	26.2	51	40	100.0	98.7	98.7	96.6	93.6	90.8	86.9	69.0	1.0
2.0		B26S2	Dark Brown, Lean CLAY with Sand	CL	A	22.4	47	36	100.0	100.0	100.0	100.0	99.7	99.4	98.8	81.1	2.0
3.0		B26S3	Dark Brown, Fat CLAY with Sand	CH	A	26.1	64	52	100.0	100.0	100.0	100.0	99.7	99.4	98.8	84.2	3.0
4.0																	4.0
5.0																	5.0
6.0		B26S4	Dark Brown, Fat CLAY	CH	A	29.0	59	47	100.0	100.0	100.0	99.9	99.7	99.5	99.3	88.4	6.0
7.0																	7.0
8.0		B26S5	Dark Brown, Fat CLAY	CH	A	25.7	66	53	100.0	100.0	100.0	99.6	99.1	98.6	97.0	86.4	8.0
9.0																	9.0
10.0																	10.0

Boring terminated at 10 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 27

Project: Ennis Municipal Airport
Location: Runway Shoulder at 32°19'31.45"N; 96°39'43.56"W
Date Drilled: 5/22/2025

Boring Depth: 10 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-27	3-1/4" HMAC		C												
		B27S1	6-1/4" BASE. Light Brown, Silty SAND	SM	A	25.9	Non-Plastic		100.0	98.1	98.1	96.3	94.9	91.4	82.1	48.8	
1.0		B27S2	Brown, Fat CLAY with Sand	CH	A	19.9	55	42	100.0	100.0	100.0	99.9	99.7	99.5	98.9	72.3	1.0
2.0																	2.0
3.0		B27S3	Brown, Lean CLAY with Sand	CL	A	18.3	48	37	100.0	100.0	100.0	100.0	99.7	98.6	97.2	71.3	3.0
4.0																	4.0
5.0																	5.0
		B27S4	Brown, Sandy Fat CLAY	CH	A	18.4	50	38	100.0	100.0	100.0	99.4	98.9	97.8	96.9	66.8	
6.0																	6.0
7.0																	7.0
		B27S5	Brown, Sandy Lean CLAY	CL	A	19.6	45	36	100.0	100.0	100.0	99.3	98.9	98.2	96.8	64.0	
8.0																	8.0
9.0																	9.0
10.0																	10.0

Boring terminated at 10 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 28

Project: Ennis Municipal Airport
Location: Runway Shoulder at 32°19'30.42"N; 96°39'43.92"W
Date Drilled: 5/22/2025

Boring Depth: 10 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-28	3" HMAC		C												
		B28S1	Brown, Clayey SAND with Gravel	SC	A	27.0	50	28	100.0	100.0	100.0	94.8	83.3	64.7	40.7	13.8	
1.0		B28S2	Brown, Fat CLAY with Sand	CH	A	20.3	55	44	100.0	100.0	100.0	100.0	100.0	99.4	98.8	70.2	1.0
2.0																	2.0
3.0		B28S3	Brown, Fat CLAY with Sand	CH	A	19.9	53	38	100.0	100.0	100.0	100.0	99.4	98.6	97.2	73.0	3.0
4.0																	4.0
5.0																	5.0
6.0		B28S4	Brown, Fat CLAY with Sand	CH	A	18.4	51	37	100.0	100.0	100.0	100.0	99.6	98.8	97.2	71.1	6.0
7.0																	7.0
8.0		B28S5	Brown, Sandy Lean CLAY	CL	A	18.0	49	37	100.0	100.0	100.0	100.0	99.0	96.3	91.9	66.6	8.0
9.0																	9.0
10.0																	10.0

Boring terminated at 10 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 29

Project: Ennis Municipal Airport
Location: Runway Shoulder at 32°19'43.54"N; 96°39'49.04"W
Date Drilled: 5/22/2025

Boring Depth: 10 ft.
Water Level: N / A
Drilling Method: A = Auger, C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-29	3-3/8" HMAC		C												
		B29S1	Brown, Sandy Lean CLAY	CL	A	26.4	49	36	100.0	100.0	100.0	98.6	96.1	92.9	85.3	60.6	
1.0		B29S2	Brown, Fat CLAY with Sand	CH	A	21.4	52	41	100.0	100.0	100.0	100.0	99.8	99.2	98.2	80.8	1.0
2.0																	2.0
3.0		B29S3	Brown, Fat CLAY with Sand	CH	A	21.4	63	52	100.0	100.0	100.0	98.7	91.4	96.7	95.6	75.8	3.0
4.0																	4.0
5.0																	5.0
6.0		B29S4	Brown, Sandy Fat CLAY	CH	A	24.0	54	43	100.0	100.0	98.6	95.0	92.7	90.4	87.6	69.8	6.0
7.0																	7.0
8.0		B29S5	Yellowish Brown, Fat CLAY	CH	A	25.8	61	47	100.0	100.0	100.0	99.2	98.3	96.4	93.2	85.3	8.0
9.0																	9.0
10.0																	10.0

Boring terminated at 10 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 30

Project: Ennis Municipal Airport
Location: Runway Shoulder at 32°19'52.78"N; 96°39'52.66"W
Date Drilled: 5/22/2025

Boring Depth: 1.5 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-30	2" HMAC		C												
0.5		B30S1	Dark Brown, Fat CLAY with Sand	CH	A	23.0	65	53	100.0	100.0	100.0	99.0	97.9	96.5	94.2	83.1	0.5
1.0		B30S2	Dark Brown, Fat CLAY	CH	A	27.2	72	60	100.0	100.0	100.0	99.2	98.3	97.2	95.7	87.0	1.0
1.5			Boring terminated at 1.5 ft due to auger refusal. No groundwater was encountered.														1.5
2.0																	2.0
2.5																	2.5
3.0																	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 31

Project: Ennis Municipal Airport
Location: Connector Taxiway at 32°19'34.94"N; 96°39'46.82"W
Date Drilled: 5/21/2025

Boring Depth: 10 ft.
Water Level: N / A
Drilling Method: A = Auger, C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		C-31	9-1/4" HMAC		C												
1.0		B31S1	5-3/4" BASE. Brown, Silty GRAVEL with Sand	GM	A	3.6	Non-Plastic		100.0	90.4	79.4	60.5	56.0	45.2	34.7	21.9	1.0
2.0		B31S2	Very Dark Grayish Brown, Sandy Fat CLAY	CH	A	22.6	55	44	100.0	100.0	100.0	99.3	98.1	96.1	93.2	69.3	2.0
3.0		B31S3	Brown, Fat CLAY with Sand	CH	A	21.1	66	55	100.0	97.5	96.5	96.5	95.7	94.0	93.0	71.0	3.0
4.0																	4.0
5.0																	5.0
6.0		B31S4	Brown, Sandy Lean CLAY	CL	A	16.7	47	36	100.0	100.0	100.0	99.7	99.0	97.5	94.7	69.4	6.0
7.0																	7.0
8.0		B31S5	Brown, Sandy Fat CLAY	CH	A	19.6	53	42	100.0	100.0	100.0	100.0	99.7	99.0	98.3	65.3	8.0
9.0																	9.0
10.0																	10.0

Boring terminated at 10 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 32

Project: Ennis Municipal Airport
Location: Existing Pavement Soutth of Taxiway at 32°19'32.52"N; 96°39'46.18"W
Date Drilled: 5/21/2025

Boring Depth: 10 ft.
Water Level: N / A
Drilling Method: A = Auger
C = Core

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification		Drilling Method	Moisture Content (%)	Atterberg Limits		Sieve Analysis, Percent Passing								Depth (ft)
			Material Description	Group Symbol			LL	PI	3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	
		C-32	4" HMAC		C												
1.0		B32S1	Dark Brown, Fat CLAY with Sand	CH	A	18.6	55	43	100.0	100.0	100.0	100.0	100.0	99.9	99.7	74.9	1.0
2.0		B32S2	Dark Brown, Sandy Lean CLAY	CL	A	2.2	20	10	100.0	100.0	100.0	99.7	99.2	98.7	97.6	67.5	2.0
3.0		B32S3	Dark Brown, Fat CLAY with Sand	CH	A	21.1	63	52	100.0	98.0	98.0	96.7	96.1	95.5	94.5	70.5	3.0
4.0																	4.0
5.0																	5.0
6.0		B32S4	Brown, Fat CLAY with Sand	CH	A	18.5	60	49	100.0	100.0	100.0	100.0	99.8	99.7	98.4	72.2	6.0
7.0																	7.0
8.0		B32S5	Brown, Fat CLAY with Sand	CH	A	21.0	61	49	100.0	100.0	100.0	99.6	99.5	99.0	98.2	74.1	8.0
9.0																	9.0
10.0																	10.0

Boring terminated at 10 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Boring No. 33

Project: Ennis Municipal Airport
Location: Proposed Taxiway at 32°19'29.21"N; 96°39'45.10"W
Date Drilled: 5/21/2025

Boring Depth: 10 ft.
Water Level: N / A
Drilling Method: A = Auger

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
		NS	Top Soil with Vegetation														
1.0		B33S1	Dark Brown, Sandy Lean CLAY	CL	A	17.1	36	24	100.0	100.0	100.0	100.0	100.0	99.9	99.6	63.4	1.0
2.0																	2.0
3.0		B33S2	Brown, Fat CLAY with Sand	CH	A	17.3	65	55	100.0	100.0	100.0	99.3	99.0	98.6	95.0	73.8	3.0
4.0																	4.0
5.0																	5.0
6.0		B33S3	Brown, Fat CLAY with Sand	CH	A	21.0	60	49	100.0	100.0	100.0	99.5	99.3	99.0	98.5	75.4	6.0
7.0																	7.0
8.0		B33S4	Brown, Fat CLAY with Sand	CH	A	19.2	61	48	100.0	100.0	100.0	100.0	99.5	99.0	98.3	74.1	8.0
9.0																	9.0
10.0																	10.0

Boring terminated at 10 ft. No groundwater was encountered.

Rodriguez Engineering Laboratories

Bore Log Data
Test Pit No. 1

Project: Ennis Municipal Airport
Location: Runway 16-34 at 32°19'40.94"N; 96°39'47.79"W
Date Drilled: 4/30/2025

Test Pit Depth: 20 inches
Water Level: N / A
Drilling Method: E = Excavatior

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
0.5		NS	6-3/4" HMAC		E												0.5
1.0		TP1S1	6-3/4" BASE. Light Brown, Silty SAND with Gravel	SM	E	4.6	17	3	100.0	83.9	82.2	69.1	59.6	45.2	23.1	10.0	1.0
1.5		TP1S2	Very Dark Gray, Sandy SILT	ML	E	14.0	44	10	100.0	95.2	95.0	90.9	85.4	78.1	68.6	50.2	1.5
2.0			*Test pit terminated at 20 inches. No groundwater was encountered.*														2.0
2.5																	2.5
3.0																	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

Rodriguez Engineering Laboratories

Bore Log Data
Test Pit No. 2

Project: Ennis Municipal Airport
Location: Parallel Taxiway at 32°19'53.96"N; 96°39'55.21"W
Date Drilled: 4/30/2025

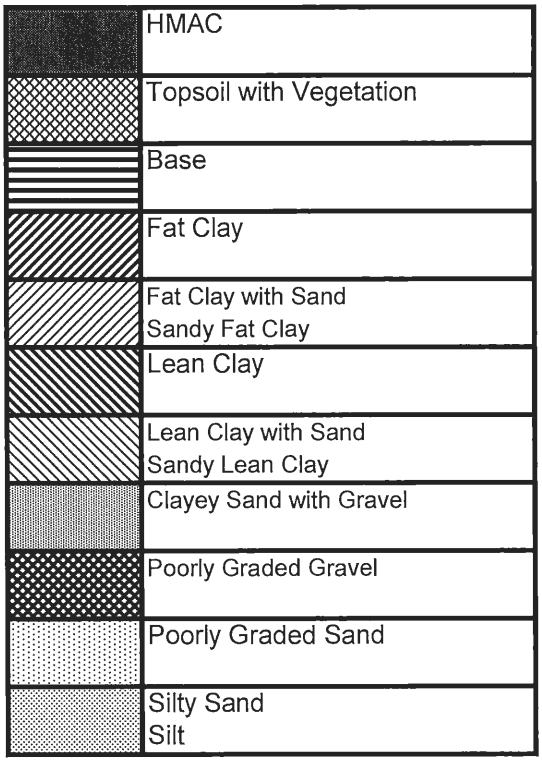
Test Pit Depth: 20 inches
Water Level: N / A
Drilling Method: E = Excavatior

Depth (ft)	Soil Symbol	Sample No.	Laboratory Classification: Material Description	Laboratory Classification: Group Symbol	Drilling Method	Moisture Content (%)	Atterberg Limits: LL	Atterberg Limits: PI	Sieve Analysis, Percent Passing: 3"	7/8"	3/4"	3/8"	No.4	No.10	No.40	No.200	Depth (ft)
0.5		NS	6-1/2" HMAC		E												0.5
1.0		TP2S1	7-1/2" BASE. Light Brown, Poorly Graded GRAVEL with Silt and Sand	GP - GM	E	7.6	Non-Plastic		100.0	71.9	68.5	58.5	49.3	41.6	34.1	6.9	1.0
1.5		TP2S2	Very Dark Gray, Sandy SILT	ML	E	14.0	44	10	100.0	95.2	95.0	90.9	85.4	78.1	68.6	50.2	1.5
2.0			*Test pit terminated at 20 inches. No groundwater was encountered.*														2.0
2.5																	2.5
3.0																	3.0
3.5																	3.5
4.0																	4.0
4.5																	4.5
5.0																	5.0

LEGEND OF TERMINOLOGY

GRAVELS More than half of Coarse fraction is LARGER than No. 4 Sieve	**Clean Gravels** Little or no Fines	**GW**	Well-Graded, gravel-sand mixtures, mixtures, little or no fines
		GP	Poorly-Graded gravels, gravel-sand mixtures, little or no fines
	Gravels with Fines Appreciable Amount of fines	**GM**	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay Mixtures
SANDS More than half of Coarse fraction is SMALLER than No. 4 Sieve	**Clean Sands** Little or no Fines	**SW**	Well-Graded sands, gravely sands, little or no fines
		SP	Poorly-Graded sands, gravely sands little or no fines
	Sands with Fines Appreciable Amount of fines	**SM**	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
SILTS and CLAYS Liquid Limit LESS than 50		**ML**	Inorganic silts & very fine sands, rock flour, silty or clayey fine sands or clayey silts w/slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravely clays, sandy clays
		OL	Organic silts & organic silty clays of low plasticity
SILTS and CLAYS Liquid Limit GREATER than 50		**MH**	Inorganic silts, micoceous or diatomaceous fine sand or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
Highly ORGANIC Soils		**PI**	Peat & other highly organic soils

Legend of Symbols



Appendix B:

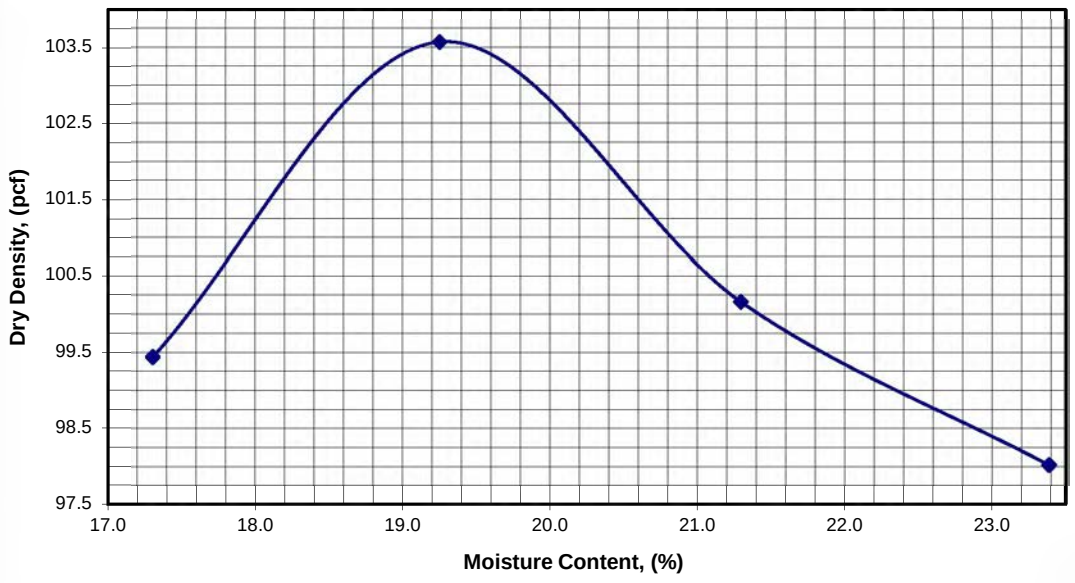
Proctor and CBR Data

Ennis Municipal Airport
Ellis, Texas
Proctor Chart for CBR Sample No. 1

Laboratory No:	RE25 1168-1	**Compactive Effort:**	ASTM D698-C
Material Type:	Subgrade	**Maximum Density** (pcf)**:**	**103.7**
Sample Location:	Test Pit No. 1	**Optimum Moisture** (%)**:**	**19.5**

Specimen No.	1	2	3	4	5
% Water Added	8.0	10.0	12.0	14.0	--
Net Wt. Of Specimen & Mold (g)	6741.2	6974.4	6906.0	6887.3	--
Tare Wt. Of Mold (g)	2772.9	2772.9	2772.9	2772.9	--
Wet Wt. Of Specimen (lb)	8.749	9.263	9.112	9.071	--
Volume of Specimen (ft^3)	0.0750	0.0750	0.0750	0.0750	--
Wet Density of Specimen (pcf)	116.6	123.5	121.5	120.9	--
Guesstimated Dry Density (pcf)	108.0	112.3	108.5	106.1	--
Wet Wt. Of Specimen & Pan (g)	2767.6	3746.8	4913.9	3672.3	--
Dry Wt. Of Specimen & Pan (g)	2448.2	3282.9	4198.4	3135.1	--
Tare Wt. Of Pan (g)	602.6	873.0	838.4	837.9	--
Wt. Of Water (g)	319.4	463.9	715.5	537.2	--
Dry Wt. Of Material (g)	1845.6	2409.9	3360.0	2297.2	--
Total % Moisture of Specimen	**17.3**	**19.2**	**21.3**	**23.4**	--
Dry Density of Specimen (pcf)	**99.4**	**103.6**	**100.2**	**98.0**	--

Dry Density vs. Moisture Content



Ennis Municipal Airport
Ellis, Texas
Proctor Chart for CBR Sample No. 1

Laboratory No: RE25 1168-1

Material Type: Subgrade

Sample Location: Test Pit No. 1

Compactive Effort: ASTM D698-C

Maximum Density (pcf)**:** **103.7**

Optimum Moisture (%)**:** **19.5**

Specimen No.	1	2	3
No. of Blows	**10 Blows**	**25 Blows**	**56 Blows**
Net Wt. Of Spec.& Mold (g)	7819.9	8106.8	8448.8
Tare Wt. Of Mold (g)	4258.6	4199.7	4214.5
Wet Wt. Of Specimen (lb)	7.851	8.614	9.335
Volume of Specimen (ft^3)	0.0750	0.0750	0.0750
Wet Density of Spec.(pcf)	104.7	114.8	124.5
Wet Wt. of Spec.& Pan (g)	1698.7	1698.7	1698.7
Dry Wt. Of Spec. & Pan (g)	1469.8	1469.8	1469.8
Tare Wt. Of Pan (g)	337.4	337.4	337.4
Wt. Of Water (g)	228.9	228.9	228.9
Dry Wt. Of Material (g)	1132.4	1132.4	1132.4
Total % Moisture of Spec.	**20.2**	**20.2**	**20.2**
Target % Moisture of Spec.	**19.5**	**19.5**	**19.5**
Dry Density of Spec. (pcf)	**87.1**	**95.5**	**103.5**
Initial Measurement (Div.)	15	15	15
Final Measurement (Div.)	23	19	21
Percentage of Swelling	**0.2**	**0.1**	**0.1**

10 blows/lift

Penetration (in)	Load (lb)	Stress (psi)
0.025	23.1	7.7
0.050	56.1	18.7
0.075	70.9	23.6
0.100	80.6	26.9
0.125	98.9	33.0
0.150	104.2	34.7
0.175	116.7	38.9
0.200	124.6	41.5
0.300	166.6	55.5
0.400	211.6	70.5
0.500	242.6	80.9

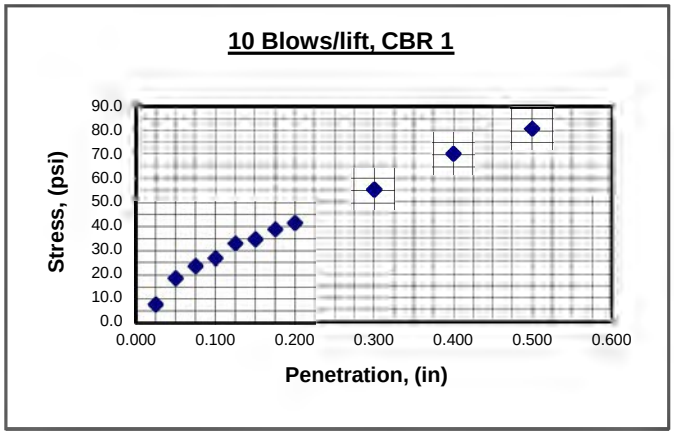
25 blows/lift

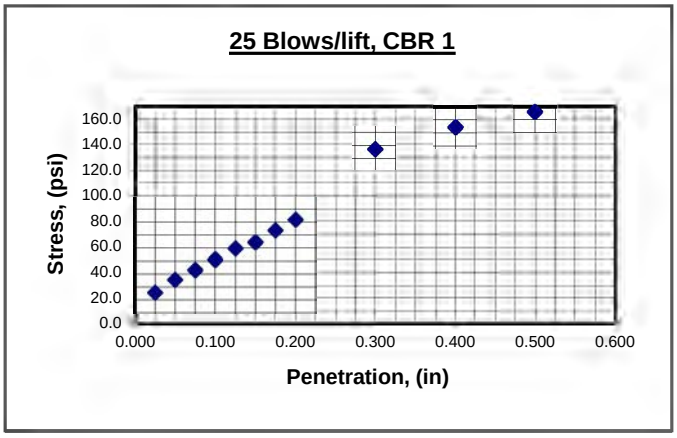
Penetration (in)	Load (lb)	Stress (psi)
0.025	76.2	25.4
0.050	106.2	35.4
0.075	129.4	43.1
0.100	152.9	51.0
0.125	178.4	59.5
0.150	192.6	64.2
0.175	220.6	73.5
0.200	245.2	81.7
0.300	411.7	137.2
0.400	463.6	154.5
0.500	498.4	166.1

56 blows/lift

Penetration (in)	Load (lb)	Stress (psi)
0.025	59.6	19.9
0.050	107.2	35.7
0.075	184.2	61.4
0.100	229.6	76.5
0.125	274.2	91.4
0.150	311.4	103.8
0.175	342.6	114.2
0.200	361.8	120.6
0.300	499.2	166.4
0.400	619.8	206.6
0.500	719.2	239.7

Ennis Municipal Airport
Ellis, Texas
Proctor Chart for CBR Sample No. 1





Dry Density @ 10 Blows/lift (pcf) = 87.1

$CBR_{0.100}$ = (26.9 /1000) x 100 = 2.69

$CBR_{0.200}$ = (41.5 /1500) x 100 = 2.77

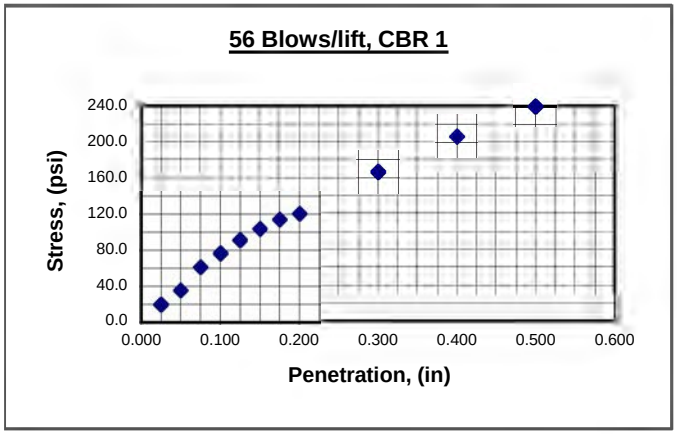
Use CBR = 2.77

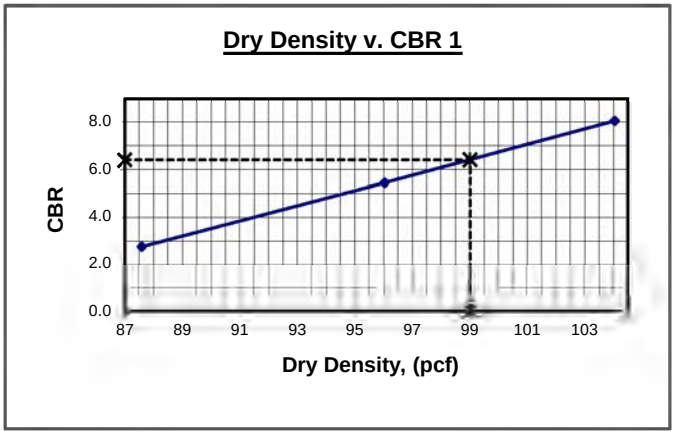
Dry Density @ 25 Blows/lift (pcf) = 95.5

$CBR_{0.100}$ = (51.0 /1000) x 100 = 5.10

$CBR_{0.200}$ = (81.7 /1500) x 100 = 5.45

Use CBR = 5.45





Dry Density @ 56 Blows/lift (pcf) = 103.5

$CBR_{0.100}$ = (76.5 /1000) x 100 = 7.65

$CBR_{0.200}$ = (120.6 /1500) x 100 = 8.04

Use CBR = 8.04

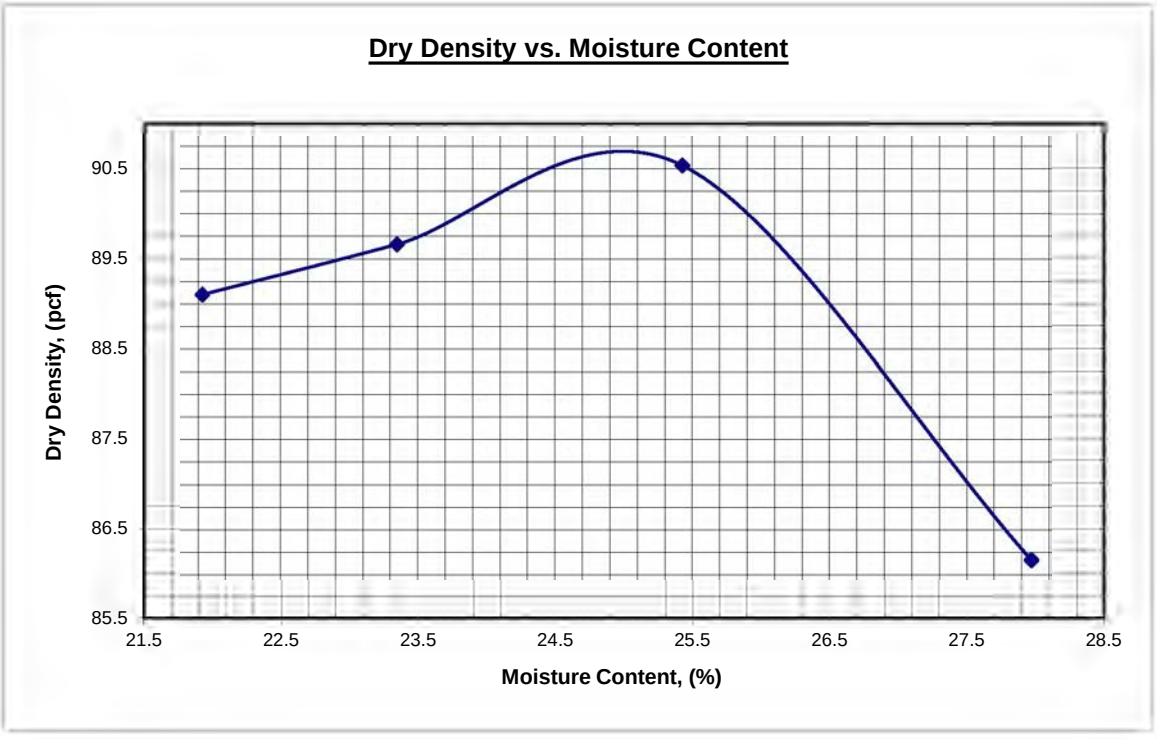
Design CBR @ 95 % Max. Dry Density = 6.4

Design CBR @ 100% Max. Dry Density = 8.0

Ennis Municipal Airport
Ellis, Texas
Proctor Chart for CBR Sample No. 2

Laboratory No:	RE25 1168-3	**Compactive Effort:**	ASTM D698-C
Material Type:	Subgrade	**Maximum Density** (pcf)**:**	**90.7**
Sample Location:	Test Pit No. 2	**Optimum Moisture** (%)**:**	**25.0**

Specimen No.	1	2	3	4	5
% Water Added	8.0	10.0	12.0	14.0	--
Net Wt. Of Specimen & Mold (g)	6469.0	6535.4	6636.2	6524.1	--
Tare Wt. Of Mold (g)	2772.9	2772.9	2772.9	2772.9	--
Wet Wt. Of Specimen (lb)	8.148	8.295	8.517	8.270	--
Volume of Specimen (ft^3)	0.0750	0.0750	0.0750	0.0750	--
Wet Density of Specimen (pcf)	108.6	110.6	113.6	110.3	--
Guesstimated Dry Density (pcf)	100.6	100.5	101.4	96.7	--
Wet Wt. Of Specimen & Pan (g)	2813.8	4316.3	4700.2	4758.3	--
Dry Wt. Of Specimen & Pan (g)	2456.0	3613.0	3918.7	3918.8	--
Tare Wt. Of Pan (g)	824.5	600.8	845.1	917.4	--
Wt. Of Water (g)	357.8	703.3	781.5	839.5	--
Dry Wt. Of Material (g)	1631.5	3012.2	3073.6	3001.4	--
Total % Moisture of Specimen	**21.9**	**23.3**	**25.4**	**28.0**	--
Dry Density of Specimen (pcf)	**89.1**	**89.7**	**90.5**	**86.2**	--



Ennis Municipal Airport
Ellis, Texas
Proctor Chart for CBR Sample No. 2

Laboratory No:	RE25 1168-3	**Compactive Effort:**	ASTM D698-C
Material Type:	Subgrade	**Maximum Density** (pcf)**:**	**90.7**
Sample Location:	Test Pit No. 2	**Optimum Moisture** (%)**:**	**25.0**

Specimen No.	**1**	**2**	**3**
No. of Blows	**10 Blows**	**25 Blows**	**56 Blows**
Net Wt. Of Spec.& Mold (g)	7402.5	7812.1	8135.8
Tare Wt. Of Mold (g)	4216.9	4180.9	4218.1
Wet Wt. Of Specimen (lb)	7.023	8.005	8.637
Volume of Specimen (ft^3)	0.0750	0.0750	0.0750
Wet Density of Spec.(pcf)	93.6	106.7	115.2
Wet Wt. of Spec.& Pan (g)	3396.5	3396.5	3396.5
Dry Wt. Of Spec. & Pan (g)	2811.5	2811.5	2811.5
Tare Wt. Of Pan (g)	428.4	428.4	428.4
Wt. Of Water (g)	585.0	585.0	585.0
Dry Wt. Of Material (g)	2383.1	2383.1	2383.1
Total % Moisture of Spec.	**24.5**	**24.5**	**24.5**
Target % Moisture of Spec.	**25.0**	**25.0**	**25.0**
Dry Density of Spec. (pcf)	**75.2**	**85.7**	**92.5**
Initial Measurement (Div.)	30	32	19
Final Measurement (Div.)	34	49	28
Percentage of Swelling	**0.1**	**0.4**	**0.2**

10 blows/lift

Penetration (in)	Load (lb)	Stress (psi)
0.025	12.6	4.2
0.050	23.6	7.9
0.075	39.4	13.1
0.100	55.2	18.4
0.125	59.9	20.0
0.150	66.4	22.1
0.175	71.8	23.9
0.200	79.2	26.4
0.300	100.9	33.6
0.400	133.8	44.6
0.500	146.2	48.7

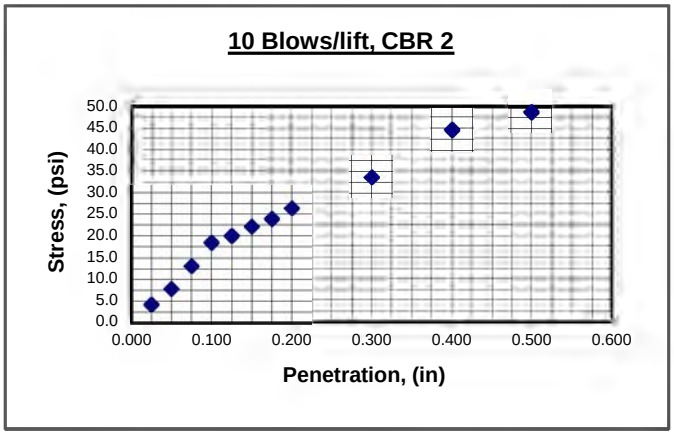
25 blows/lift

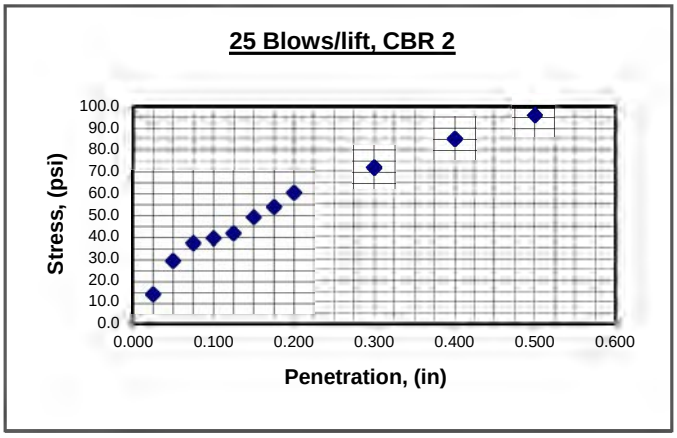
Penetration (in)	Load (lb)	Stress (psi)
0.025	42.6	14.2
0.050	88.9	29.6
0.075	112.6	37.5
0.100	119.1	39.7
0.125	125.9	42.0
0.150	147.8	49.3
0.175	162.3	54.1
0.200	181.4	60.5
0.300	216.4	72.1
0.400	255.8	85.3
0.500	288.6	96.2

56 blows/lift

Penetration (in)	Load (lb)	Stress (psi)
0.025	77.5	25.8
0.050	130.2	43.4
0.075	182.2	60.7
0.100	219.4	73.1
0.125	243.6	81.2
0.150	260.1	86.7
0.175	270.7	90.2
0.200	283.7	94.6
0.300	312.8	104.3
0.400	349.4	116.5
0.500	379.9	126.6

Ennis Municipal Airport
Ellis, Texas
Proctor Chart for CBR Sample No. 2





Dry Density @ 10 Blows/lift (pcf) = 75.2

$CBR_{0.100}$ = (18.4 /1000) x 100 = 1.84

$CBR_{0.200}$ = (26.4 /1500) x 100 = 1.76

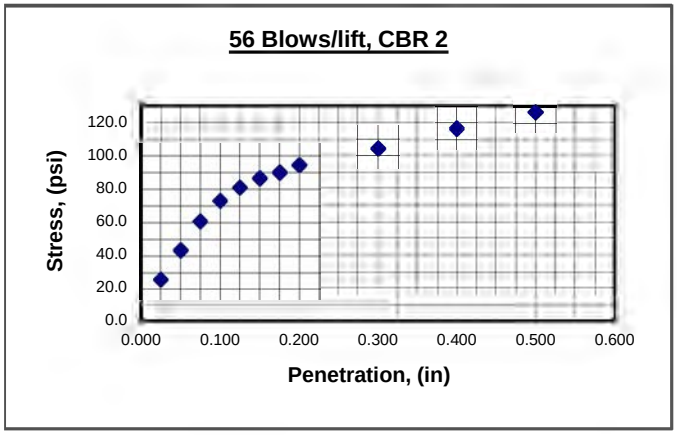
Use CBR = **1.84**

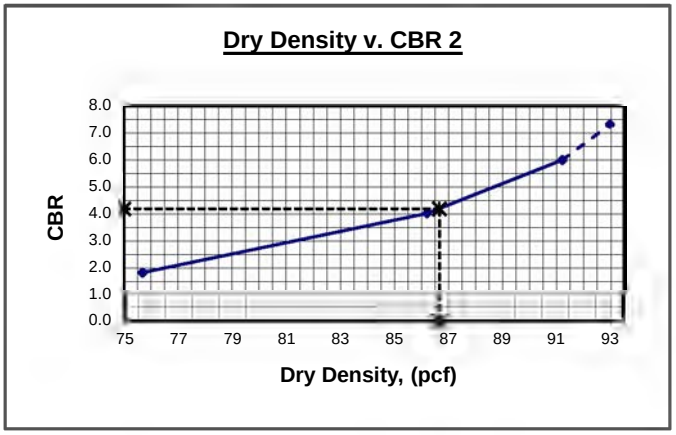
Dry Density @ 25 Blows/lift (pcf) = 85.7

$CBR_{0.100}$ = (39.7 /1000) x 100 = 3.97

$CBR_{0.200}$ = (60.5 /1500) x 100 = 4.03

Use CBR = **4.03**





Dry Density @ 56 Blows/lift (pcf) = 92.5

$CBR_{0.100}$ = (73.1 /1000) x 100 = 7.31

$CBR_{0.200}$ = (94.6 /1500) x 100 = 6.30

Use CBR = **7.31**

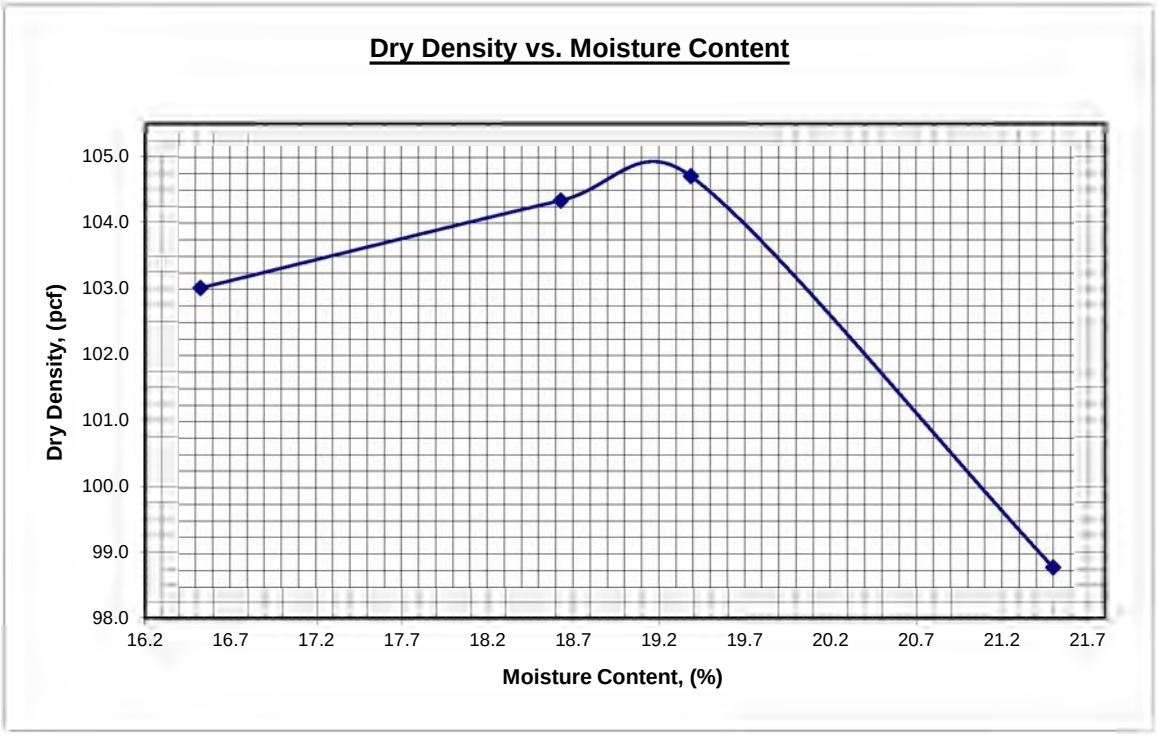
Design CBR @ 95 % Max. Dry Density = **4.2**

Design CBR @ 100% Max. Dry Density = **6.0**

Ennis Municipal Airport
Ellis, Texas
Proctor Chart for CBR Sample No. 3

Laboratory No:	RE25 1168-3	**Compactive Effort:**	ASTM D698-C
Material Type:	Subgrade	**Maximum Density** (pcf)**:**	**105.0**
Sample Location:	Boring No. 33	**Optimum Moisture** (%)**:**	**19.2**

Specimen No.	1	2	3	4	5
% Water Added	10.0	12.0	14.0	16.0	--
Net Wt. Of Specimen & Mold (g)	6857.3	6984.3	7026.2	6857.0	--
Tare Wt. Of Mold (g)	2773.2	2773.2	2773.2	2773.2	--
Wet Wt. Of Specimen (lb)	9.004	9.284	9.376	9.003	--
Volume of Specimen (ft^3)	0.0750	0.0750	0.0750	0.0750	--
Wet Density of Specimen (pcf)	120.1	123.8	125.0	120.0	--
Guesstimated Dry Density (pcf)	109.1	110.5	109.7	103.5	--
Wet Wt. Of Specimen & Pan (g)	3296.3	3425.9	1862.8	2376.0	--
Dry Wt. Of Specimen & Pan (g)	2960.5	3023.7	1702.3	2023.8	--
Tare Wt. Of Pan (g)	928.7	864.6	874.4	385.5	--
Wt. Of Water (g)	335.8	402.2	160.5	352.2	--
Dry Wt. Of Material (g)	2031.8	2159.1	827.9	1638.3	--
Total % Moisture of Specimen	**16.5**	**18.6**	**19.4**	**21.5**	--
Dry Density of Specimen (pcf)	**103.0**	**104.3**	**104.7**	**98.8**	--



Ennis Municipal Airport
Ellis, Texas
Proctor Chart for CBR Sample No. 3

Laboratory No:	RE25 1168-3	**Compactive Effort:**	ASTM D698-C
Material Type:	Subgrade	**Maximum Density** (pcf)**:**	**105.0**
Sample Location:	Boring No. 33	**Optimum Moisture** (%)**:**	**19.2**

Specimen No.	**1**	**2**	**3**
No. of Blows	**10 Blows**	**25 Blows**	**56 Blows**
Net Wt. Of Spec.& Mold (g)	8066.7	8286.2	8407.5
Tare Wt. Of Mold (g)	4175.4	4199.8	4202.7
Wet Wt. Of Specimen (lb)	8.579	9.009	9.270
Volume of Specimen (ft^3)	0.0750	0.0750	0.0750
Wet Density of Spec.(pcf)	114.4	120.1	123.6
Wet Wt. of Spec.& Pan (g)	1897.5	1897.5	1897.5
Dry Wt. Of Spec. & Pan (g)	1657.0	1657.0	1657.0
Tare Wt. Of Pan (g)	422.6	422.6	422.6
Wt. Of Water (g)	240.5	240.5	240.5
Dry Wt. Of Material (g)	1234.4	1234.4	1234.4
Total % Moisture of Spec.	**19.5**	**19.5**	**19.5**
Target % Moisture of Spec.	**19.2**	**19.2**	**19.2**
Dry Density of Spec. (pcf)	**95.7**	**100.5**	**103.4**
Initial Measurement (Div.)	15	15	15
Final Measurement (Div.)	15	18	18
Percentage of Swelling	**0.0**	**0.1**	**0.1**

10 blows/lift

Penetration (in)	Load (lb)	Stress (psi)
0.025	15.9	5.3
0.050	29.1	9.7
0.075	35.4	11.8
0.100	43.1	14.4
0.125	46.3	15.4
0.150	50.8	16.9
0.175	52.0	17.3
0.200	53.7	17.9
0.300	58.5	19.5
0.400	65.0	21.7
0.500	74.5	24.8

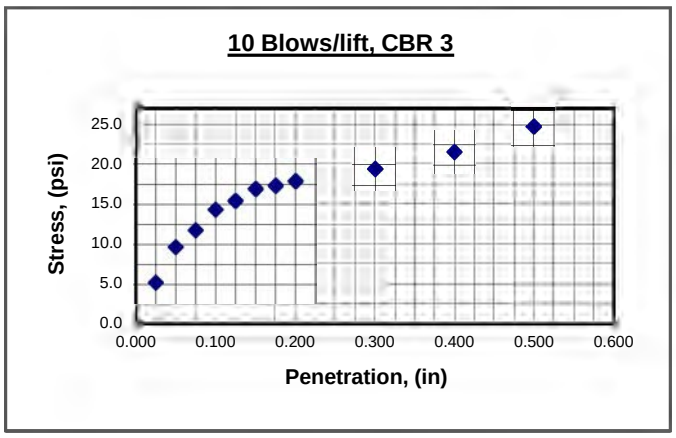
25 blows/lift

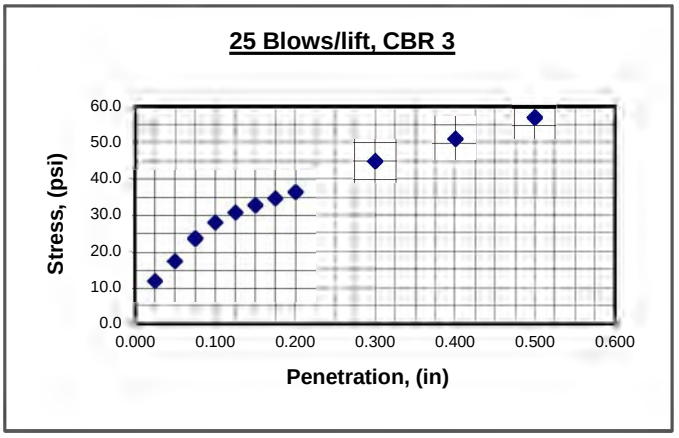
Penetration (in)	Load (lb)	Stress (psi)
0.025	36.4	12.1
0.050	52.8	17.6
0.075	71.3	23.8
0.100	84.2	28.1
0.125	92.6	30.9
0.150	98.6	32.9
0.175	104.2	34.7
0.200	109.4	36.5
0.300	134.9	45.0
0.400	153.6	51.2
0.500	171.4	57.1

56 blows/lift

Penetration (in)	Load (lb)	Stress (psi)
0.025	44.6	14.9
0.050	76.3	25.4
0.075	89.6	29.9
0.100	102.6	34.2
0.125	118.4	39.5
0.150	126.9	42.3
0.175	140.6	46.9
0.200	161.6	53.9
0.300	196.4	65.5
0.400	236.4	78.8
0.500	272.6	90.9

Ennis Municipal Airport
Ellis, Texas
Proctor Chart for CBR Sample No. 3





Dry Density @ 10 Blows/lift (pcf) = 95.7

$CBR_{0.100}$ = (14.4 /1000) x 100 = 1.44

$CBR_{0.200}$ = (17.9 /1500) x 100 = 1.19

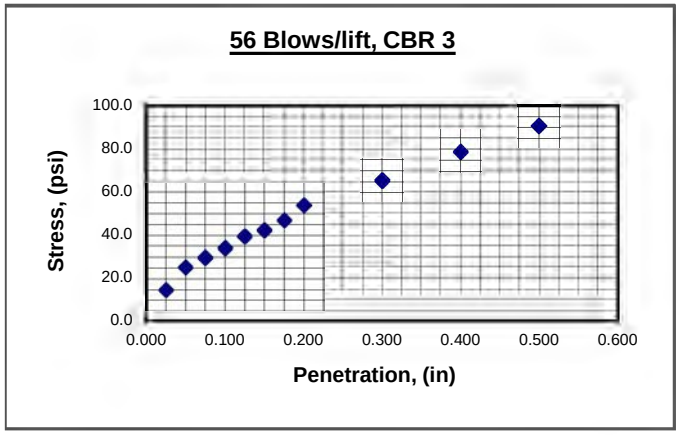
Use CBR = 1.44

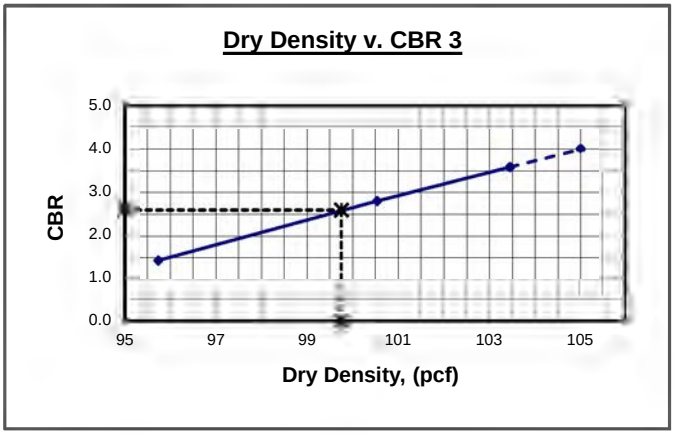
Dry Density @ 25 Blows/lift (pcf) = 100.5

$CBR_{0.100}$ = (28.1 /1000) x 100 = 2.81

$CBR_{0.200}$ = (36.5 /1500) x 100 = 2.43

Use CBR = 2.81





Dry Density @ 56 Blows/lift (pcf) = 103.4

$CBR_{0.100}$ = (34.2 /1000) x 100 = 3.42

$CBR_{0.200}$ = (53.9 /1500) x 100 = 3.59

Use CBR = 3.59

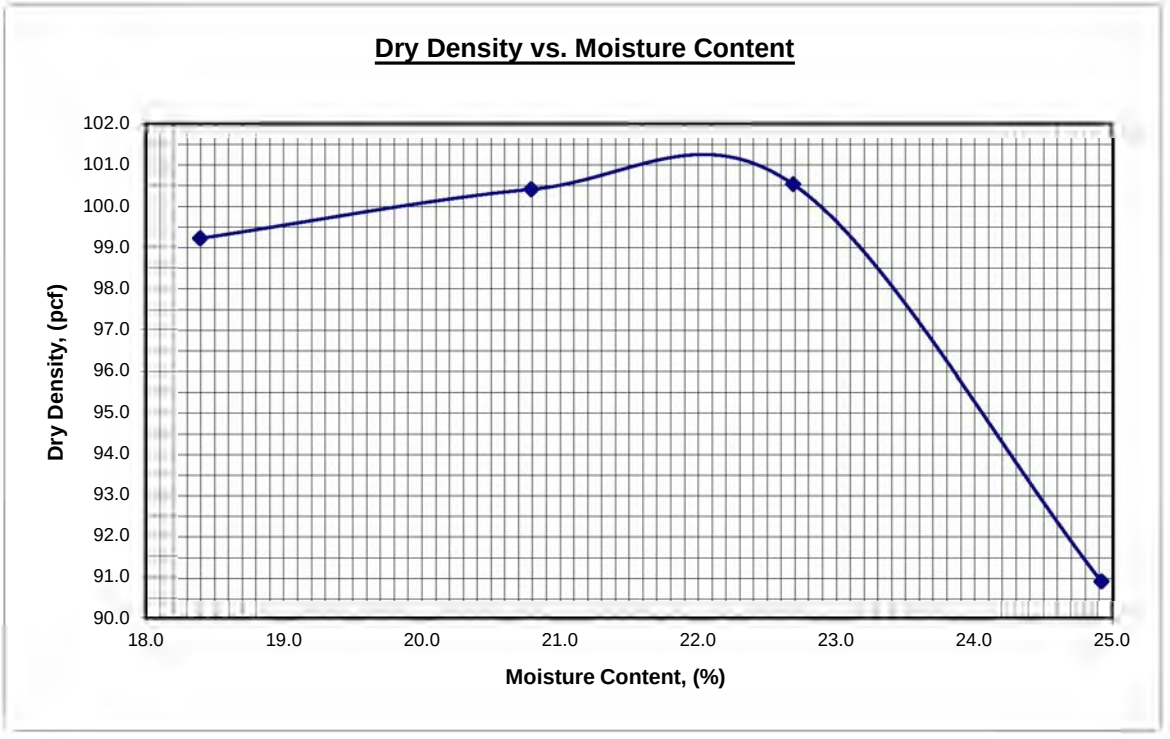
Design CBR @ 95 % Max. Dry Density = 2.6

Design CBR @ 100% Max. Dry Density = 4.0

Ennis Municipal Airport
Ellis, Texas
Proctor Chart for CBR Sample No. 3 with 5% Lime

Laboratory No:	RE25 1168-3 with 5% Lime	**Compactive Effort:**	ASTM D698-C
Material Type:	Lime Treated Subgrade	**Maximum Density** (pcf)**:**	**100.9**
Sample Location:	Boring No. 33	**Optimum Moisture** (%)**:**	**22.3**

Specimen No.	1	2	3	4	5
% Water Added	10.0	12.0	14.0	16.0	--
Net Wt. Of Specimen & Mold (g)	6769.8	6899.5	6969.5	6637.4	--
Tare Wt. Of Mold (g)	2773.2	2773.2	2773.2	2773.2	--
Wet Wt. Of Specimen (lb)	8.811	9.097	9.251	8.519	--
Volume of Specimen (ft^3)	0.0750	0.0750	0.0750	0.0750	--
Wet Density of Specimen (pcf)	117.5	121.3	123.3	113.6	--
Guesstimated Dry Density (pcf)	106.8	108.3	108.2	97.9	--
Wet Wt. Of Specimen & Pan (g)	3625.5	3362.4	2163.8	1998.7	--
Dry Wt. Of Specimen & Pan (g)	3168.7	2902.4	1887.0	1688.0	--
Tare Wt. Of Pan (g)	685.2	689.7	666.8	441.0	--
Wt. Of Water (g)	456.8	460.0	276.8	310.7	--
Dry Wt. Of Material (g)	2483.5	2212.7	1220.2	1247.0	--
Total % Moisture of Specimen	**18.4**	**20.8**	**22.7**	**24.9**	--
Dry Density of Specimen (pcf)	**99.2**	**100.4**	**100.5**	**90.9**	--



Ennis Municipal Airport
Ellis, Texas
Proctor Chart for CBR Sample No. 3 with 5% Lime

Laboratory No: RE25 1168-3 with 5% Lime
Material Type: Lime Treated Subgrade
Sample Location: Boring No. 33

Compactive Effort: ASTM D 698-C
Maximum Density (pcf)**:** **100.9**
Optimum Moisture (%)**:** **22.3**

Specimen No.	1	2	3
No. of Blows	**10 Blows**	**25 Blows**	**56 Blows**
Net Wt. Of Spec.& Mold (g)	8001.5	8163.3	8388.9
Tare Wt. Of Mold (g)	4145.3	4171.2	4211.6
Wet Wt. Of Specimen (lb)	8.501	8.801	9.209
Volume of Specimen (ft^3)	0.0750	0.0750	0.0750
Wet Density of Spec.(pcf)	113.4	117.3	122.8
Wet Wt. of Spec.& Pan (g)	3215.4	3215.4	3215.4
Dry Wt. Of Spec. & Pan (g)	2776.0	2776.0	2776.0
Tare Wt. Of Pan (g)	812.4	812.4	812.4
Wt. Of Water (g)	439.4	439.4	439.4
Dry Wt. Of Material (g)	1963.6	1963.6	1963.6
Total % Moisture of Spec.	**22.4**	**22.4**	**22.4**
Target % Moisture of Spec.	**22.3**	**22.3**	**22.3**
Dry Density of Spec. (pcf)	**92.6**	**95.9**	**100.3**
Initial Measurement (Div.)	15	15	15
Final Measurement (Div.)	12	23	39
Percentage of Swelling	**-0.1**	**0.2**	**0.5**

10 blows/lift

Penetration (in)	Load (lb)	Stress (psi)
0.025	238.9	79.6
0.050	314.6	104.9
0.075	374.1	124.7
0.100	437.1	145.7
0.125	496.5	165.5
0.150	563.1	187.7
0.175	622.1	207.4
0.200	675.4	225.1
0.300	886.2	295.4
0.400	1074.3	358.1
0.500	1254.1	418.0

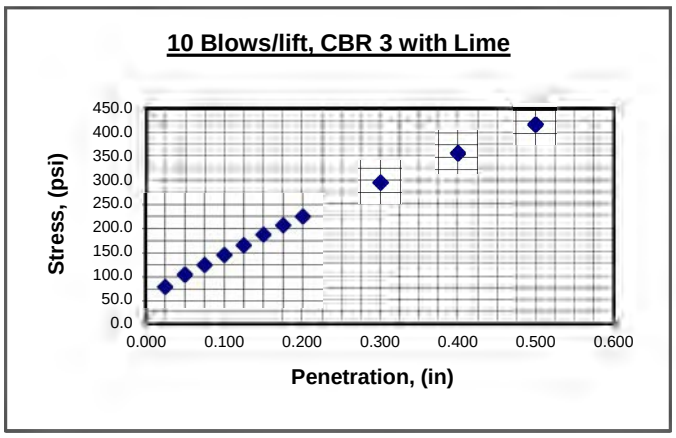
25 blows/lift

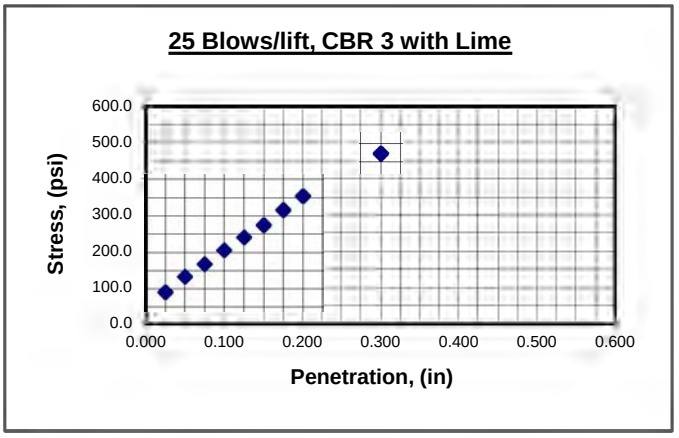
Penetration (in)	Load (lb)	Stress (psi)
0.025	273.4	91.1
0.050	399.2	133.1
0.075	504.2	168.1
0.100	616.9	205.6
0.125	723.6	241.2
0.150	825.4	275.1
0.175	949.2	316.4
0.200	1063.2	354.4
0.300	1419.4	473.1
0.400	1866.9	622.3
0.500	2201.3	733.8

56 blows/lift

Penetration (in)	Load (lb)	Stress (psi)
0.025	459.6	153.2
0.050	684.6	228.2
0.075	799.2	266.4
0.100	928.6	309.5
0.125	1077.6	359.2
0.150	1216.4	405.5
0.175	1372.9	457.6
0.200	1489.4	496.5
0.300	1816.4	605.5
0.400	2273.6	757.9
0.500	2709.1	903.0

Ennis Municipal Airport
Ellis, Texas
Proctor Chart for CBR Sample No. 3 with 5% Lime





Dry Density @ 10 Blows/lift (pcf) = 92.6

$CBR_{0.100}$ = (145.7 /1000) x 100 = 14.57

$CBR_{0.200}$ = (225.1 /1500) x 100 = 15.01

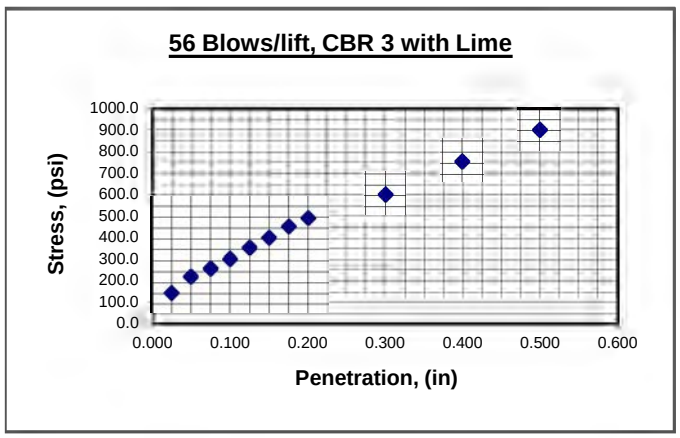
Use CBR = 15.01

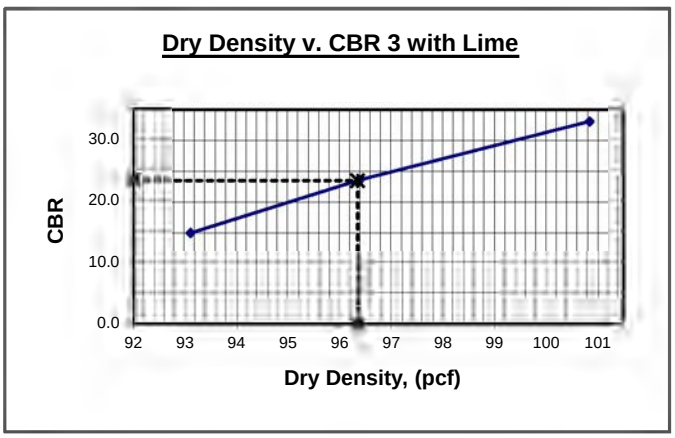
Dry Density @ 25 Blows/lift (pcf) = 95.9

$CBR_{0.100}$ = (205.6 /1000) x 100 = 20.56

$CBR_{0.200}$ = (354.4 /1500) x 100 = 23.63

Use CBR = 23.63





Dry Density @ 56 Blows/lift (pcf) = 100.3

$CBR_{0.100}$ = (309.5 /1000) x 100 = 30.95

$CBR_{0.200}$ = (496.5 /1500) x 100 = 33.10

Use CBR = 33.10

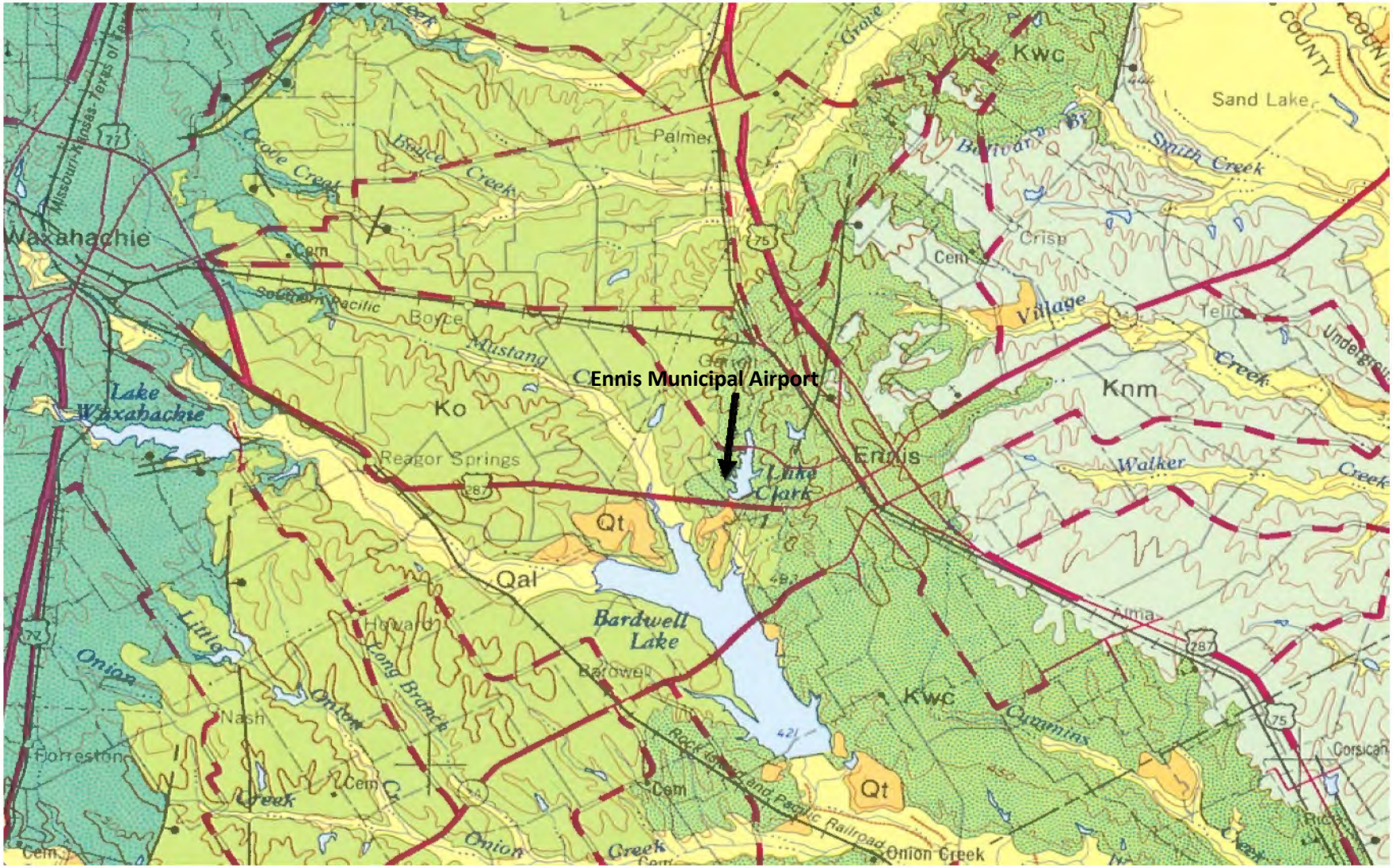
Design CBR @ 95 % Max. Dry Density = 23.5

Design CBR @ 100% Max. Dry Density = 33.1

Appendix C:

University of Texas, Bureau of Economic Geology Map and Map of Borehole Locations

Ennis Municipal Airport
Ellis, Texas



GEOLOGIC ATLAS OF TEXAS, DALLAS SHEET

GAYLE SCOTT MEMORIAL EDITION

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Kwc

Wolfe City Sand

Note: All borehole and test pit locations are approximate.

Rodriguez Engineering Laboratories LLC	
Ennis Municipal Airport Ellis, Texas Bores 1-33 & Test Pits 1-2	
Woolpert	
Date: 6/12/2025	Scale: N/A

Rodriguez Engineering Laboratories LLC	
Ennis Municipal Airport Ellis, Texas Bores 1-33 & Test Pits 1-2	
Woolpert	
Date: 6/12/2025	Scale: N/A

Note: All borehole and test pit locations are approximate.

Rodriguez Engineering Laboratories LLC
Ennis Municipal Airport
Ellis, Texas
Borehole and Test Pit Location Coordinates

Bore No.	Location	Latitude	Longitude
Bore 1	Runway 16-34	32°20'5.40"N	96°39'57.15"W
Bore 2		32°19'56.03"N	96°39'53.64"W
Bore 3		32°19'46.64"N	96°39'50.10"W
Bore 4		32°19'37.26"N	96°39'46.20"W
Bore 5		32°19'28.60"N	96°39'42.75"W
Bore 6	Parallel Taxiway	32°20'4.42"N	96°39'59.45"W
Bore 7		32°19'57.41"N	96°39'56.61"W
Bore 8		32°19'50.46"N	96°39'53.77"W
Bore 9		32°19'43.42"N	96°39'51.08"W
Bore 10	Connector Taxiway	32°20'5.19"N	96°39'58.84"W
Bore 11		32°19'57.69"N	96°39'55.90"W
Bore 12	Apron	32°19'39.64"N	96°39'51.29"W
Bore 13		32°19'40.10"N	96°39'52.46"W
Bore 14		32°19'40.48"N	96°39'50.57"W
Bore 15		32°19'40.84"N	96°39'51.78"W
Bore 16	Parallel Taxiway	32°19'37.30"N	96°39'48.66"W
Bore 17	Extended area West of Runway 34-End	32°19'28.23"N	96°39'44.70"W
Bore 18	Connector Taxiway	32°19'40.01"N	96°39'48.88"W
Bore 19	Runway Shoulder	32°19'59.75"N	96°39'54.65"W
Bore 20		32°19'46.45"N	96°39'49.43"W
Bore 21		32°19'33.86"N	96°39'44.52"W
Bore 22		32°19'34.22"N	96°39'45.39"W
Bore 23		32°19'48.22"N	96°39'50.85"W
Bore 24		32°20'2.26"N	96°39'56.41"W
Bore 25		32°20'4.64"N	96°39'56.57"W
Bore 26		32°19'48.91"N	96°39'50.40"W
Bore 27		32°19'31.45"N	96°39'43.56"W
Bore 28		32°19'30.42"N	96°39'43.92"W
Bore 29		32°19'43.54"N	96°39'49.04"W
Bore 30		32°19'52.78"N	96°39'52.66"W
Bore 31	Connector Taxiway	32°19'34.94"N	96°39'46.82"W
Bore 32	Existing Pavement South of Taxiway	32°19'32.52"N	96°39'46.18"W
Bore 33	Proposed Taxiway	32°19'29.21"N	96°39'45.10"W
Test Pit 1	Runway 16-34	32°19'40.94"N	96°39'47.79"W
Test Pit 2	Parallel Taxiway	32°19'53.96"N	96°39'55.21"W

Note: All borehole and test pit locations are approximate.

Appendix D:

Falling Weight Deflectometer (FWD) Results

Rodriguez Engineering Laboratories, LLC

Pass 06-L

TTI MODULUS ANALYSIS SYSTEM (SUMMARY REPORT) (Version 6.1)

District:
County :
Highway/Road:

	Thickness(in)	MODULI RANGE(psi) Minimum	Maximum	Poisson Ratio Values
Pavement:	6.50	390,000	1,120,000	H1: v = 0.35
Base:	6.38	8,000	30,000	H2: v = 0.35
Subbase:	0.00			H3: v = 0.00
Subgrade:	200.00(User Input)	9,000		H4: v = 0.40

Station	Load (lbs)	Measured Deflection (mils): R1	R2	R3	R4	R5	R6	R7	Calculated Moduli values (ksi): SURF(E1)	BASE(E2)	SUBB(E3)	SUBG(E4)	Absolute Dpth to ERR/Sens	Bedrock
200.000	8,401	27.18	15.38	8.08	4.62	3.14	2.48	1.80	390.0	8.0	0.0	10.1	13.30	85.3 *
408.000	8,478	18.30	12.03	6.48	3.85	2.66	2.11	1.49	390.0	10.6	0.0	13.4	7.12	96.7 *
641.000	8,302	15.69	9.75	5.78	3.56	2.48	1.91	1.42	390.0	22.2	0.0	14.1	6.50	124.5 *
826.000	8,149	15.71	11.29	6.48	3.39	2.33	1.66	1.22	426.6	9.9	0.0	14.5	4.17	68.0
1037.000	8,182	10.57	7.42	4.89	3.20	2.30	1.81	1.13	892.8	30.0	0.0	15.9	6.59	170.6 *
1268.000	8,445	13.40	9.01	5.66	3.58	2.43	1.71	1.19	481.6	30.0	0.0	14.9	2.99	99.3 *
1451.000	8,160	15.07	10.32	6.90	4.50	3.02	2.14	1.50	470.8	30.0	0.0	11.6	2.68	114.2 *
1610.000	8,248	16.35	10.88	6.85	4.35	2.92	2.25	1.43	390.0	28.2	0.0	11.7	3.90	112.2 *
1836.000	7,996	18.65	13.26	8.62	5.55	3.67	2.61	1.74	390.0	21.4	0.0	9.2	1.63	107.7 *
2047.000	8,149	21.32	14.93	9.22	5.84	4.00	2.90	1.96	390.0	11.9	0.0	8.8	4.32	124.9 *
2248.000	8,007	10.73	7.43	5.59	4.28	3.20	2.51	1.54	1120.0	30.0	0.0	12.9	10.88	80.2 *
2630.000	8,259	14.31	10.43	6.86	4.61	3.23	2.55	1.70	635.9	30.0	0.0	11.2	4.85	141.5 *
2819.000	8,226	16.69	11.50	7.15	4.59	3.24	2.63	1.89	390.0	30.0	0.0	10.9	5.64	151.8 *
3030.000	8,259	18.57	12.11	7.42	4.74	3.31	2.57	1.85	390.0	19.2	0.0	10.7	6.55	140.8 *
3427.000	8,018	14.80	11.19	7.85	5.43	3.83	2.81	1.83	730.7	30.0	0.0	9.3	2.87	92.5 *
3609.000	8,061	15.59	11.12	7.04	4.66	3.35	2.65	1.80	475.0	30.0	0.0	10.6	5.82	178.1 *
3804.000	8,270	9.88	6.50	4.40	3.14	2.34	1.86	1.34	1120.0	30.0	0.0	17.0	10.10	257.0 *
3919.000	8,105	10.09	7.68	5.26	3.60	2.56	2.06	1.50	1120.0	30.0	0.0	14.2	5.07	152.3 *
Mean:		15.72	10.68	6.70	4.31	3.00	2.29	1.57	588.5	24.0	0.0	12.3	5.83	120.5
Std. Dev:		4.29	2.47	1.29	0.80	0.53	0.39	0.26	281.0	8.4	0.0	2.4	3.04	36.6
Var Coeff(%):		27.31	23.13	19.19	18.69	17.73	17.15	16.34	47.7	34.9	0.0	19.8	52.21	30.4

Pass 06-R

TTI MODULUS ANALYSIS SYSTEM (SUMMARY REPORT) (Version 6.1)

District:
County :
Highway/Road:

	Thickness(in)	MODULI RANGE(psi) Minimum	Maximum	Poisson Ratio Values
Pavement:	6.50	390,000	1,120,000	H1: v = 0.35
Base:	6.38	8,000	30,000	H2: v = 0.35
Subbase:	0.00			H3: v = 0.00
Subgrade:	200.00(User Input)	9,000		H4: v = 0.40

Station	Load (lbs)	Measured Deflection (mils): R1	R2	R3	R4	R5	R6	R7	Calculated Moduli values (ksi): SURF(E1)	BASE(E2)	SUBB(E3)	SUBG(E4)	Absolute Dpth to ERR/Sens	Bedrock
0.000	8,302	30.32	19.00	10.37	5.93	3.94	3.09	2.19	390.0	8.0	0.0	7.7	13.27	84.6 *
206.000	8,182	15.52	11.20	6.75	3.94	2.65	2.05	1.42	390.0	23.1	0.0	12.4	3.69	94.5 *
414.000	8,237	14.96	10.11	6.12	3.74	2.60	1.98	1.40	390.0	29.4	0.0	13.2	3.96	119.1 *
600.000	8,620	16.52	9.50	5.21	3.12	2.09	1.58	1.15	390.0	13.0	0.0	17.2	7.78	101.7 *
805.000	8,467	14.92	9.93	5.75	3.44	2.35	1.78	1.32	390.0	23.8	0.0	14.8	3.96	102.7 *
1045.000	8,149	14.91	10.75	6.99	4.58	3.17	2.38	1.67	516.5	30.0	0.0	11.1	3.61	132.1 *
1207.000	8,379	13.63	8.87	5.57	3.72	2.59	1.80	1.23	483.4	30.0	0.0	14.6	5.57	93.6 *
1426.000	8,543	10.96	6.72	4.45	3.21	2.46	1.97	1.42	948.0	30.0	0.0	17.3	12.59	98.5 *
1614.000	8,040	15.13	10.27	6.45	4.12	2.71	2.00	1.22	390.0	30.0	0.0	12.3	2.21	101.5 *
1824.000	8,050	18.69	13.35	8.66	5.20	3.44	2.41	1.68	390.0	16.0	0.0	9.7	1.68	111.5 *
2006.000	8,302	20.76	11.63	6.76	4.50	3.46	2.83	1.95	390.0	12.8	0.0	11.4	14.26	300.0 *
2226.000	8,281	11.44	8.71	6.55	4.83	3.59	2.59	1.61	1120.0	30.0	0.0	11.4	6.69	84.3 *
2629.000	8,281	10.58	8.33	6.05	4.37	3.22	2.46	1.59	1120.0	30.0	0.0	12.5	7.14	86.6 *
2810.000	7,963	11.23	7.88	5.33	3.83	2.88	2.34	1.67	1094.8	30.0	0.0	12.9	8.77	300.0 *
3017.000	7,985	15.11	10.12	6.27	4.20	3.11	2.41	1.63	425.0	30.0	0.0	11.9	7.70	92.8 *
3425.000	8,138	13.74	9.30	6.07	4.07	2.87	2.21	1.56	569.1	30.0	0.0	12.7	6.27	147.7 *
3621.000	8,007	16.98	12.16	7.96	5.31	3.86	3.00	1.97	465.5	30.0	0.0	9.2	5.63	216.8 *
3983.000	8,379	10.11	7.17	4.80	3.29	2.47	1.87	1.28	1120.0	30.0	0.0	16.0	7.58	91.8 *
Mean:		15.31	10.28	6.45	4.19	2.97	2.26	1.55	610.1	25.3	0.0	12.7	6.80	103.8
Std. Dev:		4.71	2.77	1.42	0.77	0.53	0.43	0.28	306.6	7.5	0.0	2.6	3.63	31.1
Var Coeff(%):		30.75	26.91	22.00	18.41	17.96	18.89	18.19	50.3	29.7	0.0	20.4	53.37	30.0

Rodriguez Engineering Laboratories, LLC

Pass 18-L

TTI MODULUS ANALYSIS SYSTEM (SUMMARY REPORT) (Version 6.1)

District:
County :
Highway/Road:

	Thickness(in)	MODULI RANGE(psi) Minimum	Maximum	Poisson Ratio Values
Pavement:	6.50	390,000	1,120,000	H1: v = 0.35
Base:	6.38	8,000	30,000	H2: v = 0.35
Subbase:	0.00			H3: v = 0.00
Subgrade:	200.00(User Input)	9,000		H4: v = 0.40

Station	Load (lbs)	Measured Deflection (mils): R1	R2	R3	R4	R5	R6	R7	Calculated Moduli values (ksi): SURF(E1)	BASE(E2)	SUBB(E3)	SUBG(E4)	Absolute Dpth to ERR/Sens	Bedrock
0.000	8,423	31.38	18.47	10.73	6.28	4.04	3.07	2.31	390.0	8.0	0.0	7.6	12.17	97.9 *
219.000	8,083	16.05	11.28	6.48	4.11	2.87	2.33	1.50	390.0	24.3	0.0	11.9	5.89	130.1 *
403.000	8,204	16.28	10.73	6.41	4.01	2.78	2.15	1.44	390.0	22.8	0.0	12.5	5.45	130.3 *
603.000	8,270	25.59	16.17	9.09	5.04	2.96	2.22	1.75	390.0	8.0	0.0	9.6	12.37	76.2 *
812.000	8,226	16.99	9.45	5.59	3.64	2.52	2.00	1.32	390.0	17.4	0.0	14.2	9.99	127.4 *
1005.000	8,291	18.67	10.90	6.54	4.19	2.96	2.23	1.50	390.0	14.3	0.0	12.4	9.10	153.5 *
1233.000	8,456	18.87	11.39	6.65	4.03	2.59	1.83	1.15	390.0	9.6	0.0	13.7	5.22	93.8 *
1427.000	8,291	14.39	9.67	6.38	4.41	3.25	2.50	1.61	625.6	30.0	0.0	11.8	8.03	87.4 *
1644.000	8,489	14.29	7.39	4.36	2.96	2.39	1.88	1.36	390.0	30.0	0.0	17.7	15.11	300.0 *
1852.000	8,500	12.44	8.96	5.87	4.07	2.94	2.30	1.46	858.5	30.0	0.0	13.1	6.53	175.2 *
2036.000	8,160	15.00	9.27	5.61	3.83	2.89	2.23	1.58	396.7	30.0	0.0	13.4	9.73	99.0 *
2199.000	8,171	18.87	13.42	8.47	5.67	3.96	2.98	1.95	390.0	27.7	0.0	8.9	4.20	138.4 *
2614.000	8,226	15.90	10.70	6.80	4.49	3.31	2.74	1.93	447.9	30.0	0.0	11.2	8.20	261.4 *
2872.000	8,160	20.92	14.47	8.82	5.59	3.87	2.89	2.00	390.0	12.5	0.0	9.1	5.30	132.2 *
3023.000	8,029	14.69	10.08	6.68	4.62	3.43	2.72	1.89	617.3	30.0	0.0	10.8	8.09	297.4 *
3425.000	8,335	9.28	6.71	4.78	3.52	2.70	2.15	1.52	1120.0	30.0	0.0	15.7	11.61	95.1 *
3614.000	8,368	10.76	8.43	6.04	4.33	3.18	2.44	1.68	1120.0	30.0	0.0	12.6	6.35	95.2 *
3939.000	8,182	14.26	9.81	6.27	3.97	2.67	2.17	1.48	465.5	30.0	0.0	12.8	4.30	112.5 *
Mean:		16.92	10.96	6.75	4.38	3.07	2.38	1.64	530.6	23.0	0.0	12.2	8.20	123.1
Std. Dev:		5.19	2.99	1.58	0.82	0.49	0.37	0.29	248.0	8.8	0.0	2.5	3.13	41.8
Var Coeff(%):		30.69	27.32	23.46	18.79	15.97	15.41	17.62	46.7	38.1	0.0	20.2	38.16	33.9

Pass 18-R

TTI MODULUS ANALYSIS SYSTEM (SUMMARY REPORT) (Version 6.1)

District:
County :
Highway/Road:

	Thickness(in)	MODULI RANGE(psi) Minimum	Maximum	Poisson Ratio Values
Pavement:	6.50	390,000	1,120,000	H1: v = 0.35
Base:	6.38	8,000	30,000	H2: v = 0.35
Subbase:	0.00			H3: v = 0.00
Subgrade:	200.00(User Input)	9,000		H4: v = 0.40

Station	Load (lbs)	Measured Deflection (mils): R1	R2	R3	R4	R5	R6	R7	Calculated Moduli values (ksi): SURF(E1)	BASE(E2)	SUBB(E3)	SUBG(E4)	Absolute Dpth to ERR/Sens	Bedrock
217.000	8,489	17.20	9.83	5.52	3.33	2.37	1.88	1.39	390.0	13.9	0.0	15.4	10.01	107.8 *
402.000	8,675	17.53	10.07	6.06	3.91	2.88	2.19	1.56	390.0	22.5	0.0	13.5	9.96	197.1 *
601.000	8,795	15.72	9.39	4.82	2.99	2.04	1.82	1.15	390.0	16.5	0.0	17.7	9.76	107.1 *
827.000	8,335	20.23	12.92	7.68	4.46	2.79	2.08	1.43	390.0	8.0	0.0	12.0	4.70	88.9 *
1016.000	8,368	32.66	19.57	11.19	6.21	3.90	3.02	2.09	390.0	8.0	0.0	7.3	15.78	80.8 *
1203.000	8,182	21.79	14.69	8.96	5.23	3.45	2.62	1.76	390.0	8.0	0.0	9.8	5.08	98.0 *
1418.000	8,500	15.78	11.11	6.90	4.54	3.30	2.60	1.85	469.9	30.0	0.0	11.5	6.38	199.0 *
1628.000	8,554	14.84	9.68	5.34	3.59	2.68	2.18	1.41	390.0	30.0	0.0	14.5	9.26	254.1 *
1792.000	8,423	12.23	8.58	5.54	3.57	2.65	2.16	1.39	729.3	30.0	0.0	14.4	7.72	191.0 *
2011.000	8,248	18.24	14.18	8.72	5.60	3.93	3.08	1.92	390.0	29.7	0.0	8.9	4.60	140.6 *
2243.000	8,379	16.69	12.26	7.79	5.25	3.88	2.92	2.06	505.9	30.0	0.0	9.8	5.54	101.8 *
2615.000	8,335	12.25	8.84	6.06	4.29	3.23	2.56	1.66	1059.4	30.0	0.0	12.0	7.51	86.8 *
2810.000	8,007	16.99	12.17	7.68	4.98	3.51	2.65	1.92	390.0	30.0	0.0	9.9	3.90	151.0 *
3002.000	8,215	15.28	10.11	6.36	4.42	3.34	2.80	1.77	509.8	30.0	0.0	11.5	10.27	300.0 *
3408.000	8,029	14.67	10.36	6.84	4.59	3.35	2.60	1.67	587.6	30.0	0.0	10.8	6.36	88.9 *
3617.000	7,985	15.50	11.55	7.78	5.30	3.81	3.01	2.03	627.5	30.0	0.0	9.3	4.89	186.3 *
3940.000	8,215	10.98	7.15	4.48	3.05	2.28	1.86	1.31	744.7	30.0	0.0	17.0	10.33	281.8 *
Mean:		16.98	11.32	6.92	4.43	3.14	2.47	1.67	514.4	23.9	0.0	12.1	7.77	130.5
Std. Dev:		4.88	2.91	1.71	0.93	0.60	0.43	0.29	186.4	9.1	0.0	3.0	3.08	51.4
Var Coeff(%):		28.73	25.70	24.70	21.02	19.06	17.30	17.26	36.2	38.0	0.0	24.4	39.66	39.4

Rodriguez Engineering Laboratories, LLC

Taxiway 6-L

TTI MODULUS ANALYSIS SYSTEM (SUMMARY REPORT) (Version 6.1)

District:
County :
Highway/Road:

	Thickness(in)	MODULI RANGE(psi) Minimum	Maximum	Poisson Ratio Values
Pavement:	5.50	410,000	1,160,000	H1: v = 0.35
Base:	7.20	8,000	30,000	H2: v = 0.35
Subbase:	0.00			H3: v = 0.00
Subgrade:	200.00(User Input)	9,000		H4: v = 0.40

Station	Load (lbs)	Measured Deflection (mils): R1	R2	R3	R4	R5	R6	R7	Calculated Moduli values (ksi): SURF(E1)	BASE(E2)	SUBB(E3)	SUBG(E4)	Absolute Dpth to ERR/Sens	Bedrock
0.000	8,302	14.83	10.51	7.01	4.61	3.34	2.55	1.69	938.1	30.0	0.0	11.1	5.82	94.1 *
232.000	8,105	27.23	18.72	10.60	6.08	3.99	2.65	2.06	410.0	8.0	0.0	8.1	3.54	85.6 *
456.000	8,160	17.32	12.35	7.78	4.93	3.49	2.62	1.78	554.6	30.0	0.0	10.1	4.13	97.7 *
612.000	8,204	26.64	16.23	8.96	5.56	3.78	2.94	2.26	410.0	8.0	0.0	9.3	9.00	113.9 *
816.000	8,423	19.40	12.49	7.14	4.32	3.11	2.55	1.73	410.0	23.2	0.0	11.4	7.33	110.8 *
1011.000	7,908	20.69	14.61	9.22	5.73	3.85	2.96	2.32	410.0	25.8	0.0	8.4	2.98	116.0 *
1204.000	7,963	19.37	14.32	9.35	6.02	4.15	3.04	2.10	510.6	30.0	0.0	8.1	1.95	134.3 *
1400.000	8,281	19.80	12.78	7.94	5.24	3.69	2.94	2.04	410.0	30.0	0.0	9.8	6.75	150.3 *
1612.000	7,963	19.45	14.33	9.45	6.09	4.29	3.26	2.56	541.4	30.0	0.0	8.0	3.19	160.6 *
2020.000	8,061	19.40	12.69	7.63	4.79	3.30	2.52	1.83	410.0	25.2	0.0	10.2	5.00	128.3 *
2223.000	8,138	29.66	19.52	10.96	6.43	4.69	3.71	2.67	410.0	8.0	0.0	7.4	8.86	93.3 *
2419.000	8,565	42.92	26.16	11.89	5.99	4.49	3.69	2.29	410.0	8.0	0.0	6.5	21.13	55.8 *
2625.000	8,357	29.57	17.68	9.20	5.11	3.55	2.65	1.65	410.0	8.0	0.0	9.1	9.32	76.4 *
2818.000	8,215	18.45	11.98	6.85	4.31	3.10	2.55	1.72	410.0	27.7	0.0	11.3	7.37	143.8 *
3002.000	8,434	38.89	23.76	11.11	6.17	4.52	3.50	2.51	410.0	8.0	0.0	6.8	16.74	68.8 *
Mean:		24.24	15.88	9.01	5.43	3.82	2.94	2.08	470.3	20.0	0.0	9.0	7.54	105.8
Std. Dev:		8.16	4.53	1.61	0.71	0.52	0.42	0.34	139.6	10.3	0.0	1.6	5.24	33.0
Var Coeff(%):		33.65	28.50	17.84	13.15	13.59	14.32	16.46	29.7	51.7	0.0	17.4	69.56	31.2

Taxiway 6-R

TTI MODULUS ANALYSIS SYSTEM (SUMMARY REPORT) (Version 6.1)

District:
County :
Highway/Road:

	Thickness(in)	MODULI RANGE(psi) Minimum	Maximum	Poisson Ratio Values
Pavement:	5.50	410,000	1,160,000	H1: v = 0.35
Base:	7.20	8,000	30,000	H2: v = 0.35
Subbase:	0.00			H3: v = 0.00
Subgrade:	200.00(User Input)	9,000		H4: v = 0.40

Station	Load (lbs)	Measured Deflection (mils): R1	R2	R3	R4	R5	R6	R7	Calculated Moduli values (ksi): SURF(E1)	BASE(E2)	SUBB(E3)	SUBG(E4)	Absolute Dpth to ERR/Sens	Bedrock
0.000	8,368	16.97	12.07	7.63	4.83	3.27	2.58	1.57	584.7	30.0	0.0	10.6	3.62	117.3 *
210.000	8,083	18.64	13.69	8.00	4.93	3.31	2.45	1.74	449.1	23.8	0.0	10.0	3.11	107.2
420.000	8,401	11.07	8.39	5.72	3.95	2.92	2.31	1.42	1160.0	30.0	0.0	14.0	10.04	251.2 *
625.000	7,941	20.53	14.47	8.76	5.40	3.78	2.83	2.02	410.0	23.8	0.0	8.8	3.77	128.6 *
803.000	8,171	24.94	16.07	9.00	5.27	3.54	2.70	1.95	410.0	8.3	0.0	9.6	6.43	94.0 *
1013.000	8,105	16.31	10.79	6.87	4.54	3.37	2.64	1.75	622.6	30.0	0.0	11.0	8.31	92.7 *
1225.000	8,094	19.26	13.12	8.21	5.37	3.81	2.86	2.13	436.0	30.0	0.0	9.3	5.11	123.4 *
1415.000	7,930	15.54	10.79	7.00	4.76	3.44	2.70	1.84	786.0	30.0	0.0	10.3	6.95	191.2 *
1651.000	8,105	17.85	13.15	8.73	5.96	4.26	3.32	2.25	761.1	30.0	0.0	8.4	4.84	174.9 *
1850.000	8,368	12.91	9.23	6.06	4.20	3.16	2.49	1.62	1160.0	30.0	0.0	12.5	8.23	86.8 *
2009.000	8,401	18.35	11.79	7.15	4.59	3.33	2.44	1.65	410.0	30.0	0.0	11.2	6.18	187.3 *
2206.000	8,467	28.62	17.64	9.64	5.88	4.03	2.97	2.04	410.0	8.0	0.0	8.8	7.96	113.5 *
2412.000	8,138	24.00	15.50	8.93	5.14	3.40	2.61	1.95	410.0	9.2	0.0	9.8	5.34	89.9 *
2609.000	8,237	33.17	21.35	11.25	5.89	3.52	2.64	2.03	410.0	8.0	0.0	7.6	15.18	65.2 *
2800.000	8,248	17.37	11.60	6.92	4.44	3.28	2.62	1.83	463.2	30.0	0.0	11.2	7.59	179.9 *
3000.000	8,160	18.50	12.13	7.17	4.54	3.17	2.52	1.92	410.0	29.2	0.0	10.8	5.75	136.7 *
3203.000	8,467	38.06	20.43	8.52	4.89	3.52	2.95	2.13	410.0	8.0	0.0	8.6	20.90	62.0 *
Mean:		20.71	13.66	7.97	4.98	3.48	2.68	1.87	570.7	22.8	0.0	10.1	7.61	118.4
Std. Dev:		7.06	3.60	1.38	0.59	0.33	0.24	0.22	253.9	9.9	0.0	1.6	4.46	44.3
Var Coeff(%):		34.09	26.38	17.31	11.91	9.60	9.09	12.01	44.5	43.2	0.0	15.8	58.61	37.4

Connectors

Connector A

TTI MODULUS ANALYSIS SYSTEM (SUMMARY REPORT) (Version 6.1)

District:
County :
Highway/Road:

	Thickness(in)	MODULI RANGE(psi) Minimum	Maximum	Poisson Ratio Values
Pavement:	9.25	410,000	1,160,000	H1: v = 0.35
Base:	5.75	4,000	30,000	H2: v = 0.35
Subbase:	0.00			H3: v = 0.00
Subgrade:	75.00(User Input)	9,000		H4: v = 0.40

Station	Load (lbs)	Measured Deflection (mils): R1	R2	R3	R4	R5	R6	R7	Calculated Moduli values (ksi): SURF(E1)	BASE(E2)	SUBB(E3)	SUBG(E4)	Absolute Dpth to ERR/Sens	Bedrock
2664.000	8,226	20.81	12.90	6.80	3.90	2.71	2.06	1.30	410.0	4.0	0.0	7.7	19.98	94.4 *
Mean:		20.81	12.90	6.80	3.90	2.71	2.06	1.30	410.0	4.0	0.0	7.7	19.98	94.4
Std. Dev:		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.0
Var Coeff(%):		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.0

Connector B

TTI MODULUS ANALYSIS SYSTEM (SUMMARY REPORT) (Version 6.1)

District:
County :
Highway/Road:

	Thickness(in)	MODULI RANGE(psi) Minimum	Maximum	Poisson Ratio Values
Pavement:	5.00	410,000	1,160,000	H1: v = 0.35
Base:	0.00			H2: v = 0.00
Subbase:	0.00			H3: v = 0.00
Subgrade:	65.00(by DB)	9,000		H4: v = 0.40

Station	Load (lbs)	Measured Deflection (mils): R1	R2	R3	R4	R5	R6	R7	Calculated Moduli values (ksi): SURF(E1)	BASE(E2)	SUBB(E3)	SUBG(E4)	Absolute Dpth to ERR/Sens	Bedrock
1940.000	8,565	34.01	20.65	10.85	5.75	3.49	2.45	1.78	587.9	0.0	0.0	4.9	21.61	68.0
1996.000	8,313	29.85	18.73	9.81	5.36	3.30	2.71	1.78	711.8	0.0	0.0	5.1	21.73	72.4
Mean:		31.93	19.69	10.33	5.56	3.40	2.58	1.78	649.8	0.0	0.0	5.0	21.67	70.0
Std. Dev:		2.94	1.36	0.74	0.28	0.13	0.18	0.00	87.6	0.0	0.0	0.1	0.08	2.2
Var Coeff(%):		9.21	6.90	7.12	4.96	3.96	7.13	0.00	13.5	0.0	0.0	2.8	0.38	3.1

Connector C

TTI MODULUS ANALYSIS SYSTEM (SUMMARY REPORT) (Version 6.1)

District:
County :
Highway/Road:

	Thickness(in)	MODULI RANGE(psi) Minimum	Maximum	Poisson Ratio Values
Pavement:	4.88	410,000	1,160,000	H1: v = 0.35
Base:	6.63	4,000	150,000	H2: v = 0.35
Subbase:	0.00			H3: v = 0.00
Subgrade:	65.86(by DB)	6,000		H4: v = 0.40

Station	Load (lbs)	Measured Deflection (mils): R1	R2	R3	R4	R5	R6	R7	Calculated Moduli values (ksi): SURF(E1)	BASE(E2)	SUBB(E3)	SUBG(E4)	Absolute Dpth to ERR/Sens	Bedrock
4273.000	8,215	32.19	20.95	10.79	5.59	3.68	3.10	2.17	410.0	17.0	0.0	4.7	18.36	63.1 *
0.000	8,050	25.05	15.35	8.13	4.86	3.54	2.80	2.01	410.0	47.3	0.0	5.3	19.79	100.1 *
Mean:		28.62	18.15	9.46	5.23	3.61	2.95	2.09	410.0	32.2	0.0	5.0	19.07	77.4
Std. Dev:		5.05	3.96	1.88	0.52	0.10	0.21	0.11	0.0	21.4	0.0	0.5	1.01	17.6
Var Coeff(%):		17.64	21.82	19.88	9.88	2.74	7.19	5.41	0.0	66.6	0.0	9.1	5.31	22.7

Connector D

TTI MODULUS ANALYSIS SYSTEM (SUMMARY REPORT) (Version 6.1)

District:
County :
Highway/Road:

	Thickness(in)	MODULI RANGE(psi) Minimum	Maximum	Poisson Ratio Values
Pavement:	6.75	410,000	1,160,000	H1: v = 0.35
Base:	6.25	4,000	150,000	H2: v = 0.35
Subbase:	0.00			H3: v = 0.00
Subgrade:	109.77(by DB)	6,000		H4: v = 0.40

Station	Load (lbs)	Measured Deflection (mils): R1	R2	R3	R4	R5	R6	R7	Calculated Moduli values (ksi): SURF(E1)	BASE(E2)	SUBB(E3)	SUBG(E4)	Absolute Dpth to ERR/Sens	Bedrock
3414.000	8,182	20.41	15.11	9.43	5.89	4.02	3.15	2.19	410.0	24.0	0.0	6.6	7.43	122.8 *
Mean:		20.41	15.11	9.43	5.89	4.02	3.15	2.19	410.0	24.0	0.0	6.6	7.43	122.8
Std. Dev:		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.0
Var Coeff(%):		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.0

Appendix E:

Dynamic Cone Penetrometer (DCP) Results

Ennis Municipal Airport
DCP Test Data

Rodriguez Engineering Laboratories, LLC

Project: *Ennis Municipal Airport* **Date:** 21-May-25

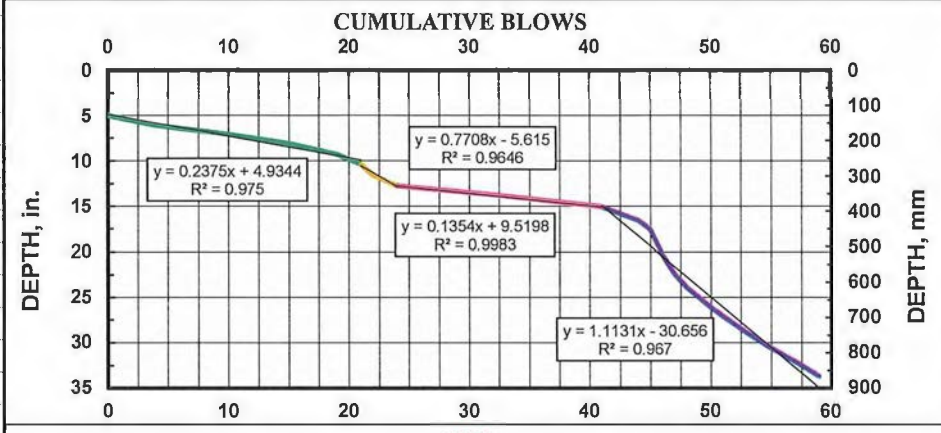
Location: Boring No. 11 **Soil Type(s):** Silty Gravel with Sand, Fat Clay with Sand

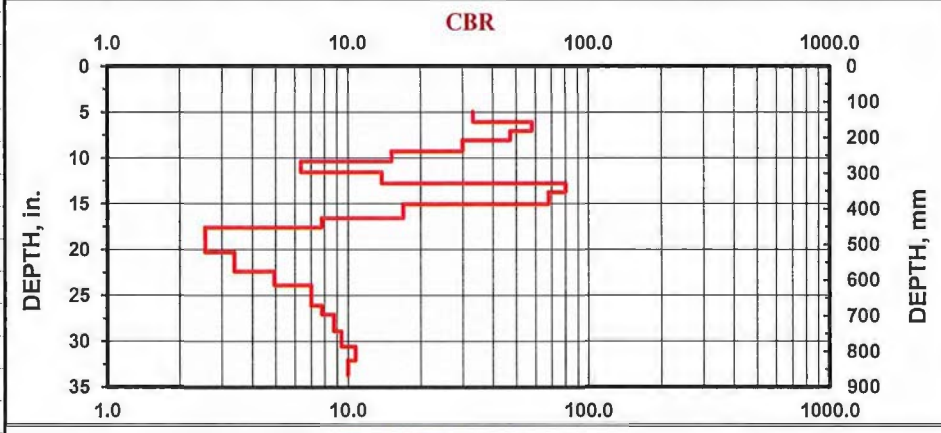
Hammer
- ○ 10.1 lbs.
- ◉ 17.6 lbs.
- ○ Both hammers used

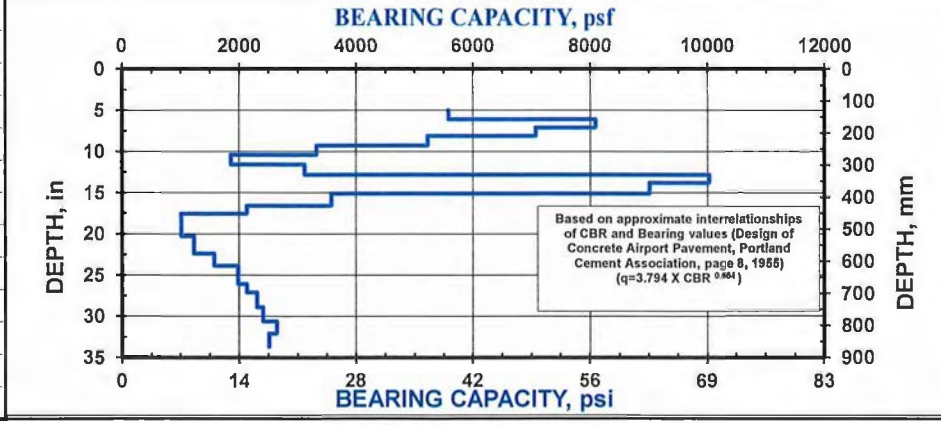
Soil Type
- ○ CH
- ○ CL
- ◉ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	127	1
4	155	1
6	180	1
5	206	1
4	236	1
2	264	1
1	295	1
2	325	1
8	351	1
9	384	1
3	422	1
1	447	1
1	516	1
1	569	1
1	607	1
1	635	1
1	663	1
1	688	1
2	734	1
2	777	1
2	815	1
2	856	1

Layer	Depth (in)	Slope	CBR	E (PSI)
1	5.0 - 10.4	0.2375	39.0	58522
2	10.4 - 12.8	0.7708	17.8	26686
3	12.8 - 15.1	0.1354	101.3	151917
4	15.1 - 33.7	1.1131	12.3	18479







Ennis Municipal Airport
DCP Test Data

Rodriguez Engineering Laboratories, LLC

Project: *Ennis Municipal Airport* **Date:** 21-May-25

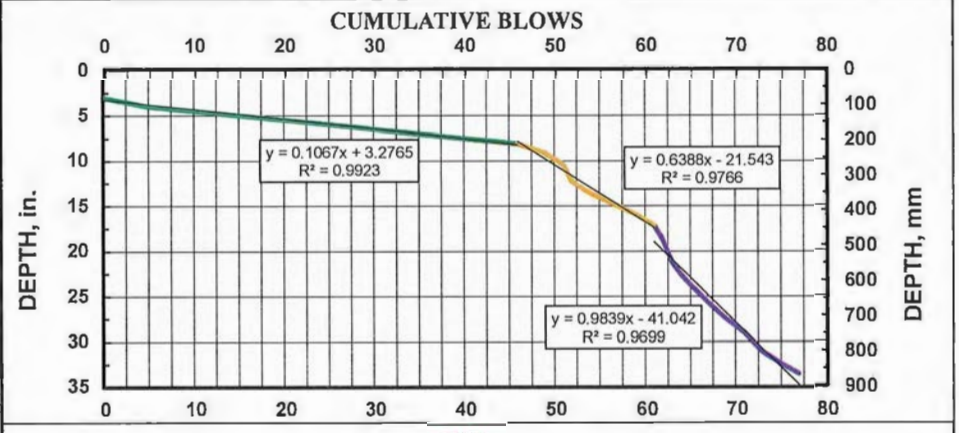
Location: Boring No. 13 **Soil Type(s):** Poorly Graded Gravel, Silt with Sand

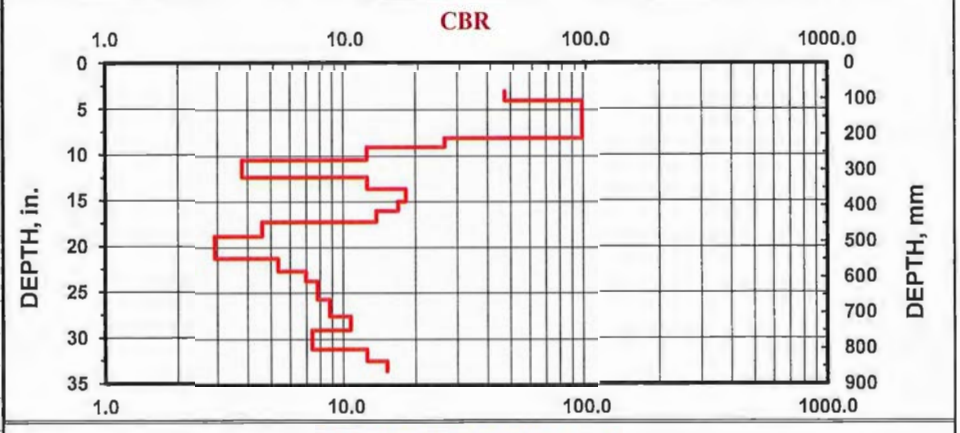
Hammer
- ○ 10.1 lbs.
- ◉ 17.6 lbs.
- ○ Both hammers used

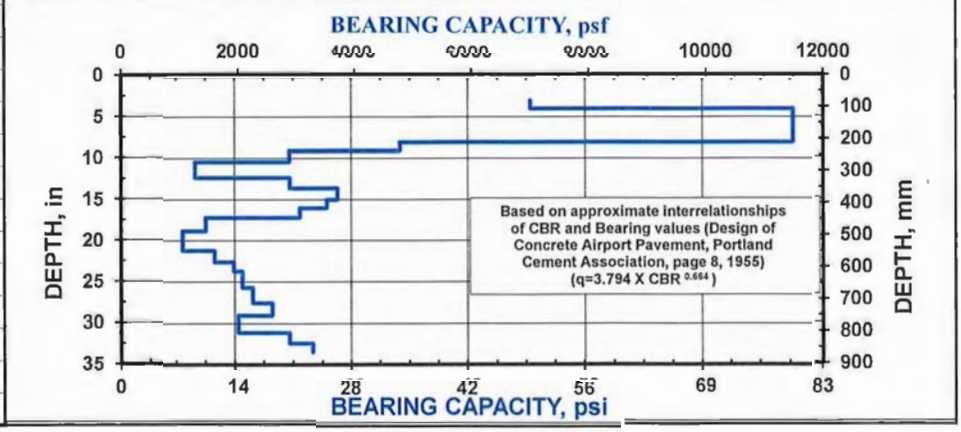
Soil Type
- ○ CH
- ○ CL
- ◉ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	76	1
5	102	1
10	127	1
10	152	1
10	178	1
11	206	1
3	231	1
2	264	1
1	312	1
2	345	1
3	381	1
2	406	1
2	437	1
1	478	1
1	539	1
1	574	1
1	602	1
1	627	1
1	653	1
2	699	1
2	737	1
2	790	1
2	823	1
2	851	1

Layer	Depth (in)	Slope	CBR	E (PSI)
1	3.0 - 8.1	0.1067	95.6	143389
2	8.1 - 17.2	0.6388	12.9	19322
3	17.2 - 33.5	0.9839	7.9	11911







Ennis Municipal Airport
DCP Test Data

Rodriguez Engineering Laboratories, LLC

Project: *Ennis Municipal Airport* **Date:** 22-May-25

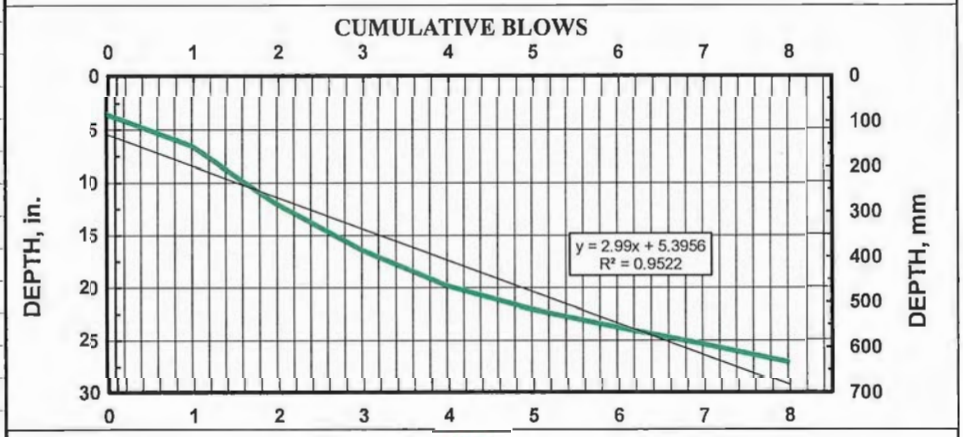
Location: Boring No. 26 **Soil Type(s):** Sandy Fat Clay, Lean Clay with Sand

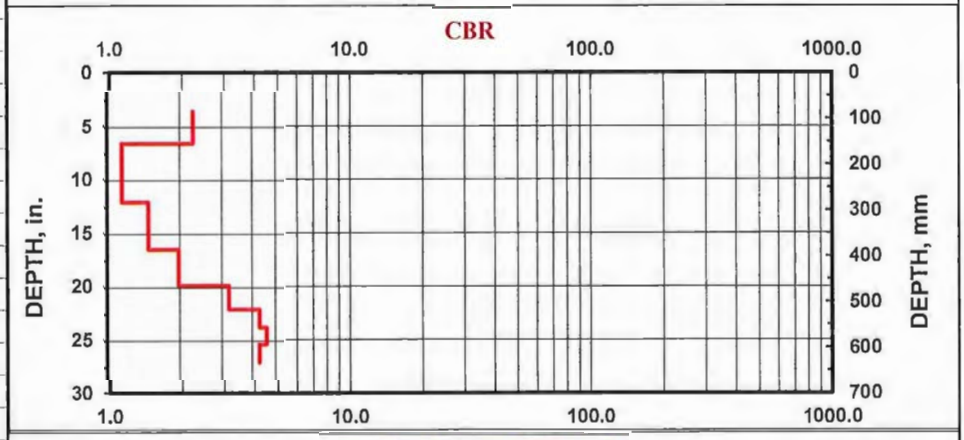
Hammer
- ○ 10.1 lbs.
- ◉ 17.6 lbs.
- ○ Both hammers used

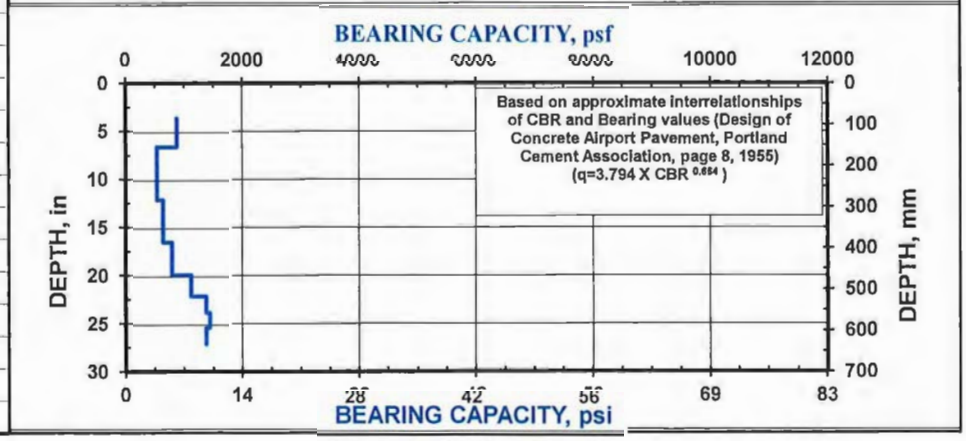
Soil Type
- ○ CH
- ○ CL
- ◉ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	89	1
1	165	1
1	305	1
1	417	1
1	503	1
1	559	1
1	602	1
1	643	1
1	686	1

Layer	Depth (in)	Slope	CBR	E (PSI)
1	3.5 - 27.0	2.9900	2.3	3430







Ennis Municipal Airport
DCP Test Data

Rodriguez Engineering Laboratories, LLC

Project: *Ennis Municipal Airport* **Date:** 21-May-25

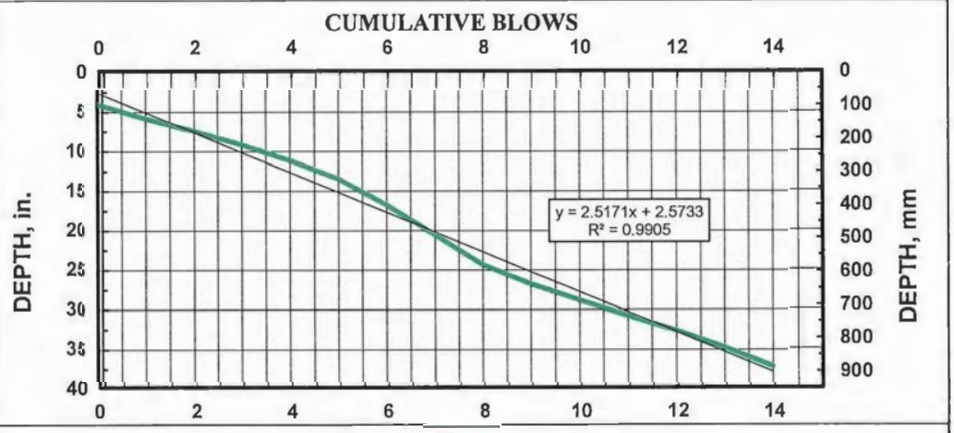
Location: Boring No. 33 **Soil Type(s):** Sandy Lean Clay, Fat Clay with Sand

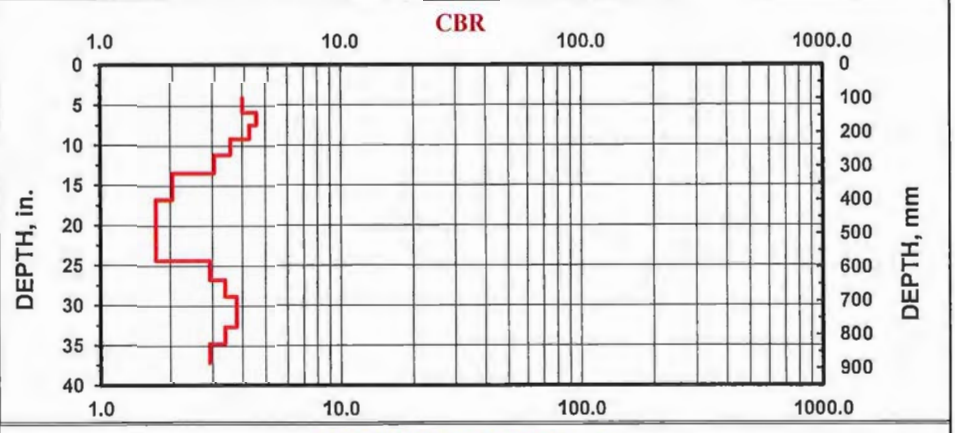
Hammer
- ○ 10.1 lbs.
- ◉ 17.6 lbs.
- ○ Both hammers used

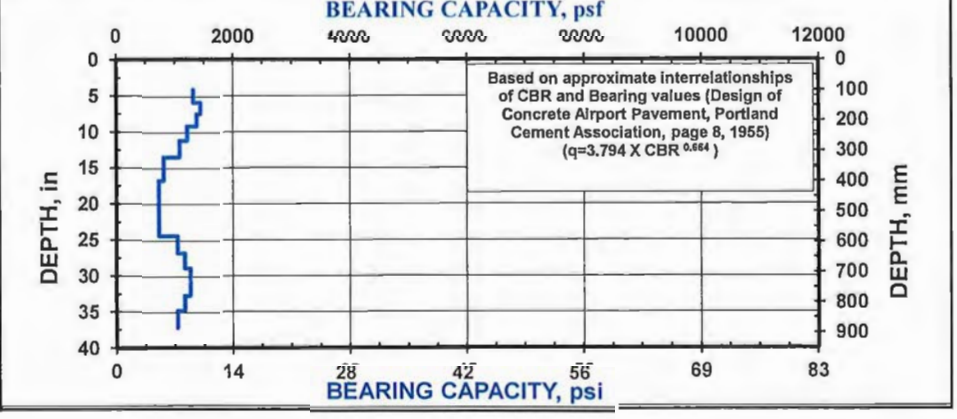
Soil Type
- ○ CH
- ○ CL
- ◉ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	102	1
1	147	1
1	188	1
1	231	1
1	282	1
1	340	1
1	424	1
1	521	1
1	617	1
1	678	1
1	732	1
1	780	1
1	828	1
1	881	1
1	942	1

Layer	Depth (in)	Slope	CBR	E (PSI)
1	4.0 - 37.1	2.5171	2.8	4160







Ennis Municipal Airport
DCP Test Data

Rodriguez Engineering Laboratories, LLC

Project: *Ennis Municipal Airport* **Date:** 30-Apr-25

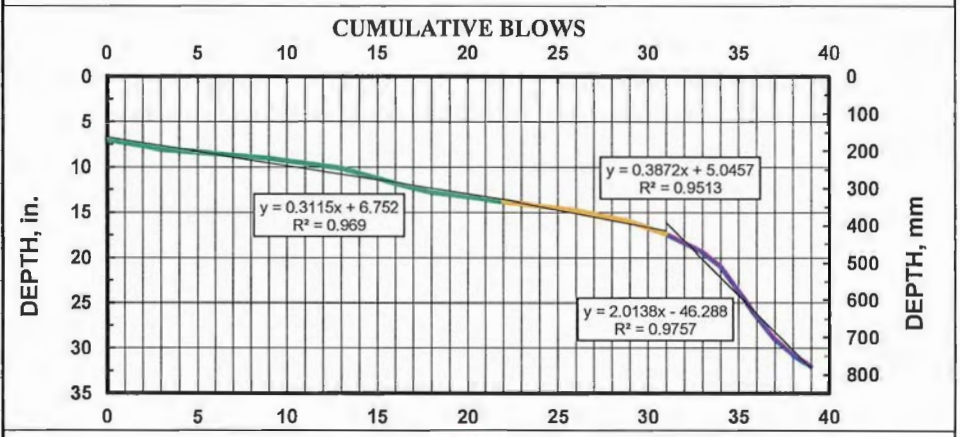
Location: Test Pit No. 1 **Soil Type(s):** Silty Sand with Gravel

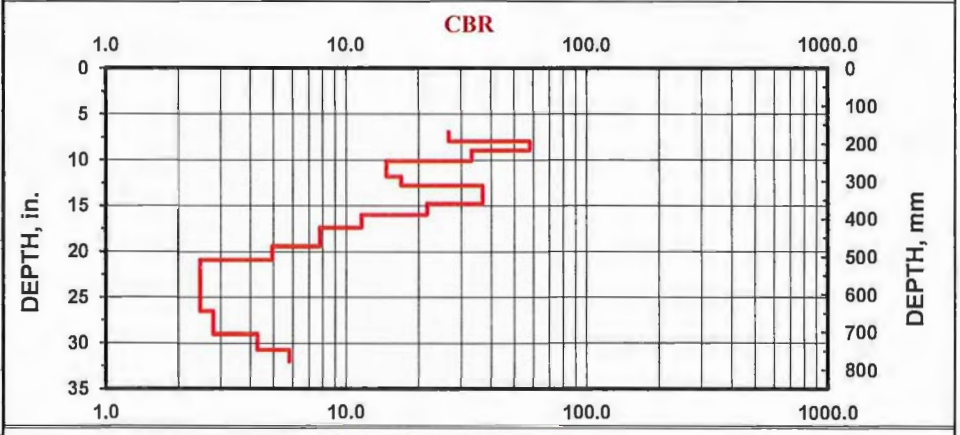
Hammer
- ○ 10.1 lbs.
- ◉ 17.6 lbs.
- ○ Both hammers used

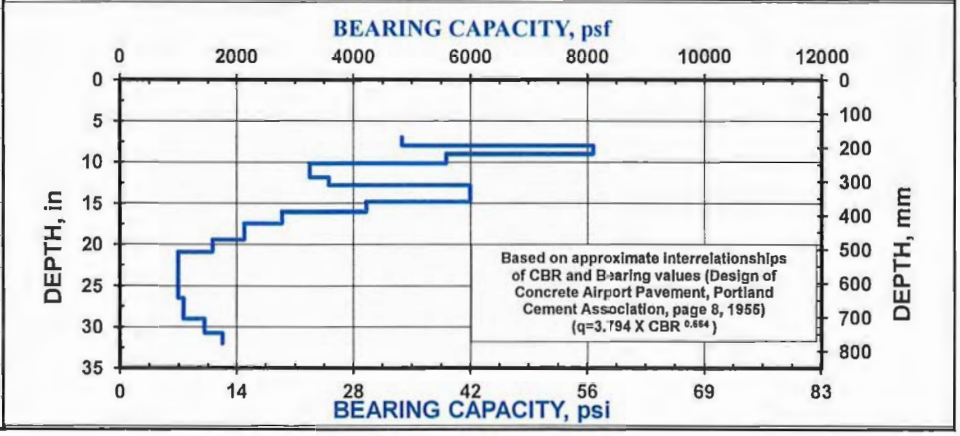
Soil Type
- ○ CH
- ○ CL
- ◉ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	178	1
3	203	1
6	229	1
4	257	1
3	300	1
2	325	1
4	351	1
4	376	1
3	406	1
2	442	1
2	493	1
1	531	1
1	602	1
1	673	1
1	737	1
1	780	1
1	813	1

Layer	Depth (in)	Slope	CBR	E (PSI)
1	7.0 - 13.8	0.3115	28.8	43190
2	13.8 - 17.4	0.3872	22.6	33851
3	17.4 - 32.0	2.0138	3.6	5340







Ennis Municipal Airport
DCP Test Data

Rodriguez Engineering Laboratories, LLC

Project: *Ennis Municipal Airport* **Date:** 30-Apr-25

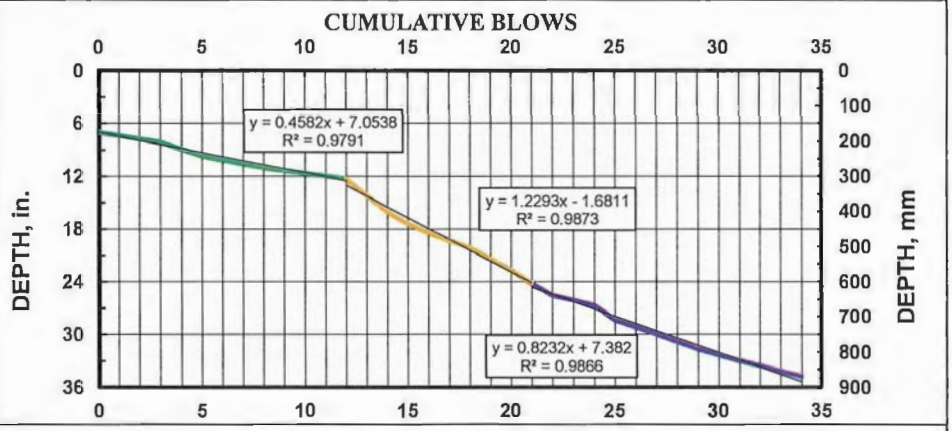
Location: Test Pit No. 2 **Soil Type(s):** Poorly Graded Gravel with Silt and Sand

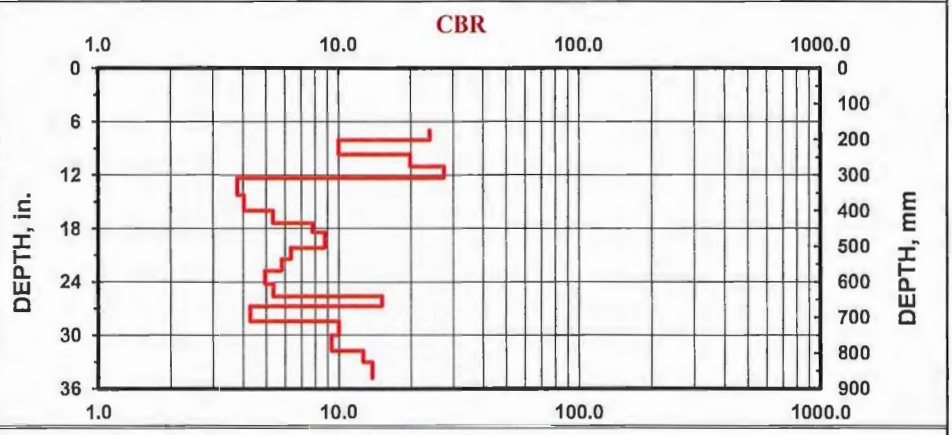
Hammer
- ○ 10.1 lbs.
- ◉ 17.6 lbs.
- ○ Both hammers used

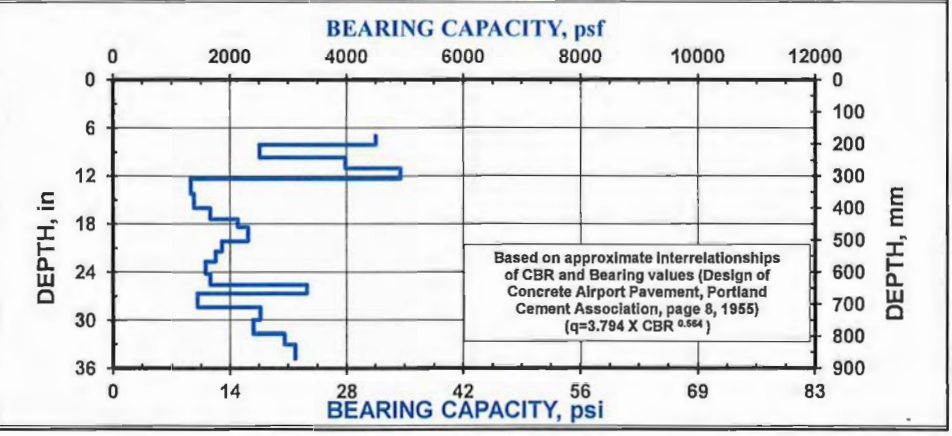
Soil Type
- ○ CH
- ○ CL
- ◉ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	178	1
3	206	1
2	246	1
3	279	1
4	312	1
1	361	1
1	406	1
1	442	1
1	467	1
2	513	1
1	544	1
1	577	1
1	615	1
1	650	1
2	678	1
1	721	1
2	762	1
2	805	1
2	838	1
3	884	1

Layer	Depth (in)	Slope	CBR	E (PSI)
1	7.0 - 12.3	0.4582	18.7	28034
2	12.3 - 24.2	1.2293	6.2	9282
3	24.2 - 34.8	0.8232	9.7	14544







Appendix F:

Lime Stabilization by pH Method

Determining Stabilization Ability of Lime by the Soil pH Method

Ennis Municipal Airport

Ellis, Texas

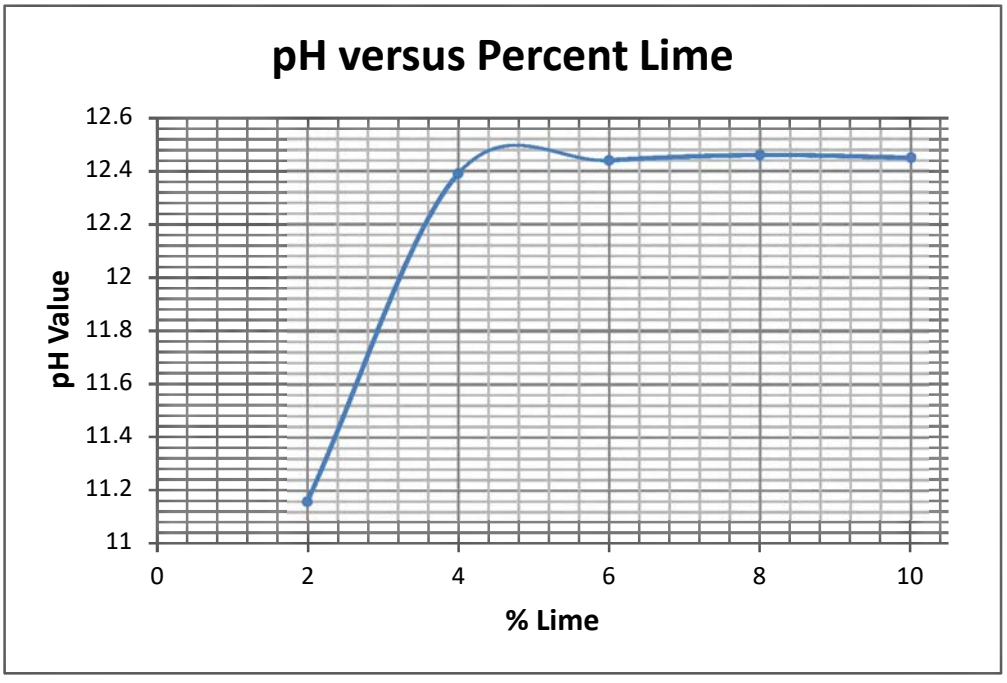
Sample from CBR #1

Water Content of Air-Dried Sample

Mass of Wet Sample + Tare (g):	0.0
Mass of Dry Sample + Tare (g):	0.0
Tare Mass (g):	0.0
Hygroscopic Moisture Content (%):	0.0

pH Value of Soil-Lime-Water Mixtures

Lime (%)	2	4	6	8	10
Soil (g)	30.0	30.0	30.0	30.0	30.0
Lime (g)	0.6	1.2	1.8	2.4	3.0
Water (ml)	150	150	150	150	150
pH Value	11.16	12.39	12.44	12.46	12.45



Determining Stabilization Ability of Lime by the Soil pH Method

Ennis Municipal Airport

Ellis, Texas

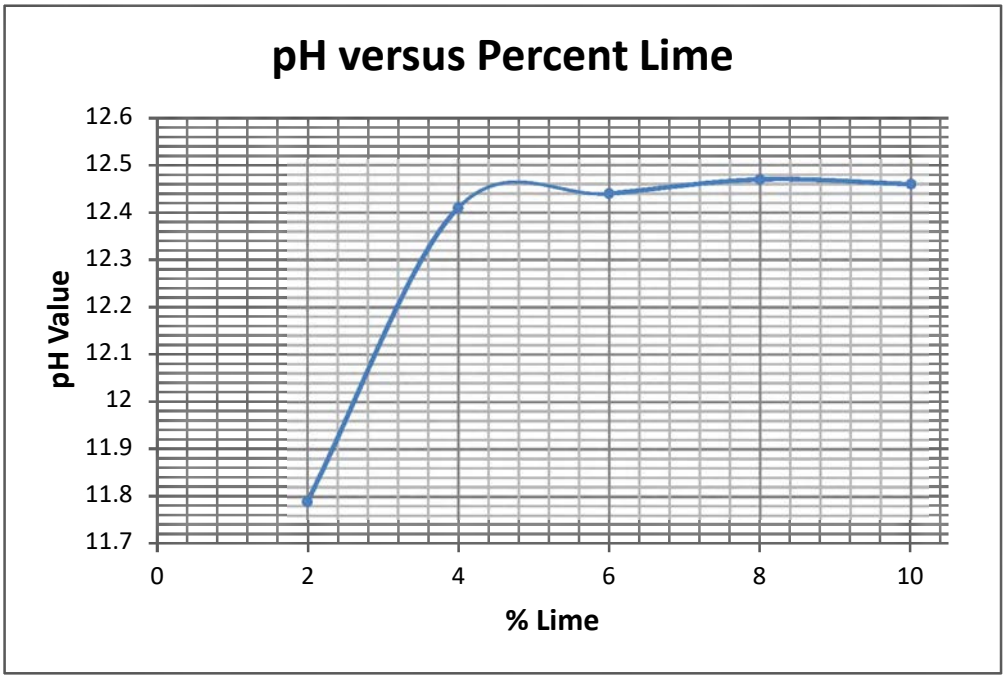
Sample from CBR #2

Water Content of Air-Dried Sample

Mass of Wet Sample + Tare (g):	0.0
Mass of Dry Sample + Tare (g):	0.0
Tare Mass (g):	0.0
Hygroscopic Moisture Content (%):	0.0

pH Value of Soil-Lime-Water Mixtures

Lime (%)	2	4	6	8	10
Soil (g)	30.0	30.0	30.0	30.0	30.0
Lime (g)	0.6	1.2	1.8	2.4	3.0
Water (ml)	150	150	150	150	150
pH Value	11.79	12.41	12.44	12.47	12.46



Determining Stabilization Ability of Lime by the Soil pH Method

Ennis Municipal Airport

Ellis, Texas

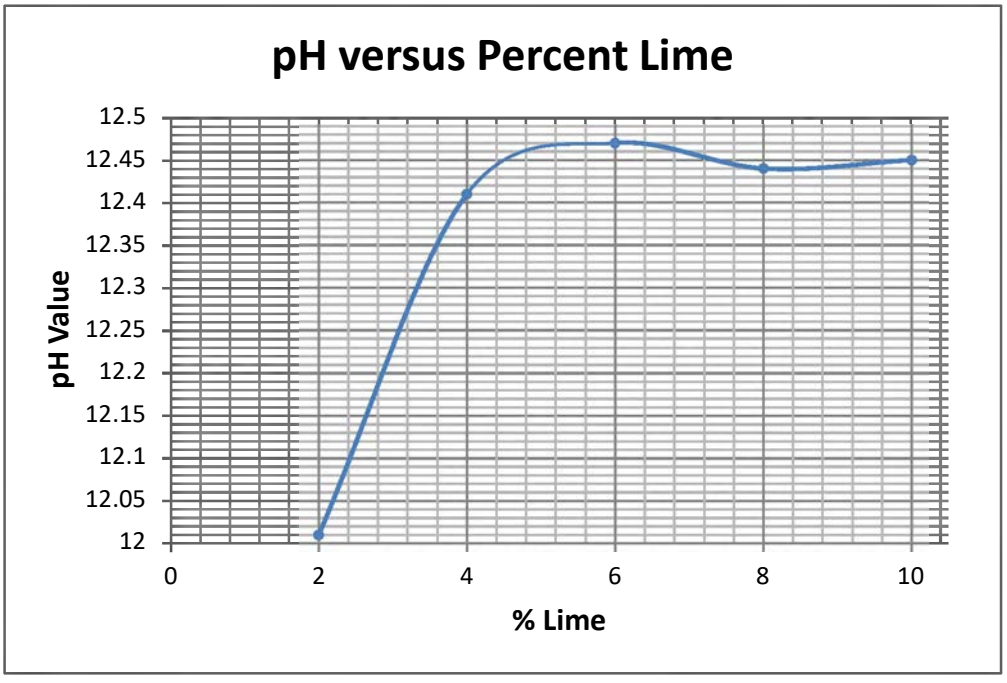
Sample from CBR #3

Water Content of Air-Dried Sample

Mass of Wet Sample + Tare (g):	0.0
Mass of Dry Sample + Tare (g):	0.0
Tare Mass (g):	0.0
Hygroscopic Moisture Content (%):	0.0

pH Value of Soil-Lime-Water Mixtures

Lime (%)	2	4	6	8	10
Soil (g)	30.0	30.0	30.0	30.0	30.0
Lime (g)	0.6	1.2	1.8	2.4	3.0
Water (ml)	150	150	150	150	150
pH Value	12.01	12.41	12.47	12.44	12.45



Appendix G:

Flexible Pavement Section

Federal Aviation Administration FAARFIELD 2.1 Structure Report

FAARFIELD 2.1.1 (Build 12/21/2023)

Job Name: Ennis Pavement_250701

Structure: Taxiway Extension

Analysis Type: HMA on Aggregate

Last Run: Life/Compaction Analysis 2025-07-01 16:43:49

Calculated Life = 30.9 Years

Total thickness to the top of the subgrade = 10.5in.

Pavement Structure Information by Layer

No.	Type	Thickness (in.)	Modulus (psi)	CBR	Poisson's Ratio	Strength R (psi)
1	P-401/P-403 HMA Surface	4.0	200,000	0	0.35	0
2	P-209 Crushed Aggregate	6.5	16,256	0	0.35	0
3	Subgrade	0	4,500	3	0.35	0

Airplane Information

No.	Name	Gross Wt. (lbs)	Annual Departures	% Annual Growth
1	Beechcraft Bonanza F33A	3,412	60	3
2	Beechcraft Bonanza F33A	3,412	210	3
3	Beechcraft Bonanza F33A	3,412	120	3
4	Cessna 172 Skyhawk	2,558	600	3
5	PA-28R-200 Cherokee Arrow	2,500	270	3
6	PA-46-350P Malibu Mirage	4,118	30	3
7	S-5	5,000	270	3
8	S-5	5,000	30	3
9	Beechcraft King Air B200	12,590	900	3
10	S-10	10,000	270	3
11	Beechcraft Bonanza F33A	3,412	870	3
12	S-3	3,000	30	3
13	PA-34-220T Seneca II/ III/ IV/V	4,570	30	3
14	Beechcraft Bonanza F33A	3,412	30	3
15	Beechcraft King Air C90	9,710	420	3
16	PA-46-350P Malibu Mirage	4,118	60	3
17	Cessna 208B Grand Caravan EX	8,750	30	3
18	S-3	3,000	30	3
19	Cessna 182 Skylane	3,110	120	3
20	Beechcraft King Air 350	15,100	30	3
21	S-5	5,000	60	3
22	D-15	15,000	120	3
23	S-3	3,000	150	3
24	S-10	10,000	30	3
25	S-5	5,000	90	3
26	S-3	3,000	30	3
27	S-3	3,000	60	3
28	S-5	5,000	30	3
29	S-5	5,000	90	3
30	D-15	15,000	30	3
31	Beechcraft Baron 55	5,424	60	3
32	PA-46-350P Malibu Mirage	4,118	30	3
33	S-10	10,000	30	3
34	S-5	5,000	30	3
35	S-5	5,000	30	3

Additional Airplane Information

Subgrade CDF

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	Beechcraft Bonanza F33A	0.00	0.00	4.79
2	Beechcraft Bonanza F33A	0.00	0.00	4.79
3	Beechcraft Bonanza F33A	0.00	0.00	4.79
4	Cessna 172 Skyhawk	0.00	0.00	5.2
5	PA-28R-200 Cherokee Arrow	0.00	0.00	5.21
6	PA-46-350P Malibu Mirage	0.00	0.00	4.9
7	S-5	0.00	0.00	4.7
8	S-5	0.00	0.00	4.7
9	Beechcraft King Air B200	0.11	0.14	2.93
10	S-10	0.02	0.02	4.09
11	Beechcraft Bonanza F33A	0.00	0.00	4.79
12	S-3	0.00	0.00	5.12
13	PA-34-220T Seneca II/ III/ IV/V	0.00	0.00	4.82
14	Beechcraft Bonanza F33A	0.00	0.00	4.79
15	Beechcraft King Air C90	0.00	0.00	4.2
16	PA-46-350P Malibu Mirage	0.00	0.00	4.9
17	Cessna 208B Grand Caravan EX	0.00	0.00	4.52
18	S-3	0.00	0.00	5.12
19	Cessna 182 Skylane	0.00	0.00	5.03
20	Beechcraft King Air 350	0.06	0.07	2.87
21	S-5	0.00	0.00	4.7
22	D-15	0.31	0.31	2.79
23	S-3	0.00	0.00	5.12
24	S-10	0.00	0.00	4.09
25	S-5	0.00	0.00	4.7
26	S-3	0.00	0.00	5.12
27	S-3	0.00	0.00	5.12
28	S-5	0.00	0.00	4.7
29	S-5	0.00	0.00	4.7
30	D-15	0.08	0.08	2.79
31	Beechcraft Baron 55	0.00	0.00	4.68
32	PA-46-350P Malibu Mirage	0.00	0.00	4.9
33	S-10	0.00	0.00	4.09
34	S-5	0.00	0.00	4.7
35	S-5	0.00	0.00	4.7

Subgrade Compaction Requirements

NonCohesive Soil

Percent Maximum Dry Density(%)	Depth of compaction from pavement surface (in.)	Depth of compaction from top of subgrade (in.)	Critical Airplane for Compaction
100	0 - 5	--	Beechcraft King Air B200
95	5 - 10	--	Beechcraft King Air 350
90	10 - 20	0 - 9	Beechcraft King Air 350
85	20 - 31	9 - 20	Beechcraft King Air 350

Cohesive Soil

Percent Maximum Dry Density(%)	Depth of compaction from pavement surface (in.)	Depth of compaction from top of subgrade (in.)	Critical Airplane for Compaction
95	0 - 4	--	Beechcraft King Air B200
90	4 - 8	--	Beechcraft King Air 350
85	8 - 13	0 - 3	Beechcraft King Air 350
80	13 - 19	3 - 9	Beechcraft King Air 350

Subgrade Compaction Notes:

1. Noncohesive soils, for the purpose of determining compaction control, are those with a plasticity index (PI) less than 3.

2. Tabulated values indicate depth ranges within which densities should equal or exceed the indicated percentage of the maximum dry density as specified in item P-152.

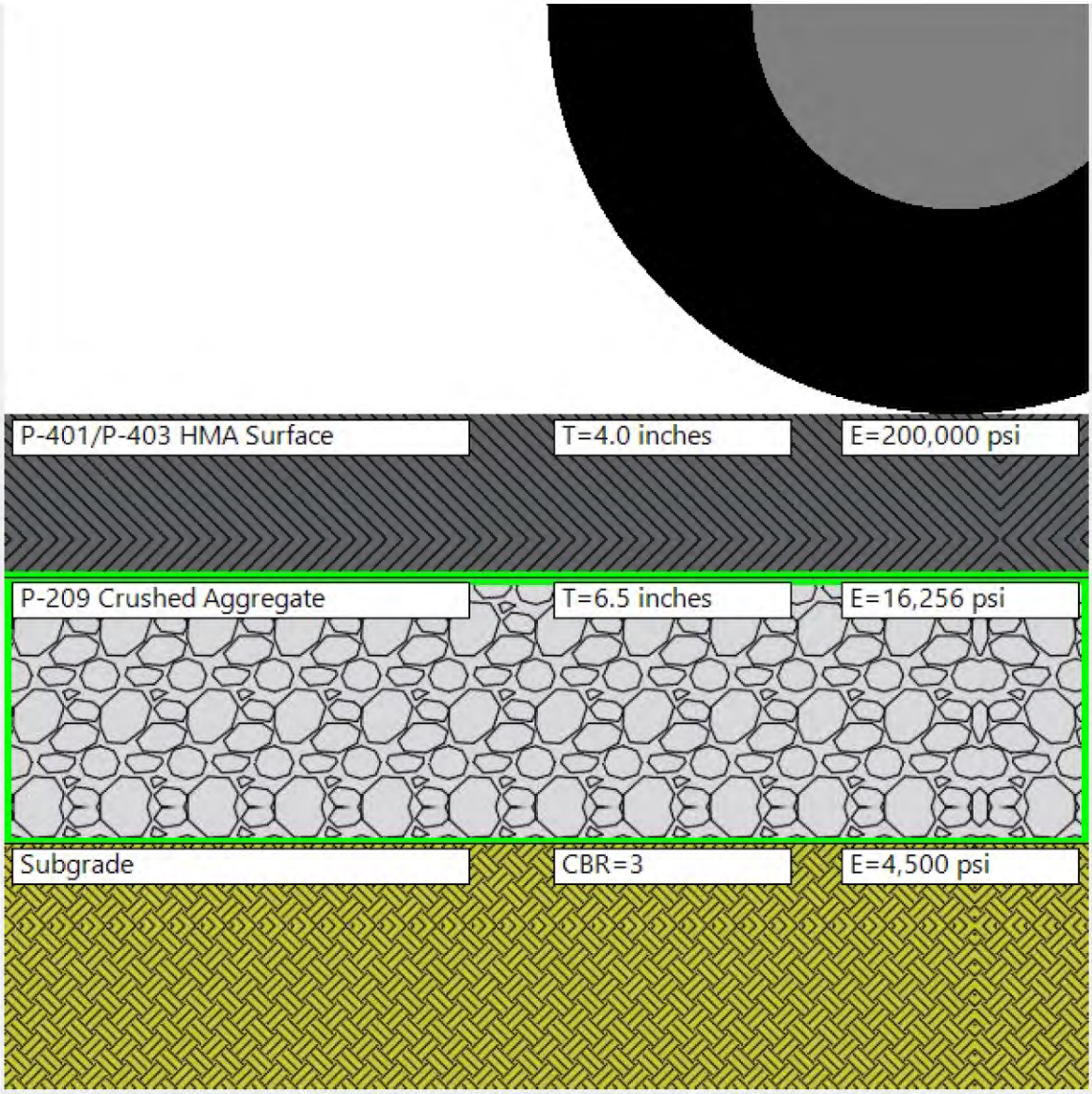
3. Maximum dry density is determined using ASTM Method D 698.

4. The subgrade in cut areas should have natural densities shown or should (a) be compacted from the surface to achieve the required densities, (b) be removed and replaced at the densities shown, or (c) when economics and grades permit, be covered with sufficient select or subbase material so that the uncompacted subgrade is at a depth where the in-place densities are satisfactory.

5. For swelling soils refer to AC 150/5320-6F paragraph 3.10.

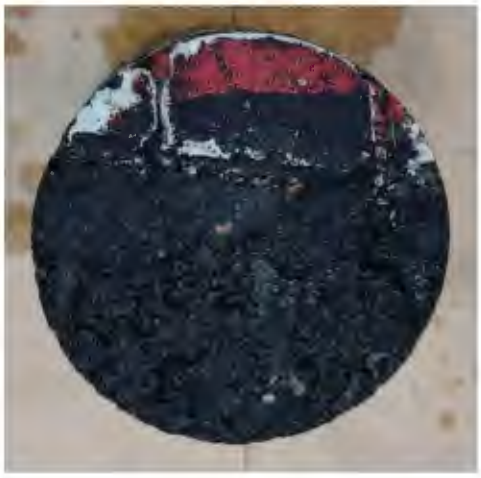
NOTE:

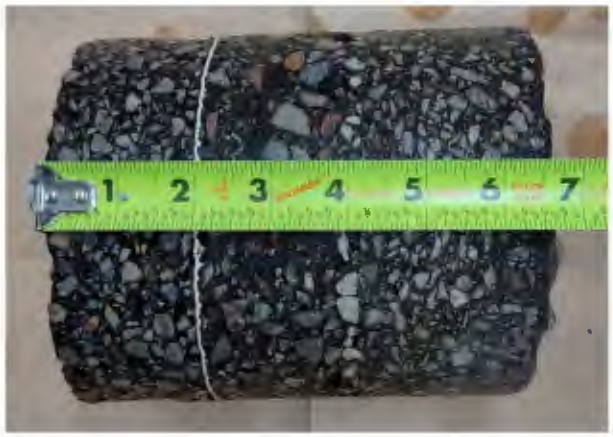
User is responsible for checking frost protection requirements.


P-401/P-403 HMA Surface
T=4.0 inches
E=200,000 psi
P-209 Crushed Aggregate
T=6.5 inches
E=16,256 psi
Subgrade
CBR=3
E=4,500 psi

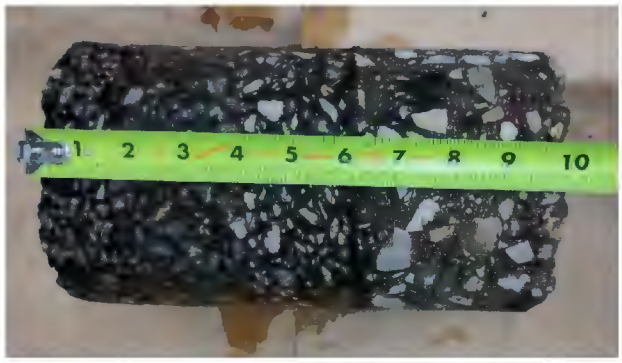
Appendix H:

Core Pictures





Core 1
Asphalt = 6-1/2''

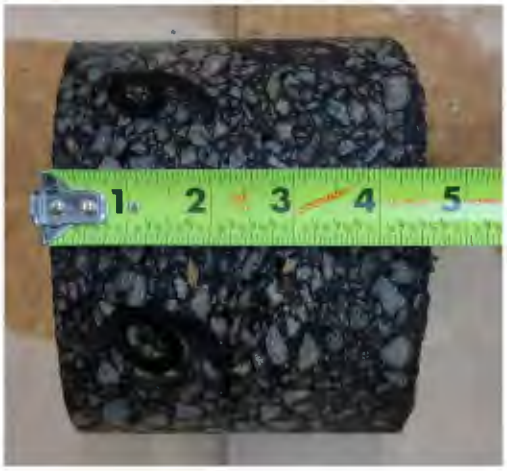


Core 2
Asphalt = 9-7/8''

Core 3
Asphalt = 9'' (The bottom 3" of the core was broken apart and was not retrieved by the core bit)

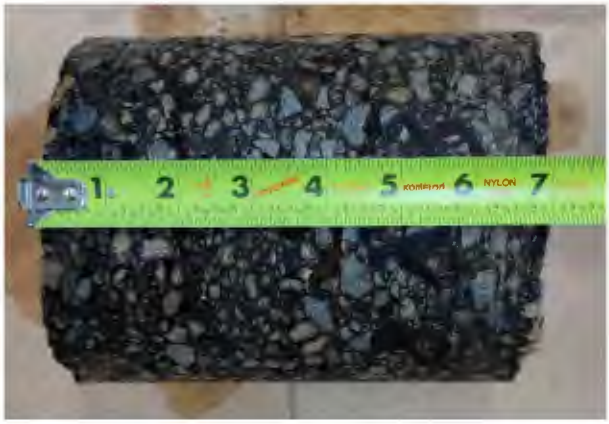
Core 4
Asphalt = 6-3/4''

Core 5
Asphalt = 5-1/2'' (The bottom 2" of the core was broken apart and was not retrieved by the core bit)



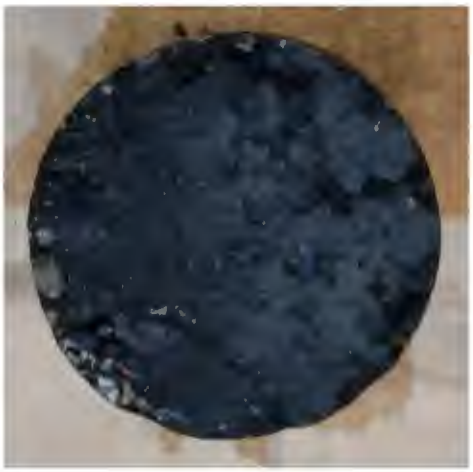
Core 6
Asphalt = 4-1/2''

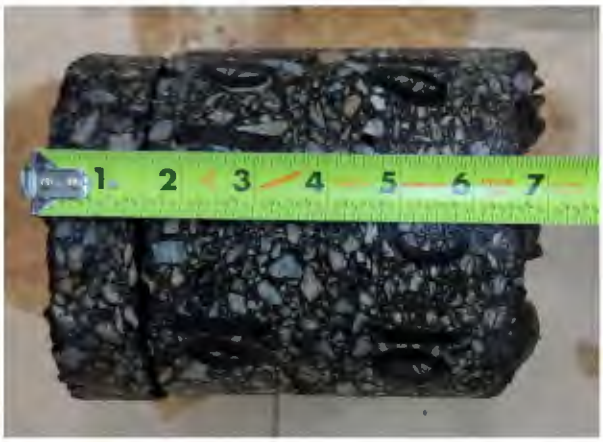
Core 7
Asphalt = 5''



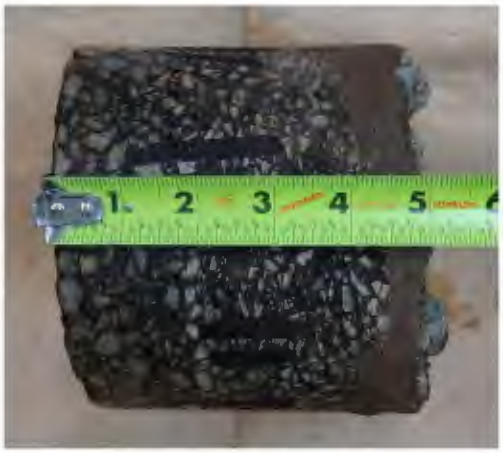
Core 8
Asphalt =6-7/8''

Core 9
Asphalt = 5''

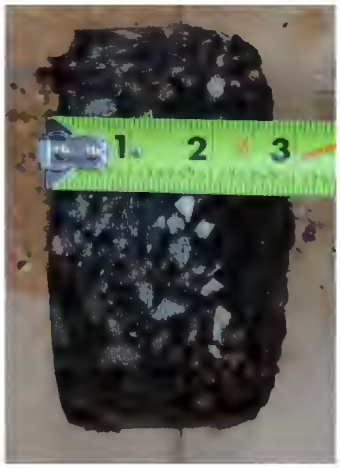




Core 10
Asphalt = 6-3/4”

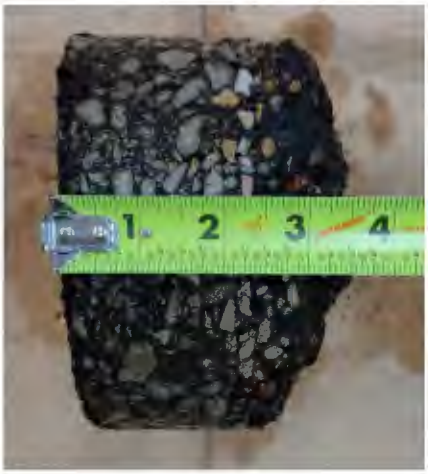


Core 11
Asphalt = 4-7/8”



Core 12
Asphalt = 2-3/4”

Core 13
Asphalt = 2-1/2”

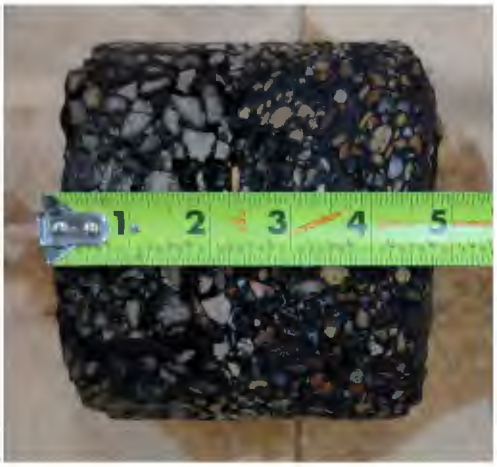


Core 14
Asphalt = 3-1/4”

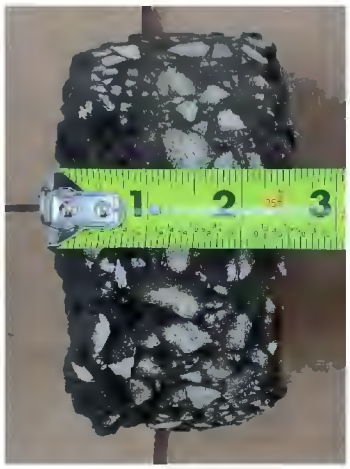
Core 15
Asphalt = 3-3/8”

Core 16
Asphalt = 4-1/2''

Core 17
Asphalt = 5''



Core 18
Asphalt = 4-3/4''

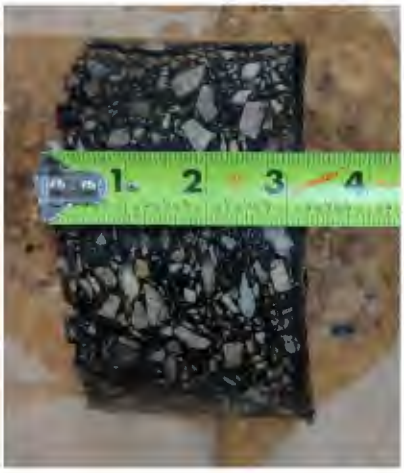


Core 19
Asphalt = 2-1/2”

Core 20
Asphalt = 3-1/4”

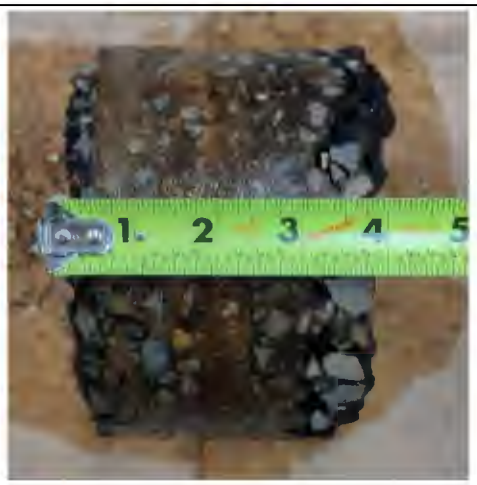
Core 21
Asphalt = 3-5/8”

Core 22
Asphalt = 3-1/2”

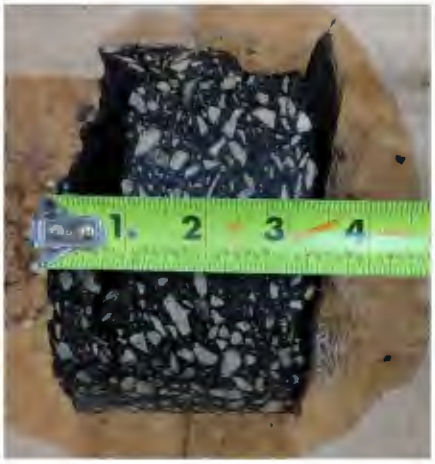


Core 23
Asphalt = 3”

Core 24
Asphalt = 3-5/8”



Core 25A
Asphalt = 3-3/4”



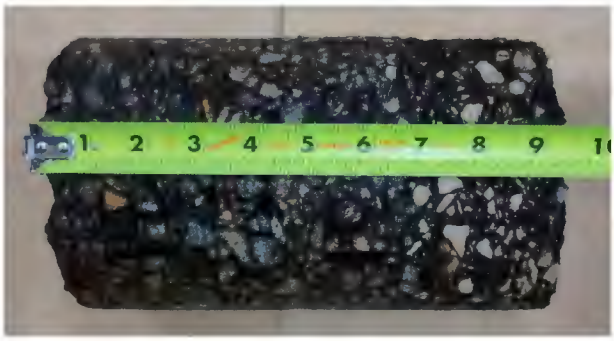
Core 26
Asphalt = 3-1/4”

Core 27
Asphalt = 3-1/4”

Core 28
Asphalt = 3”

Core 29
Asphalt = 3-3/8”

Core 30
Asphalt = 2”



Core 31
Concrete= 9-1/4''

Core 32
Asphalt = 4''

Appendix I:

Test Pit Pictures

Test Pit 1	
	HMAC = 6-3/4” Base = 6-3/4”
Test Pit 2	
	HMAC = 6-1/2” Base = 7-1/2”

Appendix J:

Field Pictures

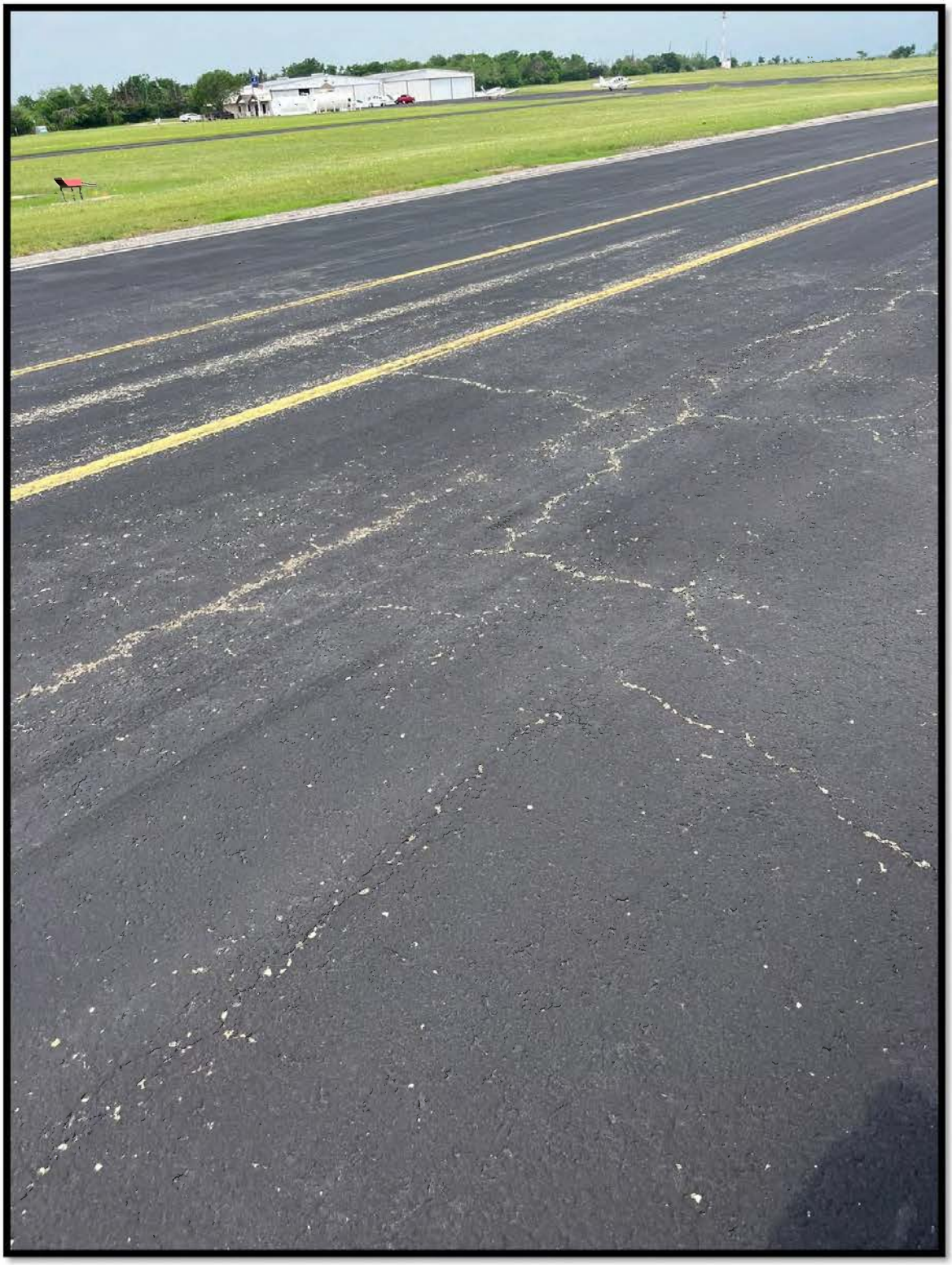


Figure 1: Runway General Condition

Figure 2: Runway General Condition

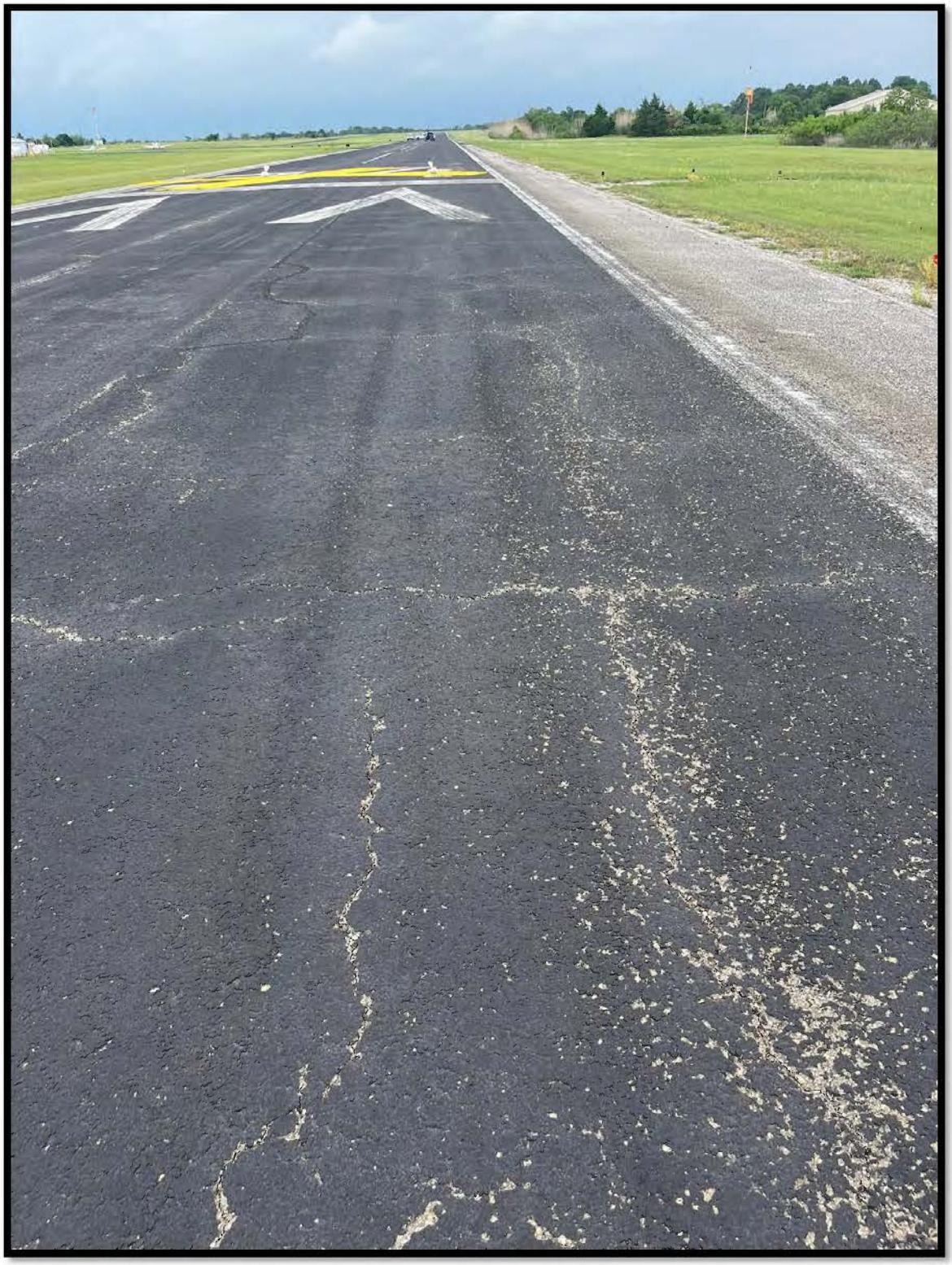


Figure 3: Runway General Condition

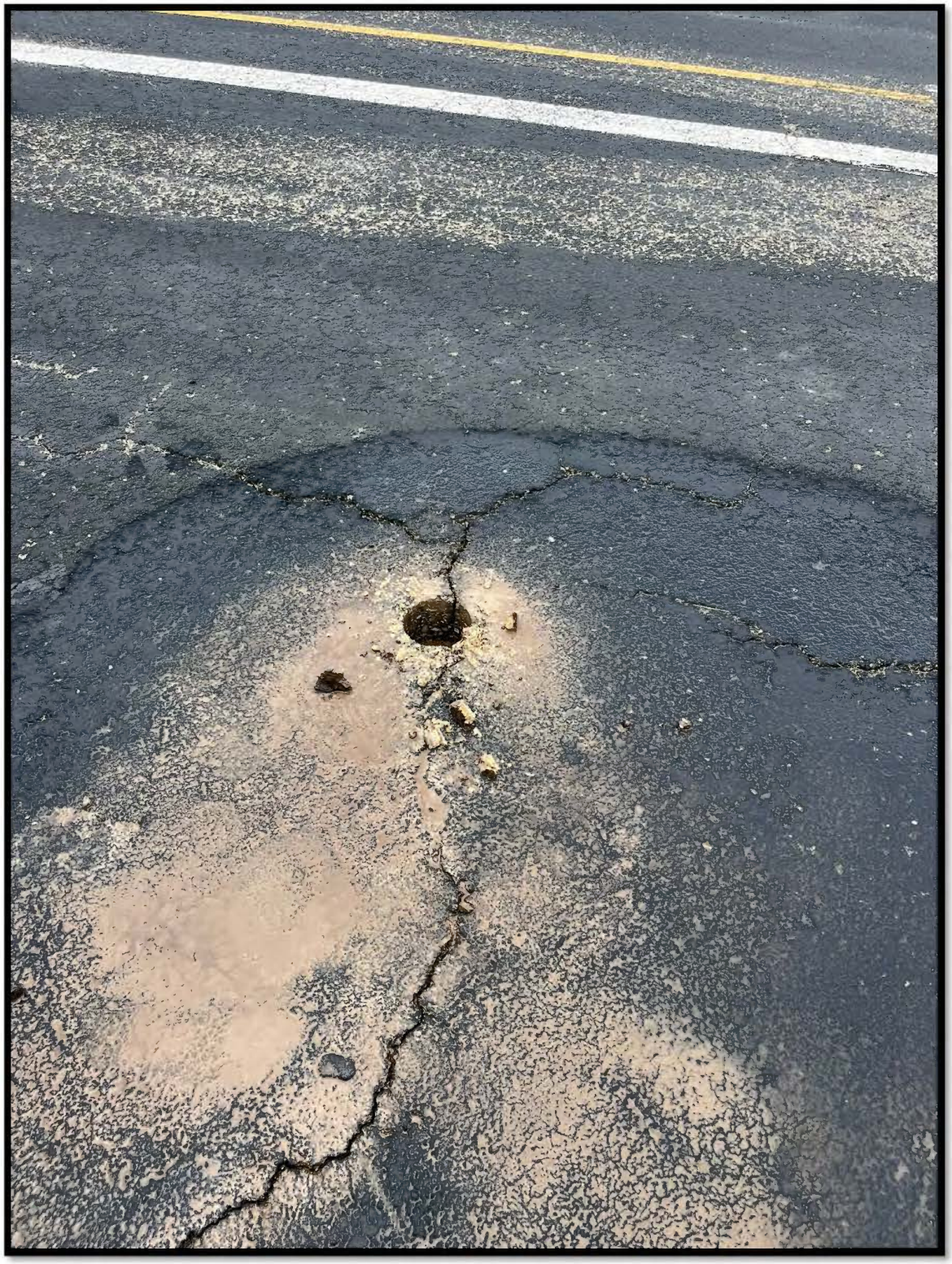


Figure 4: Core Sample Taken at the Crack

Figure 5: Core Sample Taken at the Crack

Figure 6: Core Sample Taken at the Crack

DRAWING INDEX

2618ENNIS INDEX OF DRAWINGS

SHEET NO.	SHEET TITLE	SHEET DESCRIPTION
1	G001	COVER SHEET
2	G002	INDEX OF DRAWINGS AND SUMMARY OF QUANTITIES
3	G003	GENERAL NOTES I
4	G004	GENERAL NOTES II
5	G005	MASTER LEGEND & ABBREVIATIONS
6	G006	PROJECT LAYOUT AND SURVEY CONTROL PLAN
7	G020	GEOTECHNICAL INVESTIGATION PLAN
8	G021	GEOTECHNICAL INVESTIGATION - BORE LOGS I
9	G022	GEOTECHNICAL INVESTIGATION - BORE LOGS II
10	G023	GEOTECHNICAL INVESTIGATION - BORE LOGS III
11	G024	GEOTECHNICAL INVESTIGATION - BORE LOGS IV
12	G025	GEOTECHNICAL INVESTIGATION - BORE LOGS V
13	G026	GEOTECHNICAL INVESTIGATION - BORE LOGS VI
14	G027	GEOTECHNICAL INVESTIGATION - BORE LOGS VII
15	G028	GEOTECHNICAL INVESTIGATION - BORE LOGS VIII
16	G029	GEOTECHNICAL INVESTIGATION - BORE LOGS IX
17	G030	GEOTECHNICAL INVESTIGATION - BORE LOGS X
18	G031	GEOTECHNICAL INVESTIGATION - BORE LOGS XI
19	G032	GEOTECHNICAL INVESTIGATION - BORE LOGS XII
20	G033	GEOTECHNICAL INVESTIGATION - BORE LOGS XIII
21	G034	GEOTECHNICAL INVESTIGATION - BORE LOGS XIV
22	G035	GEOTECHNICAL INVESTIGATION - BORE LOGS XV
23	G036	GEOTECHNICAL INVESTIGATION - BORE LOGS XVI
24	G037	GEOTECHNICAL INVESTIGATION - BORE LOGS XVII
25	G038	GEOTECHNICAL INVESTIGATION - BORE LOGS XVIII
26	G039	GEOTECHNICAL INVESTIGATION - BORE LOGS XIX
27	G050	CONSTRUCTION SAFETY NOTES
28	G051	CONSTRUCTION SAFETY OVERALL PHASING PLAN
29	G052	CONSTRUCTION SAFETY PLAN - PHASE 1A
30	G053	CONSTRUCTION SAFETY PLAN - PHASE 1B
31	G054	CONSTRUCTION SAFETY PLAN - PHASE 2
32	G055	CONSTRUCTION SAFETY DETAILS
33	G056	TRAFFIC CONTROL PLAN
34	G070	EROSION CONTROL NOTES
35	G071	EROSION CONTROL DETAILS
36	G072	ENVIRONMENTAL EXHIBIT
37	C101	DEMOLITION PLAN - STA. 1042+62.72 TO STA. 1038+00, RUNWAY 16/34
38	C102	DEMOLITION PLAN - STA. 1038+00 TO STA. 1031+50, RUNWAY 16/34
39	C103	DEMOLITION PLAN - STA. 1031+50 TO STA. 1025+00, RUNWAY 16/34
40	C104	DEMOLITION PLAN - STA. 1025+00 TO STA. 1018+50, RUNWAY 16/34
41	C105	DEMOLITION PLAN - STA. 1018+50 TO STA. 1012+00, RUNWAY 16/34 AND APRON
42	C105A	DEMOLITION PLAN - MATCHLINE A, APRON
43	C106	DEMOLITION PLAN - STA. 1012+00 TO STA. 1005+50, RUNWAY 16/34
44	C107	DEMOLITION PLAN - STA. 1005+50 TO STA. 1002+44.29, RUNWAY 16/34
45	C108	DEMOLITION PLAN - STA. 1012+00 TO STA. 1005+50 - RUNWAY 16/34, MATCHLINE B, ADDITIVE ALTERNATE BID NO. 1
46	C108A	DEMOLITION PLAN - STA. 1012+00 TO STA 1005+50, RUNWAY 16/34, MATCHLINE B, ADDITIVE ALTERNATE BID NO. 1
47	C109	DEMOLITION PLAN - STA. 1005+50 TO STA. 1002+44.29, RUNWAY 16/34, ADDITIVE ALTERNATE BID NO. 1
48	C201	GEOMETRY PLAN - STA. 1042+61.82 TO STA. 1038+00, RUNWAY 16/34
49	C202	GEOMETRY PLAN - STA. 1038+00 TO STA. 1031+50, RUNWAY 16/34
50	C203	GEOMETRY PLAN - STA. 1031+50 TO STA. 1025+00, RUNWAY 16/34
51	C204	GEOMETRY PLAN - STA. 1025+00 TO STA. 1018+50, RUNWAY 16/34
52	C205	GEOMETRY PLAN - STA. 1018+50 TO STA. 1012+00 AND MATCHLINE A, RUNWAY 16/34
53	C205A	GEOMETRY PLAN - MATCHLINE A, APRON
54	C206	GEOMETRY PLAN - STA. 1012+00 TO STA. 1005+50, RUNWAY 16/34
55	C207	GEOMETRY PLAN - STA. 1005+50 TO STA. 1002+44.29, RUNWAY 16/34
56	C208	GEOMETRY PLAN - STA. 1012+91.5 TO STA. 1006+50, RUNWAY 16/34 ADDITIVE ALTERNATE BID NO. 1
57	C209	GEOMETRY PLAN - STA. 1006+50 TO STA. 1002+44.29, RUNWAY 16/34 ADDITIVE ALTERNATE BID NO. 1
58	C221	TYPICAL SECTIONS
59	C222	PAVEMENT DETAILS

60	C301	GRADING PLAN - STA. 1046+62.72 TO STA. 1038+00, RUNWAY 16/34
61	C302	GRADING PLAN - STA. 1031+50 TO STA. 1038+00, RUNWAY 16/37
62	C303	GRADING PLAN - STAL. 1031+50 TO STA. 1025+00, RUNWAY 16/34
63	C304	GRADING PLAN - STA. 1025+00 TO STA. 1018+50, RUNWAY 16/34
64	C305	GRADING PLAN - STA. 1018+50 TO STA. 1012+00, RUNWAY 16/34
65	C305A	GRADING PLAN - MATCHLINE A, RUNWAY 16/34
66	C306	GRADING PLAN - STA. 1012+00 TO STA. 1005+50, RUNWAY 16/34
67	C307	GRADING PLAN - STA. 1005+50 TO STA. 1002+44.29, RUNWAY 16/34
68	C308	GRADING PLAN - STA. 1012+91.25 TO STA. 1006+50, RUNWAY 16/34, ADDITIVE ALTERNATE BID NO. 1
69	C309	GRADING PLAN - STA. 1006+50 TO STA. 1002+44.29, RUNWAY 16/34, ADDITIVE ALTERNATE BID NO.1
70	C401	PLAN & PROFILE - STA. 1043+50 TO STA. 1033+00, RUNWAY 16/34
71	C402	PLAN & PROFILE - STA. 1033+00 TO STA. 1022+50, RUNWAY 16/34
72	C403	PLAN & PROFILE - STA. 1022+50 TO STA. 1012+00, RUNWAY 16/34
73	C404	PLAN & PROFILE - STA. 1012+00 TO STA. 1002+00, RUNWAY 16/34
74	C405	PLAN & PROFILE - STA. 598+00 TO STA. 610+50, TAXIWAY A
75	C406	PLAN & PROFILE - STA. 610+50 TO STA. 623+00, TAXIWAY A
76	C407	PLAN & PROFILE - STA. 623+00 TO STA. 633+66, TAXIWAY A
77	C408	PLAN & PROFILE - STA. 590+50 TO STA. 603+00, TAXIWAY A, ADDITIVE BID ALTERNATE NO. 1
78	C409	PLAN & PROFILE - TAXIWAY A2, TAXIWAY A3, AND TAXIWAY A4
79	C410	PLAN & PROFILE, TAXIWAY A4, ADDITIVE BID ALTERNATE NO. 1
80	C501	DRAINAGE PLAN AND PROFILE, TAXIWAY A3
81	C502	DRAINAGE PLAN & PROFILE - TAXILANE 1, TAXILANE 2, AND TAXILANE 3 - ADDITIVE ALTERNATE BID NO. 1
82	C701	PAVEMENT MARKING PLAN - STA. 1042+61.82 TO STA. 1038+00, RUNWAY 16/34
83	C702	PAVEMENT MARKING PLAN - STA. 1038+00 TO STA. 1031+50, RUNWAY 16/34
84	C703	PAVEMENT MARKING PLAN - STA. 1031+50 TO STA. 1025+00, RUNWAY 16/34
85	C704	PAVEMENT MARKING PLAN - STA. 1025+00 TO STA. 1018+50, RUNWAY 16/34
86	C705	PAVEMENT MARKING PLAN - STA. 1018+50 TO STA. 1012+00 AND MATCHLINE A, RUNWAY 16/34
87	C705A	PAVEMENT MARKING PLAN - MATCHLINE A, APRON
88	C706	PAVEMENT MARKING PLAN - STA. 1012+00 TO STA. 1005+50, RUNWAY 16/34
89	C707	PAVEMENT MARKING PLAN - STA. 1005+50 TO STA. 1002+44.29, RUNWAY 16/34
90	C708	MARKING PLAN - STA. 1012+91.5 TO STA. 1006+50, RUNWAY 16/37 ADDITIVE ALTERNATE BID NO. 1
91	C709	MARKING PLAN - STA. 1006+50 TO STA. 1002+44.29, RUNWAY 16/34 ADDITIVE ALTERNATE BID NO. 1
92	C721	PAVEMENT MARKING DETAILS
93	E001	ELECTRICAL LEGEND AND NOTES
94	E201	ELECTRICAL GEOMETRY STA. 1043+00 TO STA. 1036+50, RUNWAY 16/34
95	E202	ELECTRICAL GEOMETRY STA. 1036+50 TO STA. 1030+00, RUNWAY 16/34
96	E203	ELECTRICAL GEOMETRY STA. 1030+00 TO STA. 1023+50, RUNWAY 16/34
97	E204	ELECTRICAL GEOMETRY STA. 1023.50 TO STA. 1017+00, RUNWAY 16/34
98	E205	ELECTRICAL GEOMETRYSTA. 1017+00 TO STA. 1010+50, RUNWAY 16/34
99	E206	ELECTRICAL GEOMETRY STA. 1010+50 TO STA. 1005+00, RUNWAY 16/34
100	E207	ELECTRICAL GEOMETRY STA. 1005+00 TO STA. 1002+00, RUNWAY 16/34
101	E250	ELECTRICAL DETAILS AND NOTES
102	E251	ELECTRICAL DETAILS AND NOTES
103	E252	ELECTRICAL DETAILS AND NOTES
104	E253	ELECTRICAL DETAILS AND NOTES
105	E254	ELECTRICAL DETAILS AND NOTES
106	E255	ELECTRICAL DETAILS AND NOTES
107	E256	ELECTRICAL DETAILS AND NOTES
108	SETP-CD-A	SAFETY END TREATMENT FOR DESIGN 1 TO 7 ARCH PIPE CULVERTS - TYPE II ~ CROSS DRAINAGE
109	SETP-CD	FOR 12" DIA TO 60" DIA PIPE CULVERTS - TYPE II ~ CROSS DRAINAGE