

SPECIFICATIONS AND BID ITEMS

FOR THE

Reconstruction of Precinct 4 -Year 2 Roads

Cluster 1

**NCR 1291, NCR 1294 (NORTH), NCR 1294 (SOUTH), WCR
30, WCR 35, WCR 39, & WCR 40**

COUNTY JUDGE

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January 2022

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PART A

STANDARD SPECIFICATIONS

Item 100

Preparing Right of Way



1. DESCRIPTION

Prepare the right of way and designated easements for construction operations by removing and disposing of all obstructions when removal of such obstructions is not specifically shown on the plans to be paid by other Items.

2. CONSTRUCTION

Protect designated features on the right of way and prune trees and shrubs as directed. Do not park equipment, service equipment, store materials, or disturb the root area under the branches of trees designated for preservation. Treat cuts on trees with an approved tree wound dressing within 20 min. of making a pruning cut or otherwise causing damage to the tree when shown on the plans. Follow all local and state regulations when burning. Pile and burn brush at approved locations as directed. Coordinate work with state and federal authorities when working in state or national forests or parks. Test, remove, and dispose of hazardous materials in accordance with Article 6.10., "Hazardous Materials."

Clear areas shown on the plans of all obstructions, except those landscape features that are to be preserved. Such obstructions include remains of houses and other structures, foundations, floor slabs, concrete, brick, lumber, plaster, septic tank drain fields, basements, abandoned utility pipes or conduits, equipment, fences, retaining walls, and other items as specified on the plans. Remove vegetation and other landscape features not designated for preservation, curb and gutter, driveways, paved parking areas, miscellaneous stone, sidewalks, drainage structures, manholes, inlets, abandoned railroad tracks, scrap iron, and debris, whether above or below ground. Removal of live utility facilities is not included in this Item. Remove culverts, storm sewers, manholes, and inlets in proper sequence to maintain traffic and drainage.

Notify the Engineer in writing when items not shown on the plans and not reasonably detectable (buried with no obvious indication of presence) are encountered and required to be removed. These items will be handled in accordance with Article 4.5., "Differing Site Conditions."

Remove obstructions not designated for preservation to 2 ft. below natural ground in areas receiving embankment. Remove obstructions to 2 ft. below the excavation level in areas to be excavated. Remove obstructions to 1 ft. below natural ground in all other areas. Cut trees and stumps off to ground level when allowed by the plans or directed. Plug the remaining ends of abandoned underground structures over 3 in. in diameter with concrete to form a tight closure. Backfill, compact, and restore areas where obstructions have been removed unless otherwise directed. Use approved material for backfilling. Dispose of wells in accordance with Item 103, "Disposal of Wells."

Accept ownership, unless otherwise directed, and dispose of removed materials and debris at locations off the right of way in accordance with local, state, and federal requirements.

3. MEASUREMENT

This Item will be measured by the acre; by the 100-ft. station, regardless of the width of the right of way; or by each tree removed.

4. PAYMENT

For "acre" and "station" measurement, the work performed in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Preparing Right of Way." For "each"

measurement, the work performed in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Preparing Right of Way (Tree)" of the diameter specified. This price is full compensation for pruning of designated trees and shrubs; removal and disposal of structures and obstructions; backfilling of holes; furnishing and placing concrete for plugs; and equipment, labor, tools, and incidentals.

Total payment of this Item will not exceed 10% of the original contract amount until final acceptance. The remainder will be paid on the estimate after the final acceptance under Article 5.12., "Final Acceptance."

Item 216

Proof Rolling



1. DESCRIPTION

Proof-roll earthwork, base, or both to locate unstable areas.

2. EQUIPMENT

- 2.1. **Specified Equipment.** Furnish rollers that weigh at least 25 tons when loaded. The maximum acceptable load is 50 tons. Provide rollers that meet the requirements of Section 210.2.4., "Pneumatic Tire Rollers."
- 2.2. **Alternative Equipment.** The Contractor may use alternate compaction equipment that produces results equivalent to the specified equipment in the same period of time as approved. Discontinue the use of the alternative equipment and furnish the specified equipment if the desired results are not achieved.

3. CONSTRUCTION

Perform proof rolling as directed. Adjust the load and tire inflation pressures within the range of the manufacturer's charts or tabulations, as directed. Make at least 2 coverages with the proof roller. Offset each trip of the roller by at most one tire width. Operate rollers at a speed between 2 and 6 mph, as directed. Correct unstable or nonuniform areas, if found, in accordance with the applicable Item.

4. MEASUREMENT

Rolling will be measured by the hour operated on surfaces being tested.

5. PAYMENT

The work performed and equipment furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Proof Rolling." This price is full compensation for furnishing and operating equipment and for labor, materials, 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. Use Tex-100-E material definitions.

- 2.1. **Aggregate.** Furnish aggregate of the type and grade shown on the plans and meeting the requirements of 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.

Table 1
Material Requirements

Property	Test Method	Grade 1-2	Grade 3	Grade 4 ²	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		
Liquid Limit, % Max	Tex-104-E	40	40	As shown on the plans	35
Plasticity Index, Max ¹	Tex-106-E	10	12	As shown on the plans	10
Plasticity index, Min ¹		As shown on the plans			
Wet ball mill, % Max	Tex-116-E	40	-	As shown on the plans	40
Wet ball mill, % Max increase passing the #40 sieve		20	-	As shown on the plans	20
Min compressive strength, psi	Tex-117-E			As shown on the plans	
lateral pressure 0 psi		35	-		-
lateral pressure 3 psi		-	-		90
lateral pressure 15 psi		175	-		175

- Determine plastic index in accordance with Tex-107-E (linear shrinkage) when liquid limit is unattainable as defined in Tex-104-E.
- Grade 4 may be further designated as Grade 4A, Grade 4B, etc.

- 2.1.1. **Material Tolerances.** The Engineer may accept material if no more than 1 of the 5 most recent gradation tests has an individual sieve outside the specified limits of the gradation.

When target grading is required by the plans, no single failing test may exceed the master grading by more than 5 percentage points on sieves No. 4 and larger or 3 percentage points on sieves smaller than No. 4.

The Engineer may accept material if no more than 1 of the 5 most recent plasticity index tests is outside the specified limit. No single failing test may exceed the allowable limit by more than 2 points.

- 2.1.2. **Material Types.** Do not use fillers or binders unless approved. Furnish the type specified 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 2 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 2 or more crushed faces as determined by Tex-460-A, Part I. Blending of 2 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 in Section 247.2.1.3.2., "Recycled Material (Including Crushed Concrete) Requirements," and be managed in a way to provide for uniform quality. The Engineer may require separate dedicated stockpiles in order to verify compliance.
- 2.1.2.5. **Type E.** Caliche, iron ore or as otherwise shown on the plans.
- 2.1.3. **Recycled Material.** Recycled asphalt pavement (RAP) and other recycled materials may be used when shown on the plans. Request approval to blend 2 or more sources of recycled materials.
- 2.1.3.1. **Limits on Percentage.** Do not exceed 20% RAP by weight, when RAP is allowed, unless otherwise shown on the plans. The percentage limitations for other recycled materials will be as shown on the plans.
- 2.1.3.2. **Recycled Material (Including Crushed Concrete) Requirements.**
- 2.1.3.2.1. **Contractor-Furnished Recycled Materials.** Provide recycled materials that have a maximum sulfate content of 3,000 ppm when tested in accordance with Tex-145-E. When the Contractor furnishes the recycled materials, including crushed concrete, the final product will be subject to the requirements of Table 1 for the grade specified. Certify compliance with DMS-11000, "Evaluating and Using Nonhazardous Recyclable Materials Guidelines," for Contractor furnished recycled materials. In addition, recycled materials must be free from reinforcing steel and other objectionable material and have at most 1.5% deleterious material when tested in accordance with Tex-413-A. For RAP, do 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.
- 2.1.3.2.2. **Department-Furnished Required Recycled Materials.** When the Department furnishes and requires the use of recycled materials, unless otherwise shown on the plans:
- Department-required recycled material will not be subject to the requirements in Table 1,
 - Contractor-furnished materials are subject to the requirements in Table 1 and this Item,
 - the final product, blended, will be subject to the requirements in Table 1, and
 - for final product, unblended (100% Department-furnished required recycled material), the liquid limit, plasticity index, wet ball mill, and compressive strength is waived.
- Crush Department-furnished RAP so that 100% passes the 2 in. sieve. The Contractor is responsible for uniformly blending to meet the percentage required.
- 2.1.3.2.3. **Department-Furnished and Allowed Recycled Materials.** When the Department furnishes and allows the use of recycled materials or allows the Contractor to furnish recycled materials, the final blended product is subject to the requirements of Table 1 and the plans.
- 2.1.3.3. **Recycled Material Sources.** Department-owned recycled material is available to the Contractor only when shown on the plans. Return unused Department-owned recycled materials to the Department stockpile location designated by the Engineer unless otherwise shown on the plans.

The use of Contractor-owned recycled materials is allowed when shown on the plans. Contractor-owned surplus recycled materials 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. Do not intermingle Contractor-owned recycled material with Department-owned recycled material unless approved.

- 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.

3. EQUIPMENT

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

- 3.1. Provide rollers in accordance with Item 210, "Rolling." Provide proof rollers in accordance with Item 216, "Proof Rolling," when required.
- 3.2. 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 shown on the plans. After construction and acceptance of the stockpile, 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 accordance 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, "Proof Rolling," 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 with 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."
- Begin rolling longitudinally at the sides and proceed towards 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 alternate 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 with 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 Control.** Compact to at least 100% of the maximum dry density determined by Tex-113-E, unless otherwise shown on the plans. Maintain moisture during compaction within ± 2 percentage points of the optimum moisture content as determined by Tex-113-E. Measure the moisture content of the material in accordance with Tex-115-E or Tex-103-E during compaction daily and report the results the same day to the Engineer, unless otherwise shown on the plans or directed. Do not achieve density by drying the material after compaction.
- The Engineer will determine roadway density and moisture content of completed sections in accordance with Tex-115-E. The Engineer may accept the section if no more than 1 of the 5 most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.
- 4.4. **Finishing.** After completing compaction, clip, skin, or tight-blade the surface with 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 with 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 feet measured longitudinally or 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 re-compact 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.** This section applies to the final travel lanes that receive a 1 or 2 course surface treatment for the final surface, unless otherwise shown on the plans. Measure ride quality of the base course after placement of the prime coat and before placement of the surface treatment, unless otherwise approved. Use a certified profiler operator from the Department's MPL. When requested, furnish the Engineer documentation for the person certified to operate the profiler.

Provide all profile measurements to the Engineer in electronic data files within 3 days after placement of the prime coat 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 having an average international roughness index (IRI) value greater than 100.0 in. per mile to an IRI value of 100.0 in. per mile or less for each wheelpath, unless otherwise shown on the plans.

Re-profile and correct sections that fail to maintain ride quality until placement of the next course, as directed. Correct re-profiled sections until specification requirements are met, as approved. Perform this work at no additional expense to the Department.

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 for 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.
- 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 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 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 a location approved by the Engineer. Scales must conform to 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 shown 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.

Sprinkling and rolling, except 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, "Proof Rolling."

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 accordance with pertinent Items or 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, and 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, and 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, and equipment, labor, tools, and incidentals.

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 specified on the plans.

2. MATERIALS

Provide asphalt materials that meet the stated requirements when tested in accordance with the referenced Department, AASHTO, and ASTM test methods. Provide asphalt materials that have been preapproved for use by the Construction Division in accordance with Tex-545-C, "Asphalt Binder Quality Program," unless otherwise shown on the plans.

Acronyms used in this Item are defined in Table 1.

Table 1
Acronyms

Acronym	Definition
Test Procedure Designations	
Tex T or R D	Department AASHTO ASTM
Polymer Modifier Designations	
P SBR or L SBS TR	polymer-modified styrene-butadiene rubber (latex) styrene-butadiene-styrene block co-polymer tire rubber (from ambient temperature grinding of truck and passenger tires)
AC	asphalt cement
AE	asphalt emulsion
AE-P	asphalt emulsion prime
A-R	asphalt-rubber
C	cationic
EAP&T	emulsified asphalt prime and tack
H-suffix	harder residue (lower penetration)
HF	high float
MC	medium-curing
MS	medium-setting
PCE	prime, cure, and erosion control
PG	performance grade
RC	rapid-curing
RS	rapid-setting
S-suffix	stockpile usage
SCM	special cutback material
SS	slow-setting

- 2.1. **Asphalt Cement.** Provide asphalt cement that is homogeneous, water-free, and nonfoaming when heated to 347°F, and meets the requirements in Table 2.

Table 2
Asphalt Cement

Property	Test Procedure	Viscosity Grade									
		AC-0.6		AC-1.5		AC-3		AC-5		AC-10	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity 140°F, poise 275°F, poise	T 202	40 0.4	80 -	100 0.7	200 -	250 1.1	350 -	400 1.4	600 -	800 1.9	1,200 -
Penetration, 77°F, 100g, 5 sec.	T 49	350	-	250	-	210	-	135	-	85	-
Flash point, C.O.C., °F	T 48	425	-	425	-	425	-	425	-	450	-
Solubility in trichloroethylene, %	T 44	99.0	-	99.0	-	99.0	-	99.0	-	99.0	-
Spot test	Tex-509-C	Neg.		Neg.		Neg.		Neg.		Neg.	
Tests on residue from Thin-Film Oven Test: Viscosity, 140°F, poise Ductility, ¹ 77°F 5 cm/min., cm	T 179 T 202 T 51	- 100	180 -	- 100	450 -	- 100	900 -	- 100	1,500 -	- 100	3,000 -

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 asphalt cement that is smooth, homogeneous, and meets the requirements of Table 3. Supply samples of the base asphalt cement and polymer additives if requested.

Table 3
Polymer-Modified Asphalt Cement

Property	Test Procedure	Polymer-Modified Viscosity Grade											
		AC-5 w/2% SBR		AC-10 w/2% SBR		AC-15P		AC-20XP		AC-10-2TR		AC-20-5TR	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Polymer		SBR		SBR		SBS		SBS		TR		TR	
Polymer content, % (solids basis)	Tex-533-C	2.0	-	2.0	-	3.0	-	-	-	2.0	-	5.0	-
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	-	-	-
Viscosity 140°F, poise 275°F, poise	T 202 T 202	700 -	- 7.0	1,300 -	- 8.0	1,500 -	- 8.0	2,000 -	- -	1,000 -	- 8.0	2,000 -	- 10.0
Penetration, 77°F, 100 g, 5 sec.	T 49	120	-	80	-	100	150	75	115	95	130	75	115
Ductility, 5cm/min., 39.2°F, cm	T 51	70	-	60	-	-	-	-	-	-	-	-	-
Elastic recovery, 50°F, %	Tex-539-C	-	-	-	-	55	-	55	-	30	-	55	-
Softening point, °F	T 53	-	-	-	-	-	-	120	-	110	-	120	-
Polymer separation, 48 hr.	Tex-540-C	None		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: Creep stiffness S, -18°C, MPa m-value, -18°C	Tex-541-C and R 28 T 313	-	-	-	-	-	300	-	300	-	300	-	300
		-	-	-	-	0.300	-	0.300	-	0.300	-	0.300	-

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

Table 4
Rapid-Curing Cutback Asphalt

Property	Test Procedure	Type-Grade					
		RC-250		RC-800		RC-3000	
		Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	250	400	800	1,600	3,000	6,000
Water, %	D95	–	0.2	–	0.2	–	0.2
Flash point, T.O.C., °F	T 79	80	–	80	–	80	–
Distillation test:	T 78						
Distillate, percentage by volume of total distillate to 680°F							
to 437°F		40	75	35	70	20	55
to 500°F		65	90	55	85	45	75
to 600°F		85	–	80	–	70	–
Residue from distillation, volume %		70	–	75	–	82	–
Tests on distillation residue:							
Viscosity, 140°F, poise	T 202	60	240	60	240	60	240
Ductility, 5 cm/min., 77°F, cm	T 51	100	–	100	–	100	–
Solubility in trichloroethylene, %	T 44	99.0	–	99.0	–	99.0	–
Spot test	Tex-509-C	Neg.		Neg.		Neg.	

Table 5
Medium-Curing Cutback Asphalt

Property	Test Procedure	Type-Grade							
		MC-30		MC-250		MC-800		MC-3000	
		Min	Max	Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	30	60	250	500	800	1,600	3,000	6,000
Water, %	D95	–	0.2	–	0.2	–	0.2	–	0.2
Flash point, T.O.C., °F	T 79	95	–	122	–	140	–	149	–
Distillation test:	T 78								
Distillate, percentage by volume of total distillate to 680°F									
to 437°F		–	35	–	20	–	–	–	–
to 500°F		30	75	5	55	–	40	–	15
to 600°F		75	95	60	90	45	85	15	75
Residue from distillation, volume %		50	–	67	–	75	–	80	–
Tests on distillation residue:									
Viscosity, 140°F, poise	T 202	30	120	30	120	30	120	30	120
Ductility, 5 cm/min., 77°F, cm	T 51	100	–	100	–	100	–	100	–
Solubility in trichloroethylene, %	T 44	99.0	–	99.0	–	99.0	–	99.0	–
Spot test	Tex-509-C	Neg.		Neg.		Neg.		Neg.	

Table 6
Special-Use Cutback Asphalt

Property	Test Procedure	Type-Grade					
		MC-2400L		SCM I		SCM II	
		Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	2,400	4,800	500	1,000	1,000	2,000
Water, %	D95	–	0.2	–	0.2	–	0.2
Flash point, T.O.C., °F	T 79	150	–	175	–	175	–
Distillation test:	T 78						
Distillate, percentage by volume of total distillate to 680°F							
to 437°F		–	–	–	–	–	–
to 500°F		–	35	–	0.5	–	0.5
to 600°F		35	80	20	60	15	50
Residue from distillation, volume %		78	–	76	–	82	–
Tests on distillation residue:							
Polymer		SBR		–		–	
Polymer content, % (solids basis)	Tex-533-C	2.0	–	–	–	–	–
Penetration, 100 g, 5 sec., 77°F	T 49	150	300	180	–	180	–
Ductility, 5 cm/min., 39.2°F, cm	T 51	50	–	–	–	–	–
Solubility in trichloroethylene, %	T 44	99.0	–	99.0	–	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 in Tables 7, 8, 9, and 10.

Table 7
Emulsified Asphalt

Property	Test Procedure	Type-Grade									
		Rapid-Setting		Medium-Setting				Slow-Setting			
		HFRS-2		MS-2		AES-300		SS-1		SS-1H	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72										
77°F, sec.		–	–	–	–	75	400	20	100	20	100
122°F, sec.		150	400	100	300	–	–	–	–	–	–
Sieve test, %	T 59	–	0.1	–	0.1	–	0.1	–	0.1	–	0.1
Miscibility	T 59	–		–		–		Pass		Pass	
Cement mixing, %	T 59	–	–	–	–	–	–	–	2.0	–	2.0
Coating ability and water resistance:	T 59										
Dry aggregate/after spray		–	–	–	–	Good/Fair	–	–	–	–	–
Wet aggregate/after spray		–	–	–	–	Fair/Fair	–	–	–	–	–
Demulsibility, 35 ml of 0.02 N CaCl ₂ , %	T 59	50	–	–	30	–	–	–	–	–	–
Storage stability, 1 day, %	T 59	–	1	–	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	–	65	–	60	–	60	–
Oil distillate, % by volume of emulsion		–	0.5	–	0.5	–	5	–	0.5	–	0.5
Tests on residue from distillation:											
Penetration, 77°F, 100 g, 5 sec.	T 49	100	140	120	160	300	–	120	160	70	100
Solubility in trichloroethylene, %	T 44	97.5	–	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	–	–	–	1,200	–	–	–	–	–

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		CRS-2H		CMS-2		CMS-2S		CSS-1		CSS-1H	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec. 122°F, sec.	T 72	-	-	-	-	-	-	-	-	20	100	20	100
		150	400	150	400	100	300	100	300	-	-	-	-
Sieve test, %	T 59	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1
Cement mixing, %	T 59	-	-	-	-	-	-	-	-	-	2.0	-	2.0
Coating ability and water resistance: Dry aggregate/after spray Wet aggregate/after spray	T 59	-	-	-	-	Good/Fair	Good/Fair	Good/Fair	Good/Fair	-	-	-	-
		-	-	-	-	Fair/Fair	Fair/Fair	Fair/Fair	Fair/Fair	-	-	-	-
Demulsibility, 35 ml of 0.8% Sodium dioctyl sulfosuccinate, %	T 59	70	-	70	-	-	-	-	-	-	-	-	-
Storage stability, 1 day, %	T 59	-	1	-	1	-	1	-	1	-	1	-	1
Particle charge	T 59	Positive		Positive		Positive		Positive		Positive		Positive	
Distillation test: Residue by distillation, % by wt. Oil distillate, % by volume of emulsion	T 59	65	-	65	-	65	-	65	-	60	-	60	-
		-	0.5	-	0.5	-	7	-	5	-	0.5	-	0.5
Tests on residue from distillation: Penetration, 77°F, 100 g, 5 sec. Solubility in trichloroethylene, % Ductility, 77°F, 5 cm/min., cm	T 49	120	160	70	110	120	200	300	-	120	160	70	110
	T 44	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-
	T 51	100	-	80	-	100	-	-	-	100	-	80	-

Table 9
Polymer-Modified Emulsified Asphalt

Property	Test Procedure	Type-Grade											
		Rapid-Setting				Medium-Setting				Slow-Setting			
		RS-1P		HFRS-2P		AES-150P		AES-300P		AES-300S		SS-1P	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec. 122°F, sec.	T 72	-	-	-	-	75	400	75	400	75	400	30	100
		50	200	150	400	-	-	-	-	-	-	-	-
Sieve test, %	T 59	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1
Miscibility	T 59	-	-	-	-	-	-	-	-	-	-	-	Pass
Coating ability and water resistance: Dry aggregate/after spray Wet aggregate/after spray	T 59	-	-	-	-	Good/Fair	Good/Fair	Good/Fair	Good/Fair	Good/Fair	Good/Fair	-	-
		-	-	-	-	Fair/Fair	Fair/Fair	Fair/Fair	Fair/Fair	Fair/Fair	Fair/Fair	-	-
Demulsibility, 35 ml of 0.02 N CaCl ₂ , %	T 59	60	-	50	-	-	-	-	-	-	-	-	-
Storage stability, 1 day, %	T 59	-	1	-	1	-	1	-	1	-	1	-	1
Breaking index, g	Tex-542-C	-	80	-	-	-	-	-	-	-	-	-	-
Distillation test: ¹ Residue by distillation, % by wt. Oil distillate, % by volume of emulsion	T 59	65	-	65	-	65	-	65	-	65	-	60	-
		-	3	-	0.5	-	3	-	5	-	7	-	0.5
Tests on residue from distillation: Polymer content, wt. % (solids basis) Penetration, 77°F, 100 g, 5 sec. Solubility in trichloroethylene, % Viscosity, 140°F, poise Float test, 140°F, sec. Ductility, ² 39.2°F, 5 cm/min., cm Elastic recovery, ² 50°F, %	Tex-533-C	-	-	3.0	-	-	-	-	-	-	-	3.0	-
	T 49	225	300	90	140	150	300	300	-	300	-	100	140
	T 44	97.0	-	97.0	-	97.0	-	97.0	-	97.0	-	97.0	-
	T 202	-	-	1,500	-	-	-	-	-	-	-	1,300	-
	T 50	-	-	1,200	-	1,200	-	1,200	-	1,200	-	-	-
	T 51	-	-	50	-	-	-	-	-	-	-	50	-
	Tex-539-C	55	-	55	-	-	-	-	-	-	-	-	-
Tests on RTFO curing of distillation residue Elastic recovery, 50°F, %	Tex-541-C	-	-	-	-	50	-	50	-	30	-	-	-
	Tex-539-C	-	-	-	-	-	-	-	-	-	-	-	-

- Exception to T 59: Bring the temperature on the lower thermometer slowly to 350°F ±10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 min. (±5 min.) from the first application of heat.
- 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-1P		CRS-2P		CHFRS-2P		CMS-1P ³		CMS-2P ³		CSS-1P	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec. 122°F, sec.	T 72	-	-	-	-	-	-	20	100	-	-	20	100
		50	150	150	400	100	400	-	-	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	60	-	70	-	60	-	-	-	-	-	-	-
Storage stability, 1 day, %	T 59	-	1	-	1	-	1	-	-	-	-	-	1
Breaking index, g	Tex-542-C	-	80	-	-	-	-	-	-	-	-	-	-
Particle charge	T 59	Positive		Positive		Positive		Positive		Positive		Positive	
Distillation test: ¹ Residue by distillation, % by weight Oil distillate, % by volume of emulsion	T 59	65	-	65	-	65	-	65	-	65	-	62	-
		-	3	-	0.5	-	0.5	-	0.5	-	0.5	-	0.5
Tests on residue from distillation: Polymer content, wt. % (solids basis)	Tex-533-C	-	-	3.0	-	3.0	-	-	-	-	-	3.0	-
Penetration, 77°F, 100 g, 5 sec.	T 49	225	300	90	150	80	130	40	-	40	-	55	90
Viscosity, 140°F, poise	T 202	-	-	1,300	-	1,300	-	-	5,000	-	5,000	-	-
Solubility in trichloroethylene, %	T 44	97.0	-	97.0	-	95.0	-	-	-	-	-	97.0	-
Softening point, °F	T 53	-	-	-	-	130	-	-	-	-	-	135	-
Ductility, 77°F, 5 cm/min., cm	T 51	-	-	-	-	-	-	-	-	-	-	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	45	-	55	-	55	-	45	-	45	-	-	-
Tests on rejuvenating agent: Viscosity, 140°F, cSt	T 201	-	-	-	-	-	-	50	175	50	175	-	-
Flash point, C.O.C., °F	T 48	-	-	-	-	-	-	380	-	380	-	-	-
Saturates, % by weight	D2007	-	-	-	-	-	-	-	30	-	30	-	-
Solubility in n-pentane, % by weight	D2007	-	-	-	-	-	-	99	-	99	-	-	-
Tests on rejuvenating agent after TFO or RTFO:	T 240 or T 179												
Weight Change, %		-	-	-	-	-	-	-	6.5	-	6.5	-	-
Viscosity Ratio		-	-	-	-	-	-	-	3.0	-	3.0	-	-
Tests on latex: ⁴ Tensile strength, die C dumbbell, psi	D412 ⁵	-	-	-	-	-	-	500	-	500	-	-	-
Change in mass after immersion in rejuvenating agent, %	D471	-	-	-	-	-	-	-	40 ⁶	-	40 ⁶	-	-

- Exception to T 59: Bring the temperature on the lower thermometer slowly to 350°F (±0°F). Maintain at this temperature for 20 min. Complete total distillation in 60 min. (±5 min.) from the first application of heat.
- CRS-2P must meet one of either the ductility or elastic recovery requirements.
- With all precertification samples of CMS-1P or CMS-2P, submit certified test reports showing that the rejuvenating agent and latex meet the stated requirements. Submit samples of these raw materials if requested by the Engineer.
- Preparation of latex films: Use any substrate which produces a film of uniform cross-section. Apply latex using a drawdown tool that will deliver enough material to achieve desired residual thickness. Cure films for 14 days at 75°F and 50% relative humidity.
- Cut samples for tensile strength determination using a crosshead speed of 20 in./min.
- Specimen must remain intact after exposure and removal of excess rejuvenating agent.

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

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 77°F, sec. 122°F, sec.	T 72	– 15	– 150	– –	– –	10 –	100 –
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: Residue after both distillations, % by wt. Total oil distillate from both distillations, % by volume of emulsion	T 59 & T 78	40 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 Kinematic viscosity, ⁵ 140°F, cSt Flash point C.O.C., °F Solubility in trichloroethylene, % Float test, 122°F, sec.	T 202 T 201 T 48 T 44 T 50	– – – 97.5 50	– – – – 200	800 – – – –	– – – – –	– 100 400 – –	– 350 – – –

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 (PCBs) have been mixed with the product; and
a Material Safety Data Sheet.

Exception to T 59: In dilution, use 350 ml of distilled or deionized water and a 1,000-ml beaker.

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.

Exception to T 59: Leave sample in the oven until foaming ceases, then cool and weigh.

PCE must meet either the kinematic viscosity requirement or the particle size requirement.

- 2.6. **Recycling Agent.** Recycling agent and emulsified recycling agent must meet the requirements in Table 12. Additionally, recycling agent and residue from emulsified recycling agent, when added in the specified proportions to the recycled asphalt, must meet the properties specified on the plans.

Table 12
Recycling Agent and Emulsified Recycling Agent

Property	Test Procedure	Recycling Agent		Emulsified Recycling Agent	
		Min	Max	Min	Max
Viscosity, Saybolt Furol, 77°F, sec.	T 72	–	–	15	100
Sieve test, %	T 59	–	–	–	0.1
Miscibility ¹	T 59	–	–	No coagulation	
Residue by evaporation, ² % by wt.	T 59	–	–	60	–
Tests on recycling agent or residue from evaporation: Flash point, C.O.C., °F Kinematic viscosity, 140°F, cSt 275°F, cSt	T 48 T 201	400 75	– 200	400 75	– 200
		–	10.0	–	10.0

1. Exception to T 59: Use 0.02 N CaCl₂ solution in place of water.

2. Exception to T 59: Maintain sample at 300°F until foaming ceases, then cool and weigh.

- 2.7. **Crumb Rubber Modifier.** Crumb rubber modifier (CRM) consists of automobile and truck tires processed by ambient temperature grinding.

CRM must be:

- free from contaminants including fabric, metal, and mineral and other nonrubber substances;
- free-flowing; and
- nonfoaming when added to hot asphalt binder.

Ensure rubber gradation meets the requirements of the grades in Table 13 when tested in accordance with Tex-200-F, Part I, using a 50-g sample.

Table 13
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	–	–		

- 2.8. **Crack Sealer.** Provide polymer-modified asphalt-emulsion crack sealer meeting the requirements of Table 14. Provide rubber-asphalt crack sealer meeting the requirements of Table 15.

Table 14
Polymer-Modified Asphalt-Emulsion 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	Tex-543-C		
Residue by evaporation, % by wt.		65	–
Tests on residue from evaporation:			
Penetration, 77°F, 100 g, 5 sec.	T 49	35	75
Softening point, °F	T 53	140	–
Ductility, 39.2°F, 5 cm/min., cm	T 51	100	–

Table 15
Rubber-Asphalt Crack Sealer

Property	Test Procedure	Class A		Class B	
		Min	Max	Min	Max
CRM content, Grade A or 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, 20°F ⁴	D5329	–	–	–	Pass

1. Provide certification that the Min % virgin rubber was added.
2. Agitate the sealing compound with a 3/8- to 1/2-in. (9.5- to 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 to 10 rapid circular strokes. Accomplish agitation in 3 to 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 over 1/4 in. deep for any specimen after completion of the test.

- 2.9. **Asphalt-Rubber Binders.** Provide asphalt-rubber (A-R) binders that are mixtures of asphalt binder and CRM, which have been reacted at elevated temperatures. Provide A-R binders meeting D6114 and containing a minimum of 15% CRM by weight. Provide Types I or II, containing CRM Grade C, for use in hot-

mixed aggregate mixtures. Provide Types II or III, containing CRM Grade B, for use in surface treatment binder. Ensure binder properties meet the requirements of Table 16.

Table 16
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 Thin-Film Oven Test:	T 179						
Retained penetration ratio, 39.2°F, 200 g, 60 sec., % of original	T 49	75	–	75	–	75	–

- 2.10. **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 of Table 17.

Separation testing is not required if:

- a modifier is introduced separately at the mix plant either by injection in the asphalt line or mixer,
- the binder is blended on site 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 17
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, ⁷ Test temperature @ 10 rad/sec., °C	58			64			70			76			82					
Elastic recovery, D6084, 50°F, % Min	-	-	30	-	-	30	50	-	30	50	60	30	50	60	70	50	60	70
Rolling Thin-Film Oven (Tex-541-C)																		
Mass loss, Tex-541-C, Max, %	1.0																	
Dynamic shear, T 315: G*/sin(δ), Min, 2.20 kPa, Max, 5.00 kPa, ⁷ Test temperature @ 10 rad/sec., °C	58			64			70			76			82					
Pressure Aging Vessel (PAV) Residue (R 28)																		
PAV aging temperature, °C	100																	
Dynamic shear, T 315: G*/sin(δ), Max, 5,000 kPa 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: ^{5,6} 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: ⁶ 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

- Pavement temperatures are estimated from air temperatures using an algorithm contained in a Department-supplied computer program, may be provided by the Department, or by following the procedures outlined in AASHTO MP 2 and PP 28.
- 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).
- 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.
- 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 viscometry (T 316).
- Silicone beam molds, as described in AASHTO TP 1-93, are acceptable for use.
- 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.
- Maximum values for unaged and RTFO aged dynamic shear apply only to materials used as substitute binders, as described in specification items, 340, 341, and 344.

3. EQUIPMENT

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

4. CONSTRUCTION

Typical Material Use. Use materials shown in Table 18, unless otherwise determined by the Engineer.

Table 18
Typical Material Use

Material Application	Typically Used Materials
Hot-mixed, hot-laid asphalt mixtures	PG binders, A-R binders Types I and II
Surface treatment	AC-5, AC-10, AC-5 w/2% SBR, AC-10 w/2% SBR, AC-15P, AC-20XP, AC-10-2TR, AC-20-5TR, HFRS-2, MS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P, CHFRS-2P, A-R binders Types II and III
Surface treatment (cool weather)	RS-1P, CRS-1P, RC-250, RC-800, RC-3000, MC-250, MC-800, MC-3000, MC-2400L
Precoating	AC-5, AC-10, PG 64-22, SS-1, SS-1H, CSS-1, CSS-1H
Tack coat	PG Binders, SS-1H, CSS-1H, EAP&T
Fog seal	SS-1, SS-1H, CSS-1, CSS-1H
Hot-mixed, cold-laid asphalt mixtures	AC-0.6, AC-1.5, AC-3, AES-300, AES-300P, CMS-2, CMS-2S
Patching mix	MC-800, SCM I, SCM II, AES-300S
Recycling	AC-0.6, AC-1.5, AC-3, AES-150P, AES-300P, recycling agent, emulsified recycling agent
Crack sealing	SS-1P, polymer mod AE crack sealant, rubber asphalt crack sealers (Class A, Class B)
Microsurfacing	CSS-1P
Prime	MC-30, AE-P, 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

- 4.1. **Storage and Application Temperatures.** Use storage and application temperatures in accordance with Table 19. 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 of Table 19.

Table 19
Storage and Application Temperatures

Type-Grade	Application		Storage Maximum (°F)
	Recommended Range (°F)	Maximum Allowable (°F)	
AC-0.6, AC-1.5, AC-3	200–300	350	350
AC-5, AC-10	275–350	350	350
AC-5 w/2% SBR, AC-10 w/2% SBR, AC-15P, AC-20-5TR	300–375	375	360
RC-250	125–180	200	200
RC-800	170–230	260	260
RC-3000	215–275	285	285
MC-30, AE-P	70–150	175	175
MC-250	125–210	240	240
MC-800, SCM I, SCM II	175–260	275	275
MC-3000, MC-2400L	225–275	290	290
HFRS-2, MS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P, CMS-2, CMS-2S, AES-300, AES-300S, AES-150P, AES-300P	120–160	180	180
SS-1, SS-1H, CSS-1, CSS-1H, PCE, EAP&T, SS-1P, RS-1P, CRS-1P, CSS-1P, recycling agent, emulsified recycling agent, polymer mod AE crack sealant	50–130	140	140
PG binders	275–350	350	350
Rubber asphalt crack sealers (Class A, Class B)	350–375	400	–
A-R binders 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 is subsidiary or is included in payment for other pertinent items.

Item 310

Prime Coat



1. DESCRIPTION

Prepare and treat existing or newly constructed surface with an asphalt binder or other specialty prime coat binder material. Apply blotter material as required.

2. MATERIALS

- 2.1. **Binder.** Use material of the type and grade shown on the plans in accordance with Item 300, "Asphalts, Oils, and Emulsions," or as listed in the Department's MPL for prime coat binders.
- 2.2. **Blotter.** Use either base course sweepings obtained from cleaning the base or native sand as blotter materials unless otherwise shown on the plans or approved.

3. EQUIPMENT

Provide applicable equipment in accordance with Article 316.3., "Equipment."

4. CONSTRUCTION

- 4.1. **General.** Apply the mixture when the air temperature is at or above 60°F, or above 50°F and rising. Measure the air temperature in the shade away from artificial heat. The Engineer will determine when weather conditions are suitable for application.
- Do not permit traffic, hauling, or placement of subsequent courses over freshly constructed prime coats. Maintain the primed surface until placement of subsequent courses or acceptance of the work.
- 4.2. **Surface Preparation.** Prepare the surface by sweeping or other approved methods. Lightly sprinkle the surface with water before applying bituminous material, when directed, to control dust and ensure absorption.
- 4.3. **Application.**
- 4.3.1. **Binder.** The Engineer will select the application temperature within the limits recommended in Item 300, "Asphalts, Oils, and Emulsions," or by the material manufacturer. Apply material within 15°F of the selected temperature but do not exceed the maximum allowable temperature.
- Distribute the material smoothly and evenly at the rate selected by the Engineer. Roll the freshly applied prime coat with a pneumatic-tire roller to ensure penetration when directed.
- 4.3.2. **Blotter.** Spread blotter material before allowing traffic to use a primed surface. Apply blotter material to primed surface at the specified rate when "Prime Coat and Blotter" is shown on the plans as a bid item or as directed. Apply blotter to spot locations when "Prime Coat" is shown on the plans as a bid item or as directed to accommodate traffic movement through the work area. Remove blotter material before placing the surface. Dispose of blotter material according to applicable state and federal requirements.

5. MEASUREMENT

This Item will be measured by the gallon of binder placed and accepted.

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 "Prime Coat" or "Prime Coat and Blotter" of the type and grade of binder specified. This price is full compensation for cleaning and sprinkling the area to be primed; materials, including blotter material; and rolling, equipment, labor, tools, and incidentals.

Item 340

Dense-Graded Hot-Mix Asphalt (Small Quantity)



1. DESCRIPTION

Construct a hot-mix asphalt (HMA) pavement layer composed of a compacted, dense-graded mixture of aggregate and asphalt binder mixed hot in a mixing plant. This specification is intended for small quantity (SQ) HMA projects, typically under 5,000 tons total 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 when the Contractor makes a source or formulation change, and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time 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 as specified in 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 listed in Table 1. Document all test results on 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 given in 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 hot-mix listed in the BRSQC. Rated values for surface treatment (ST) do not apply to coarse aggregate sources used in hot-mix asphalt.

For sources not listed on the Department's BRSQC:

- build an individual stockpile for each material;
- request the Department test the stockpile for specification compliance; and
- once approved, do not add material to the stockpile unless otherwise approved.

Provide aggregate from non-listed sources only when tested by the Engineer and approved before use. Allow 30 calendar days for the Engineer to sample, test, and report results for non-listed sources.

Provide coarse aggregate with at least the minimum SAC shown on the plans. SAC requirements only apply to aggregates used on the surface of travel lanes. SAC requirements apply to aggregates used on surfaces other than travel lanes when shown on the plans. The SAC for sources on 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 in Table 1 may be blended with a Class A aggregate to meet requirements for Class A materials. 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 when blending Class A and B aggregates to meet a Class A requirement. Blend by volume if the bulk specific gravities of the Class A and 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 at any time during production, when the Contractor blends Class A and B aggregates to meet a Class A requirement, to 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. The Engineer will use the Department's mix design Excel 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 using the gradations supplied by the Contractor on the mixture design report as an input for the Excel template; however, a failing spot check will require confirmation with a stockpile gradation determined by the Engineer.

- 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 from organic impurities.

The Engineer may test the intermediate aggregate in accordance with Tex-408-A to verify the material is free from 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 gradation requirements in Table 2. Supply fine aggregates that are free from organic impurities. The Engineer may test the fine aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. No more than 15% of the total aggregate may be field sand or other uncrushed fine aggregate. Use fine aggregate, with the exception of 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)	As shown on the plans
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
Combined Aggregate³		
Sand equivalent, %, Min	Tex-203-F	45

1. Not used for acceptance purposes. Optional test used by the Engineer as an indicator of the need for further investigation.
2. Only applies to crushed gravel.
3. Aggregates, without mineral filler, RAP, RAS, or additives, combined as used in the job-mix formula (JMF).

Table 2
Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Weight 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 sufficiently dry, free-flowing, and free from 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 in Table 3.

Table 3
Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Weight 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 (PG) asphalt specified on the plans.
- 2.5. **Tack Coat.** Furnish CSS-1H, SS-1H, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions." Specialized or preferred tack coat materials may 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.

The Engineer will obtain at least one sample of the tack coat binder per project in accordance with Tex-500-C, Part III, and test it to verify compliance with Item 300, "Asphalts, Oils, and Emulsions." The Engineer will obtain the sample from the asphalt distributor immediately before use.

- 2.6. **Additives.** Use the type and rate of additive specified when shown on the plans. Additives that facilitate mixing, 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.** 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).** Warm Mix Asphalt (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 Department's MPL.

WMA is 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 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.

2.7. **Recycled Materials.** Use of RAP and RAS is permitted unless otherwise shown on the plans. Do not exceed the maximum allowable percentages of RAP and RAS shown in Table 4. The allowable percentages shown in Table 4 may be decreased or increased when shown on the plans. Determine asphalt binder content and gradation of the RAP and RAS stockpiles for mixture design purposes in accordance with Tex-236-F. The Engineer may verify the asphalt binder content of the stockpiles at any time 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 shown in 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 Tables 4 and 5 are defined as follows:

- **Surface.** The final HMA lift placed at or near the top of the pavement structure;
- **Intermediate.** Mixtures placed below an HMA surface mix and less than or equal to 8.0 in. from the riding surface; and
- **Base.** Mixtures placed greater than 8.0 in. from the riding surface.

2.7.1. **RAP.** RAP is salvaged, milled, pulverized, broken, or crushed asphalt pavement. Crush or break RAP so that 100% of the particles pass the 2 in. sieve. Fractionated RAP is defined as 2 or more RAP stockpiles, divided into coarse and fine fractions.

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. This allowance does not apply to a Contractor using unfractionated RAP. Department-owned RAP generated through 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.

The coarse RAP stockpile will contain only material retained by processing over a 3/8-in. or 1/2-in. screen unless otherwise approved. The fine RAP stockpile will contain only material passing the 3/8-in. or 1/2-in. screen unless otherwise approved. The Engineer may allow the Contractor to use an alternate to the 3/8-in. or 1/2-in. screen to fractionate the RAP. The maximum percentages of fractionated RAP may be comprised of coarse or fine fractionated RAP or the combination of both coarse and fine fractionated RAP.

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
Maximum Allowable Amounts of RAP¹

Maximum Allowable Fractionated RAP ² (%)			Maximum Allowable Unfractionated RAP ³ (%)		
Surface	Intermediate	Base	Surface	Intermediate	Base
20.0	30.0	40.0	10.0	10.0	10.0

1. Must also meet the recycled binder to total binder ratio shown in Table 5.
2. Up to 5% RAS may be used separately or as a replacement for fractionated RAP.
3. Unfractionated RAP may not be combined with fractionated RAP or RAS.

2.7.2.

RAS. Use of post-manufactured RAS or post-consumer RAS (tear-offs) is permitted unless otherwise shown on the plans. Up to 5% RAS may be used separately or as a replacement for fractionated RAP in accordance with Table 4 and Table 5. 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 by-product. Post-consumer RAS is processed shingle scrap removed from residential structures. Comply with all regulatory requirements stipulated for RAS by the TCEQ. RAS may be used separately or in conjunction with RAP.

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 5.0% 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 Department's MPL. Remove substantially all materials before use that are not part of the shingle, such as wood, paper, metal, plastic, and felt paper. 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. Unless otherwise shown on the plans, the Contractor may use a substitute PG binder listed in Table 5 instead of the PG binder originally specified, 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 300.2.10., "Performance-Graded Binders"; and
- 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 only be allowed at the discretion of the Engineer if the Hamburg Wheel test results are between 10.0 mm and 12.5 mm.

Table 5
Allowable Substitute PG Binders and Maximum Recycled Binder Ratios

Originally Specified PG Binder	Allowable Substitute PG Binder	Maximum Ratio of Recycled Binder ¹ to Total Binder (%)		
		Surface	Intermediate	Base
HMA				
76-22 ²	70-22 or 64-22	20.0	20.0	20.0
	70-28 or 64-28	30.0	35.0	40.0
70-22 ²	64-22	20.0	20.0	20.0
	64-28 or 58-28	30.0	35.0	40.0
64-22 ²	58-28	30.0	35.0	40.0
76-28 ²	70-28 or 64-28	20.0	20.0	20.0
	64-34	30.0	35.0	40.0
70-28 ²	64-28 or 58-28	20.0	20.0	20.0
	64-34 or 58-34	30.0	35.0	40.0
64-28 ²	58-28	20.0	20.0	20.0
	58-34	30.0	35.0	40.0
WMA³				
76-22 ²	70-22 or 64-22	30.0	35.0	40.0
70-22 ²	64-22 or 58-28	30.0	35.0	40.0
64-22 ⁴	58-28	30.0	35.0	40.0
76-28 ²	70-28 or 64-28	30.0	35.0	40.0
70-28 ²	64-28 or 58-28	30.0	35.0	40.0
64-28 ⁴	58-28	30.0	35.0	40.0

1. Combined recycled binder from RAP and RAS.
2. Use no more than 20.0% recycled binder when using this originally specified PG binder.
3. WMA as defined in Section 340.2.6.2., "Warm Mix Asphalt (WMA)."
4. When used with WMA, this originally specified PG binder is allowed for use at the maximum recycled binder ratios shown in this table.

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 by the specification, Contractors may perform other QC tests as deemed necessary. At any time during the project, the Engineer may perform production and placement tests as deemed necessary in accordance with Item 5, "Control of the Work." Schedule and participate in a pre-paving meeting with the Engineer on or before the first day of paving unless otherwise directed.

- 4.1. **Certification.** Personnel certified by the Department-approved hot-mix asphalt 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.

Table 6
Test Methods, Test Responsibility, and Minimum Certification Levels

Test Description	Test Method	Contractor	Engineer	Level ¹
1. Aggregate and Recycled Material Testing				
Sampling	Tex-221-F	✓	✓	1A
Dry sieve	Tex-200-F, Part I	✓	✓	1A
Washed sieve	Tex-200-F, Part II	✓	✓	1A
Deleterious material	Tex-217-F, Parts I & III	✓	✓	1A
Decantation	Tex-217-F, Part II	✓	✓	1A
Los Angeles abrasion	Tex-410-A		✓	TxDOT
Magnesium sulfate soundness	Tex-411-A		✓	TxDOT
Micro-Deval abrasion	Tex-461-A		✓	2
Crushed face count	Tex-460-A	✓	✓	2
Flat and elongated particles	Tex-280-F	✓	✓	2
Linear shrinkage	Tex-107-E	✓	✓	2
Sand equivalent	Tex-203-F	✓	✓	2
Organic impurities	Tex-408-A	✓	✓	2
2. Asphalt Binder & Tack Coat Sampling				
Asphalt binder sampling	Tex-500-C, Part II	✓	✓	1A/1B
Tack coat sampling	Tex-500-C, Part III	✓	✓	1A/1B
3. Mix Design & Verification				
Design and JMF changes	Tex-204-F	✓	✓	2
Mixing	Tex-205-F	✓	✓	2
Molding (TGC)	Tex-206-F	✓	✓	1A
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F	✓	✓	1A
VMA ² (calculation only)	Tex-204-F	✓	✓	2
Rice gravity	Tex-227-F	✓	✓	1A
Ignition oven correction factors ³	Tex-236-F	✓	✓	2
Indirect tensile strength	Tex-226-F	✓	✓	2
Hamburg Wheel test	Tex-242-F	✓	✓	2
Boil test	Tex-530-C	✓	✓	1A
4. Production Testing				
Mixture sampling	Tex-222-F	✓	✓	1A
Molding (TGC)	Tex-206-F		✓	1A
Molding (SGC)	Tex-241-F		✓	1A
Laboratory-molded density	Tex-207-F		✓	1A
VMA ² (calculation only)	Tex-204-F		✓	1A
Rice gravity	Tex-227-F		✓	1A
Gradation & asphalt binder content ³	Tex-236-F		✓	1A
Moisture content	Tex-212-F		✓	1A
Hamburg Wheel test	Tex-242-F		✓	2
Boil test	Tex-530-C		✓	1A
5. Placement Testing				
Trimming roadway cores	Tex-207-F	✓	✓	1A/1B
In-place air voids	Tex-207-F		✓	1A/1B
Establish rolling pattern	Tex-207-F	✓		1B
Ride quality measurement	Tex-1001-S	✓	✓	Note ⁴

1. Level 1A, 1B, and 2 are certification levels provided by the Hot Mix Asphalt Center certification program.
2. Voids in mineral aggregates.
3. Refer to Section 340.4.8.3., "Production Testing," for exceptions to using an ignition oven.
4. 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, Testing, and Responsibilities.** Use Department-provided Excel templates to record and calculate all test data pertaining to the mixture design. The Engineer will use Department Excel templates for any production and placement testing. Obtain the latest version of the Excel templates at <http://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/forms/site-manager.html> or from the Engineer.

The maximum allowable time for the Engineer to exchange test data with the Contractor is as given in Table 7 unless otherwise approved. The Engineer will immediately report to the Contractor any test result that requires suspension of production or placement or that fails to meet the specification requirements.

Subsequent mix 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 Testing			
Gradation	Engineer	Contractor	1 working day of completion of the test
Asphalt binder content			
Laboratory-molded density			
VMA (calculation)			
Hamburg Wheel test			
Moisture content			
Boil test			
Binder tests	Placement Testing		
In-place air voids	Engineer	Contractor	1 working day of completion of the test ¹

1. 2 days are allowed if cores cannot be dried to constant weight within 1 day.

4.3. Mixture Design.

4.3.1. **Design Requirements.** The Contractor may design the mixture using a Texas Gyratory Compactor (TGC) or a Superpave Gyratory Compactor (SGC) unless otherwise shown on the plans. Use the typical weight design example given in Tex-204-F, Part I, when using a TGC. Use the Superpave mixture design procedure given in Tex-204-F, Part IV, when using a SGC. Design the mixture to meet the requirements listed in Tables 1, 2, 3, 4, 5, 8, 9, and 10.

4.3.1.1. **Target Laboratory-Molded Density When The TGC Is Used.** Design the mixture at a 96.5% target laboratory-molded density. Increase the target laboratory-molded density to 97.0% or 97.5% at the Contractor's discretion or when shown on the plans or specification.

4.3.1.2. **Design Number of Gyration (Ndesign) When The SGC Is Used.** Design the mixture at 50 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 noted in Table 9. The Ndesign level may be reduced to no less than 35 gyrations at the Contractor's discretion.

Use an approved laboratory from the Department's MPL to perform the Hamburg Wheel test in accordance with Tex-242-F, and provide results with the mixture design, or provide the laboratory mixture and request that the Department perform the Hamburg Wheel test. 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 at any time 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 Excel template. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- asphalt binder content and aggregate gradation of RAP and RAS stockpiles;
- the target laboratory-molded density (or Ndesign level when using the SGC);

- results of all applicable tests;
- the mixing and molding temperatures;
- the signature of the Level 2 person or persons that 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 Weight or Volume) and VMA Requirements

Sieve Size	A Coarse Base	B Fine Base	C Coarse Surface	D Fine Surface	F Fine Mixture
2"	100.0 ¹	–	–	–	–
1-1/2"	98.0–100.0	100.0 ¹	–	–	–
1"	78.0–94.0	98.0–100.0	100.0 ¹	–	–
3/4"	64.0–85.0	84.0–98.0	95.0–100.0	100.0 ¹	–
1/2"	50.0–70.0	–	–	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	30.0–50.0	40.0–60.0	43.0–63.0	50.0–70.0	70.0–90.0
#8	22.0–36.0	29.0–43.0	32.0–44.0	35.0–46.0	38.0–48.0
#30	8.0–23.0	13.0–28.0	14.0–28.0	15.0–29.0	12.0–27.0
#50	3.0–19.0	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	2.0–7.0
Design VMA, % Minimum					
–	12.0	13.0	14.0	15.0	16.0
Production (Plant-Produced) VMA, % Minimum					
–	11.5	12.5	13.5	14.5	15.5

1. Defined as maximum sieve size. No tolerance allowed.

Table 9
Laboratory Mixture Design Properties

Mixture Property	Test Method	Requirement
Target laboratory-molded density, % (TGC)	Tex-207-F	96.5 ¹
Design gyrations (N _{design} for SGC)	Tex-241-F	50 ²
Indirect tensile strength (dry), psi	Tex-226-F	85–200 ³
Boil test ⁴	Tex-530-C	–

1. Increase to 97.0% or 97.5% at the Contractor's discretion or when shown on the plans or specification.
2. Adjust within a range of 35–100 gyrations when shown on the plans or specification or when mutually agreed between the Engineer and Contractor.
3. The Engineer may allow the IDT strength to exceed 200 psi if the corresponding Hamburg Wheel rut depth is greater than 3.0 mm and less than 12.5 mm.
4. Used to establish baseline for comparison to production results. May be waived when approved.

Table 10
Hamburg Wheel Test Requirements

High-Temperature Binder Grade	Test Method	Minimum # of Passes ¹ @ 12.5 mm ² Rut Depth, Tested @ 50°C
PG 64 or lower	Tex-242-F	10,000
PG 70		15,000
PG 76 or higher		20,000

1. May be decreased or waived when shown on the plans.
2. When the rut depth at the required minimum number of passes is less than 3 mm, the Engineer may require the Contractor to increase the target laboratory-molded density (TGC) by 0.5% to no more than 97.5% or lower the N_{design} level (SGC) to no less than 35 gyrations.

4.3.2.

Job-Mix Formula Approval. The job-mix formula (JMF) is the combined aggregate gradation, target laboratory-molded density (or N_{design} 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. When WMA is used, document the additive or process used and recommended rate on the JMF1 submittal. Furnish a mix design report (JMF1) with representative samples of all component materials and request approval to produce the trial batch. Provide approximately 10,000 g of the design mixture and request that the Department perform the Hamburg Wheel test if opting to have the Department perform the test. The Engineer will verify JMF1 based on plant-produced mixture from the trial batch unless otherwise determined. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF1. Provide split samples of the mixtures and blank samples used to determine the ignition oven correction factors. The Engineer will determine the aggregate and asphalt correction factors from the ignition oven used for production testing in accordance with Tex-236-F.

The Engineer will use a TGC calibrated in accordance with Tex-914-K in molding production samples. Provide an SGC at the Engineer's field laboratory for use in molding production samples if the SGC is used to design the mix.

The Engineer may perform Tex-530-C and retain the tested sample for comparison purposes during production. The Engineer may waive the requirement for the boil test.

4.3.3. **JMF Adjustments.** If JMF adjustments are necessary to achieve the specified requirements, 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 Table 4 and Table 5;
- meet the master gradation limits shown in Table 8; and
- be within the operational tolerances of the current JMF listed in Table 11.

The Engineer may adjust the asphalt binder content to maintain desirable laboratory density near the optimum value while achieving other mix requirements.

Table 11
Operational Tolerances

Description	Test Method	Allowable Difference Between Trial Batch and JMF1 Target	Allowable Difference from Current JMF Target
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	Must be within master grading limits in Table 8	±5.0 ^{1,2}
Individual % retained for sieves smaller than #8 and larger than #200			±3.0 ^{1,2}
% passing the #200 sieve			±2.0 ^{1,2}
Asphalt binder content, %	Tex-236-F	±0.5	±0.3 ²
Laboratory-molded density, %	Tex-207-F	±1.0	±1.0
VMA, %, min	Tex-204-F	Note ³	Note ³

1. When within these tolerances, mixture production gradations may fall outside the master grading limits; however, the % passing the #200 will be considered out of tolerance when outside the master grading limits.
2. Only applies to mixture produced for Lot 1 and higher.
3. Mixture is required to meet Table 8 requirements.

4.4. **Production Operations.** Perform a new trial batch when the plant or plant location is changed. Take corrective action and receive approval to proceed after any production suspension for noncompliance to 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 on the mixture design report; or
- RAS stockpile used in the mix is more than 2.0% higher than the value shown on the mixture design report.

4.4.1. **Storage and Heating of Materials.** Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions," or outside the manufacturer's recommended values. Provide the Engineer with daily records of asphalt binder and hot-mix asphalt discharge temperatures (in legible and

discernible increments) in accordance with Item 320, "Equipment for Asphalt Concrete Pavement," 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.

- 4.4.2. **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 350°F (or 275°F for WMA) and is not lower than 215°F. The Department will not pay for or allow placement of any mixture produced above 350°F.

Produce WMA within the target discharge temperature range of 215°F and 275°F when WMA is required. Take corrective action any time 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. The Engineer may determine the moisture content 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. The Engineer will obtain the sample immediately after discharging the mixture into the truck, and will perform the test promptly.

- 4.5. **Hauling Operations.** Clean all truck beds before use to ensure that mixture is not contaminated. Use a release agent shown on the Department's MPL to coat the inside bed of the truck when necessary.

Use equipment for hauling as defined in Section 340.4.6.3.2., "Hauling Equipment." Use other hauling equipment only when allowed.

- 4.6. **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 hand-held thermal camera or infrared thermometer 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 and an approximate station number or GPS coordinates on each ticket unless otherwise directed. 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. 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 with lane lines, 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 in Table 12 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./sq. yd. for each inch of pavement unless otherwise shown on the plans.

Table 12
Compacted Lift Thickness and Required Core Height

Mixture Type	Compacted Lift Thickness Guidelines		Minimum Untrimmed Core Height (in.) Eligible for Testing
	Minimum (in.)	Maximum (in.)	
A	3.00	6.00	2.00
B	2.50	5.00	1.75
C	2.00	4.00	1.50
D	1.50	3.00	1.25
F	1.25	2.50	1.25

- 4.6.1. **Weather Conditions.** Place mixture when the roadway surface temperature is at or above 60°F unless otherwise approved. Measure the roadway surface temperature with a hand-held 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. The Engineer may restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hr. of paving.
- 4.6.2. **Tack Coat.** 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 a thin, uniform tack coat to all contact surfaces of curbs, structures, and all joints. 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. Roll the tack coat with a pneumatic-tire roller to remove streaks and other irregular patterns when directed.
- 4.6.3. **Lay-Down Operations.**
- 4.6.3.1. **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.
- 4.6.3.2. **Hauling Equipment.** Use belly dumps, live bottom, or end dump trucks to haul and transfer mixture; however, with exception of paving miscellaneous areas, end dump trucks are only allowed when used in conjunction with an MTD with remixing capability unless otherwise allowed.
- 4.6.3.3. **Screed Heaters.** Turn off screed heaters, to prevent overheating of the mat, if the paver stops for more than 5 min.
- 4.7. **Compaction.** Compact the pavement uniformly to contain between 3.8% and 8.5% in-place air voids.
- Furnish the type, size, and number of rollers required for compaction as approved. Use a pneumatic-tire roller to seal the surface unless excessive pickup of fines occurs. 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 with rollers. The Engineer may require rolling with a trench roller on widened areas, in trenches, and in other limited areas.
- Complete all compaction operations before the pavement temperature drops below 160°F unless otherwise allowed. The Engineer may allow compaction with a light finish roller operated in static mode for pavement temperatures below 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.

4.8. **Production Acceptance.**

4.8.1. **Production Lot.** Each day of production is defined as a production lot. Lots will be sequentially numbered and correspond to each new day of production. Note that lots are not subdivided into sublots for this specification.

4.8.2. **Production Sampling.**

4.8.2.1. **Mixture Sampling.** The Engineer may obtain mixture samples in accordance with Tex-222-F at any time during production.

4.8.2.2. **Asphalt Binder Sampling.** The Engineer may obtain or require the Contractor to obtain 1 qt. samples of the asphalt binder at any time during production from a port located immediately upstream from the mixing drum or pug mill in accordance with Tex-500-C, Part II. The Engineer may test any of the asphalt binder samples to verify compliance with Item 300, "Asphalts, Oils, and Emulsions."

4.8.3. **Production Testing.** The Engineer will test at the frequency listed in the Department's *Guide Schedule of Sampling and Testing* and this specification. The Engineer may suspend production if production tests do not meet specifications or are not within operational tolerances listed in Table 11. Take immediate corrective action if the Engineer's laboratory-molded density on any sample is less than 95.0% or greater than 98.0%, 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 use alternate methods for determining the asphalt binder content and aggregate gradation if the aggregate mineralogy is such that Tex-236-F does not yield reliable results. Use the applicable test procedure if an alternate test method is selected.

Table 13
Production and Placement Testing

Description	Test Method
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F
Individual % retained for sieves smaller than #8 and larger than #200	
% passing the #200 sieve	
Laboratory-molded density	Tex-207-F
Laboratory-molded bulk specific gravity	
In-Place air voids	
VMA	Tex-204-F
Moisture content	Tex-212-F, Part II
Theoretical maximum specific (Rice) gravity	Tex-227-F
Asphalt binder content	Tex-236-F
Hamburg Wheel test	Tex-242-F
Recycled Asphalt Shingles (RAS) ¹	Tex-217-F, Part III
Asphalt binder sampling and testing	Tex-500-C
Tack coat sampling and testing	Tex-500-C, Part III
Boil test	Tex-530-C

1. Testing performed by the Construction Division or designated laboratory.

4.8.3.1. **voids in Mineral Aggregates (VMA).** The Engineer may determine the VMA for any production lot. Take immediate corrective action if the VMA value for any lot is less than the minimum VMA requirement for production listed in Table 8. 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 listed in Table 8. In addition to suspending production, the Engineer may require removal and replacement or may allow the lot to be left in place without payment.

- 4.8.3.2. **Hamburg Wheel Test.** The Engineer may perform a Hamburg Wheel test at any time during production, including when the boil test indicates a change in quality from the materials submitted for JMF1. In addition to testing production samples, the Engineer may obtain cores and perform Hamburg Wheel tests on any areas of the roadway where rutting is observed. Suspend production until further Hamburg Wheel tests meet the specified values when the production or core samples fail the Hamburg Wheel test criteria in Table 10. Core samples, if taken, will be obtained from the center of the finished mat or other areas excluding the vehicle wheel paths. The Engineer may require up to the entire lot of any mixture failing the Hamburg Wheel test to be removed and replaced at the Contractor's expense.

If the Department's or Department-approved laboratory's Hamburg Wheel test results in a "remove and replace" condition, the Contractor may request that the Department confirm the results by re-testing the failing material. The Construction Division will perform the Hamburg Wheel tests and determine the final disposition of the material in question based on the Department's test results.

- 4.8.4. **Individual Loads of Hot-Mix.** The Engineer can 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. **Placement Acceptance.**

- 4.9.1. **Placement Lot.** A placement lot is defined as the area placed during a production lot (one day's production). Placement lot numbers will correspond with production lot numbers.

- 4.9.2. **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, and other similar areas. Miscellaneous areas also include level-ups and thin overlays when the layer thickness specified on the plans is less than the minimum untrimmed core height eligible for testing shown in Table 12. The specified layer thickness is based on the rate of 110 lb./sq. yd. for each inch of pavement unless another rate is shown on the plans. Compact miscellaneous areas in accordance with Section 340.4.7., "Compaction." Miscellaneous areas are not subject to in-place air void determination except for temporary detours when shown on the plans.

- 4.9.3. **Placement Sampling.** Provide the equipment and means to obtain and trim roadway cores on site. On site is defined as in close proximity to where the cores are taken. Obtain the cores within one working day of the time the placement lot is completed unless otherwise approved. Obtain two 6-in. diameter cores side-by-side at each location selected by the Engineer for in-place air void determination unless otherwise shown on the plans. For Type D and Type F mixtures, 4-in. diameter cores are allowed. 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 the cores from the roadway in accordance with Tex-207-F if the core heights meet the minimum untrimmed value listed in Table 12. Trim the cores on site in the presence of the Engineer. Use a permanent marker or paint pen to record the date and lot number on each core as well as the designation as Core A or 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 they are trimmed 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 Roadway Core Custody protocol located at <http://www.txdot.gov/business/specifications.htm> to provide a secure means and process that protects the integrity of the cores during transport.

Instead of the Contractor trimming the cores on site 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 with other methods when approved.

4.9.4. **Placement Testing.** The Engineer may measure in-place air voids at any time during the project to verify specification compliance.

4.9.4.1. **In-Place Air Voids.** The Engineer will measure in-place air voids in accordance with Tex-207-F and Tex-227-F. Cores not meeting the height requirements in Table 12 will not be tested. Before drying to a constant weight, cores may be pre-dried using a Corelok or similar vacuum device to remove excess moisture. The Engineer will use the corresponding theoretical maximum specific gravity to determine the air void content of each core. The Engineer will use the average air void content of the 2 cores to determine the in-place air voids at the selected location.

The Engineer will use the vacuum method to seal the core if required by Tex-207-F. The Engineer will use the test results from the unsealed core 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.

Take immediate corrective action when the in-place air voids exceed the range of 3.8% and 8.5% to bring the operation within these tolerances. The Engineer may suspend operations or require removal and replacement if the in-place air voids are less than 2.7% or greater than 9.9%. 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. Areas defined in Section 340.9.2., "Miscellaneous Areas," are not subject to in-place air void determination.

4.9.5. **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 and 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 one day while the Contractor is taking appropriate corrective action.

4.9.6. **Ride Quality.** Use Surface Test Type A to evaluate ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

5. MEASUREMENT

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."

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under Section 340.5., "Measurement," will be paid for at the unit bid price for "Dense Graded Hot-Mix Asphalt (SQ)" of the mixture type, SAC, and binder specified. These prices are full compensation for surface preparation, materials including tack coat, placement, equipment, labor, tools, and incidentals.

Trial batches will not be paid for unless they are included in pavement work approved by the Department.

Pay adjustment for ride quality, if applicable, will be determined in accordance with Item 585, "Ride Quality for Pavement Surfaces."

Item 462

Concrete Box Culverts and Drains



1. DESCRIPTION

Furnish, construct, and install concrete box culverts and drains.

2. MATERIALS

2.1. **General.** Furnish materials in accordance with the following.

- Item 420, "Concrete Substructures,"
- Item 421, "Hydraulic Cement Concrete,"
- Item 440, "Reinforcement for Concrete," and
- Item 464, "Reinforced Concrete Pipe."

Provide cast-in-place or precast, formed or machine-made, box culverts, and drains. Use Class S concrete for top slabs of cast-in-place concrete culverts for culverts with overlay, a 1- to 2-course surface treatment or a top slab that is the final riding surface unless otherwise shown on the plans. Use Class C concrete for the rest of the culvert and for all other cast-in-place boxes. Culverts with fill do not require Class S concrete.

Furnish material for machine-made precast boxes in accordance with [DMS-7310](#), "Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification."

2.2. **Fabrication.**

2.2.1. **Cast-in-Place.** Meet Item 420, "Concrete Substructures" and Item 422, "Concrete Superstructures."

2.2.2. **Formed Precast.** Meet Item 424, "Precast Concrete Structural Members (Fabrication)."

2.2.3. **Machine-Made Precast.** Machine-made precast box culvert fabrication plants must be approved in accordance with [DMS-7310](#), "Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification." The Department's MPL shows approved machine-made precast box culvert plants. Fabricate machine-made precast boxes in accordance with [DMS-7310](#), "Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification."

2.3. **Testing.**

2.3.1. **Cast-in-Place.** Provide test specimens that meet Item 421, "Hydraulic Cement Concrete."

2.3.2. **Formed Precast.** Make, cure, and test compressive test specimens in accordance with [Tex-704-I](#).

2.3.3. **Machine-Made Precast.** Make, cure, and test compressive test specimens in accordance with [DMS-7310](#), "Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification."

2.3.4. **Testing Equipment.** The producer must furnish all equipment required for testing concrete for boxes produced in a precasting plant.

2.4. **Lifting Holes.** Provide no more than 4 lifting holes in each section for precast boxes. 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 box section. Use lifting holes no larger than 3 in. in diameter. Cut no more than 5 in. in any direction of reinforcement per layer for lifting holes.

2.5. **Marking.** Mark precast boxes with the following:

- name or trademark of fabricator and plant location;
- ASTM designation;
- date of manufacture;
- box size;
- minimum and maximum fill heights;
- designated fabricator's approval stamp;
- boxes to be used for jacking and boring (when applicable);
- designation "SR" for boxes meeting sulfate-resistant concrete plan requirements (when applicable); and
- match-marks for proper installation, when required under Section 462.2.6., "Tolerances."

Mark 1 end of each box section, for boxes without lifting holes, on the inside and outside walls to indicate the top or bottom as it will be installed.

Indent markings into the box section or paint them on each box with waterproof paint.

2.6. **Tolerances.** Ensure precast sections meet the permissible variations listed in ASTM C1577 and that the sides of a section at each end do not vary from being perpendicular to the top and bottom by more than 1/2 in. when measured diagonally between opposite interior corners.

Ensure wall and slab thicknesses are not less than shown on the plans except for occasional deficiencies not greater than 3/16 in. or 5%, whichever is greater. If proper jointing is not affected, thicknesses in excess of plan requirements are acceptable.

Deviations from the above tolerances will be acceptable if the sections can be fitted at the plant or jobsite and the joint opening at any point does not exceed 1 in. Use match-marks for proper installation on sections that have been accepted in this manner.

2.6.1. **Boxes for Jacking Operations.** Use boxes for jacking operations as defined in Item 476, "Jacking, Boring, or Tunneling Pipe or Box," meeting the following additional requirements:

- The box ends must be square such that no point deviates more than 3/8 in. from a plane placed on the end of the box that is perpendicular to the box sides, and
- The slab and wall thicknesses must not be less than specified on the plans and must not exceed the specified thickness by more than 1/2 in.

2.7. **Defects and Repair.** Fine cracks on the surface of the member that do not extend to the plane of the nearest reinforcement are acceptable unless the cracks are numerous and extensive. Repair cracks that extend into the plane of the reinforcing steel in an approved manner. Excessive damage, honeycomb, or cracking will be subject to structural review. The Engineer may accept boxes with repairs that are sound, properly finished, and cured in conformance with pertinent specifications. Discontinue further production of precast sections when fine cracks on the surface indicate poor curing practices until corrections are made and proper curing is provided.

Repair machine-made precast boxes in accordance with [DMS-7310](#), "Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification."

2.8. **Storage and Shipment.** Store precast sections on a level surface. Do not place any load on the sections until design strength is reached and curing is complete. Shipment of sections is permissible when the design strength and curing requirements have been met.

Store and ship machine-made precast boxes in accordance with [DMS-7310](#), "Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification."

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 shown on the plans or permitted. Jack, bore, or tunnel in accordance with Item 476, "Jacking, Boring, or Tunneling Pipe or Box." Immediate backfilling is permitted for all box structures where joints consist of materials other than mortar. Take precautions in placing and compacting the backfill to avoid any movement of the boxes or damage to the joints. Remove and replace boxes damaged by the Contractor at no expense to the Department.
- 3.2. **Placement of Boxes.** Place the box sections in conformance with the plans or as directed when precast boxes are used to form multiple barrel structures. Place material to be used between barrels as shown on the plans or as directed. Start the laying of boxes on the bedding at the outlet end and proceed toward the inlet end with the abutting sections properly matched unless otherwise authorized. Fit, match, and lay the boxes to form a smooth, uniform conduit true to the established lines and grades. Lower the box sections into the trench, for trench installations, without damaging the box or disturbing the bedding and the sides of the trench. Carefully clean the ends of the box before it is placed. Prevent the earth or bedding material from entering the box as it is laid. Remove and re-lay, without extra compensation, boxes that are not in alignment or show excessive settlement after laying. Form and place cast-in-place boxes in accordance with Item 420, "Concrete Substructures."
- 3.3. **Jointing.** Use any of the jointing materials in accordance with the joint requirements specified in Item 464, "Reinforced Concrete Pipe," unless otherwise shown on the plans. Box joints for rubber gasketed material may be substituted for tongue and groove joints, provided they meet the requirements of ASTM C1677 for design of the joints and permissible variations in dimensions.
- 3.4. **Connections and Stub Ends.** Make connections of boxes to existing boxes, pipes, drains, or 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. Connect boxes to any required headwalls, wingwalls, safety end treatments or riprap, or other structures as shown on the plans or as directed. Repair any damage to the existing structure resulting from making the connections. Finish stub ends for connections to future work not shown on the plans by installing watertight plugs into the free end of the box.
- Fill lifting holes with mortar or concrete and cure for precast boxes. Precast concrete or mortar plugs may be used.
- 3.5. **Extending.** Break back and extend existing culverts in accordance with Section 420.4.8 "Extending Existing Substructures," and Section 422.4.5 "Extending Existing Slabs," as applicable.

4. MEASUREMENT

This Item will be measured by the foot. Measurement will be made between the ends of the culvert or drain along the flow line, not including safety end treatments. Safety end treatments will be measured in accordance with Item 467, "Safety End Treatment." Measurement of spurs, branches, or new connection box section will be made from the intersection of the flow line with the outside surface of the structure into which it connects. Where inlets, headwalls, wingwalls, catch basins, manholes, junction chambers, or other structures are included in lines of culverts or drains, the length of box section tying into the structure wall will be included for measurement, but no other portion of the structure length or width will be included.

The measured length of multiple barrel structures 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 "Concrete Box Culvert" of the size specified. This price is full compensation for constructing, furnishing, and transporting sections; preparation and shaping of the bed; backfill material between box sections; jointing of sections; jointing material; cutting of sections on skew or slope; connections to new or existing structures; breaking back, removing and disposing of portions of the existing structure and replacing portions of the existing structure as required to make connections; concrete and reinforcing steel; and equipment, labor, materials, 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, "Excavation and Backfill for Structures." 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, "Jacking, Boring, or Tunneling Pipe or Box."

Item 466

Headwalls and Wingwalls



1. DESCRIPTION

Furnish, construct, and install concrete headwalls and wingwalls for drainage structures and underpasses.

2. MATERIALS

2.1. **General.** Furnish materials in accordance with the following.

- Item 420, "Concrete Substructures,"
- Item 421, "Hydraulic Cement Concrete," and
- Item 440, "Reinforcement for Concrete."

Use Class C concrete for cast-in-place and precast concrete units unless otherwise shown on the plans. Furnish cast-in-place or precast headwalls and wingwalls unless otherwise shown on the plans.

2.2. **Fabrication.**

2.2.1. **General.** Fabricate cast-in-place concrete units and precast units in accordance with Item 420 "Concrete Substructures." Use the following definitions for headwalls and wingwalls:

- "Headwalls" refers to all walls, including wings, at the ends of single-barrel and multiple-barrel pipe culvert structures.
- "Wingwalls" refers to all walls at the ends of single-barrel or multiple-barrel box culvert structures.

2.2.2. **Lifting Holes.** Provide no more than 4 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 1 longitudinal wire or 2 circumferential wires per layer of reinforcing steel when locating lift holes. Repair spalled areas around lifting holes.

2.2.3. **Marking.** Clearly mark each precast unit before shipment from the casting or fabrication yard with the following:

- 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 concrete units until 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 them 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. The repaired units will be acceptable if they conform to the requirements of this Item and the repairs are sound, properly finished, and cured in conformance with pertinent specifications.

3. CONSTRUCTION

- 3.1. **General.** Remove portions of existing structures and drill, dowel, and grout in accordance with Item 420, "Concrete Substructures."
- 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 in accordance with the details shown on the plans. Furnish jointing material in accordance with Item 464, "Reinforced Concrete Pipe," or as shown on the plans.

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.

4. MEASUREMENT

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.

- 4.1. **Headwalls.** Headwalls will be measured by each end of a structure.
- 4.2. **Wingwalls.** Wingwalls will be measured by one of the following methods:
- 4.2.1. **Square Foot.** Wingwalls will be measured by the square foot of the front surface area of the wall of each type. The area will be measured from the top of the footing or apron to the top of the wall unless otherwise shown on the plans. If there is no footing or apron, then measurement is from the bottom of the wall.
- 4.2.2. **Each.** Wingwalls will be measured by each end of a structure.

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 price bid for "Headwalls" of the type and pipe size (diameter or design) specified, "Wingwalls" of the type specified when measurement is by the square foot, or "Wingwalls" of the type and wall height specified when measurement is by each. For payment purposes, the wingwall height will be rounded to the nearest foot. All wingwalls and headwalls of the same type will be paid for equally when skew does not affect the type. This price is full compensation for constructing, furnishing, transporting, and installing the headwalls or wingwalls; connecting to existing structure; breaking back, removing and disposing of portions of the existing structure, and replacing portions of the existing structure as required to make connections; excavation and backfill; and concrete, reinforcing steel, corrugated metal pipe or reinforced concrete pipe, equipment, labor, tools, and incidentals.

Apron concrete or riprap between or around the wingwalls of single- or multiple-barrel box culvert structures will be measured and paid for in accordance with Item 432, "Riprap."

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 considered subsidiary to this Item.

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," and
- 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, "Corrugated Metal Pipe."

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, "Galvanizing."

2.2. **Fabrication.** Fabricate cast-in-place concrete units and precast units in accordance with Item 420, "Concrete Substructures." Provide either prefabricated metal end sections or mitered 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 in accordance with the details shown on the plans when required.

- 2.2.1.2. **Type II.** Provide Type II SET in accordance with the details 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 4 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 1 longitudinal wire or 2 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. 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 445.3.5., "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, "Concrete Substructures." Furnish concrete riprap in accordance with Item 432, "Riprap."
- 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 in accordance with the details shown on the plans. Furnish jointing material in accordance with Item 464, "Reinforced Concrete Pipe."
- 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 indicated 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 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)
- 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 existing 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, corrugated metal pipe or reinforced concrete pipe, 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 considered 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 considered 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 price bid for each SET will be shown on the plans. Any riprap placed beyond the limits shown will be paid in accordance with Item 432, "Riprap." Riprap between multiple precast SET units will be required as shown on the plans and is included in the price bid for SET.

When precast SETs are provided as an option to mitered RCP, riprap aprons will not be required unless the plans specifically require riprap aprons for precast SET units. The plans will show the limits of the riprap to be included with the precast SET for payment.

PART B

GUIDE SCHEDULE OF SAMPLING AND TESTING

GUIDE SCHEDULE OF SAMPLING & TESTING FOR DESIGN BID-BUILD (DBB) PROJECTS - (DBB Guide Schedule)

JUNE 28, 2019



Using the Guide Schedule

Research of sampling and testing rates, listed for project tests in the following Guide Schedule, show that the Department's and the Contractor's risk of either rejecting "good" material or accepting "bad" material range from 20% to 40%.

To reduce this risk, we recommend that the sampling rate be increased during initial production. A four-fold increase in testing frequency will generally reduce risk to approximately 5%. The intent of increasing testing, at the start of production, is to insure the Contractor's processes are in control and to establish acceptability requirements early.

There is a need to increase the frequency of testing for high-variability materials and when testing results do not meet specifications. The Engineer may require the Contractor to reimburse the Department for costs resulting from failing test results, in accordance with the specifications.

Materials incorporated in TxDOT projects are subjected to various quality assurance procedures such as testing (as outlined in this document), certification, quality monitoring, approved lists, etc. The Engineer and testing staff should familiarize themselves with materials to be used before work begins by reviewing the specifications and this document. Discuss material testing requirements with the Contractor.

Other testing required by the specifications, but not shown in the DBB Guide Schedule, should be performed at a frequency necessary to provide adequate confidence that materials meet specifications.

NOTE—The TxDOT District Area Engineer or Director of Construction must submit a "Materials Certification Letter" at final acceptance of the project. The intent of this letter is to ensure that the quality of all materials incorporated into the project is in conformance with the plans and specifications, thus ensuring a service life equivalent to the design life. Any material represented by an acceptance test, that does not meet the criteria contained in the plans and specifications, is considered an exception. Exceptions must be listed in the materials certification letter. For projects with federal oversight, submit the materials certification letter (See Appendix D of DBB QAP) to the FHWA division administrator, with a copy to **the Materials and Tests Division (MTD)**. For non-federal oversight projects, submit the material certification letter (Appendix E of DBB QAP) to the TxDOT District Engineer, with a copy to **MTD**. Refer to section 4.1 of the "Quality Assurance Program for Design-Bid-Build Projects" (DBB QAP).

Assuring the quality of the product and proper incorporation of materials into the project begins with proper sampling practices. Sampling, testing, and construction inspection must be performed collaboratively to assure the specific attributes of the finished product reflect quality workmanship. Sampling guidance for hot-mix asphalt is contained in Tex-225-F, "Random Selection of Bituminous Mixture Samples," and the respective specification for that material. All remaining materials are covered by method and materials specifications, to which the following applies.

This is a guide for minimum sampling and testing.
Testing frequency may need to be increased for high material variability or when test results approach specification limits.

For acceptance testing, especially that which directly determines payment for the Contractor, sampling personnel should provide randomness in sampling by avoiding patterned sampling routines. Examples of such sampling practices are as follows:

- Soils/flexible base: Vary sampling between stockpiling operations, completed stockpile, windrow, and project site. Vary the time of day sampling is performed.
- Aggregates: Sample aggregates nearest the point of incorporation into the work. Vary sampling between stockpiling operations, completed stockpile, belt sampling, and if deemed necessary, railroad cars/trucks. Vary the time of day sampling is performed.
- Concrete (structural and miscellaneous): Always sample as near as practicable to the point of placement. For strength testing, vary the time of day or the number of truck from which the concrete is sampled. Tests for slump, air, and temperature should be done often to ensure the consistent control of the concrete production (not applicable to miscellaneous concrete).

This Guide Schedule is applicable to all contracts associated with the 2014 Standard Specifications.

This is a guide for minimum sampling and testing.
Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE I – EMBANKMENTS, SUBGRADES, BACKFILL, AND BASE COURSES

			PROJECT TESTS		
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION OR TIME OF SAMPLING (D)	FREQUENCY OF SAMPLING (F)	REMARKS
EMBANKMENT (CUTS & FILLS)	Liquid Limit (A)	Tex-104-E	During stockpiling operations, from completed stockpile, or project site (B)	Materials with PI ≤ 15: 10,000 CY	For Type A embankment or when required by the plans. This test may be waived for embankment cuts as directed by the Engineer . Determine a new liquid limit and plasticity index for each different material or notable change in material. Sample in accordance with Tex-100-E. When shown on plans. This test may be waived for embankment cuts, as directed by the Engineer. Sample in accordance with Tex-100-E. Not required for ordinary compaction. Determine a new optimum moisture and maximum density for each different material or notable change in material. Sample in accordance with Tex-100-E. Not required for ordinary compaction. Determine a new optimum moisture and maximum density according to Tex-114-E for each different material or notable change in material. Correct the moisture contents measured by nuclear density gauge in Tex-115-E with the moisture contents determined in accordance with Tex-103-E, as necessary for control, for each different material or notable change in material and adjust the density accordingly. Materials such as RAP, gypsum, lime, cement, and iron ore tend to bias the counts for nuclear density gauges.
	Plasticity Index (A)	Tex-106-E		Materials with PI > 15: 5,000 CY	
	Gradation	Tex-110-E		Each 10,000 CY	
	Moisture/Density	Tex-114-E		As directed by the Engineer	
	In-place Density (A)	Tex-115-E	As directed by the Engineer	Fill: each 5,000 CY min. 1 per lift.	
Cut: each 6,000 LF					
RETAINING WALL (NON-SELECT BACKFILL)	As shown above for Embankment (Cuts and Fills)		As shown above for Embankment (Cuts and Fills)	As shown above for Embankment (Cuts and Fills)	Sample in accordance with Tex-100-E.
RETAINING WALL (SELECT BACKFILL)	Plasticity Index (A)	Tex-106-E	During stockpiling operations, from completed stockpile, or project site (B)	Each 5,000 CY	Required only for Type CS backfill . Test the fraction of material finer than the No. 200 sieve. Sample in accordance with Tex-400-E.
	Gradation	Tex-110-E	During stockpiling operations, from completed stockpile, or project site (B)	Each 5,000 CY	Required only for Drainage Aggregate. Sample in accordance with Tex-400-A.
		Tex-401-A			Required only for Select Backfill. Sample in accordance with Tex-400-A.
Resistivity (A)	Tex-129-E	During stockpiling operations, from completed stockpile, or project site (B)	Each 5,000 CY	For material with resistivity between 1,500 and 3,000 ohm-cm, determine chloride and sulfate content, as specified in Item 423. Sample in accordance with Tex-400-A.	

This is a guide for minimum sampling and testing.
 Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE I – EMBANKMENTS, SUBGRADES, BACKFILL, AND BASE COURSES

			PROJECT TESTS		
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION OR TIME OF SAMPLING (D)	FREQUENCY OF SAMPLING (F)	REMARKS
RETAINING WALL (SELECT BACKFILL) (continued)	pH (A)	Tex-128-E	During stockpiling operations, from completed stockpile, or project site (B)	Each 5,000 CY	Sample in accordance with Tex-400-A.
	Magnesium Soundness	Tex-411-A	During stockpiling operations, or from completed stockpile	1 per source, per project	Test when backfill sources appear to contain particles such as shale, caliche, or other soft, poor-durability particles. Sample in accordance with Tex-400-A.
	Micro-Deval	Tex-461-A	During stockpiling operations, or from completed stockpile	1 per source, per project	May be used as an alternate to the magnesium soundness only when the % loss from the micro-deval is not greater than 20%. When the % loss from the micro-deval is greater than 20%, the magnesium soundness governs aggregate verification. Sample in accordance with Tex-400-A.
	In-place Density (A)	Tex-115-E	As directed by the Engineer.	1 per backfill lift, per wall	Not required for rock backfill. For walls greater than 500 ft. in length, perform one test per lift for every 500 ft. in length. (F) Correct the moisture contents measured by nuclear density gauge in Tex-115-E with the moisture contents determined in accordance with Tex-103-E for each different material or notable change in material and adjust the density accordingly.
UNTREATED BASE COURSES	Liquid Limit (A)	Tex-104-E	During stockpiling operations, from completed stockpile, or windrow (B)	Each 5,000 CY	Sample in accordance with Tex-400-A.
	Plasticity Index (A)	Tex-106-E	During stockpiling operations, from completed stockpile, or windrow (B)	Each 5,000 CY	
	Gradation (A)	Tex-110-E	During stockpiling operations, from completed stockpile, or windrow (B)	Each 5,000 CY	Sample in accordance with Tex-400-A.
	Moisture/Density	Tex-113-E	From completed stockpile at the source (E)	Each 20,000 CY	Not required for ordinary compaction. Sample in accordance with Tex-400-A.

This is a guide for minimum sampling and testing.
Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE I – EMBANKMENTS, SUBGRADES, BACKFILL, AND BASE COURSES

			PROJECT TESTS			
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION OR TIME OF SAMPLING (D)	FREQUENCY OF SAMPLING (F)	REMARKS	
UNTREATED BASE COURSES (Continued)	Wet Ball Mill (A)	Tex-116-E	From completed stockpile at the source (E)	Each 20,000 CY	Required for Grades 1–2 and 5, and as shown on the plans for Grade 4. Sample in accordance with Tex-400-A.	
	Strength (A)	Tex-117-E	From completed stockpile at the source (E)	Each 20,000 CY	Required for Grades 1–2 and 5, and as shown on the plans for Grade 4. When base material is from a source where the District has a record of satisfactory triaxial results, the frequency of testing may be reduced to one per 30,000 CY. If any one test falls below the minimum value required, the frequency of testing will return to the original frequency of 20,000 CY. Sample in accordance with Tex-400-A.	
	In-place Density (A)	Tex-115-E	As directed by the Engineer	Each 3,000 CY, min. 1 per lift	Correct the moisture contents measured by nuclear density gauge in Tex-115-E with the moisture contents determined in accordance with Tex-103-E, as necessary for control, for each different material or notable change in material and adjust the density accordingly. Materials such as RAP, gypsum, lime, cement, and iron ore tend to bias the counts for nuclear density gauges.	
	Thickness (A)	Tex-140-E	As directed by the Engineer	Each 3,000 CY	Not required where survey grade control documents are compliant.	
	Ride Quality (A)	Tex-1001-S Surface Test, Type B	Final riding surface of travel lanes		This applies to the final travel lanes that receive a 1- or 2-course surface treatment for the final surface, unless otherwise shown on the plans.	
TREATED SUBGRADE AND BASE COURSES	SUBGRADE BEFORE TREATMENT	Organic Content	Tex-148-E	As directed by the Engineer	1 per project, per source or as directed by the Engineer	Required for existing subgrade material and material imported from a borrow source. Soil survey and geologic maps may be used to determine sampling locations. Sample in accordance with Tex-100-E.
		Sulfate Content	Tex-145-E	As directed by the Engineer	1 per 500 feet or 5,000 CY	Required for existing subgrade material and material imported from a borrow source. Soil survey and geologic maps may be used to determine sampling locations. Sample in accordance with Tex-100-E.
	NEW BASE MATERIAL	Liquid Limit (A)	Tex-104-E	During stockpiling operations, from completed stockpile, or windrow (B)	Each 5,000 CY	When central mix site or plant is used, windrow sampling may be waived. Sample in accordance with Tex-400-A.

This is a guide for minimum sampling and testing.
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TABLE I – EMBANKMENTS, SUBGRADES, BACKFILL, AND BASE COURSES

			PROJECT TESTS			
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION OR TIME OF SAMPLING (D)	FREQUENCY OF SAMPLING (F)	REMARKS	
TREATED SUBGRADE AND BASE COURSES (Continued)	NEW BASE MATERIAL (Continued)	Plasticity Index (A)	Tex-106-E	During stockpiling operations, from completed stockpile, or windrow (B)	Each 5,000 CY	
		Gradation (A)	Tex-110-E	During stockpiling operations, from completed stockpile, or windrow (B)	Each 5,000 CY	Sample in accordance with Tex-400-A.
		Wet Ball Mill (A)	Tex-116-E	From completed stockpile at the source (E)	Each 20,000 CY	Required for Grades 1–2 and 5, and as shown on the plans for Grade 4. Sample in accordance with Tex-400-A.
		Strength (A)	Tex-117-E	From completed stockpile at the source (E)	Each 20,000 CY	Required for Grades 1–2 and 5, and as shown on the plans for Grade 4. When base material is from a source where the District has a record of satisfactory triaxial results, the frequency of testing may be reduced to one per 30,000 CY. If any one test falls below the minimum value required, the frequency of testing will return to the original frequency of 20,000 CY.
	LIME	Compliance with DMS-6350	Tex-600-J	During delivery to project	Commercial Lime Slurry: each 200 tons of lime Carbide Lime Slurry: each 100 tons of lime	Sample in accordance with Tex-600-J. Verify the source is listed on the current Material Producer List for Lime . Only materials appearing on the Material Producer List will be accepted. Sample frequency for Carbide Lime Slurry may be increased as directed by the Engineer. For Hydrated Lime and Quick Lime, project testing is not required but it is encouraged to sample and test the material at a rate of 1 per project as a best practice.
	CEMENT	Compliance with DMS-4600		Railroad car, truck, or cement bins		Verify the source is listed on the current Material Producer List for Cement. If not, sample and test in accordance with DMS-4600. (C)
	FLY ASH MATERIAL	Compliance with DMS-4615		Project samples at location directed by the Engineer		Verify the source is listed on the current Material Producer List for Fly Ash . Only materials from MTD approved sources appearing on the Material Producer List for Fly Ash will be accepted. Project testing is not required but it is encouraged to sample and test the material at a rate of 1 per project as a best practice. (C)

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TABLE I – EMBANKMENTS, SUBGRADES, BACKFILL, AND BASE COURSES

MATERIAL OR PRODUCT		TEST FOR	TEST NUMBER	PROJECT TESTS		REMARKS
				LOCATION OR TIME OF SAMPLING (D)	FREQUENCY OF SAMPLING (F)	
TREATED SUBGRADE AND BASE COURSES (Continued)	COMPLETE MIXTURE	Pulverization Gradation	Tex-101-E, Part III	Roadway, after pulverization and mixing	As necessary for control	At the beginning of the project, one test must be made for each 4,500 CY or 6,000 tons until the Engineer is satisfied that acceptable pulverization results are being obtained. Sample in accordance with Tex-100-E.
		Moisture/Density Curve and Strength	Tex-120-E, Part II, or Tex-121-E, Part II	From roadway windrow after treatment (E)	Each 20,000 CY	Not required for ordinary compaction. Determine a new moisture/density curve for each different or notable change in material. Perform Tex-120-E, Part II, for Cement Treated Material, and Tex-121-E, Part II, for Lime, Lime-Fly Ash, or Fly Ash Treated Material. If Tex-120-E, Part I, Tex-121-E, Part I, or Tex-127-E is performed before the project, this test may be waived. Sample in accordance with Tex-100-E.
		Moisture/Density Curve and Strength	Tex-120-E, Part I, Tex-121-E, Part I, or Tex-127-E	From roadway before treatment	As necessary for control	Perform Tex-120-E, Part I, on cement treated material, and Tex-121-E, Part I, for lime-fly ash or fly ash treated material. Verifies the field strength by comparing results from the mix design. Performed at the direction of the Engineer and when notable change in material, as described above for Part II of the test procedures. Sample in accordance with Tex-100-E.
		In-place Density (A)	Tex-115-E	As directed by the Engineer	Each 3,000 CY, min 1 per lift	Determine the appropriate moisture/density curve for each different material or notable change in material. Correct the moisture contents measured by nuclear density gauge in Tex-115-E with the moisture contents determined in accordance with Tex-103-E, as necessary for control, for each different material or notable change in material and adjust the density accordingly. Stabilizers and materials such as RAP, gypsum, and iron ore tend to bias the counts for nuclear density gauges.
		Thickness (A)	Tex-140-E	As directed by the Engineer	Each 3,000 CY	Not required where survey grade control documents are used for compliance.

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TABLE I – EMBANKMENTS, SUBGRADES, BACKFILL, AND BASE COURSES					
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	PROJECT TESTS		REMARKS
			LOCATION OR TIME OF SAMPLING (D)	FREQUENCY OF SAMPLING (F)	
RECLAIMED ASPHALT PAVEMENT (RAP), CRUSHED CONCRETE, and RECYCLED MATERIALS	Sulfate Content	Tex-145-E	During stockpiling operations, from completed stockpile, or windrow	Each 5,000 CY	Required only for contractor furnished recycled material, including crushed concrete. Not required for RAP. Sample in accordance with Tex-400-A.
	Deleterious Material	Tex-413-A		Each 5,000 CY	Required only for contractor furnished recycled material, including crushed concrete. Sample in accordance with Tex-400-A.
	Decantation	Tex-406-A	During stockpiling operations, from completed stockpile, or windrow	Each 5,000 CY	Required only for contractor furnished RAP. Sample in accordance with Tex-400-A.

TABLE I – FOOTNOTES	
A	When this project acceptance test fails, but the product is accepted, document the reasons for acceptance in SiteManager (SM), in the remarks field, and on the end of the Project Materials Certification Letter.
B	Engineer will select any of these locations or any combinations thereof with the provision that the initial sample will be obtained from the completed stockpile at the source and at least one out of ten consecutive samples will be taken at the project site (from the windrow for treated and untreated bases and embankments when possible).
C	Attach the corresponding QM test report for SiteManager projects to satisfy project sampling and testing requirements.
D	For acceptance testing, especially that which directly determines payment for the Contractor, sampling personnel should provide randomness in sampling by avoiding patterned sampling routines. Examples of such sampling practices are as follows: <ul style="list-style-type: none"> • Soils/Flexible Base: For gradation, liquid limit, and plastic limit, vary sampling between stockpiling operations, completed stockpile, windrow, and project site. Vary the time of day sampling is performed. • Aggregates: Sample aggregates nearest the point of incorporation into the work. Vary sampling between stockpiling operations, completed stockpile, belt sampling, and if deemed necessary, railroad cars/trucks. Vary the time of day sampling is performed.
E	The Engineer will sample from the completed stockpile at the source and test before placement.
F	Each test performed that is based on a quantity of material is considered “or fraction thereof” for calculating number of tests.

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TABLE IA – ASPHALT TREATED BASE (Plant Mix)

			PROJECT TESTS		
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION OR TIME OF SAMPLING (C)	FREQUENCY OF SAMPLING (D)	REMARKS
AGGREGATE	Liquid Limit (A)	Tex-104-E	During stockpiling operations, from completed stockpile, or before mixing	Each 5,000 CY	Sample in accordance with Tex-400-A.
	Plasticity Index (A)	Tex-106-E	During stockpiling operations, from completed stockpile, or before mixing	Each 5,000 CY	
	Wet Ball Mill (A)	Tex-116-E	During stockpiling operations, from completed stockpile, or before mixing	1 per project, per source	Sample in accordance with Tex-400-A. (B)
LIME	Compliance with DMS-6350		During delivery to the project	Hydrated Lime: 1 per project Commercial Lime Slurry: each 200 tons of lime (D) Carbide Lime Slurry: each 100 tons of lime (D) Quick Lime: 1 per project	On projects requiring less than 50 tons, material from MTD approved sources may be accepted on the basis of Producer's Certification without sampling.
RECLAIMED ASPHALT PAVEMENT (RAP), and RECYCLED AGGREGATE	Decantation	Tex-406-A, Part I	During stockpiling operations, from completed stockpile, or before mixing	Each 10,000 CY	Sample in accordance with Tex-400-A.
RECYCLED ASPHALT SHINGLES (RAS)	Decantation	Tex-217-F, Part III	During stockpiling operations, from completed stockpile, or before mixing	Each 10,000 CY	Sample in accordance with Tex-400-A.
ASPHALT BINDER	Compliance with Item 300		Sampling port nearest the storage tank	1 per project, per grade, per source	Test a minimum of one sample taken from the project. Sample binder in accordance with Tex-500-C, Part II. Verify that the binder is from a preapproved source when it arrives on the project, and that the lab number on the shipping ticket is within the valid dates shown on the MTD QM test report or in the SiteManager (SM) Assistant. The Engineer must associate one QM sample per project in SM.

This is a guide for minimum sampling and testing.
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TABLE IA – ASPHALT TREATED BASE (Plant Mix)

			PROJECT TESTS		
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION OR TIME OF SAMPLING (C)	FREQUENCY OF SAMPLING (D)	REMARKS
TACK COAT	Compliance with Item 300		Distributor	1 per project, per grade, per source	<p>Test a minimum of one sample taken from the project. Sample tack coat in accordance with Tex-500-C, Part III.</p> <p>Verify that the binder is from a preapproved source when it arrives on the project, and that the lab number on the shipping ticket is within the valid dates shown on the MTD QM test report or in the SM Assistant.</p> <p>The Engineer must associate one QM sample per project in SM.</p>
COMPLETE MIXTURE	Gradation (A)	Tex-200-F, Part I	Plant Mix (C)	20,000 CY (25,000 tons)	<p>Sample in accordance with Tex-222-F.</p> <p>Determine the gradation of the aggregate from the complete mixture tested in accordance with Tex-236-F.</p>
	Laboratory Density (A)	Tex-126-E	Plant Mix (C)	20,000 CY (25,000 tons)	Sample in accordance with Tex-222-F.
	Percent Asphalt (A)	Tex-236-F	Plant Mix (C)	Each 1,500 CY (2,000 tons) or days production	Determine an asphalt content correction factor for ignition oven at a minimum of one per project. Sample in accordance with Tex-222-F.
	Indirect Tensile Strength – Dry	Tex-226-F	Plant Mix	1 per project, per design	Sample in accordance with Tex-222-F.
	Moisture Susceptibility	Tex-530-C	As directed by the Engineer	1 per project, per design	This test may be waived, when shown on the plans. Sample in accordance with Tex-222-F.
ROADWAY	In-Place Air Voids (A)	Tex-207-F	Roadway cores, as directed by the Engineer (C, D)	Each 3,000 CY, min 1 per lift	Not required for ordinary compaction or when air void requirements are waived. Sample in accordance with Tex-222-F.
	Ride Quality	Tex-1001-S Surface Test, Type A	On Finished Surface		Unless otherwise shown on the plans.

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TABLE IA – FOOTNOTES	
A	When this project acceptance test fails, but the product is accepted, document the reasons for acceptance in SiteManager (SM), in the remarks field, and on the end of the Project Materials Certification Letter.
B	Engineer will select any of these locations or any combinations thereof with the provision that at least one out of ten consecutive samples will be taken at the project site (from the windrow for treated and untreated bases and embankments when possible).
C	For acceptance testing, especially that which directly determines payment for the Contractor, sampling personnel should provide randomness in sampling by avoiding patterned sampling routines. Examples of such sampling practices are as follows: <ul style="list-style-type: none">• Soils/Flexible Base: Vary sampling between stockpiling operations, completed stockpile, windrow, and project site. Vary the time of day sampling is performed.• Aggregates: Sample aggregates nearest the point of incorporation into the work. Vary sampling between stockpiling operations, completed stockpile, belt sampling, and if deemed necessary, railroad cars/trucks. Vary the time of day sampling is performed.
D	Each test performed, that is based on a quantity of material, is considered “or fraction thereof” for calculating number of tests.

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TABLE II – SEAL COAT					
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	PROJECT TESTS		REMARKS
			LOCATION OR TIME OF SAMPLING (C)	FREQUENCY OF SAMPLING (D)	
AGGREGATE	Gradation (A)	Tex-200-F, Part I	Stockpile (At source or at point of delivery)	Each 1,000 CY	Rate may be reduced to each 2,000 CY if the Engineer approves a contractor quality control plan. Sample in accordance with Tex-221-F.
	L. A. Abrasion (A)	Tex-410-A	Stockpile	1 per project, per source	Verify the published value of the source, as listed on the current Material Producer List for BRSQC , meets the project specifications. If not, sample and test at 1 per 20,000 CY before use. Sample in accordance with Tex-221-F. (B)
	Magnesium Soundness (A)	Tex-411-A	Stockpile	1 per project, per source	Verify the published value of the source, as listed on the current Material Producer List for BRSQC , meets the project specifications. If not, sample and test at 1 per 20,000 CY before use. Sample in accordance with Tex-221-F. (B)
	Surface Aggregate Classification (A)	Tex-612-J, Tex-411-A	Stockpile	1 per project, per source	Verify the published value of the source, as listed on the current Material Producer List for BRSQC , meets the project specifications. If not, sample and test at 1 per 20,000 CY before use. Sample in accordance with Tex-221-F. (B)
	Pressure Slake (A)	Tex-431-A	Stockpile	1 per 20,000 CY	Same as above. Required only for lightweight aggregate. Sample in accordance with Tex-221-F.
	Freeze Thaw (A)	Tex-432-A	Stockpile	1 per 20,000 CY	Same as above. Required only for lightweight aggregate. Sample in accordance with Tex-221-F.
	Unit Weight	Tex-404-A	Stockpile	1 per 20,000 CY	Same as above. Required only for lightweight aggregate. Sample in accordance with Tex-221-F.
	24 hr. Water Absorption (A)	Tex-433-A	Stockpile	1 per 20,000 CY	Same as above. Required only for lightweight aggregate. Sample in accordance with Tex-221-F.
	Crushed Face Count	Tex-460-A, Part I	Stockpile	1 per 20,000 CY	Only required for crushed gravel. Sample in accordance with Tex-221-F.
	Deleterious Material (A)	Tex-217-F, Part I	Stockpile	1 per 10,000 CY	Not required for lightweight aggregate. Sample in accordance with Tex-221-F.
	Decantation (A)	Tex-406-A	Stockpile	1 per 10,000 CY	Sample in accordance with Tex-221-F.
Flakiness Index	Tex-224-F	Stockpile	Frequency as directed by the Engineer	Sample in accordance with Tex-221-F.	

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TABLE II – SEAL COAT					
			PROJECT TESTS		
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION OR TIME OF SAMPLING (C)	FREQUENCY OF SAMPLING (D)	REMARKS
AGGREGATE (Continued)	Micro Deval	Tex-461-A	Stockpile	1 per project or as necessary for control	Compare result to published value listed on the current Material Producer List for BRSQC . Submit sample to MTD for Soundness and L.A. Abrasion testing when results differ by more than 3% points, unless otherwise directed by the Engineer . Sample in accordance with Tex-221-F.
	White Rock Count	Tex-220-F	Stockpile		Required only for Limestone Rock Asphalt. Not required when MTD provides inspection at the plant. Sample in accordance with Tex-221-F.
	Naturally Impregnated Bitumen Content	Tex-236-F	Stockpile		Required only for Limestone Rock Asphalt. Not required when MTD provides inspection at the plant. Sample in accordance with Tex-221-F.
PRECOATED AGGREGATE	Asphalt Content	Tex-210-F	Stockpile	Frequency as directed by the Engineer when a target value is specified	Sample in accordance with Tex-221-F.
ASPHALT BINDER	Compliance with Item 300		Distributor	1 per project, per grade, per source	Test a minimum of one sample taken from the project. Sample asphalt binder in accordance with Tex-500-C, Part III. Verify that the binder is from a preapproved source when it arrives on the project, and that the lab number on the shipping ticket is within the valid dates shown on the MTD QM test report or in the SM Assistant. The Engineer must associate one QM sample per project in SM.

TABLE II – FOOTNOTES	
A	When this project acceptance test fails, but the product is accepted, document the reasons for acceptance in SiteManager, in the remarks field, and on the end of the Project Materials Certification Letter.
B	Attach the corresponding QM test report for SiteManager projects to satisfy project sampling and testing requirements.
C	For acceptance testing, especially that which directly determines payment for the Contractor, sampling personnel should provide randomness in sampling by avoiding patterned sampling routines. Examples of such sampling practices are as follows: <ul style="list-style-type: none"> Aggregates: Sample aggregates nearest the point of incorporation into the work. Vary sampling between stockpiling operations, completed stockpile, belt sampling, and if deemed necessary, railroad cars/trucks. Vary the time of day sampling is performed.
D	Each test performed, that is based on a quantity of material, is considered “or fraction thereof” for calculating number of tests.

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TABLE III – HYDRAULIC CEMENT CONCRETE – STRUCTURAL (Classes: C, F, H, S, CO, K, LMC, or SS)						
			PROJECT TESTS			
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION OR TIME OF SAMPLING (D)	FREQUENCY OF SAMPLING (E)	REMARKS	
MINERAL AGGREGATE	COARSE AGGREGATE	Decantation (B)	Tex-406-A	From stockpile at concrete plant	Each 20,000 CY of concrete (each source)	Sample in accordance with Tex-400-A.
		Sieve Analysis (A) (B)	Tex-401-A		Each 1,000 CY of concrete (each source)	Test combined aggregate when used. Sample in accordance with Tex-400-A.
		Deleterious Materials (B)	Tex-413-A		1 per project or as necessary for control	Sample in accordance with Tex-400-A.
		Los Angeles Abrasion (A) (B)	Tex-410-A		One, each source	Verify the value of the source, as listed on the current Material Producer list for CRSQC , meets the project specifications. If not, sample and submit to MTD for testing before use in accordance with Tex- 499-A. Sample in accordance with Tex-400-A. (C)
		Magnesium Soundness (A) (B)	Tex-411-A		One, each source	Verify the value of the source, as listed on the current CRSQC , meets the project specifications. (C)
	FINE AGGREGATE	Sand Equivalent (B)	Tex-203-F	From stockpile at concrete plant	1 per project or as necessary for control	Test combined aggregate when used. Sample in accordance with Tex-400-A.
		Organic Impurities (B)	Tex-408-A		1 per project, per source	Sample in accordance with Tex-400-A.
		Sieve Analysis (A) (B)	Tex-401-A		Each 1,000 CY of concrete (each source)	Sample in accordance with Tex-400-A.
		Fineness Modulus (B)	Tex-402-A		1 per project or as necessary for control	Test combined aggregate when used. Test to confirm material variability when strength values are in question. Sample in accordance with Tex-400-A.
		Deleterious Material (B)	Tex-413-A		1 per project or as necessary for control	Test to confirm material variability when strength values are in question. Sample in accordance with Tex-400-A.

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TABLE III – HYDRAULIC CEMENT CONCRETE – STRUCTURAL (Classes: C, F, H, S, CO, K, LMC, or SS)						
			PROJECT TESTS			
MATERIAL OR PRODUCT		TEST FOR	TEST NUMBER	LOCATION OR TIME OF SAMPLING (D)	FREQUENCY OF SAMPLING (E)	REMARKS
MINERAL AGGREGATE (Continued)	FINE AGGREGATE (Continued)	Acid Insoluble Residue (A) (B)	Tex-612-J		Two, each source	Only for concrete subject to direct traffic. Verify the value of the source, as listed on the current CRSQC , meets the project specifications. If not, sample and submit to MTD for testing before use in accordance with Tex-499-A. Sample in accordance with Tex-400-A. (C)
SILICA FUME		Compliance with DMS-4630 (A)		Railroad car, truck, bags or silos	1 per project, per class of concrete (For each type and brand)	Provide MTD with one 4 x 8 concrete sample for silica fume dispersion verification. Verify the source is listed on the Material Producer List for Silica Fume. Sample in accordance with Tex-300-D.
METAKAOLIN		Compliance with DMS-4635 (A)		Railroad car, truck or silos	1 per project, per class of concrete (For each type and brand)	Sample in accordance with Tex-300-D.
MIX DESIGN		Compliance with Standard Specification Item 421.4.A		At source (if not approved)	Min. 1 design per class, per source	Verify if cement, fly ash, slag cement, and chemical admixture sources are listed on the Material Producer Lists. If not, sample and submit to MTD for testing. Water testing is contracted by the concrete supplier (commercial lab report to be reviewed by TxDOT). Sample in accordance with Tex-300-D for cement and in accordance with Tex-733-I for fly ash.
JOINT MATERIAL		Compliance with DMS-6300				Verify the source is listed on the Material Producer List for Joint Sealers . If not, sample and test before use in accordance with DMS-6310. (C) Sample in accordance with Tex-500-C.
CURING COMPOUND		Compliance with DMS-4650		Sampled at jobsite; tested by MTD . See remarks.	When requested by MTD	Only products listed on the Material Producer List for Concrete Curing Compounds will be allowed. When sample is requested by MTD , sample in accordance with Tex-718-I. Ensure container has been agitated and mixed before sampling. (C)
EVAPORATION RETARDANTS		Compliance with DMS-4650				Only products listed on the Material Producer list for Evaporation Retardants will be allowed. (C)
REINFORCING STEEL		Compliance with the Std. Specifications & Spec. Provisions	As Specified			Only materials from MTD approved sources listed on the Material Producer Lists for Reinforcing Steel Mills and Seven Wire Steel Strand will be allowed. (C)

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TABLE III – HYDRAULIC CEMENT CONCRETE – STRUCTURAL (Classes: C, F, H, S, CO, K, LMC, or SS)

			PROJECT TESTS		
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION OR TIME OF SAMPLING (D)	FREQUENCY OF SAMPLING (E)	REMARKS
MECHANICAL COUPLERS	Compliance with DMS-4510	Tex-743-I	Sampled at jobsite; Tested by MTD	3 couplers per lot (500 couplers) for each type, model, bar size, and grade	Only materials from MTD approved sources listed on the Material Producer List for Mechanical Couplers will be allowed. (C)
LATEX	Compliance with DMS-4640 for concrete chemical admixtures				Verify the Latex is listed on the Material Producer List for Chemical Admixtures.
EPOXY	Compliance with DMS-6100, unless otherwise specified		Sampled at jobsite if not pre-approved by MTD .	1 per batch or shipment	Verify the source is listed on the Material Producer List for Epoxies and Adhesives . If not, sample and test before use in accordance with DMS-6100. Sample in accordance with Tex-734-I. (C)
CONCRETE	Compressive Strength (A)	Tex-418-A	At point of concrete placement	4 cylinders for each 60 CY per class, per day (For bridge railing and traffic railing, testing may be reduced to 4 cylinders per 180 CY per class regardless of days)	Sampling must be in accordance with Tex-407-A. Making additional cylinders for 56 day testing should be considered when slow strength gain mixtures are being used, or when the approved mix design has a history of failing to meet design strength at 28 days. Test two cylinders at 7 days, and if the average value is below the design strength, as defined in Item 421, Table 8, test the remaining 2 cylinders at 28 days, or 56 days if additional cylinder were not made. If the average value of the 2 cylinders tested at 7 days meets the minimum design strength, listed in Item 421, Table 8, the remaining cylinders are not required to be tested. If the average value of the 7 and 28 day cylinders are below the design strengths, and 56 day cylinders were made, test the remaining set at 56 days.
	Slump	Tex-415-A		1 test, per 4 strength specimens	Sample in accordance with Tex-407-A. Perform slump and temperature tests on the same load from which strength test specimens are made. Perform entrained air test only when entrained air concrete is specified on the plans. Check temperature of every load for bridge slabs and mass concrete placements. Contractor's required testing will be in accordance with specification requirements for the appropriate specification Item #.
	Entrained Air (A)	Tex-416-A or Tex-414-A			
	Temperature of Concrete (A)	Tex-422-A			

This is a guide for minimum sampling and testing.
 Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE III – HYDRAULIC CEMENT CONCRETE – STRUCTURAL (Classes: C, F, H, S, CO, K, LMC, or SS)					
			PROJECT TESTS		
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION OR TIME OF SAMPLING (D)	FREQUENCY OF SAMPLING (E)	REMARKS
CONCRETE (Continued)	Bridge Deck or Culvert Top Slab Thickness and Depth of Reinforcement	Tex-423-A, Part II	During dry run and during concrete placement (Bridge decks and direct traffic culverts)	1 per span	Min 6–Max 18 locations per span.

TABLE III – FOOTNOTES	
A	When this project acceptance test fails, but the product is accepted, document the reasons for acceptance in SiteManager, in the remarks field, and on the end of the Project Materials Certification Letter.
B	These Project Tests may be used for one or more projects being furnished concrete from the same plant during the same period.
C	Attach the corresponding QM test report for SiteManager projects to satisfy project sampling and testing requirements.
D	For acceptance testing, especially that which directly determines payment for the Contractor, sampling personnel should provide randomness in sampling by avoiding patterned sampling routines. Examples of such sampling practices are as follows: <ul style="list-style-type: none"> • Aggregates: Sample aggregates nearest the point of incorporation into the work. Vary sampling between stockpiling operations, completed stockpile, and if deemed necessary, railroad cars/trucks. Vary the time of day sampling is performed. • Concrete (structural): Always sample as near as practicable to the point of placement. For strength testing, vary the time of day or the number of truck from which the concrete is sampled. Test often for slump, air, and temperature to ensure the consistent control of the concrete production.
E	Each test performed, that is based on a quantity of material, is considered “or fraction thereof” for calculating number of tests.

This is a guide for minimum sampling and testing.
Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE IV – HYDRAULIC CEMENT CONCRETE – NON-STRUCTURAL CONCRETE (Classes: A, B, or E)					
			PROJECT TESTS		
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION OR TIME OF SAMPLING (B)	FREQUENCY OF SAMPLING (C)	REMARKS
CONCRETE	Compressive Strength (A)	Tex-418-A	At point of concrete placement	2 cylinders per 180 CY, per class	Sampling must be in accordance with Tex-407-A. Strength will be determined by 7-day specimens.
MIX DESIGN	Compliance with the Standard Specification		At source if not approved	Min. 1 design per class, per source	Verify if cement, fly ash, slag cement, and chemical admixture sources are listed on the Material Producer Lists. If not, sample and submit to MTD for testing. Sample in accordance with Tex-300-D for cement and in accordance with Tex-733-I for fly ash. Water testing is contracted by the concrete supplier (commercial lab report to be reviewed by TxDOT).
SILICA FUME	Compliance with DMS-4630		Railroad car, truck, bags, or silos	1 test per project, per class (for each type and brand)	Sample in accordance with Tex-300-D. Provide MTD with one 4 x 8 concrete sample for silica fume dispersion verification. Verify the source is listed on the Material Producer List for Silica Fume.
METAKAOLIN	Compliance with DMS-4635		Railroad car, truck, or silos	1 test per project, per class (for each type and brand)	Sample in accordance with Tex-300-D.

TABLE IV – FOOTNOTES	
A	When this project acceptance test fails, but the product is accepted, document the reasons for acceptance in SiteManager, in the remarks field, and on the end of the Project Materials Certification Letter.
B	For acceptance testing, especially that which directly determines payment for the Contractor, sampling personnel should provide randomness in sampling by avoiding patterned sampling routines. Examples of such sampling practices are as follows: <ul style="list-style-type: none"> Concrete (miscellaneous): Always sample as near as practicable to the point of placement. For strength testing, vary the time of day or the number of truck from which the concrete is sampled.
C	Each test performed, that is based on a quantity of material, is considered “or fraction thereof” for calculating number of tests.

This is a guide for minimum sampling and testing.
Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE V – HYDRAULIC CEMENT CONCRETE PAVEMENT (Classes: P or HES)

			PROJECT TESTS			
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION OR TIME OF SAMPLING	FREQUENCY OF SAMPLING (D)	REMARKS	
MINERAL AGGREGATE	COARSE AGGREGATE	Decantation	Tex-406-A	From stockpile at concrete plant	Each 20,000 CY of concrete (each source)	Sample in accordance with Tex-400-A.
		Sieve Analysis (A)	Tex-401-A		As necessary for control	Sample in accordance with Tex-400-A. Test combined aggregate when used.
		Deleterious Materials	Tex-413-A		Each 20,000 CY of concrete (each source)	Sample in accordance with Tex-400-A.
		L.A. Abrasion (A)	Tex-410-A		One, each source	Verify the value of the source, as listed on the current CRSQC, meets the project specifications. If not, sample and submit to MTD for testing before use in accordance with Tex-499-A. Sample in accordance with Tex-400-A. (C)
		Magnesium Soundness (A)	Tex-411-A			
	FINE AGGREGATE	Sand Equivalent	Tex-203-F	From stockpile at concrete plant	Each 3,000 CY of concrete (Each source or combination of sources)	Sample in accordance with Tex-400-A. Test combined aggregate when used. At least one per week's production.
		Organic Impurities	Tex-408-A		1 per project, per source	Sample in accordance with Tex-400-A.
		Sieve Analysis (A)	Tex-401-A		As necessary for control	Sample in accordance with Tex-400-A. Test combined aggregate when used.
		Fineness Modulus (B)	Tex-402-A			
		Deleterious Material (B)	Tex-413-A		Each 20,000 CY of concrete (each source)	Sample in accordance with Tex-400-A.
		Acid Insoluble (A)	Tex-612-J		1 per project, per source	Verify the value of the source, as listed on the current CRSQC, meets the project specifications. If not, sample and submit to MTD for testing before use in accordance with Tex-499-A. Sample in accordance with Tex-400-A. (C)
MIX DESIGN	Compliance with the Standard Specifications Item 421.4.A		At source, if not approved	Min. 1 design, per class, per source	Verify if cement, fly ash, ground granulated blast furnace slag, and admixture sources are listed on the Material Producer List. If not, sample and submit to MTD for testing. Sample in accordance with Tex-300-D for cement and in accordance with Tex-733-I for fly ash. Water testing is contracted by the concrete supplier (commercial lab report to be reviewed by TxDOT).	
SILICA FUME	Compliance with DMS-4630		Railroad car, truck, bags, or silos	1 per project, per class of concrete (For each type and brand)	Sample in accordance with Tex-300-D. Provide MTD with one 4 x 8 concrete sample for silica fume dispersion verification. Verify the source is listed on the Material Producer List for Silica Fume.	

This is a guide for minimum sampling and testing.
Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE V – HYDRAULIC CEMENT CONCRETE PAVEMENT (Classes: P or HES)

			PROJECT TESTS		
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION OR TIME OF SAMPLING	FREQUENCY OF SAMPLING (D)	REMARKS
METAKAOLIN	Compliance with DMS-4635		Railroad car, truck, or silos	1 per project, per class of concrete (For each type and brand)	Sample in accordance with Tex-300-D.
JOINT MATERIAL	Compliance with DMS-6310		Sampled at jobsite if not sampled at source by MTD ; tested by MTD . See remarks.	1 per batch or shipment	Sample in accordance with Tex-500-C. Sampling may be waived when the source is listed on the Material Producer List for Joint Sealers . (C)
CURING COMPOUND	Compliance with DMS-4650		Sampled at jobsite; tested by MTD . See remarks.	When requested by MTD	Only products listed on the Material Producer List for Concrete Curing Compounds will be allowed. When sample is requested by MTD , sample in accordance with Tex-718-I. Ensure container has been agitated and mixed before sampling. (C)
EVAPORATION RETARDANTS	Compliance with DMS-4650				Only products listed on the Material Producer List for Evaporation Retardants will be allowed. (C)
REINFORCING STEEL	Compliance with the Std. Specifications & Spec. Provisions	As Specified			Only materials from MTD approved sources listed on the Material Producer List for Reinforcing Steel Mills and Seven Wire Steel Strand will be accepted. (C)
MULTIPLE PIECE TIE BARS	Compliance with DMS-4515	Tex-712-I	Sampled at jobsite if not sampled at source by MTD ; tested by MTD . See remarks.	Refer to Tex-711-I for sampling rates	Only materials from MTD approved sources listed on the Material Producer List for Multiple Piece Tie-bars for Concrete Pavements will be allowed. Sample in accordance with Tex-711-I.
EPOXY	Compliance with DMS-6100		Sampled at jobsite if not pre-approved by MTD . See remarks.	1 batch per shipment	Verify the source is listed on the Material Producer List for Epoxyes and Adhesives . If not, sample and test before use in accordance with DMS-6100. Sample in accordance with Tex-734-I. (C)
CONCRETE	Strength (A) (B)	Tex-448-A or Tex-418-A	At point of concrete placement	2 cylinders for every 10 contractor job control tests	Sample in accordance with Tex-407-A. When the contract requires the project testing to be by the Engineer, the frequency and job control testing will be in accordance with the item of work. Split sample verification testing used when contractor performs job control testing. When job control testing by the contractor is waived by the plans, the frequency of sampling will be one test (2 specimens) for each 3,000 SY of concrete or fraction thereof or per day and split sample verification testing will be waived. Contractor's required testing will be in accordance with specification requirements for the appropriate specification Item #.

This is a guide for minimum sampling and testing.
Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE V – HYDRAULIC CEMENT CONCRETE PAVEMENT (Classes: P or HES)

			PROJECT TESTS		
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION OR TIME OF SAMPLING	FREQUENCY OF SAMPLING (D)	REMARKS
CONCRETE (Continued)	Slump	Tex-415-A	At time and location strength specimens are made	1 test for every 10 contractor job control tests.	Sample in accordance with Tex-407-A. Slump is not required for slip-formed pavement. Perform slump and temperature tests on the same load from which the strength specimens are made. Perform entrained air test only when entrained air concrete is specified on the plans. Contractor's required testing will be in accordance with specification requirements for the appropriate specification Item #.
	Entrained Air (A)	Tex-416-A or Tex-414-A			
	Temperature	Tex-422-A			
	Pavement Texture	Tex-436-A	Final Riding Surface of travel lanes	1 per day, per driving lane	Perform when carpet drag is the only surface texture required on the plans.
	Thickness	Tex-423-A, Part I	Center of paving machine	Every 500 feet	Methods other than Tex-423-A may be shown on the plans.
	Ride Quality (A)	Tex-1001-S Surface Test, Type B	Final riding surface of travel lanes		Engineer may verify contractor's results for surface test Type B. For traditional design-bid-build TxDOT projects, MTD has contracted with TTI to perform random ride verification at 10% frequency. Results from surface test Type A are not required to be reported.

TABLE V – FOOTNOTES

A	When this project acceptance test fails, but the product is accepted, document the reasons for acceptance in SiteManager, in the remarks field, and on the end of the Project Materials Certification Letter.
B	When a project test does not meet the specified strength requirements and a reduced pay factor is assigned, document the analysis on the Letter of Certification of Materials Used.
C	Attach the corresponding QM test report for SiteManager projects to satisfy project sampling and testing requirements.
D	Each test performed, that is based on a quantity of material, is considered "or fraction thereof" for calculating number of tests.

This is a guide for minimum sampling and testing.
Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE VI – HOT-MIX ASPHALT PAVEMENT (Items 341, 342, 344, 346, 347 and 348)
(All testing as noted in Table VI may be waived for exempt production as defined by specification.)

			PROJECT TESTS		
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION (Per Design)	FREQUENCY OF SAMPLING (E)	REMARKS
COARSE AGGREGATE	L. A. Abrasion (A)	Tex-410-A	Stockpile (B)	1 per project, per source	Verify the published value of the source, as listed on the current Material Producer list for BRSQC , meets the project specifications. If not, sample in accordance with Tex-221-F and submit to MTD for testing before use in accordance with Tex-499-A. (C)
	Magnesium Soundness (A)	Tex-411-A			
	Surface Aggregate Classification (A)	Tex-499-A		1 per project, per source	
	Micro Deval	Tex-461-A		1 per project, per aggregate source	
COMBINED AGGREGATE	Sand Equivalent	Tex-203-F	Stockpiles, hot bins, or feeder belts	1 per project, per source, per design	Does not apply to Item 342. Sample in accordance with Tex-221-F. The timing of when the test is performed is at the discretion of the Engineer.
ASPHALT BINDER	Compliance with Item 300 (A)		Sampling port nearest the storage tank	1 per project, per grade, per source	Test a minimum of one sample taken from the project. Sample binder at hot- mix plant in accordance with Tex-500-C, Part II. Verify that the binder is from a preapproved source when it arrives on the project, and that the lab number on the shipping ticket is within the valid dates shown on the MTD QM test report or in the SM Assistant. The Engineer must associate one QM sample, per project in SM.
TACK COAT	Compliance with Item 300 (A)		Distributor	1 per project, per grade, per source	Test a minimum of one sample taken from the project. Sample tack coat in accordance with Tex-500-C, Part III. Verify that the binder is from a preapproved source when it arrives on the project, and that the lab number on the shipping ticket is within the valid dates shown on the MTD QM test report or in the SM Assistant. The Engineer must associate one QM sample, per project in SM.

This is a guide for minimum sampling and testing.
Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE VI – HOT-MIX ASPHALT PAVEMENT (Items 341, 342, 344, 346, 347 and 348)
(All testing as noted in Table VI may be waived for exempt production as defined by specification.)

			PROJECT TESTS		
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION (Per Design)	FREQUENCY OF SAMPLING (E)	REMARKS
MIX DESIGN	Compliance with applicable specification	Tex-204-F	At source (if not approved)	Min 1 design, per Mix Type and Asphalt Grade	Verify that aggregates, recycled asphalt pavement, recycled asphalt shingles, mineral filler, asphalt binder, anti-stripping additives, and warm mix systems are on the Material Producer List where applicable and that they meet project specification requirements. Project sampling and testing may be conducted on individual materials, as necessary, for control.
COMPLETE MIXTURE	Asphalt Content (A)	Tex-236-F	Engineer Truck Sample (D)	Minimum 1 per Lot	Sample in accordance with Tex-222-F. Determine correlation factors for ignition oven using Tex-236-F at a minimum of one per project. When Tex-236-F does not yield reliable results, use alternative methods for determining asphalt content, such as, Tex-210-F (ASTM D2172/AASHTO T164) and Tex-228-F (ASTM D4125/AASHTO T287).
	Voids in Mineral Aggregates (VMA)	Tex-204-F	Truck Sample Plant Produced (D)	1 per Sublot	Sample in accordance with Tex-222-F. Contractor's required testing will be in accordance with specification requirements for the appropriate specification Item #. Does not apply to Items 342 and 348.
	Gradation (A)	Tex-200-F	Engineer Truck Sample (D)	Minimum 1, per 12 Sublots (E)	Sample in accordance with Tex-222-F. Determine correction factors for ignition oven using Tex-236-F at a minimum of one per project.
	Moisture Susceptibility	Tex-530-C	Truck Sample	1 per project	Sample in accordance with Tex-222-F, unless waived by the Engineer.
	Indirect Tensile Strength – Dry	Tex-226-F			Sample in accordance with Tex-222-F, unless waived by the Engineer. Does not apply to Items 342, 346, 347, and 348.
	Moisture Content	Tex-212-F, Part II	Engineer Truck Sample		Sample in accordance with Tex-222-F.
	Lab Molded Density (A)	Tex-207-F, Part I, VI, VIII	Truck Sample (D)	1 per Sublot 1 per Lot for Item 347	Sample in accordance with Tex-222-F. Contractor's required testing will be in accordance with specification requirements for the appropriate specification Item #.
	Drain Down Test (A)	Tex-235-F	Engineer Truck Sample	1 per 12 Sublots	Sample in accordance with Tex-222-F. Not required for Items 341, 344, and 347.
	Hamburg Wheel Test (A)	Tex-242-F	Engineer Truck Sample	1 per project	Sample in accordance with Tex-222-F. Sample during production. Does not apply to Item 348 PFC-C, PFCR-C, and Thin Bonded Wearing Course –All Types.

This is a guide for **minimum sampling and testing**.
 Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE VI – HOT-MIX ASPHALT PAVEMENT (Items 341, 342, 344, 346, 347 and 348)
 (All testing as noted in Table VI may be waived for exempt production as defined by specification.)

			PROJECT TESTS		
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION (Per Design)	FREQUENCY OF SAMPLING (E)	REMARKS
COMPLETE MIXTURE (Continued)	Cantabro Loss (A)	Tex-245-F	Engineer Truck Sample	1 per project	Sample in accordance with Tex-222-F. Sample during production. Does not apply to items 341, 344, 346, and 347.
	Overlay Test (A)	Tex-248-F	Engineer Truck Sample	1 per project	Sample in accordance with Tex-222-F. Does not apply to Items 341, 344, and 348 PFC-C, PFCR-C, and Thin Bonded Wearing Course –All Types.
ROADWAY	In-Place Air Voids (A)	Tex-207-F, Part I, VI, VIII	Roadway (D)	2 cores per Sublot	Two cores taken per Sublot and averaged. Sample in accordance with Tex-222-F. Does not apply to Items 342, 347, and 348.
	Segregation Profile (A)	Tex-207-F, Part V	Roadway	1 per project	Not required when Contractor uses thermal imaging system. Does not apply to Items 342, 347, and 348.
	Joint Density (A)	Tex-207-F, Part VII	Roadway	1 per project	
	Thermal Profile	Tex-244-F	Immediately behind paver	1 per project	Not required when Contractor uses thermal imaging system.
	Ride Quality Test Type B (A)	Tex-1001-S	Final riding surface of travel lanes	1 per project	Engineer may verify Contractor's results for surface test Type B. For traditional design-bid-build TxDOT projects, MTD has contracted with TTI to perform random ride verification at 10% frequency. Results for surface test Type A are not required to be reported.
	Permeability	Tex-246-F	Roadway	1 per project	Permeability is encouraged to use with items 342 and 348. Only applies to Item 347.
FABRIC UNDERSEAL	Compliance with DMS-6220		Sampled, tested, and approved by MTD		Sampling must be in accordance with Tex-735-l. Verify the source is listed on the current Material Producer List for Silt Fence, Filter Fabric, and Fabric Underseals . If not, sample and test before use in accordance with DMS-6220.

TABLE VI – FOOTNOTES

A	When this project acceptance test fails, but the product is accepted, document the reasons for acceptance in SiteManager, in the remarks field, and on the end of the Project Materials Certification Letter.
B	Sampling may be performed at the plant, quarry, or both. Aggregate properties may be re-tested at any time during the project. These project tests may be used for one or more projects furnishing hot mix with the same aggregate source.
C	Attach the corresponding QM test report for SiteManager projects to satisfy project sampling and testing requirements.
D	Perform random sampling as specified in Tex-225-F, "Random Selection of Bituminous Mixture Samples."
E	Each test performed, that is based on a quantity of material, is considered "or fraction thereof" for calculating number of tests.

This is a guide for minimum sampling and testing.
 Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE VII – HOT-MIX ASPHALT PAVEMENT (Items 334) (Refer to DMS-9210, “Limestone Rock Asphalt (LRA),” for testing requirements for Item 330.)					
			PROJECT TESTS		
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION	FREQUENCY (Per Design) (F)	REMARKS
COARSE AGGREGATE	L. A. Abrasion (A)	Tex-410-A	Stockpile (B)	1 per project, per source	Verify the published value of the source, as listed on the current Material Producer List for BRSQC , meets the project specifications. If not, sample in accordance with Tex-221-F and submit to MTD for testing before use in accordance with Tex-499-A. (D) Sample in accordance with Tex-221-F. Testing frequency may be reduced or eliminated based on a satisfactory test history.
	Magnesium Soundness (A)	Tex-411-A			
	Micro Deval	Tex-461-A			
	Surface Aggregate Classification (A)	Tex-499-A	Stockpile (B)	1 per project, per source	Verify the published value of the source, as listed on the current Material Producer List for BRSQC , meets the project specifications. If not, sample in accordance with Tex-221-F and submit to MTD for testing before use in accordance with Tex-499-A. SiteManager Quality Monitoring test documentation is accomplished by attaching an approved mix design.
COMBINED AGGREGATE	Sand Equivalent	Tex-203-F	Stockpiles, hot bins, or feeder belts	1 per project, per source	Sample in accordance with Tex-221-F. The timing of when the test is performed is at the discretion of the Engineer.
ASPHALT BINDER	Compliance with Item 300 (A)		Sampling port nearest the storage tank	1 per project, per grade, per source	Test a minimum of one sample taken from the project. Sample binder in accordance with Tex-500-C, Part II. Verify that the binder is from a preapproved source when it arrives on the project, and that the lab number on the shipping ticket is within the valid dates shown on the MTD QM test report or in the SM Assistant. The Engineer must associate one QM sample, per project in SM.
TACK COAT	Compliance with Item 300 (A) (C)		Distributor	1 per project, per grade, per source	Test a minimum of one sample taken from the project. Sample tack coat in accordance with Tex-500-C, Part III. Verify that the binder is from a preapproved source when it arrives on the project, and that the lab number on the shipping ticket is within the valid dates shown on the MTD QM test report or in the SM Assistant. The Engineer must associate one QM sample, per project in SM.

This is a guide for minimum sampling and testing.
Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE VII – HOT-MIX ASPHALT PAVEMENT (Items 334)

(Refer to DMS-9210, “Limestone Rock Asphalt (LRA),” for testing requirements for Item 330.)

			PROJECT TESTS		
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION	FREQUENCY (Per Design) (F)	REMARKS
MIX DESIGN	Compliance with applicable specification	Tex-204-F	At source (if not approved)	Min 1 design per Mix Type and Asphalt Grade	Verify that aggregates, recycled asphalt pavement, recycled asphalt shingles, mineral filler, asphalt binder, anti-stripping additives, and warm mix systems are on the Material Producer List where applicable and that they meet project specification requirements. Project sampling and testing may be conducted in individual materials as necessary for control.
COMPLETE MIXTURE	Asphalt Content (A)	Tex-236-F	Engineer Truck Sample (E)	Minimum of 1 per 5,000 tons	Sample in accordance with Tex-222-F. Determine correlation factors for ignition oven using Tex-236-F at a minimum of one per project.
	Voids in Mineral Aggregates (VMA)	Tex-204-F	Truck Sample Plant Produced (E)	1 per 5,000 tons	Sample in accordance with Tex-222-F.
	Gradation (A)	Tex-236-F	Truck Sample	Minimum 1 per 5,000 tons	Sample in accordance with Tex-222-F. Determine correlation factors for ignition oven using Tex-236-F at a minimum of one per project.
	Boil Test	Tex-530-C		1 per project	Sample in accordance with Tex-222-F. The timing of when the test is performed is at the discretion of the Engineer.
	Moisture Content	Tex-212-F, Part II	Truck Sample	1 per 5,000 tons	Sample in accordance with Tex-222-F. Performed by MTD at the point of production for payment calculations.
	Hydrocarbon- Volatile Content	Tex-213-F		1 per 5,000 tons	Sample in accordance with Tex-222-F. The timing of when the test is performed is at the discretion of the Engineer.
	Lab Molded Density (A)	Tex-207-F		1 per 5,000 tons	Sample in accordance with Tex-222-F.
Hveem Stability (A)	Tex-208-F	1 per 5,000 tons		Sample in accordance with Tex-222-F. The timing of when the test is performed is at the discretion of the Engineer.	
ROADWAY	Ride Quality Test Type B (A)	Tex-1001-S	Final riding surface of travel lanes		Engineer may verify Contractor’s results for surface test Type B. For traditional design-bid-build TxDOT projects, MTD has contracted with TTI to perform random ride verification at 10% frequency. Results from surface test Type A are not required to be reported.

This is a guide for minimum sampling and testing.
Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE VII – FOOTNOTES

A	When this project acceptance test fails, but the product is accepted, document the reasons for acceptance in SiteManager, in the remarks field, and on the end of the Project Materials Certification Letter.
B	Sampling may be performed at the plant, quarry, or both. Aggregate properties may be re-tested at any time during the project.
C	Or as called for in the Specifications.
D	Attach the corresponding QM test report for SiteManager projects to satisfy project sampling and testing requirements.
E	Perform random sampling as specified in Tex-225-F, “Random Selection of Bituminous Mixture Samples.”
F	Each test performed, that is based on a quantity of material, is considered “or fraction thereof” for calculating number of tests.

This is a guide for minimum sampling and testing.
 Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE VIII – HOT-MIX ASPHALT PAVEMENT (Item 340)

			PROJECT TESTS			
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION	FREQUENCY	REMARKS	
COARSE AGGREGATE	L. A. Abrasion (A)	Tex-410-A	Stockpile (B)	1 per project, per source	Verify the published value of the source, as listed on the current Material Producer List for BRSQC , meets the project specifications. If not, sample in accordance with Tex-221-F and submit to MTD for testing before use in accordance with Tex-499-A. (C)	
	Magnesium Soundness (A)	Tex-411-A				
	Micro Deval	Tex-461-A	Stockpile (B)	1 per project, per source		Sample in accordance with Tex-221-F. Testing frequency may be reduced or eliminated based on a satisfactory test history.
	Surface Aggregate Classification (A)	Tex-499-A	Stockpile (B)	1 per project, per source		Verify the published value of the source, as listed on the current Material Producer list for BRSQC , meets the project specifications. If not, sample in accordance with Tex-221-F and submit to MTD for testing before use in accordance with Tex-499-A. (C)
COMBINED AGGREGATE	Sand Equivalent	Tex-203-F	Stockpiles, hot bins, or feeder belts	1 per project, per design	Sample in accordance with Tex-221-F.	
ASPHALT BINDER	Compliance with Item 300 (A)		Sampling port nearest the storage tank	1 per project, per grade, per source	<p>Test a minimum of one sample taken from the project. Sample binder in accordance with Tex-500-C, Part II.</p> <p>Verify that the binder is from a preapproved source when it arrives on the project, and that the lab number on the shipping ticket is within the valid dates shown on the MTD QM test report or in the SM Assistant.</p> <p>The Engineer must associate one QM sample, per project in SM.</p>	
TACK COAT	Compliance with Item 300 (A)		Distributor	1 per project, per grade, per source	<p>Test a minimum of one sample taken from the project. Sample tack coat in accordance with Tex-500-C, Part III.</p> <p>Verify that the binder is from a preapproved source when it arrives on the project, and that the lab number on the shipping ticket is within the valid dates shown on the MTD QM test report or in the SM Assistant.</p> <p>The Engineer must associate one QM sample, per project in SM.</p>	
MIX DESIGN	Compliance with applicable specification	Tex-204-F	At source (if not approved)	Min. 1 design per Mix Type and Asphalt Grade	Verify that aggregates, recycled asphalt pavement, recycled asphalt shingles, mineral filler, asphalt binder, anti-stripping additives, and warm mix systems are on the Material Producer List where applicable and that they meet project specification requirements. Project sampling and testing may be conducted in individual materials as necessary for control.	

This is a guide for minimum sampling and testing.
 Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE VIII – HOT-MIX ASPHALT PAVEMENT (Item 340)

			PROJECT TESTS		
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION	FREQUENCY	REMARKS
COMPLETE MIXTURE	Asphalt Content	Tex-236-F	Truck Sample (D)	Minimum of 1 per day	Sample in accordance with Tex-222-F. Determine correlation factors for ignition oven using Tex-236-F at a minimum of one per project.
	Voids in Mineral Aggregates (VMA)	Tex-204-F	Truck Sample Plant Produced (D)	1 per day	Sample in accordance with Tex-222-F.
	Gradation (A)	Tex-236-F	Truck Sample	Minimum 1 per day	Sample in accordance with Tex-222-F. Determine correlation factors for ignition oven using Tex-236-F at a minimum of one per project.
	Boil Test	Tex-530-C		1 per project	Sample in accordance with Tex-222-F, unless waived by the Engineer.
	Indirect Tensile Strength – Dry	Tex-226-F		1 per project, per design	Sample in accordance with Tex-222-F, unless waived by the Engineer.
	Lab Molded Density (A)	Tex-207-F	Truck Sample	1 per day	Sample in accordance with Tex-222-F.
	Hamburg Wheel Tracker (A)	Tex-242-F		1 per project	Sample in accordance with Tex-222-F. Sample during production.
ROADWAY	Air Voids (A)	Tex-207-F	Selected by the Engineer (D)	1 per day (2 Cores)	Sample in accordance with Tex-222-F.
	Ride Quality Test Type B (A)	Tex-1001-S	Final riding surface of travel lanes		Engineer may verify Contractor's results for surface test Type B. For traditional design-bid-build TxDOT projects, MTD has contracted with TTI to perform random ride verification at 10% frequency. Results from surface test Type A are not required to be reported.
FABRIC UNDERSEAL	Compliance with DMS-6220		Sampled, tested, and approved by MTD		Sample in accordance with Tex-735-I. Verify the source is listed on the current Material Producer List for Silt Fence, Filter Fabric, and Fabric Underseals. If not, sample and submit to MTD for testing before use in accordance with DMS-6220.

This is a guide for minimum sampling and testing.
Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE VIII – FOOTNOTES	
A	When this project acceptance test fails, but the product is accepted, document the reasons for acceptance in SiteManager, in the remarks field, and on the end of the Project Materials Certification Letter.
B	Sampling may be performed at the plant, quarry, or both. Aggregate properties may be re-tested at any time during the project. These project tests may be used for one or more projects furnishing hot mix with the same aggregate source.
C	Attach the corresponding QM test report for SiteManager projects to satisfy project sampling and testing requirements.
D	Perform random sampling as specified in Tex-225-F, “Random Selection of Bituminous Mixture Samples.”

This is a guide for minimum sampling and testing.
 Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE IX – MICROSURFACING (Item 350)

PROJECT TESTS					
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION OF SAMPLING	FREQUENCY (Per Design)	REMARKS
AGGREGATE	Magnesium Soundness (A)	Tex-411-A	Stockpile (B)	1 per project, per source	Verify the published value of the source, as listed on the current Material Producer list for BRSQC meets the project specifications. If not, sample in accordance with Tex-221-F and submit to MTD for testing at 1 per project, per source. (C)
	Gradation	Tex-200-F, Part II		1 per project, per source	Sample in accordance with Tex-221-F.
	Crushed Face Count	Tex-460-A		1 per project, per source	Sample in accordance with Tex-221-F.
	Acid Insoluble (A)	Tex-612-J		1 per project, per source	Verify the value of the source, as listed on the current BRSQC, meets the project specifications. If not, sample and submit to MTD for testing before use in accordance with Tex-499-A. Sample in accordance with Tex-221-F. (C)
	Surface Aggregate Classification	Tex-499-A	Stockpile, or BRSQC (B)	1 per project, per source	Verify the published value of the source, as listed on the current Material Producer list for BRSQC meets the project specifications. If not, sample in accordance with Tex-221-F and submit to MTD for testing at 1 per project, per source. (C)
COMBINED BLEND	Sand Equivalent	Tex-203-F	Stockpile (B)	1 per project, per source	Sample in accordance with Tex-221-F.
ASPHALT BINDER	Compliance with Item 300 (A)		Sampling port nearest the storage tank	1 per project, per grade, per source	<p>Test a minimum of one sample taken from the project. Sample binder in accordance with Tex-500-C, Part II.</p> <p>Verify that the binder is from a preapproved source when it arrives on the project, and that the lab number on the shipping ticket is within the valid dates shown on the MTD QM test report or in the SM Assistant.</p> <p>The Engineer must associate one QM sample, per project in SM.</p>
TACK COAT	Compliance with Item 300 (A)		Distributor	1 per project, per grade, per source	<p>Test a minimum of one sample taken from the project. Sample tack coat in accordance with Tex-500-C, Part III.</p> <p>Verify that the binder is from a preapproved source when it arrives on the project, and that the lab number on the shipping ticket is within the valid dates shown on the MTD QM test report or in the SM Assistant.</p> <p>The Engineer must associate one QM sample, per project in SM.</p>

This is a guide for minimum sampling and testing.
 Testing frequency may need to be increased for high material variability or when test results approach specification limits.

TABLE IX – MICROSURFACING (Item 350)

PROJECT TESTS					
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	LOCATION OF SAMPLING	FREQUENCY (Per Design)	REMARKS
MIX DESIGN	Compliance with applicable specification	Tex-204-F	At source (if not approved)	Min. 1 design per project	Submit to MTD for approval.
CEMENT	Compliance with DMS-4600				Verify the source is listed on the current Material Producer List for Cement . If not, sample and submit to MTD for testing before use in accordance with DMS-4600.
COMPLETE MIX	Asphalt Content	Tex-236-F	During production	1 per day	Sample in accordance with Tex-222-F. Determine correlation factors for ignition oven using Tex-236-F at a minimum of one per project.
	Gradation	Tex-200-F, Part II Tex-236-F			Sample in accordance with Tex-222-F. Determine correlation factors for ignition oven use at a minimum of one per project.

TABLE IX – FOOTNOTES

A	When this project acceptance test fails, but the product is accepted, document the reasons for acceptance in SiteManager, in the remarks field, and on the end of the Project Materials Certification Letter.
B	Sampling may be performed at the plant, quarry, or both. Aggregate properties may be re-tested at any time during the project. These project tests may be used for one or more projects furnishing hot mix with the same aggregate source.
C	Attach the corresponding QM test report for SiteManager projects to satisfy project sampling and testing requirements.
D	Each test performed, that is based on a quantity of material, is considered “or fraction thereof” for calculating number of tests.

PART C

GEOTECHNICAL REPORT OF EXISTING CONDITIONS

March 31, 2021

Via email: jkelliher@dunaway.com

Attn: Jason Kelliher
Dunaway Associates, L.P.
4000 N. Big Spring Street, Ste. 101
Midland, Texas 79705

**Reference: Geotechnical Report
Midland County 2021 Roadways Reconstruction & Rehabilitation Program
Precinct 4 Cluster 1
Midland County, Texas
BEYOND Project No. GT2101001**

Dear Mr. Kelliher:

Beyond Engineering and Testing, LLC (BEYOND) is pleased to present our geotechnical engineering study for the proposed Midland County 2021 Roadways Reconstruction & Rehabilitation Program project in Midland County, Texas. Dunaway Associates, L.P. (Client) commissioned this geotechnical engineering study to explore and evaluate the subsurface conditions at the site, develop geotechnical pavement design parameters, and provide related construction recommendations for the project. Our geotechnical report describes our field exploration and laboratory testing program, our engineering interpretation pertinent to the project, as well as earthwork guidelines for the project.

We appreciate the opportunity to serve you. We look forward to working with you on construction materials testing services during construction phase. Note that BEYOND is already under contract with Client for this project. As such, a simple change order is needed to approve testing services during construction phase. Please call us if you have any questions concerning this report or any of our other services.

Respectfully submitted,
Beyond Engineering and Testing, LLC



Appasaheb "Amar" Kadam
Project Manager

GEOTECHNICAL REPORT

MIDLAND COUNTY 2021 ROADWAYS RECONSTRUCTION & REHABILITATION PROGRAM

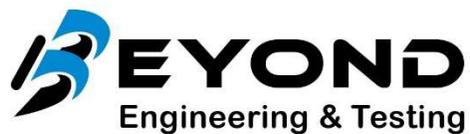
Precinct 4 Cluster 1

MIDLAND COUNTY, TEXAS

Prepared For:

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Midland, Texas 79705

Prepared By:



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March 31, 2021
BEYOND Project No. GT2101001

Geotechnical Report

MIDLAND COUNTY 2021 ROADWAYS RECONSTRUCTION & REHABILITATION PROGRAM

PRECINCT 4 CLUSTER 1
MIDLAND COUNTY, TEXAS

This Report Prepared By:



Beyond Engineering and Testing, LLC

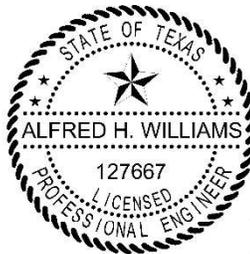
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A handwritten signature in black ink, appearing to read 'Appasaheb Kadam', written over a horizontal line.

Appasaheb "Amar" Kadam
Project Manager



3/31/2021

Reviewed by:

A handwritten signature in black ink, appearing to read 'Alfred Williams', written over a horizontal line.

Alfred Williams, P.E.
Geotechnical Department Manager

FIRM REGISTRATION NO. F-19523 - TEXAS

March 31, 2021

Project No. GT2101001

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Geotechnical Report
Midland County 2021 Roadways Reconstruction & Rehabilitation Program
Precinct 4 Cluster 1
Midland County, Texas

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APPENDIX A

Figure 1: Project Site Location Map
Figure 2: Borehole Locations Map
Figure 3: Site Vicinity Geologic Map
Log of Boring Key
Logs of Boring

APPENDIX B

Maximum Dry Density–ASTM D698 Test Results
Maximum Dry Density– ASTM D1557 and Wet Ball Mill for Base – Tex-116-E
Results Laboratory CBR (California Bearing Ratio)– ASTM D1883 Test
Results Grain Size Distribution Analysis Results – Tex-110-E
Summary of Laboratory Test Results

APPENDIX C

Summary of Dynamic Cone Penetrometer Test Results
In situ Density Test Reports
Photographic Records of Asphalt Cores

Geotechnical Report
Midland County 2021 Roadways Reconstruction & Rehabilitation Program
Precinct 4 Cluster 1
Midland County, Texas

1.0 INTRODUCTION

Beyond Engineering and Testing, LLC (BEYOND) is pleased to present our subsurface exploration and geotechnical engineering evaluation for the proposed Midland County Roadways Reconstruction & Rehabilitation project located in Midland County, Texas. The approximate project location is shown on Figure 1, Project Site Location Map, within Appendix A.

The purpose of this geotechnical investigation and report is to:

- Explore subsurface conditions;
- Conduct field and laboratory testing to characterize the engineering properties of the base and subsurface materials;
- Evaluate the feasibility of re-using the existing base materials;
- Provide pavement recommendations for the roadways, and;
- Provide earthwork requirements.

The recommendations contained in this report are based upon field and laboratory test results, engineering analyses, experience with similar subsurface conditions, and our project understanding.

2.0 PROPOSED CONSTRUCTION

BEYOND understands the proposed project comprises of pavement investigation and reconstruction of existing two-lane roadways in Midland County, Texas. This report provides our findings and pavement design recommendations for the County Road 40, County Road 35, County Road 30, County Road 1294, County Road 39, and County Road 1291. The location of each of the roadways is shown on Figure 2, Boreholes Locations Map, within Appendix A of this report. For report deliverables, the above identified county roads have been grouped under the category Precinct 4 Cluster 1.

3.0 FIELD EXPLORATION

BEYOND prepared and executed a field exploration program for the Precinct 4 Cluster 1 county roads on January 27, 2021 and January 28, 2021. The approximate boring and sampling locations are shown on Figure 2, Borehole Locations Map, within Appendix A of this report. A summary of approximate geographic latitude and longitude coordinates, and depth of each boring drilled as part of the subsurface exploration program is presented in Table 3.0.1.

Table 3.0.1 – Summary of Boring and Sampling Locations and Depths

Boring ID	Latitude (degrees)	Longitude (degrees)	Total Boring Depth (feet)
P4C1 B-01	32.042124	-102.286735	3
P4C1 B-02	32.043120	-102.282470	3
P4C1 B-03	32.044085	-102.278356	3
P4C1 B-04	32.039260	-102.281280	3
P4C1 B-05	32.035780	-102.280180	3
P4C1 B-06	32.036790	-102.276130	3
P4C1 B-07	32.030940	-102.275380	3
P4C1 B-08	32.026981	-102.286110	3
P4C1 B-09	32.028220	-102.281000	3
P4C1 B-10	32.029102	-102.277170	3
P4C1 B-11	32.030210	-102.272740	3
P4C1 B-12	32.030763	-102.273476	3
Trench Sample 1	32.030146	-102.272930	NA

Notes: Latitude and longitude coordinates provided in Table 3.0.1 were obtained from a hand-held GPS device with accuracy of approximate 15 to 20 feet.

BEYOND utilized continuous auger drilling method to advance the boreholes. We collected samples from the auger cuttings at each of the boring locations in the field, performed visual soil classification, labeled the samples as to location and depth, and bagged soil samples to minimize moisture changes.

BEYOND prepared field logs for each boring drilled. The field logs contain visual classifications of the materials encountered during drilling as well as interpolation of the subsurface conditions between samples. We also observed for groundwater level in the borehole while advancing the boreholes. These observations are discussed in subsequent sections of this report.

The project engineer reviewed the field logs, samples, and laboratory data to make appropriate modifications to the field logs. BEYOND classified soils in general accordance with the Unified Soil Classification System (USCS). The soil classification symbols on the boring logs are described in the *Boring Log Key* included in Appendix A. The final logs of boring include modifications based on our laboratory test results and observations performed on the soil samples collected in the field. The final logs of boring describe the materials encountered, strata thickness, the various depths at which the samples were obtained, as well as field test results.

4.0 SUBSURFACE CONDITIONS

4.1 Regional Geology

Quaternary Period Units

- **Windblown Cover Sand (Qcs):** Eolian deposits comprised of fine- to medium-grained sand-sized quartz grains, silty in nature, with calcareous and caliche deposits being common. Windblown sediments can reach 10 feet in thickness.

- **Caliche (Qcc):** Caliche, of several ages, with overlying materials removed. Thickness can reach 35 feet.

Tertiary Period Units

- **Ogallala Formation (To):** Fluvial sediments including sand, silt, clay, and gravel, capped by and multiple containing caliche layers.
 - Sand deposits are mainly fine- to medium-grained quartz, silty at times, calcareous, clayey in the upper sections of the formation, and contain localized quartzite lenses.
 - Silt and clay deposits contain caliche nodules, otherwise are indistinct.
 - Gravel deposits, not present across the entire formation, are comprised of sedimentary, igneous, and metamorphic rock, as well as, worn Gryphaea in channel deposits and the basal conglomerate.
 - Caliche deposits are sandy, pisolitic at the top of the formation, and often produces a caprock layer at the top of the formation.

Site vicinity geologic map is shown on Figure 3 within Appendix A of this report.

4.2 Subsurface Stratigraphy

As indicated on our logs of borings drilled as part of this study, native soils were encountered beneath the existing asphalt varying from 0.75 to 1.75 inches thick and base course thickness varying from 3 to 6 inches thick. The native soils generally encountered are as follows:

- Clay with varying amounts of sand;
- Sand with varying amounts of clay, silt and gravel.

Bedrock was not encountered in any of the borings completed as part of this study.

The above descriptions are general and depth ranges are approximate because boundaries between different strata are seldom clear and abrupt in the field. In addition, the lines separating major strata types on the logs of borings do not necessarily represent distinct lines of demarcation of the various strata. Detailed logs of borings for locations drilled as part of this study, which present the stratum descriptions, types of sampling used, laboratory test data, and additional field data, are presented in Appendix A. The Boring Log Key, defining the terms and descriptive symbols used on each log of boring, is also presented in Appendix A.

4.3 Groundwater Conditions

BEYOND did not encounter groundwater during drilling operations. Upon completing drilling operations, the drill crew backfilled the boreholes using soil cuttings.

Based on the Texas Water Development Board (TWDB) Groundwater Database of drillers reports from water wells within a 1-mile radius from the project site locations, groundwater levels at adjacent water wells were recorded at depths of 50 to 92 feet below ground surface. These measurements are from submitted driller's well reports from 2003 to 2018.

It is imperative to note that the short-term groundwater level observations performed as part of this study are not an accurate evaluation of groundwater levels at the project site and should not be interpreted as a comprehensive groundwater study. The observations made during this investigation may also not represent conditions at the time of construction and it should be understood the presence of groundwater may have an effect on certain construction activities and long-term performance of foundations and pavements. Groundwater levels are highly dependent on climatic and hydrologic conditions before and after construction, and site development including irrigation demands, drainage and other factors. If a detailed groundwater study is desired, a groundwater hydrologist should be retained to perform these services.

5.0 LABORATORY TESTS

BEYOND performed various laboratory tests to determine the soil's physical properties. These tests allow us to classify soils and to assess soil performance under the project design conditions. Laboratory tests are presented in each respective *Log of Boring* and in the *Summary of Laboratory Tests* in Appendix B. The project geotechnical engineer assigned appropriate laboratory tests on selected soil samples. BEYOND performed the following laboratory methods for soil analyses:

- **Laboratory Tests on Subgrade Materials**
 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System): ASTM D2487;
 - Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass: Tex-103-E;
 - Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils: Tex-104/105/106/107-E;
 - Test Methods for Amount of Material in Soils Finer than No. 200 (75- μ m) Sieve: Tex-111-E
 - Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis: Tex-110-E;
 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort: ASTM D698;
 - Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils: ASTM D1883.

- **Laboratory Tests on Base Materials**
 - Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass: Tex-103-E;
 - Test Methods for Liquid Limit, Plastic Limit, Plasticity Index and Linear Shrinkage of Soils: Tex-104/105/106/107-E;
 - Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis: Tex-110-E;
 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort: ASTM D1557;
 - Ball Mill Method for Determining the Disintegration of Flexible Base Material: Tex-116-E;

5.1 Geotechnical Laboratory Test Results

Moisture content tests were performed, in accordance with Tex-103-E, on selected soil samples. The test results are provided on Logs of Boring in Appendix A of the report as well as on the Summary of Laboratory Results in Appendix B of this report.

Laboratory test results indicate that the native subgrade soils have liquid limit (LL) values range from non-plastic to 31% and plastic limit (PL) value ranging from non-plastic to 18%, with Plasticity Index (PI) values ranging from about non-plastic to 19%. Based on FHWA-NHI-10-016 for the method of identifying potentially expansive soils as shown in Table 5.1.1, in general, the soils at this proposed project site possess low swell potential.

Table 5.1.1 – Method of Identifying Potentially Expansive Soils (from FHWA-NHI-10-016)

Liquid Limit (%)	Plasticity Index	Potential Swell (%)	Potential Swell Classification
< 50	< 25	< 0.5	Low
50 to 60	25 to 35	0.5 to 1.5	Marginal
> 60	> 35	> 1.5	High

Standard and Modified Proctor tests were performed on subgrade and aggregate base materials, respectively, to obtain the maximum dry unit weight and optimum moisture content in accordance with ASTM D698 and ASTM D1557 on representative bulk samples collected within the project site. A summary of test results is presented in Table 5.1.2 and Table 5.1.3.

Table 5.1.2 Summary of Standard Proctor Test Results on Subgrade (ASTM D698)

Sample Location	Depth (feet)	Material Type	Liquid Limit (%)	Plasticity Index (%)	Maximum Dry Unit Weight (pcf)	Optimum Moisture Content (%)
B-01 through B-12 (Composite)	1 - 3	SC	25	11	123.3	9.4
P4C1 Trench-1	1 - 2	SM	NP	NP	114.5	9.2

Notes: % = percent; pcf = pounds per cubic foot; SM = Silty Sand; SC = Clayey Sand; NP = Non-Plastic

Table 5.1.3 Summary of Modified Proctor Test Results on Base Materials (ASTM D1557)

Sample Location	Depth (feet)	Material Type	Liquid Limit (%)	Plasticity Index (%)	Maximum Dry Unit Weight (pcf)	Optimum Moisture Content (%)
P4C1 Trench-1 (S1)	0 - 0.5	Caliche Base	32	9	119.8	10.3
P4C1 Trench-1 (S2)	0-0.5	Caliche Base	-	-	114.6	13.0

Notes: % = percent; pcf = pounds per cubic foot; NP = Non-Plastic

Laboratory CBR tests were performed in accordance with ASTM D1883 on a representative bulk soil sample collected within the project site. A summary of the lab-soaked CBR test results along with design dry unit weight values (95% of the maximum dry density at optimum moisture content as determined by ASTM D698 and ASTM D1557) are presented in Table 5.1.4.

Table 5.1.4 Summary of CBR Test Results

Sample Location	Depth (feet)	Material Type	Dry Unit Weight (pcf)	Design CBR Soaked (%)
P4C1 - Trench 1	1-2	Subgrade (SM)	108.7 (at 95% of D698)	7.0
P4C1 - Trench 1	0-0.5	Caliche Base	108.9 (at 95% of D1557)	26.0

Notes: % = percent; pcf = pounds per cubic foot; SM = Silty Sand

Wet Ball Mill Method for Determining the disintegration of Flexible Base Material was performed in accordance with Tex-116-E on a representative bulk sample collected within the project site. A summary of the test results is presented in Table 5.1.5.

Table 5.1.5 Summary of Wet Ball Mill Test Results on Base Materials

Sample Location	Depth (feet)	Material Type	Wet Ball Mill Value	% Soil Binder
P4C1 Trench 1	0 - 0.5	Caliche Base	66	11

All the laboratory testing results are presented in Appendix B within this report.

5.2 Seismic Parameters

The following seismic parameters are based on the 2015 International Building Code (IBC) and a Site Class D for this project site. The Mapped Spectral Response Acceleration for the 1 second (S_1) and short periods (S_s) were computed using the U.S. Seismic Design Maps web-based application program developed by the Applied Technology Council (ATC). Table 5.2.1 summarizes recommended seismic parameters to be used in the design:

Table 5.2.1 Recommended Seismic Parameters

Parameter	Calculated Value
S_s – Mapped Spectral Response Acceleration at Short Period (0.2-Second)	0.132 g
S_1 – Mapped Spectral Response Acceleration at 1-Second Period	0.034 g
F_a (Site Coefficient) – Site Class D	1.6
F_v (Site Coefficient) – Site Class D	2.4

Note: Seismic Parameters were obtained from <https://hazards.atcouncil.org/#/>

6.0 EXISTING PAVEMENT CONDITION

The county roads as part of this study consist of two-lane HMAC paved surface with observed traffic consisting of light and heavy commercial vehicles. Based on our field investigation, the

existing asphalt thickness on the roads varied from 0.75 to 1.75 inches and the base course thickness varied from 3 to 6 inches. The flexible base material mostly consisted of Caliche with some crushed aggregate. BEYOND did not perform any testing on the existing asphalt cores as the plans include the removal of existing HMA and repaving with new design recommendations. Dynamic Cone Penetrometer tests were performed on the flexible base material and on native subgrade soils at all borehole locations to evaluate the in-situ strength of the base and subgrade. Summary of Dynamic Cone Penetrometer Test Results is presented in Appendix C within this report. Based on the pavement condition visual survey performed by BEYOND, existing roadway pavement seems to be in an overall fair to good condition, with some fatigue-related alligator cracking observed on CR-39, CR-35, and CR-30. Table 6.0.1 presents a summary of the existing pavement thickness and correlated field CBR test results based on in-situ Dynamic Cone Penetrometer (DCP) test conducted in accordance with ASTM D6951.

Table 6.0.1 Field Investigation Summary

Boring ID.	Roadway Name	USCS Classification of Subgrade	Asphalt Core Thickness (inches)	Base Course Thickness (inches)	*Average Correlated Subgrade CBR (%)	*Average Correlated Base CBR (%)
P4C1 B-01	W County Rd 30	SC-SM	1.75	4.0	7.7	47.3
P4C1 B-02	W County Rd 30	SC-SM	1.50	4.0	66.7	63.5
P4C1 B-03	W County Rd 30	SC	1.50	4.0	29.7	34.3
P4C1 B-04	N County Rd 1294	SC	0.75	6.0	19.6	63.6
P4C1 B-05	W County Rd 35	SC	1.00	6.0	21.3	100.0
P4C1 B-06	W County Rd 35	SC	1.50	6.0	8.2	95.7
P4C1 B-07	W County Rd 39	SM	1.25	3.0	13.2	50.0
P4C1 B-08	W County Rd 40	SM	1.25	6.0	10.8	32.1
P4C1 B-09	W County Rd 40	SM	1.75	3.0	21.8	36.8
P4C1 B-10	W County Rd 40	SM	1.50	3.0	16.1	29.3
P4C1 B-11	W County Rd 40	SC-SM	1.50	4.0	64.4	81.7
P4C1 B-12	N County Rd 1291	SM	0.75	6.0	7.4	31.8
P4C1 Trench Sample 1	W County Rd 40	SM	1.50	4.0	36.3	32.3

*The CBR (%) is unsoaked CBR value calculated based on the correlations and data obtained from the field DCP tests.

7.0 PAVEMENT DESIGN

The proposed pavement sections presented in this report are calculated based solely on engineering structural parameters. Construction cost is not included in this analysis. Daily traffic

volume for the county roads and estimated truck percentage were provided by the client. We anticipate traffic will consist of cars, pick-up trucks, delivery trucks and heavy tractor trailers. Table 7.0.1 presents the summary of Equivalent Single Axle Loads (ESAL's) for a design life of 15 years, based on an assumed truck factor of 0.24 and an annual traffic growth rate of 2% per year over the pavement design life.

Table 7.0.1 Design ESAL's

Precinct #	Roadway Name	Roadway Type	ESAL's (15 year)
Precinct 4 Cluster 1	CR 40	Collector	520,115
	CR 35	Collector	189,133
	CR 30	Minor Collector	354,624
	CR 1294	Local Residential	15,761
	CR 39	Local Residential	15,761
	CR 1291	Local Residential	15,761

7.1 Design Recommendations for Pavements

BEYOND calculated flexible pavement sections in accordance with the AASHTO Guide for Design of Pavement Structures 1993. For pavement analysis we assumed the following parameters

- Design life: 15 years
- Reliability: 90% (Collector), and 80% (Residential)
- Overall Standard Deviation: 0.40
- Initial Serviceability: 4.2
- Terminal Serviceability: 2.5
- Design Subgrade CBR-value: 7.0%
- Design Resilient Modulus (psi): 8,900
- Asphaltic Concrete: Layer structural coefficient of 0.44, and a drainage coefficient of 1.0; and
- Crushed Limestone Base Course: Layer structural coefficient of 0.14, and a drainage coefficient of 1.0.

Table 7.1.1 presents our recommended pavement sections for the roadways investigated as part of this study.

Table 7.1.1 Recommended Pavement Sections

Roadway #	ESAL's	Structural Number	Type D HMAC Thickness (inches)	New Flexible Base Thickness (inches)
CR 40	520,115	2.86	3.0	11.0
CR 35	189,133	2.44	3.0	8.0
CR 30	354,624	2.72	3.0	10.0
CR 1294	15,761	1.51	2.0	6.0*
CR 39	15,761	1.51	2.0	6.0*
CR 1291	15,761	1.51	2.0	6.0*

* For constructability purposes BEYOND recommends minimum 6.0-inch base thickness although only 4.5 to 5 inches of flex base is required to meet the required Structural Number per design calculations..

7.2 Construction Considerations

Particular attention should be given to the preparation of the existing base materials and subgrade during construction. After removal of the existing HMAC wearing course (and existing base/subgrade material if required to achieve final grading), the exposed existing base materials or subgrade should be proof-rolled prior to placement of new base material. Based on the field investigation and laboratory test results, the existing base materials do not meet TxDOT 2014 Standard Specifications Item 247 Grade 1 or 2 Flexible Base, due to the large fine percentage and potential for disintegration as indicated by the high wet ball mill value per Tex-116-E test. However, our field in-situ DCP testing and pavement condition visual survey indicate that the existing base material are in relatively stable condition, and may remain in place as subbase or subgrade support for the new flexible base material, provided it meets the proof-roll requirements outlined in Section 7.3. The recommended New Flexible Base thickness, provided in Table 7.1.1 can be placed upon properly prepared existing base materials or subgrade.

7.3 Material Specifications

It is our understanding that the existing HMAC wearing course on the above identified roadways will be removed. BEYOND does not recommend milling of existing base for reuse as New Flexible Base, since it will degrade the overall aggregate base quality and may cause the overall base material to disqualify as Crushed Limestone Base Material per specifications stated below. The pavement should be specified, constructed, and tested to meet the following requirements.

1. *Natural Subgrade* – Site preparation should begin by removing existing pavement materials, surface debris, vegetation, organic topsoil, and major root systems, if any. If the natural subgrade soil is exposed after site preparation, scarify the resulting subgrade to at least 6 inches, moisture condition and compact to a minimum of 98% of the maximum density per ASTM D698 and moisture conditioned within +/- 2% of optimum moisture content for cohesive soils or moisture conditioned within +/- 3% of optimum moisture content for cohesionless soils. The compacted surface shall be proof-rolled using a loaded tandem-axle dump truck or water truck of 25 tons or heavier. Passing proof-roll tests must show less than 1/2-inch deflection and no area pumping. Soft spots or areas exhibiting pumping should be excavated and re-compacted. If needed, use select fill in

accordance with Section 8.1 to reach final target site grade. BEYOND recommends nuclear density test frequency of one test per 500 linear feet of roadway.

2. *Existing Base Materials (Caliche)* – If the existing Caliche base material is exposed after site preparation, compact and proof-roll the exposed existing base using a loaded tandem-axle dump truck or water truck of 25 tons or heavier. Passing proof-roll tests must show less than 1/2-inch deflection and no area pumping. Soft spots or areas exhibiting pumping should be excavated and re-compacted. If needed, use select fill placed in accordance with Section 8.1 to reach final target site grade.
3. *Crushed Limestone Base Material (Flexible Base)* - Crushed rock as per Texas Department of Transportation, Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges (2014), Item 247, **Grade 1 or Grade 2**. The material should be compacted to a minimum of **95%** of the maximum density as per **ASTM D1557** at moisture content within +/- 2% of optimum moisture content.
4. *HMAC – Type D* Hot Mix Asphaltic Concrete surface course. This material should meet TxDOT Item 340 specifications.
5. *Prime Coat* – Texas Department of Transportation Item 310.

8.0 CONSTRUCTION CRITERIA

In this section, we provide various specifications and construction recommendations to allow earthwork to meet the intent of the geotechnical parameters provided in Section 7. We recommend that BEYOND be retained to provide verification testing services during construction. This allows us to verify that pavement construction items are in compliance with our recommendations.

Prior to construction, the contractor should establish proper and positive drainage to maintain a relatively dry condition at the proposed construction site. This will be important if any work is attempted during prolonged rainfall periods. Water ponding in construction areas should be avoided.

Winter weather conditions can also impact the construction process. Newly placed fill should not be placed on frozen subgrade and frozen material should not be used for fill.

Exposed subgrade should be observed by the geotechnical engineer or a qualified representative prior to placement of materials.

8.1 Select Fill Below Roadway

Select non-expansive fill material placed under the roadway new flexible base should meet one of the following soil classifications: SC-SM, SM, SC, GC or GW-GC. In addition, select fill shall possess a plasticity index, PI of less than 15 and shall not possess particle sizes greater than 3-inches. Native subgrade soils may be used as select fill provided additional testing is performed during construction to verify the material suitability.

Select fill should be placed in loose lifts not exceeding 8-inches and should be compacted to a minimum compaction of 98% of the maximum dry density as determined by ASTM D698 and moisture conditioned within +/- 2% of optimum moisture content for cohesive soils or moisture conditioned within +/- 3% of optimum moisture content for cohesionless soils.

8.2 Open Excavations

Temporary construction slopes and/or permanent embankment slopes should be protected from surface runoff water. Site grading should be designed to allow drainage at planned areas where erosion protection is provided, instead of allowing surface water to flow down unprotected slopes. Surcharge loads, either static or dynamic, should not be applied to an excavation slope. Construction equipment should be prevented from traveling along or near the top of the excavation slope. Monitoring of temporary slopes, trenches, and dewatering during construction should be undertaken by the contractor to detect early warnings of movement within slopes, structures, pavements, etc.

All excavations should be located so that no adjacent structures or utilities, existing or new, are located above a plane projected 45 degrees upward from any point in an excavation, regardless of whether it is shored or unshored.

In all cases of excavations in soils, sloped excavations and trench shields are required for excavations greater than four feet in depth. The contractor's "Competent Person" (as defined by OSHA) must inspect each trench to determine the type of bench or slope that is actually required. With all excavations, only a "competent person" shall determine whether sloped, benched, or trench shields can be used. OSHA and applicable state and local standards should be observed and followed. Site safety is the responsibility of the contractor.

8.3 Bedding Embedment and Backfill Materials for Underground Utilities

BEYOND recommends placing at least 6 inch of granular bedding material per ASTM C33 grade 7 or 8 on the base of the excavation for all underground utility pipe types. Bedding material should be free from rocks, clods, roots or other debris large than ½-inch diameter.

Bedding, Embedment and Backfill for underground utility lines should be placed in uniform layers with a maximum loose thickness of 8 inches and compacted to a minimum 95% of maximum dry density as determined by ASTM D698. Compact each lift mechanically. Utilize select fill as per section 8.1 for utility backfill beneath all paved surfaces.

Special precaution should be taken when backfilling above any existing underground utility lines. The structural capacity of existing underground utility pipes should be evaluated to ensure that additional load/stresses due to construction activities do not affect the structural integrity of the existing pipes.

8.4 Drainage

Proper drainage should be provided away from the roadway during all phases of construction and post-construction grading. Proper drainage is essential to the long-term stability of the structure. Ponding of water near the roadway from improper drainage should not be permitted.

9.0 LIMITATIONS

Recommendations contained in this report are based on our field observations and subsurface explorations, limited laboratory tests, and our present knowledge of the proposed construction. It is possible that soil conditions will vary between or beyond the points explored. If soil conditions are encountered that differ from those described herein, we should be notified immediately. If the scope of the proposed design or construction changes from that described in this report, our data should also be reviewed.

We prepared this report in substantial compliance with the generally accepted geotechnical engineering practice, as it exists in the area at the time of our study. No warranty is expressed or implied. The recommendations provided in this report are based on the assumption that BEYOND will conduct an adequate program of tests and observations during the construction phase in order to evaluate compliance with our recommendations.

This report may be used only by the client, their design team, and only for the purposes stated, within three years from its issuance. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this Report shall notify BEYOND of such intended use. Based on the intended use of the report, BEYOND may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release BEYOND from any liability resulting from the use of this report by any unauthorized party.

This is a geotechnical engineering report and is not intended to provide information about possible contaminated soils or the locations of any abandoned underground storage tanks. The owner should consult with an environmental specialist to determine whether this site is suitable from an environmental perspective.

Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard; they are not incorporated into it or "included by reference," as that latter term is used relative to contracts or other matters of law.

APPENDIX A

Figure 1: Project Site Location Map
Figure 2: Borehole Locations Map
Figure 3: Site Vicinity Geologic Map
Log of Boring Key
Logs of Boring



Figure 1 – Project Site Location Map

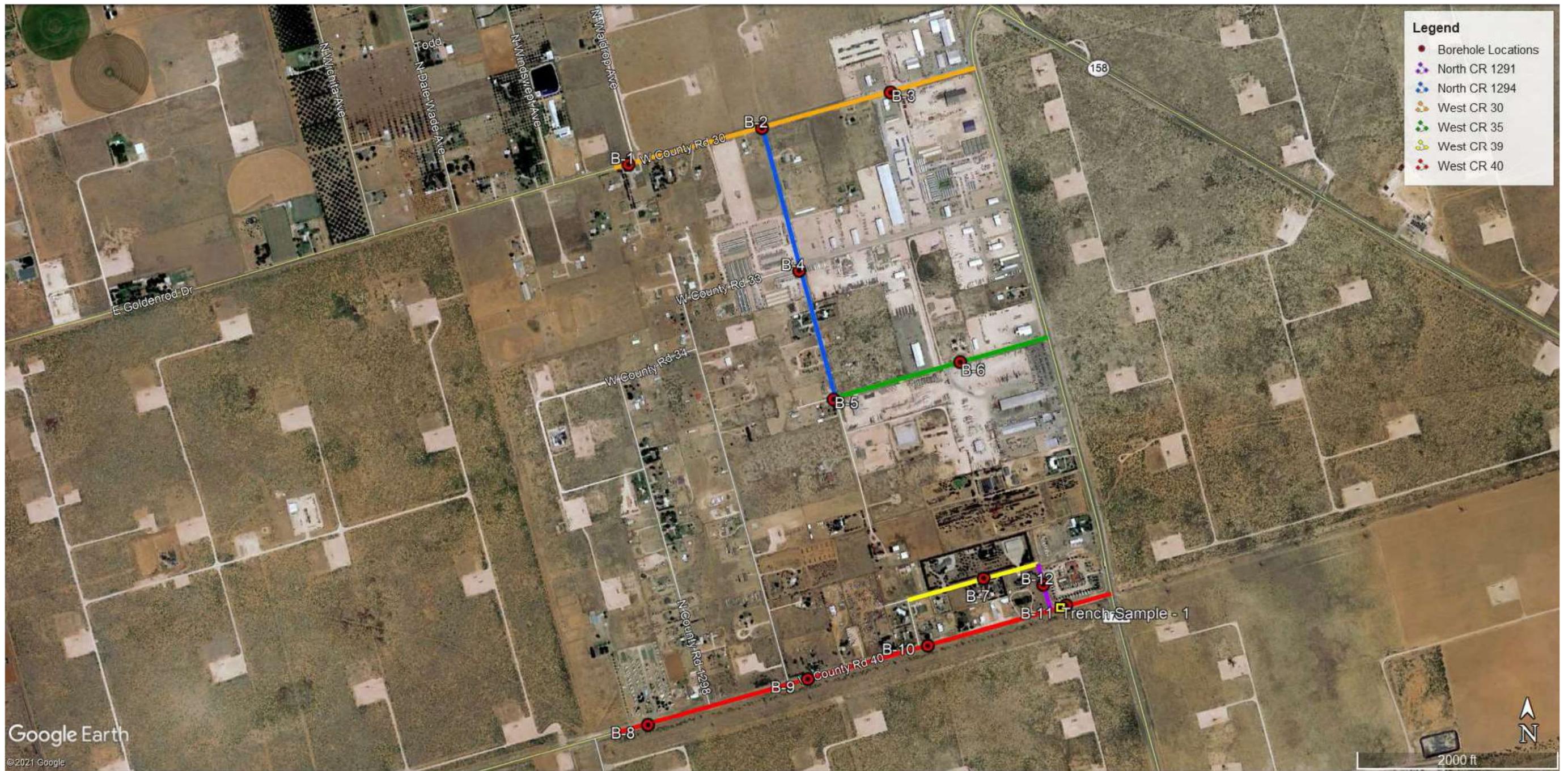


Figure 2 – Borehole Locations and Roadways Map

Windblown Cover Sand (Qcs): Eolian deposits comprised of fine- to medium-grained sand-sized quartz grains, silty in nature, with calcareous and caliche deposits being common. Windblown sediments can reach 10 feet in thickness.

Caliche (Qcc): Caliche, of several ages, with overlying materials removed. Thickness can reach 35 feet.

Ogallala Formation (To): Fluvial sediments including sand, silt, clay, and gravel, capped by and multiple containing caliche layers.

- Sand deposits are mainly fine- to medium-grained quartz, silty at times, calcareous, clayey in the upper sections of the formation, and contain localized quartzite lenses.
- Silt and clay deposits contain caliche nodules, otherwise are indistinct.
- Gravel deposits, not present across the entire formation, are comprised of sedimentary, igneous, and metamorphic rock, as well as, worn Gryphaea in channel deposits and the basal conglomerate.
- Caliche deposits are sandy, pisolitic at the top of the formation, and often produces a caprock layer at the top of the formation.

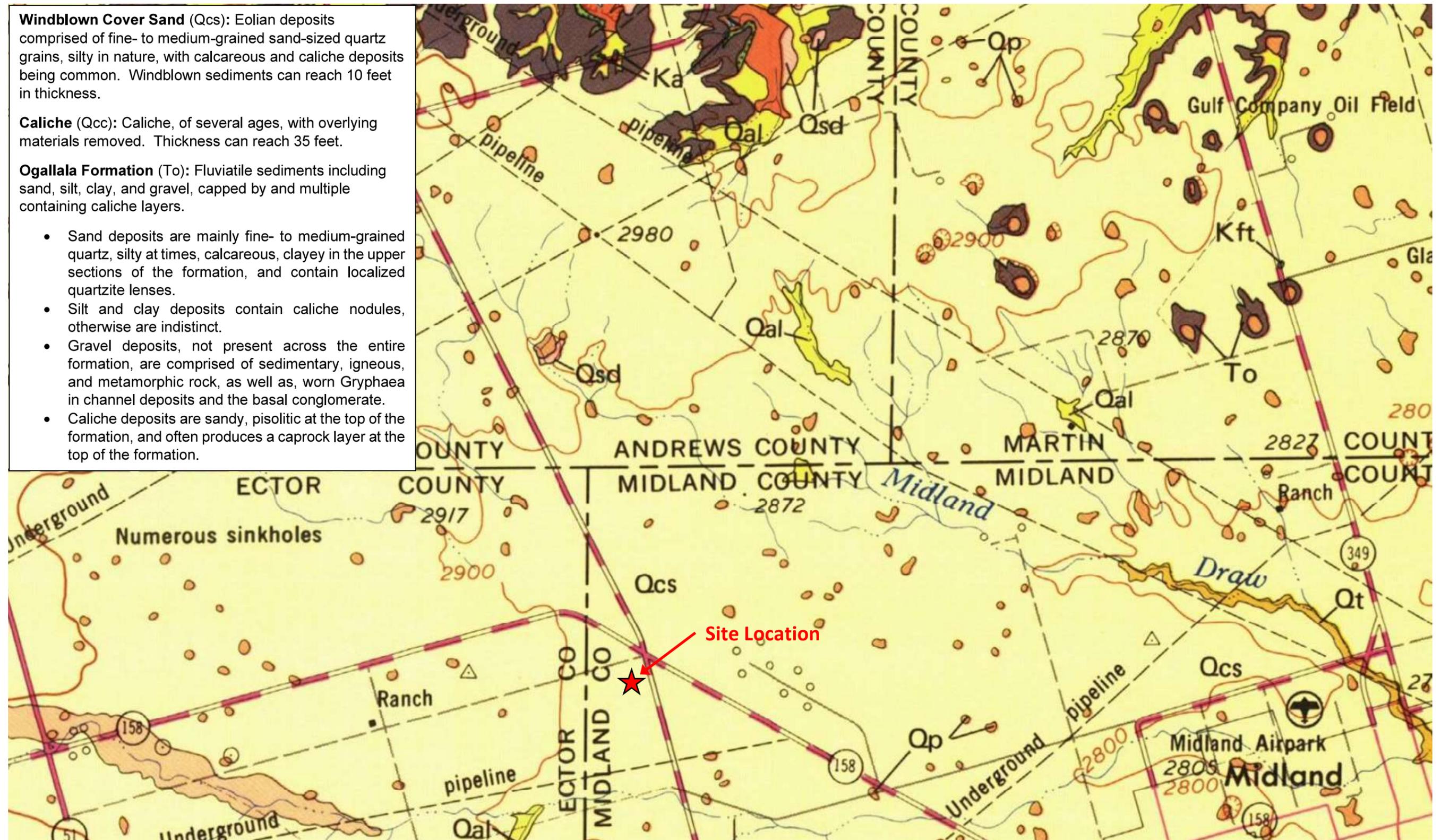


Figure 3 – Site Vicinity Geologic Map

LOG OF BORING KEY

FIELD DATA		LABORATORY DATA						DRILLING METHOD(S):																																																															
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS			DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	GROUNDWATER INFORMATION:																																																										
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TYPICAL SOIL AND ROCK SYMBOLS (USCS CLASSIFICATION)

	Lean Clay (CL)		Silty, Clayey Sand (SC-SM)		Bedrock
	Fat Clay (CH)		Poorly-Graded Sand (SP)		Basalt
	Silt (ML)		Well-Graded Sand (SW)		Limestone
	Elastic Silt (MH)		Poorly-Graded Gravel (GP)		Sandstone
	Silty Clay (CL-ML)		Well-Graded Gravel (GW)		Siltstone
	Clayey Sand (SC)		Clayey Gravel (GC)		Shale
	Silty Sand (SM)		Silty Gravel (GM)		Fill Material

DEGREE OF WEATHERING

- 1) Unweathered: No evidence of any chemical or mechanical alteration.
- 2) Slightly weathered: Slight discoloration on surface, slight alteration along discontinuities, less than 10% of the rock volume altered.
- 3) Moderately weathered: Discoloring evident, surface pitted and altered with alteration penetrating well below rock surfaces, weathering "halos" evident, 10 to 50% of the rock volume altered.
- 4) Highly weathered: Entire mass discolored, alteration pervading nearly all of the rock with some pockets of slightly weathered rock noticeable, some minerals leached away.
- 5) Decomposed: Rock reduced to a soil with relic rock texture, generally molded and crumbled by hand.

SOIL STRUCTURE

- Calcareous..... Containing calcium carbonate
- Slickensided..... The presence of planes of weakness having a slick and glossy appearance
- Interbedded..... Alternating layers of varying material

LOG OF BORING P4C1-B-1

BEYOND E&T LOG - LOG A GNNL01.GDT - 3/19/21 11:38 - T:\OPERATIONS\GEO\TECH\9-REPORT\2021\GT2101001 MIDLAND COUNTY 2021 ROADWAYS RECONSTRUCTION & REHABILITATION PROGRAM-AK\FIELD INVESTIGATION\GT2101001 - MIDLAND COUNTY 2021



Beyond Engineering and Testing, LLC
 3011-B South County Road 1260
 Midland, Texas 79706
 Telephone: 432.561.5780
 www.BeyondET.com

CLIENT: Dunaway Associates, L.P.
 PROJECT: Midland County 2021 Roadways
 LOCATION: Midland, Texas
 NUMBER: GT2101001
 DATE(S) DRILLED: 1/27/21

FIELD DATA		LABORATORY DATA							DRILLING METHOD(S):			
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS			DRY DENSITY POUNDS/CU FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)
					LL	PL	PI					
	1			6.0	19	13	6					34.8
	2			5.7								29.7
	3											
<p>DESCRIPTION OF STRATUM</p> <p>1 3/4 in. Asphalt</p> <p>4 in. Crushed Caliche Base Material</p> <p>SILTY, CLAYEY SAND (SC-SM), trace Gravel, reddish brown, moist, fine to coarse grained</p> <p>Total Depth = 3 ft.</p>												
<p>REMARKS: GPS COORDINATES: Lat. 32.042124, Long. -102.286735 Logs of Precinct 4 Cluster 1</p>												

N - STANDARD PENETRATION TEST RESISTANCE
 P - POCKET PENETROMETER RESISTANCE
 T - TXDOT CONE PENETRATER RESISTANCE
 R - ROCK CORE RECOVERY
 RQD - ROCK QUALITY DESIGNATION

LOG OF BORING P4C1-B-2

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FIELD DATA		LABORATORY DATA							DRILLING METHOD(S):							
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT	P: TONS/SQ FT	T: BLOWS	R: %	RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS							
									LL	PL	PI	DRY DENSITY POUNDS/CU FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)
	1							8.2	21	14	7					41.0
	2							10.2								
	3															

GROUNDWATER INFORMATION:
 Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION:
 DESCRIPTION OF STRATUM

1 1/2 in. Asphalt
 4 in. Crushed Caliche Base Material
 SILTY, CLAYEY SAND (SC-SM), trace Gravel, reddish brown, moist, fine to coarse grained

Total Depth = 3 ft.

N - STANDARD PENETRATION TEST RESISTANCE
 P - POCKET PENETROMETER RESISTANCE
 T - TXDOT CONE PENETRATION RESISTANCE
 R - ROCK CORE RECOVERY
 RQD - ROCK QUALITY DESIGNATION

REMARKS:
 GPS COORDINATES: Lat. 32.043120, Long. -102.282470
 Logs of Precinct 4 Cluster 1

LOG OF BORING P4C1-B-3

BEYOND E&T LOG - LOG A GNNL01.GDT - 3/19/21 11:38 - T:\OPERATIONS\GEO\TECH\9-REPORT\2021\GT2101001 MIDLAND COUNTY 2021 ROADWAYS RECONSTRUCTION & REHABILITATION PROGRAM-AK\FIELD INVESTIGATION\GT2101001 - MIDLAND COUNTY 2021



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CLIENT: Dunaway Associates, L.P.
 PROJECT: Midland County 2021 Roadways
 LOCATION: Midland, Texas
 NUMBER: GT2101001
 DATE(S) DRILLED: 1/27/21

FIELD DATA		LABORATORY DATA							DRILLING METHOD(S):			
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS			DRY DENSITY POUNDS/CU FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)
					LL	PL	PI					
	1			9.2	31	12	19					45.8
	2											
	3			12.8								58.5
DESCRIPTION OF STRATUM 1 1/2 in. Asphalt 4 in. Crushed Caliche Base Material CLAYEY SAND (SC), trace Gravel, reddish brown, moist, fine to coarse grained SANDY LEAN CLAY (CL), trace Gravel, reddish brown, moist Total Depth = 3 ft.												
REMARKS: GPS COORDINATES: Lat. 32.044085, Long. -102.278356 Logs of Precinct 4 Cluster 1												

N - STANDARD PENETRATION TEST RESISTANCE
 P - POCKET PENETROMETER RESISTANCE
 T - TXDOT CONE PENETRATION RESISTANCE
 R - ROCK CORE RECOVERY
 RQD - ROCK QUALITY DESIGNATION

LOG OF BORING P4C1-B-4

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					LL	PL	PI					
				8.0	29	18	11				31.0	
				7.3							45.5	
	1											
	2											
	3											
<p>DESCRIPTION OF STRATUM</p> <p>3/4 in. Asphalt 6 in. Crushed Caliche Base Material CLAYEY SAND (SC), trace Gravel, reddish brown, moist, fine to coarse grained</p>												
<p>REMARKS:</p> <p>Total Depth = 3 ft.</p>												
<p>N - STANDARD PENETRATION TEST RESISTANCE P - POCKET PENETROMETER RESISTANCE T - TXDOT CONE PENETRATER RESISTANCE R - ROCK CORE RECOVERY RQD - ROCK QUALITY DESIGNATION</p>												
<p>GPS COORDINATES: Lat. 32.039260, Long. -102.281280 Logs of Precinct 4 Cluster 1</p>												

DRILLING METHOD(S):
 Continuous Flight Auger

GROUNDWATER INFORMATION:
 Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION:

DESCRIPTION OF STRATUM

3/4 in. Asphalt
 6 in. Crushed Caliche Base Material

CLAYEY SAND (SC), trace Gravel, reddish brown, moist, fine to coarse grained

31.0
 45.5

1
 2
 3

Total Depth = 3 ft.

REMARKS:
 GPS COORDINATES: Lat. 32.039260, Long. -102.281280
 Logs of Precinct 4 Cluster 1

LOG OF BORING P4C1-B-5

BEYOND E&T LOG - LOG A GNNL01.GDT - 3/19/21 11:38 - T:\OPERATIONS\GEO\TECH\9-REPORT\2021\GT2101001 MIDLAND COUNTY 2021 ROADWAYS RECONSTRUCTION & REHABILITATION PROGRAM-AK\FIELD INVESTIGATION\GT2101001 - MIDLAND COUNTY 2021



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 3011-B South County Road 1260
 Midland, Texas 79706
 Telephone: 432.561.5780
 www.BeyondET.com

CLIENT: Dunaway Associates, L.P.
 PROJECT: Midland County 2021 Roadways
 LOCATION: Midland, Texas
 NUMBER: GT2101001
 DATE(S) DRILLED: 1/27/21

FIELD DATA		LABORATORY DATA							DRILLING METHOD(S): Continuous Flight Auger				
SOIL SYMBOL	DEPTH (FT)	SAMPLES N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)			ATTERBERG LIMITS			DRY DENSITY POUNDS/CU FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)
			W	U	L	P	I						
1	7.2												49.2
2	10.1		27	15	12								57.7
3													
1 in. Asphalt 6 in. Crushed Caliche Base Material CLAYEY SAND (SC), light brown, moist, fine to coarse grained SANDY LEAN CLAY (CL), light brown, moist Total Depth = 3 ft.													
N - STANDARD PENETRATION TEST RESISTANCE P - POCKET PENETROMETER RESISTANCE T - TXDOT CONE PENETRATER RESISTANCE R - ROCK CORE RECOVERY RQD - ROCK QUALITY DESIGNATION												REMARKS: GPS COORDINATES: Lat. 32.035780, Long. -102.280180 Logs of Precinct 4 Cluster 1	

LOG OF BORING P4C1-B-6

BEYOND E&T LOG - LOG A GNNL01.GDT - 3/19/21 11:38 - T:\OPERATIONS\GEO\TECH\9-REPORT\2021\GT2101001 MIDLAND COUNTY 2021 ROADWAYS RECONSTRUCTION & REHABILITATION PROGRAM-AK\FIELD INVESTIGATION\GT2101001 - MIDLAND COUNTY 2021



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 Telephone: 432.561.5780
 www.BeyondET.com

CLIENT: Dunaway Associates, L.P.
 PROJECT: Midland County 2021 Roadways
 LOCATION: Midland, Texas
 NUMBER: GT2101001
 DATE(S) DRILLED: 1/27/21

FIELD DATA		LABORATORY DATA							DRILLING METHOD(S): Continuous Flight Auger			
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS			DRY DENSITY POUNDS/CU FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)
					LL	PL	PI					
GROUNDWATER INFORMATION: Groundwater not encountered during or immediately after drilling												
SURFACE ELEVATION:												
DESCRIPTION OF STRATUM												
	1			10.1	22	14	8					48.9
	2			11.8								53.1
	3											
Total Depth = 3 ft.												
N - STANDARD PENETRATION TEST RESISTANCE P - POCKET PENETROMETER RESISTANCE T - TXDOT CONE PENETRATION RESISTANCE R - ROCK CORE RECOVERY RQD - ROCK QUALITY DESIGNATION											REMARKS: GPS COORDINATES: Lat. 32.036790, Long. -102.276130 Logs of Precinct 4 Cluster 1	

LOG OF BORING P4C1-B-7

BEYOND E&T LOG - LOG A GNNL01.GDT - 3/19/21 11:38 - T:\OPERATIONS\GEO\TECH\9-REPORT\2021\GT2101001 MIDLAND COUNTY 2021 ROADWAYS RECONSTRUCTION & REHABILITATION PROGRAM-AK\FIELD INVESTIGATION\GT2101001 - MIDLAND COUNTY 2021



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CLIENT: Dunaway Associates, L.P.
 PROJECT: Midland County 2021 Roadways
 LOCATION: Midland, Texas
 NUMBER: GT2101001
 DATE(S) DRILLED: 1/27/21

FIELD DATA		LABORATORY DATA							DRILLING METHOD(S): Continuous Flight Auger			
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS			DRY DENSITY POUNDS/CUFT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)
					LL	PL	PI					
X	0											
	1			4.4	NP	NP	NP				19.1	
	2			4.2							27.9	
	3											

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION:
DESCRIPTION OF STRATUM

1 1/4 in. Asphalt
 3 in. Crushed Caliche Base Material
 SILTY SAND (SM), trace Gravel, brown, dry to moist, fine to coarse grained

Total Depth = 3 ft.

N - STANDARD PENETRATION TEST RESISTANCE
 P - POCKET PENETROMETER RESISTANCE
 T - TXDOT CONE PENETRATER RESISTANCE
 R - ROCK CORE RECOVERY
 RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 32.030940, Long. -102.275380
Logs of Precinct 4 Cluster 1

LOG OF BORING P4C1-B-8

BEYOND E&T LOG - LOG A GNNL01.GDT - 3/19/21 11:38 - T:\OPERATIONS\GEO\TECH\9-REPORT\2021\GT2101001 MIDLAND COUNTY 2021 ROADWAYS RECONSTRUCTION & REHABILITATION PROGRAM-AK\FIELD INVESTIGATION\GT2101001 - MIDLAND COUNTY 2021



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 Telephone: 432.561.5780
 www.BeyondET.com

CLIENT: Dunaway Associates, L.P.
 PROJECT: Midland County 2021 Roadways
 LOCATION: Midland, Texas
 NUMBER: GT2101001
 DATE(S) DRILLED: 1/28/21

FIELD DATA		LABORATORY DATA							DRILLING METHOD(S):			
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS			DRY DENSITY POUNDS/CU FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)
					LL	PL	PI					
				8.9							20.9	
	1			4.6	NP	NP	NP				23.0	
	2											
	3											
<p>DESCRIPTION OF STRATUM</p> <p>1 1/2 in. Asphalt</p> <p>6 in. Crushed Caliche Base Material</p> <p>SILTY SAND (SM), trace Gravel, reddish brown, dry to moist, fine to coarse grained</p> <p>Total Depth = 3 ft.</p>												

N - STANDARD PENETRATION TEST RESISTANCE
 P - POCKET PENETROMETER RESISTANCE
 T - TXDOT CONE PENETRATION RESISTANCE
 R - ROCK CORE RECOVERY
 RQD - ROCK QUALITY DESIGNATION

REMARKS:
 GPS COORDINATES: Lat. 32.026981, Long. -102.286110
 Logs of Precinct 4 Cluster 1

LOG OF BORING P4C1-B-9

BEYOND E&T LOG - LOG A GNNL01.GDT - 3/19/21 11:38 - T:\OPERATIONS\GEO\TECH\9-REPORT\2021\GT2101001 MIDLAND COUNTY 2021 ROADWAYS RECONSTRUCTION & REHABILITATION PROGRAM-AK\FIELD INVESTIGATION\GT2101001 - MIDLAND COUNTY 2021



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CLIENT: Dunaway Associates, L.P.
 PROJECT: Midland County 2021 Roadways
 LOCATION: Midland, Texas
 NUMBER: GT2101001
 DATE(S) DRILLED: 1/28/21

FIELD DATA		LABORATORY DATA							DRILLING METHOD(S):			
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS			DRY DENSITY POUNDS/CUFT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)
					LL	PL	PI					
	1			7.6								
	2											
	3			4.9								
GROUNDWATER INFORMATION: Groundwater not encountered during or immediately after drilling												
SURFACE ELEVATION: _____												
DESCRIPTION OF STRATUM												
1 3/4 in. Asphalt 3 in. Crushed Caliche Base Material SILTY SAND (SM), trace Gravel, reddish brown, dry to moist, fine to coarse grained												
Total Depth = 3 ft.												
REMARKS: GPS COORDINATES: Lat. 32.028220, Long. -102.281000 Logs of Precinct 4 Cluster 1												
N - STANDARD PENETRATION TEST RESISTANCE P - POCKET PENETROMETER RESISTANCE T - TXDOT CONE PENETRATION RESISTANCE R - ROCK CORE RECOVERY RQD - ROCK QUALITY DESIGNATION												

LOG OF BORING P4C1-B-10

BEYOND E&T LOG - LOG A GNNL01.GDT - 3/19/21 11:38 - T:\OPERATIONS\GEO\TECH\9-REPORT\2021\GT2101001 MIDLAND COUNTY 2021 ROADWAYS RECONSTRUCTION & REHABILITATION PROGRAM-AK\FIELD INVESTIGATION\GT2101001 - MIDLAND COUNTY 2021



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CLIENT: Dunaway Associates, L.P.
 PROJECT: Midland County 2021 Roadways
 LOCATION: Midland, Texas
 NUMBER: GT2101001
 DATE(S) DRILLED: 1/28/21

FIELD DATA		LABORATORY DATA								DRILLING METHOD(S):							
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT	P: TONS/SQ FT	T: BLOWS	R: %	RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS			DRY DENSITY POUNDS/CUFT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	GROUNDWATER INFORMATION:
									LL	PL	PI						SURFACE ELEVATION:
																	DESCRIPTION OF STRATUM
X	0																1 1/2 in. Asphalt
	1							5.3	NP	NP	NP					22.3	3 in. Crushed Caliche Base Material
	2							4.9								27.8	SILTY SAND (SM), reddish brown, dry to moist, fine to coarse grained
	3																
Total Depth = 3 ft.																	
<p>REMARKS: GPS COORDINATES: Lat. 32.029102, Long. -102.277170 Logs of Precinct 4 Cluster 1</p>																	

N - STANDARD PENETRATION TEST RESISTANCE
 P - POCKET PENETROMETER RESISTANCE
 T - TXDOT CONE PENETRATER RESISTANCE
 R - ROCK CORE RECOVERY
 RQD - ROCK QUALITY DESIGNATION

LOG OF BORING P4C1-B-11

BEYOND E&T LOG - LOG A GNNL01.GDT - 3/19/21 11:38 - T:\OPERATIONS\GEO\TECH\9-REPORT\2021\GT2101001 MIDLAND COUNTY 2021 ROADWAYS RECONSTRUCTION & REHABILITATION PROGRAM-AK\FIELD INVESTIGATION\GT2101001 - MIDLAND COUNTY 2021



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CLIENT: Dunaway Associates, L.P.
 PROJECT: Midland County 2021 Roadways
 LOCATION: Midland, Texas
 NUMBER: GT2101001
 DATE(S) DRILLED: 1/28/21

FIELD DATA		LABORATORY DATA								DRILLING METHOD(S): Continuous Flight Auger		
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS			DRY DENSITY POUNDS/CU FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)
					LL	PL	PI					
GROUNDWATER INFORMATION: Groundwater not encountered during or immediately after drilling												
SURFACE ELEVATION:												
DESCRIPTION OF STRATUM												
	1			14.4	25	18	7					15.5
	2											
	3											
Total Depth = 3 ft.												
N - STANDARD PENETRATION TEST RESISTANCE P - POCKET PENETROMETER RESISTANCE T - TXDOT CONE PENETRATER RESISTANCE R - ROCK CORE RECOVERY RQD - ROCK QUALITY DESIGNATION											REMARKS: GPS COORDINATES: Lat. 32.030210, Long. -102.272740 Logs of Precinct 4 Cluster 1	

LOG OF BORING P4C1-B-12

BEYOND E&T LOG - LOG A GNNL01.GDT - 3/19/21 11:38 - T:\OPERATIONS\GEO\TECH\9-REPORT\2021\GT2101001 MIDLAND COUNTY 2021 ROADWAYS RECONSTRUCTION & REHABILITATION PROGRAM-AK\FIELD INVESTIGATION\GT2101001 - MIDLAND COUNTY 2021



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 Telephone: 432.561.5780
 www.BeyondET.com

CLIENT: Dunaway Associates, L.P.
 PROJECT: Midland County 2021 Roadways
 LOCATION: Midland, Texas
 NUMBER: GT2101001
 DATE(S) DRILLED: 1/28/21

FIELD DATA		LABORATORY DATA							DRILLING METHOD(S):			
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS			DRY DENSITY POUNDS/CU FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)
					LL	PL	PI					
	1			6.5	NP	NP	NP					28.5
	2			9.5								37.9
	3											
<p>DESCRIPTION OF STRATUM</p> <p>3/4 in. Asphalt</p> <p>6 in. Crushed Caliche Base Material</p> <p>SILTY SAND (SM), trace Gravel, brown, moist, fine to coarse grained</p> <p>Total Depth = 3 ft.</p>												
<p>REMARKS: GPS COORDINATES: Lat. 32.030763, Long. -102.273476 Logs of Precinct 4 Cluster 1</p>												

N - STANDARD PENETRATION TEST RESISTANCE
 P - POCKET PENETROMETER RESISTANCE
 T - TXDOT CONE PENETRATER RESISTANCE
 R - ROCK CORE RECOVERY
 RQD - ROCK QUALITY DESIGNATION

APPENDIX B

Maximum Dry Density–ASTM D698 Test Results

Maximum Dry Density– ASTM D1557 and Wet Ball Mill for Base – Tex-116-E

Results Laboratory CBR (California Bearing Ratio)– ASTM D1883 Test Results

Grain Size Distribution Analysis Results – Tex-110-E

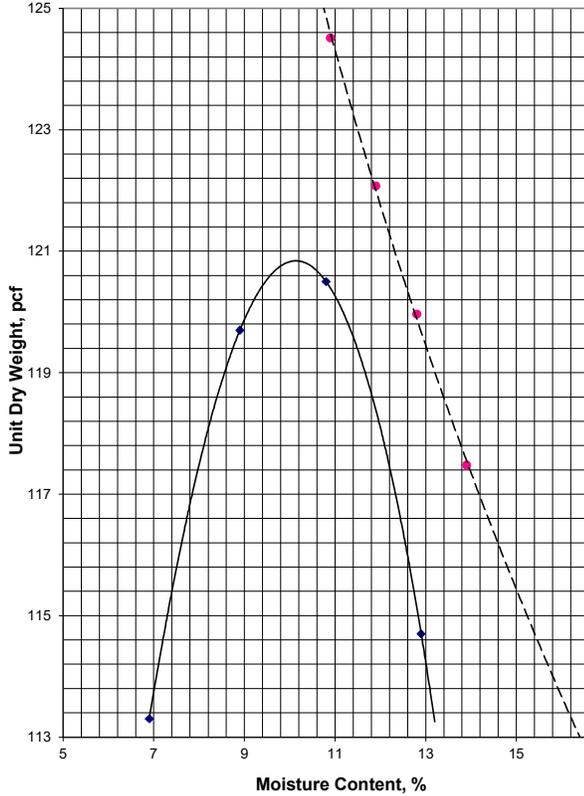
Summary of Laboratory Test Results

TO: Dunaway Associates, L.P.
 Jason Kelliher
 --
 --

PROJECT: Midland County 2021 Roadway
 Reconstruction & Rehabilitation Program
 --
 PROJECT NO.: GT2101001
 DATE: February 3, 2021
 REPORT NO.: --

MOISTURE - DENSITY RELATIONSHIP

ASTM D698: "Standard Proctor"



MATERIAL DESCRIPTION: Reddish-Brown Clayey Sand

SAMPLE LOCATION: Subgrade - P4C1_B-01 Through B-12
 (Composite Sample)

DATE SAMPLED: 2/3/2021

SAMPLED BY: Beyond ET; Buzzy D. Abalos

SAMPLE NO.: S21-063

**Test Method: ASTM D698 and D4718
 Standard Proctor with Aggregate Correction**

Preparation Method: Moist
 Rammer: Mechanical
 Compaction Method: A
 Oversize Sieve: No. 4
 % By Weight Oversize: 10%
 Bulk Specific Gravity: 2.403
 Absorption: 3.5%

Compactor: Ploog Engineering Co.
 Identification No.: M100-204122512
 Calibrated Date: January 24, 2020
 Laboratory Supervisor: Victor Moreno

Test Method: Tex-110-E

Sieve Size	Sieve Analysis % Retained	Specification
2 1/2"	0	N/A
1 3/4"	0	-
7/8"	0	-
3/8"	4	-
No. 4	11	-
No. 40	18	-

Test Method: Tex-104, 105, 106-E

Parameter	Atterberg Limits Results	Specification
LL	25	N/A
PL	14	-
PI	11	N/A

Curve Results (Finer Fraction)

Maximum Dry Unit Weight (pcf): 120.8
 Optimum Moisture Content (%): 10.1%

CORRECTED VALUE OF TOTAL SAMPLE (Agg. Correction)

Maximum Dry Unit Weight (pcf): **123.3**
 Optimum Moisture Content (%): **9.4**

Remarks:

Beyond Engineering and Testing, LLC



 Quality Review



Proctor Compaction Test (ASTM D698, D1557, TEX-113, TEX-114)

Project Name: Midland County 2021 Roadways Reconstruction

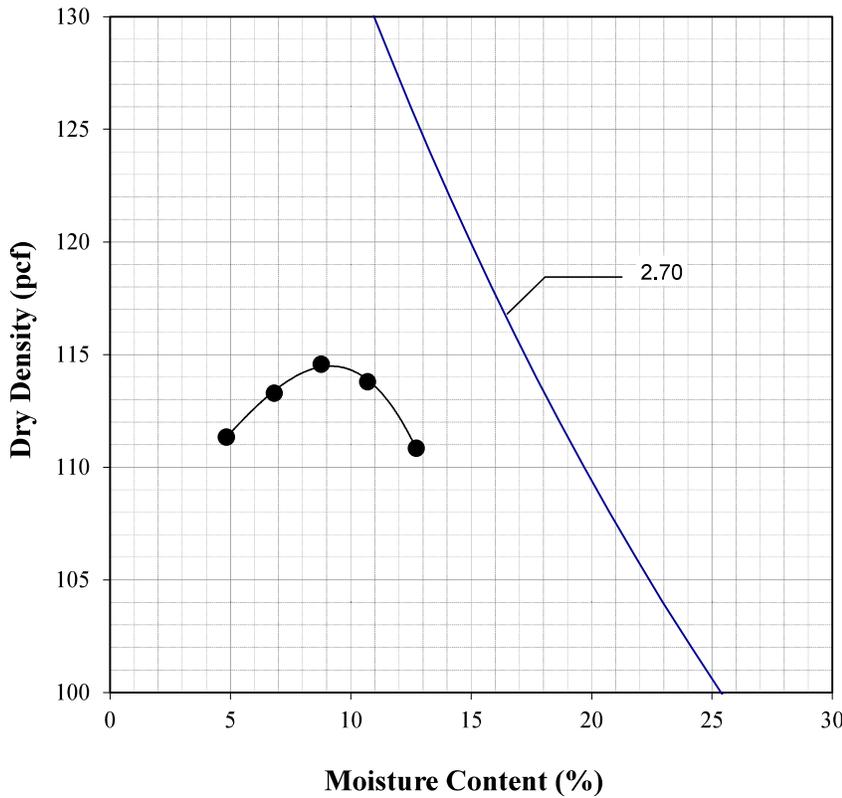
Beyond Project No.: GT2101001

Sample I.D.: P4C1 Trench 1 at 1-2 ft (Subgrade)

Test Method: ASTM D698, Method A

Test Date: 02/28/21

Moisture-Density Relationship



Water Content (%)	Dry Density (pcf)
4.8	111.3
6.8	113.3
8.8	114.6
10.7	113.8
12.7	110.8

Laboratory Compacted Samples (Finer Fraction)	
Maximum Dry Density (pcf):	114.5
Optimum Water Content (%):	9.2

HuaMiao Cao, P.E., 3/1/21

Quality Review/Date

Tested by: T.Z.

The results shown on this report are for the exclusive use of the client for whom they were obtained and apply only to the sample tested and / or inspected. They are not intended to be indicative of qualities of apparently identical products. The use of our name must receive prior written approval. Reports must be reproduced in their entirety. Unauthorized use or copying of this document is strictly prohibited by anyone other than the client for the specific project.



Proctor Compaction Test (ASTM D698, D1557, TEX-113, TEX-114)

Project Name: Midland County 2021 Roadways Reconstruction

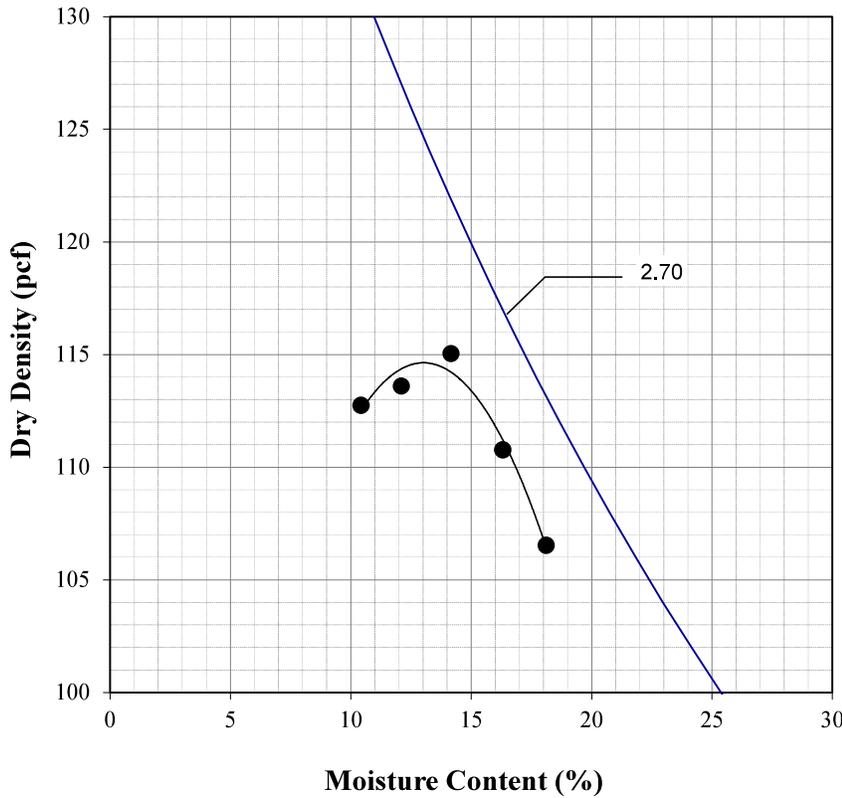
Beyond Project No.: GT2101001

Sample I.D.: P4C1 Trench 1 at 0-0.5 ft (Base)

Test Method: ASTM D1557, Method A

Test Date: 03/12/21

Moisture-Density Relationship



Water Content (%)	Dry Density (pcf)
10.4	112.8
12.1	113.6
14.1	115.1
16.3	110.8
18.1	106.5

Laboratory Compacted Samples (Finer Fraction)	
Maximum Dry Density (pcf):	114.6
Optimum Water Content (%):	13.0

HuaMiao Cao, P.E., 3/14/21

Quality Review/Date

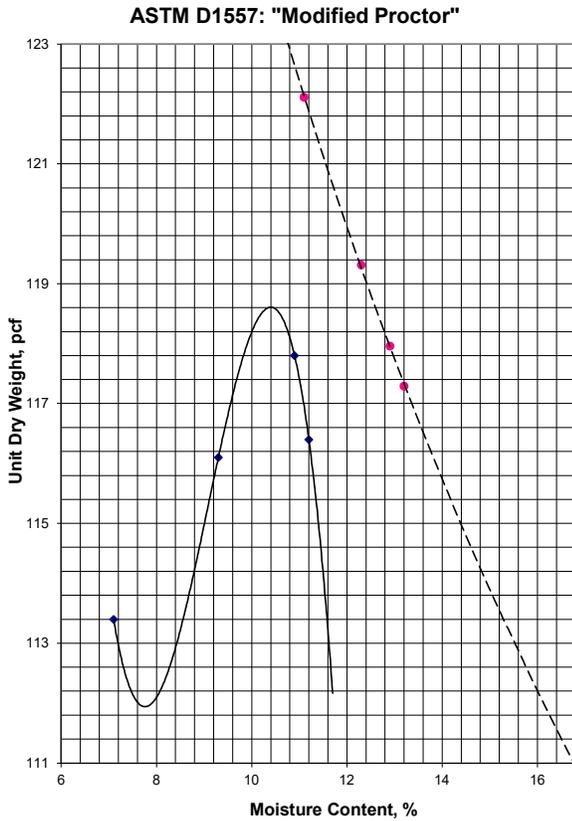
Tested by: M.E.

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TO: Dunaway Associates, L.P.
 Jason Kelliher

PROJECT: Midland County 2021 Roadway
 Reconstruction & Rehabilitation Program
 LOCATION: Midland County, Texas
 --
 PROJECT NO.: GT2101001
 DATE: February 3, 2021
 REPORT NO.: --

MOISTURE - DENSITY RELATIONSHIP



MATERIAL DESCRIPTION: Tan Clayey Sand W/Gravel

SAMPLE LOCATION: Base Mat. - P4C1_Trench 1

DATE SAMPLED: 2/3/2021

SAMPLED BY: Beyond ET; Buzzy D Abalos

SAMPLE NO.: S21-064

Test Method: ASTM D1557 and D4718
 Modified Proctor with Aggregate Correction

Preparation Method: Moist
 Rammer: Mechanical
 Compaction Method: B
 Oversize Sieve : 3/8"
 % By Weight Oversize: 19%
 Bulk Specific Gravity: 2.003
 Absorption: 10.1%

Compactor: Ploog Engineering Co.
 Identification No.: M100-204122512
 Calibrated Date: January 24, 2020
 Laboratory Supervisor: Victor Moreno

Test Method: Tex-110-E

Sieve Size	% Retained	TxDOT 2014 Item 247 Grade Specification
2 1/2"	0	N/A
1 3/4"	0	-
7/8"	6	-
3/8"	19	-
No. 4	29	-
No. 40	45	-

Test Method: Tex-104, 105, 106-E

Parameter	Results	Specification
LL	32	N/A
PL	23	-
PI	9	N/A

Test Method: Tex-116-E

Parameter	Results	Specification
Wet Ball Mill Value	66	N/A
Percent Soil Binder	55	-
% Soil Binder Increase	11	N/A

Maximum Dry Unit Weight (pcf): 118.6
 Optimum Moisture Content (%): 10.4%

CORRECTED VALUE OF TOTAL SAMPLE (Agg. Correction)

Maximum Dry Unit Weight (pcf): **119.8**
 Optimum Moisture Content (%): **10.3%**

Test Method: Tex-103-E
 Moisture Content (%) 9.2%

Remarks:

Beyond Engineering and Testing, LLC

Quality Review



CBR (California Bearing Ratio) Test

Project No. GT2101001

Test Method: ASTM D1883

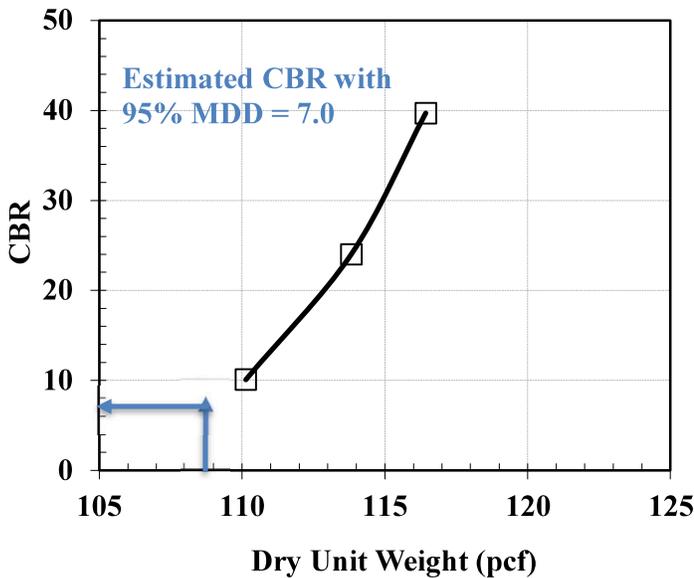
Project Na.: Midland County 2021 Roadways Reconstruction

Test Date: 3/8/2021

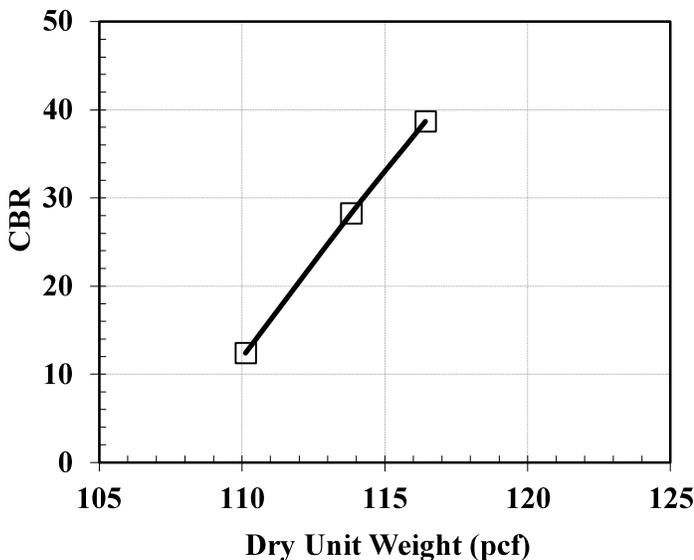
Sample ID: P4C1 Trench 1 (Subgrade 1'-2')

Rate of Penetration: 0.05 in/min

CBR for 0.100-in Penetration



CBR for 0.200-in Penetration



Initial Conditions			
Specimen No.	1	2	3
Blows per Layer	20	40	60
Surcharge Weight (lbs)	10	10	10
Water Content (%)	9.0	9.2	9.1
Dry Unit Weight (pcf)	110.1	113.8	116.4
Percent Compaction (%)	96.2	99.4	101.7
Final Conditions (soaked)			
Water Content (%) at top 1-in layer after soaking	14.7	12.7	12.8
Swell (% of initial height)	-0.2	0.0	0.0
Bearing Ratio of Sample at 0.100 in penetration	10.1	24.0	39.7
Bearing Ratio of Sample at 0.200 in penetration	12.4	28.2	38.7

Note: Soil specimens were molded to a range of densities using 20, 40 and 60 blows at optimum moisture content as per ASTM D 1883 to develop the CBR versus dry density curve. It was allowed the specimens to soak for 96 hrs prior bearing test. Removed the free water and allow the specimens to drain out for 15 min. The 10-lbs surcharge load was placed during bearing test.

HuaMiao Cao, P.E., 03/10/21

Analysis & Quality Review/Date

Specimens prepared and tested by: J.C.G & M.E.



CBR (California Bearing Ratio) Test

Project No. GT2101001

Test Method: ASTM D1883

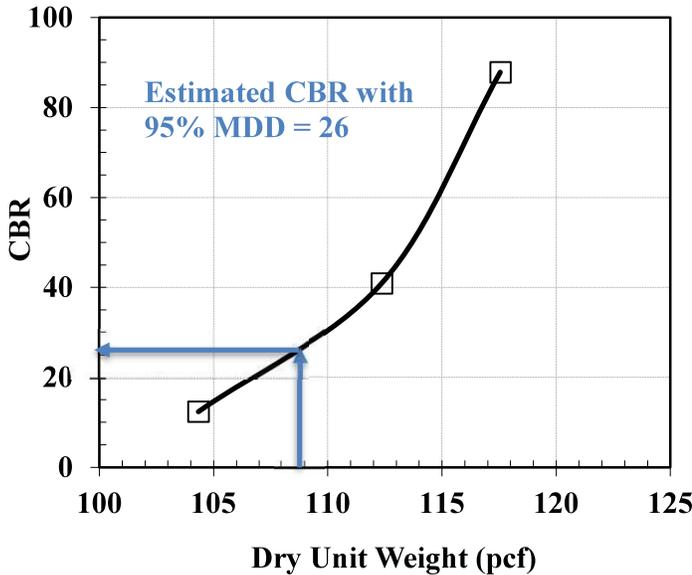
Project Na.: Midland County 2021 Roadways Reconstruction

Test Date: 3/19/2021

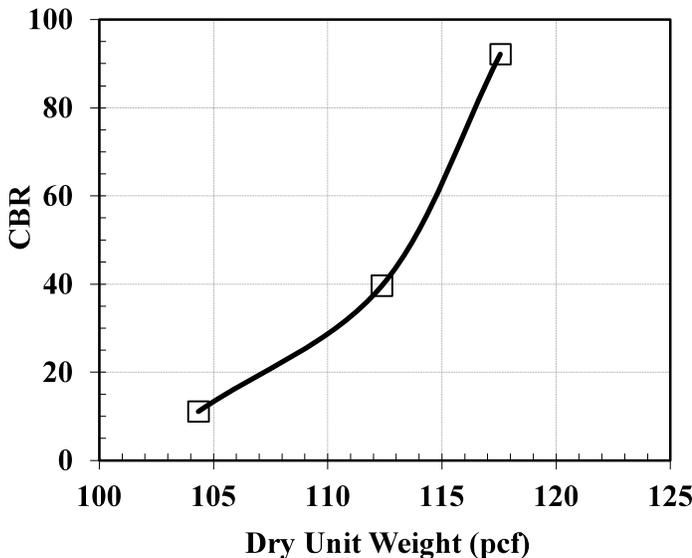
Sample ID: P4C1 Trench 1 at 0-0.5 ft (Base)

Rate of Penetration: 0.05 in/min

CBR for 0.100-in Penetration



CBR for 0.200-in Penetration



Initial Conditions			
Specimen No.	1	2	3
Blows per Layer x 5	10	25	56
Surcharge Weight (lbs)	10	10	10
Water Content (%)	12.7	12.9	12.6
Dry Unit Weight (pcf)	104.3	112.4	117.6
Percent Compaction (%)	91.0	98.0	102.6
Final Conditions (soaked)			
Water Content (%) at top 1-in layer after soaking	20.4	17.2	14.8
Swell (% of initial height)	0.1	0.2	0.2
Bearing Ratio of Sample at 0.100 in penetration	12.4	40.9	87.8
Bearing Ratio of Sample at 0.200 in penetration	11.1	39.6	92.1

Note: Soil specimens were molded to a range of densities using 10, 25 and 56 blows at optimum moisture content as per ASTM D 1883 to develop the CBR versus dry density curve. It was allowed the specimens to soak for 96 hrs prior bearing test. Removed the free water and allow the specimens to drain out for 15 min. The 10-lbs surcharge load was placed during bearing test.

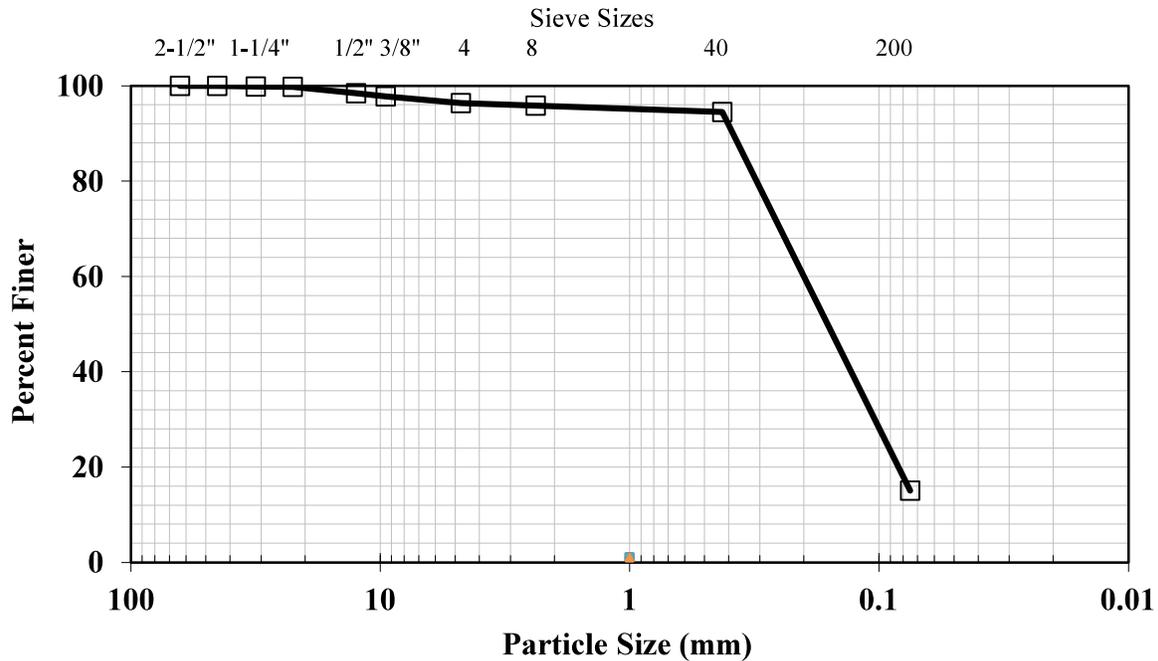
HuaMiao Cao, P.E., 03/19/21

Analysis & Quality Review/Date
 Specimens prepared and tested by: M.E.

Particle Size Analysis for Soils

Project Name: Midland County 2021 Roadways Reconstruction
 Sample ID: P4C1 Trench 1 (Subgrade)

Project No: GT2101001
 Test Method: Tex-110-E
 Test Date 02/26/21



Sieve Analysis	
Sieve Size	Percentage Passing (%)
2-1/2 in.	100.0
1-3/4 in.	100.0
1-1/4 in.	99.8
7/8 in.	99.8
1/2 in.	98.4
3/8 in.	97.8
No. 4 (4.75 mm)	96.3
No. 8 (2.38 mm)	95.8
No. 40 (450 μm)	94.5
No. 200 (75 μm)	15.0

Atterberg Limits	
Liquid Limit	-
Plastic Limit	-
Plastic Index	0

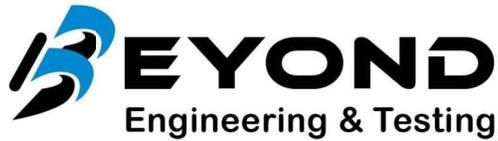
Note: Soil classifies as a silty sand (SM) in accordance with ASTM D 2487.

Huamiao Cao, P.E., 2/27/21

Quality Review/Date

Tested by: T.Z.

The results shown on this report are for the exclusive use of the client for whom they were obtained and apply only to the sample tested and / or inspected. They are not intended to be indicative of qualities of apparently identical products. The use of our name must receive prior written approval. Reports must be reproduced in their entirety. Unauthorized use or copying of this document is strictly prohibited by anyone other than the client for the specific project.



Beyond Engineering and Testing, LLC
 3011-B South County Road 1260
 Midland, Texas 79706
 Telephone: 432.561.5780
 www.BeyondET.com

SUMMARY OF LABORATORY RESULTS

CLIENT: Dunaway Associates, L.P.
 PROJECT: Midland County 2021 Roadways
 LOCATION: Midland, Texas
 NUMBER: GT2101001

Borehole	Depth (ft)	USCS	Water Content (%)	Dry Unit Weight (pcf)	LL	PL	PI	Linear Shrinkage	% passing No. 4	% passing No. 40	% passing No. 200	Compressive Strength (tsf)	Strain at Failure (%)	Confining Pressure (psi)	pH	Sulfate Content (ppm)
P4C1-B-1	0.5	SC-SM	6.0		19	13	6		99.6	97.1	34.8					
P4C1-B-1	1.0		5.7						98.0	94.2	29.7					
P4C1-B-2	1.0	SC-SM	8.2		21	14	7		99.0	95.0	41.0					
P4C1-B-2	2.0		10.2													
P4C1-B-3	0.5	SC	9.2		31	12	19		98.5	96.3	45.8					
P4C1-B-3	2.0		12.8						100.0	98.4	58.5					
P4C1-B-4	0.6	SC	8.0		29	18	11		81.5	59.5	31.0					
P4C1-B-4	1.0		7.3						98.5	93.8	45.5					
P4C1-B-5	0.6		7.2						97.1	90.8	49.2					
P4C1-B-5	2.0	CL	10.1		27	15	12		99.1	91.4	57.7					
P4C1-B-6	1.0	SC	10.1		22	14	8		91.3	85.7	48.9					
P4C1-B-6	2.0		11.8						94.4	90.4	53.1					
P4C1-B-7	0.4	SM	4.4		NP	NP	NP	1	91.3	79.7	19.1					
P4C1-B-7	1.0		4.2						97.8	94.2	27.9					
P4C1-B-8	0.6		8.9						84.0	74.7	20.9					
P4C1-B-8	1.0	SM	4.6		NP	NP	NP	1	99.7	97.9	23.0					
P4C1-B-9	0.4		7.6													
P4C1-B-9	2.0		4.9													
P4C1-B-10	0.4	SM	5.3		NP	NP	NP	1	99.2	96.2	22.3					
P4C1-B-10	1.0		4.9						100.0	98.2	27.8					
P4C1-B-11	0.5	SC-SM	14.4		25	18	7		58.3	44.3	15.5					
P4C1-B-12	0.6	SM	6.5		NP	NP	NP	4	96.5	89.7	28.5					
P4C1-B-12	1.0		9.5						95.7	91.3	37.9					

*Denotes Total Unit Weight

APPENDIX C

Summary of Dynamic Cone Penetrometer Test Results
In situ Density Test Reports
Photographic Records of Asphalt Cores

Dynamic Cone Penetrometer Test Data - Base Material

Project: Midland County 2021 Roadways Reconstruction & Rehabilitation Program							BEYOND Job #: GT2101001		
Client: Dunaway Associates, L.P.									
Phase: Precinct 4 Cluster 1									
Date: January 27, 2021							Field Tech: Dough T		
Test Location ID: P4C1-B1-Base									
Comments									
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100 mm)	
9	2	2	50.8	1	5.6	3	42.0	17.7	
11	2	4	101.6	1	4.6	3	52.6	21.7	
								Average Base CBR	47.3
								Approximate Thickness (ft)	4 inches

Date: January 27, 2021							Field Tech: Dough T		
Test Location ID: P4C1-B2-Base									
Comments									
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100 mm)	
12	2	2	50.8	1	4.2	3	58.0	23.6	
14	2	4	101.6	1	3.6	3	68.9	27.6	
								Average Base CBR	63.5
								Approximate Thickness (ft)	4 inches

Date: January 27, 2021							Field Tech: Dough T		
Test Location ID: P4C1-B3-Base									
Comments									
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100 mm)	
8	2	2	50.8	1	6.4	3	36.8	15.7	
7	2	4	101.6	1	7.3	3	31.7	13.8	
								Average Base CBR	34.3
								Approximate Thickness (ft)	4 inches

Date: January 27, 2021							Field Tech: Dough T		
Test Location ID: P4C1-B4-Base									
Comments									
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100 mm)	
14	2	2	50.8	1	3.6	3	68.9	27.6	
10	2	4	101.6	1	5.1	3	47.3	19.7	
15	2	6	152.4	1	3.4	3	74.5	29.5	
								Average Base CBR	63.6
								Approximate Thickness (ft)	6 inches

Date: January 27, 2021							Field Tech: Dough T		
Test Location ID: P4C1-B5-Base									
Comments									
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100 mm)	
20	2	2	50.8	1	2.5	3	100.0	39.4	
								Average Base CBR	100.0
								Approximate Thickness (ft)	6 inches

Dynamic Cone Penetrometer Test Data - Base Material

Project: Midland County 2021 Roadways Reconstruction & Rehabilitation Program							BEYOND Job #: GT2101001		
Client: Dunaway Associates, L.P.									
Phase: Precinct 4 Cluster 1									
Date: January 27, 2021							Field Tech: Dough T		
Test Location ID: P4C1-B6-Base									
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100 mm)	Caliche Base, Base Refusal
18	2	2	50.8	1	2.8	3	91.4	35.4	
23	2	4	101.6	1	2.2	3	100.0	45.3	
								Average Base CBR	95.7
								Approximate Thickness (ft)	6 inches

Date: January 27, 2021							Field Tech: Dough T		
Test Location ID: P4C1-B7-Base									
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100 mm)	Caliche Base
11	2	2	50.8	1	4.6	3	52.6	21.7	
10	2	4	101.6	1	5.1	3	47.3	19.7	
								Average Base CBR	50.0
								Approximate Thickness (ft)	3 inches

Date: January 28, 2021							Field Tech: Dough T		
Test Location ID: P4C1-B8-Base									
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100 mm)	Caliche Base
4	2	2	50.8	1	12.7	3	16.9	7.9	
6	2	4	101.6	1	8.5	3	26.7	11.8	
11	2	6	152.4	1	4.6	3	52.6	21.7	
								Average Base CBR	32.1
								Approximate Thickness (ft)	6 inches

Date: January 28, 2021							Field Tech: Dough T & Buzzy A		
Test Location ID: P4C1-B9-Base									
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100 mm)	Caliche Base
8	2	2	50.8	1	6.4	3	36.8	15.7	
8	2	4	101.6	1	6.4	3	36.8	15.7	
								Average Base CBR	36.8
								Approximate Thickness (ft)	3 inches

Date: January 28, 2021							Field Tech: Dough T & Buzzy A		
Test Location ID: P4C1-B10-Base									
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100 mm)	Caliche Base
5	2	2	50.8	1	10.2	3	21.8	9.8	
8	2	4	101.6	1	6.4	3	36.8	15.7	
								Average Base CBR	29.3
								Approximate Thickness (ft)	3 inches

Dynamic Cone Penetrometer Test Data - Base Material

Project: Midland County 2021 Roadways Reconstruction & Rehabilitation Program		BEYOND Job #: GT2101001								
Client: Dunaway Associates, L.P.										
Phase: Precinct 4 Cluster 1										
Date:	January 28, 2021							Field Tech:	Dough T	
Test Location ID:		P4C1-B11-Base							Comments	
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100 mm)	Caliche Base	
13	2	2	50.8	1	3.9	3	63.5	25.6		
20	2	4	101.6	1	2.5	3	100.0	39.4		
								Average Base CBR	81.7	
								Approximate Thickness (ft)	4 inches	

Date:	January 28, 2021							Field Tech:	Dough T	
Test Location ID:		P4C1-B12-Base							Comments	
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100 mm)	Caliche Base	
6	2	2	50.8	1	8.5	3	26.7	11.8		
9	2	4	101.6	1	5.6	3	42.0	17.7		
6	2	6	152.4	1	8.5	3	26.7	11.8		
								Average Base CBR	31.8	
								Approximate Thickness (ft)	6 inches	

Date:	January 28, 2021							Field Tech:	Dough T	
Test Location ID:		Trench 1							Comments	
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100 mm)	Caliche Base	
6	2	2	50.8	1	8.5	3	26.7	11.8		
3	2	4	101.6	1	16.9	3	12.3	5.9		
12	2	6	152.4	1	4.2	3	58.0	23.6		
								Average Base CBR	32.3	
								Approximate Thickness (ft)	6 inches	

Dynamic Cone Penetrometer Test Data - Subgrade

Project: Midland County 2021 Roadways Reconstruction & Rehabilitation Program							BEYOND Job #: GT2101001			
Client: Dunaway Associates, L.P.										
Phase: Precinct 4 Cluster 1										
Date: January 27, 2021							Field Tech: Dough T			
Test Location ID: P4C1-B1-Subgrade							Comments			
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100m m)	SILTY, CLAYEY SAND (SC-SM)	
5	3	3	76.2	1	15.2	3	13.8	6.6		
4	3	6	152.4	1	19.1	3	10.8	5.2		
2	5	11	279.4	1	63.5	3	2.8	1.6		
3	3	14	355.6	1	25.4	3	7.8	3.9		
3	4	18	457.2	1	33.9	3	5.6	3.0		
3	4	22	558.8	1	33.9	3	5.6	3.0	Average Subgrade CBR	7.7
									Approximate Thickness (ft)	NA

Date: January 27, 2021							Field Tech: Dough T					
Test Location ID: P4C1-B2-Subgrade							Comments					
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100m m)	SILTY, CLAYEY SAND (SC-SM)			
11	3	3	76.2	1	6.9	3	33.4	14.4				
20	2	5	127	1	2.5	3	100.0	39.4				
											Average Subgrade CBR	66.7
											Approximate Thickness (ft)	NA

Date: January 27, 2021							Field Tech: Dough T			
Test Location ID: P4C1-B3-Subgrade							Comments			
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100m m)	CLAYEY SAND (SC)	
11	3	3	76.2	1	6.9	3	33.4	14.4		
11	3	6	152.4	1	6.9	3	33.4	14.4		
15	3	9	228.6	1	5.1	3	47.3	19.7		
10	3	12	304.8	1	7.6	3	30.0	13.1		
7	3	15	381	1	10.9	3	20.1	9.2		
5	3	18	457.2	1	15.2	3	13.8	6.6	Average Subgrade CBR	29.7
									Approximate Thickness (ft)	NA

Date: January 27, 2021							Field Tech: Dough T			
Test Location ID: P4C1-B4-Subgrade							Comments			
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100m m)	CLAYEY SAND (SC)	
12	3	3	76.2	1	6.4	3	36.8	15.7		
6	3	6	152.4	1	12.7	3	16.9	7.9		
5	3	9	228.6	1	15.2	3	13.8	6.6		
4	3	12	304.8	1	19.1	3	10.8	5.2		
									Approximate Thickness (ft)	NA

Dynamic Cone Penetrometer Test Data - Subgrade

Project: Midland County 2021 Roadways Reconstruction & Rehabilitation Program							BEYOND Job #: GT2101001		
Client: Dunaway Associates, L.P.									
Phase: Precinct 4 Cluster 1									
Date: January 27, 2021							Field Tech: Dough T		
Test Location ID: P4C1-B5-Subgrade							Comments		
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100m m)	CLAYEY SAND (SC): 0 - 2 ft; SANDY LEAN CLAY (CL): 2 - 3 ft
20	3	3	76.2	1	3.8	3	65.3	26.2	
14	3	6	152.4	1	5.4	3	43.8	18.4	
5	3	9	228.6	1	15.2	3	13.8	6.6	
7	3	12	304.8	1	10.9	3	20.1	9.2	
7	3	15	381	1	10.9	3	20.1	9.2	
3	3	18	457.2	1	25.4	3	7.8	3.9	
3	3	21	533.4	1	25.4	3	7.8	3.9	
4	3	24	609.6	1	19.1	3	10.8	5.2	
5	3	27	685.8	1	15.2	1	14.9	6.6	
5	3	30	762	1	15.2	1	14.9	6.6	
4	3	33	838.2	1	19.1	1	9.5	5.2	
4	3	36	914.4	1	19.1	1	9.5	5.2	
6	3	39	990.6	1	12.7	1	21.4	7.9	
8	3	42	1066.8	1	9.5	1	38.1	10.5	
								Average Subgrade CBR	21.3
								Approximate Thickness (ft)	NA

Date: January 27, 2021							Field Tech: Dough T		
Test Location ID: P4C1-B6-Subgrade							Comments		
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100m m)	CLAYEY SAND (SC): 0 - 2 ft; SANDY LEAN CLAY (CL): 2 - 3 ft
8	3	3	76.2	1	9.5	3	23.4	10.5	
4	3	6	152.4	1	19.1	3	10.8	5.2	
4	3	9	228.6	1	19.1	3	10.8	5.2	
3	3	12	304.8	1	25.4	3	7.8	3.9	
3	4	16	406.4	1	33.9	3	5.6	3.0	
3	3	19	482.6	1	25.4	3	7.8	3.9	
3	3	22	558.8	1	25.4	3	7.8	3.9	
3	3	25	635	1	25.4	1	5.4	3.9	
2	3	28	711.2	1	38.1	1	2.4	2.6	
3	3	31	787.4	1	25.4	1	5.4	3.9	
2	3	34	863.6	1	38.1	1	2.4	2.6	
4	3	37	939.8	1	19.1	1	9.5	5.2	
								Average Subgrade CBR	8.2
								Approximate Thickness (ft)	NA

Date: January 27, 2021							Field Tech: Dough T		
Test Location ID: P4C1-B7-Subgrade							Comments		
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100m m)	SILTY SAND (SM)
7	3	3	76.2	1	10.9	3	20.1	9.2	
7	3	6	152.4	1	10.9	3	20.1	9.2	
5	3	9	228.6	1	15.2	3	13.8	6.6	
5	3	12	304.8	1	15.2	3	13.8	6.6	
4	3	15	381	1	19.1	3	10.8	5.2	
4	3	18	457.2	1	19.1	3	10.8	5.2	
4	3	21	533.4	1	19.1	3	10.8	5.2	
5	3	24	609.6	1	15.2	3	13.8	6.6	
4	3	27	685.8	1	19.1	3	10.8	5.2	
5	3	30	762	1	15.2	3	13.8	6.6	
4	3	33	838.2	1	19.1	3	10.8	5.2	
4	3	36	914.4	1	19.1	3	10.8	5.2	
5	3	39	990.6	1	15.2	3	13.8	6.6	
4	3	42	1066.8	1	19.1	3	10.8	5.2	
								Average Base CBR	13.2
								Approximate Thickness (ft)	NA

Dynamic Cone Penetrometer Test Data - Subgrade

Project: Midland County 2021 Roadways Reconstruction & Rehabilitation Program							BEYOND Job #: GT2101001			
Client: Dunaway Associates, L.P.										
Phase: Precinct 4 Cluster 1										
Date: January 28, 2021							Field Tech: Dough T			
Test Location ID: P4C1-B8-Subgrade							Comments			
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100m m)	SILTY SAND (SM)	
9	3	3	76.2	1	8.5	3	26.7	11.8		
6	3	6	152.4	1	12.7	3	16.9	7.9		
5	4	10	254	1	20.3	3	10.0	4.9		
3	3	13	330.2	1	25.4	3	7.8	3.9		
3	3	16	406.4	1	25.4	3	7.8	3.9		
4	3	19	482.6	1	19.1	3	10.8	5.2		
5	3	22	558.8	1	15.2	3	13.8	6.6		
4	3	25	635	1	19.1	3	10.8	5.2		
4	3	28	711.2	1	19.1	3	10.8	5.2		
3	3	31	787.4	1	25.4	3	7.8	3.9		
2	3	34	863.6	1	38.1	3	5.0	2.6		
3	3	37	939.8	1	25.4	3	7.8	3.9		
2	3	40	1016	1	38.1	3	5.0	2.6		
								Average Base CBR		
								Approximate Thickness (ft)	NA	

Date: January 28, 2021							Field Tech: Dough T & Buzzy A				
Test Location ID: P4C1-B9-Subgrade							Comments				
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100m m)	SILTY SAND (SM)		
9	3	3	76.2	1	8.5	3	26.7	11.8			
6	3	6	152.4	1	12.7	3	16.9	7.9			
6	3	9	228.6	1	12.7	3	16.9	7.9			
6	3	12	304.8	1	12.7	3	16.9	7.9			
6	3	15	381	1	12.7	3	16.9	7.9			
8	3	18	457.2	1	9.5	3	23.4	10.5			
7	3	21	533.4	1	10.9	3	20.1	9.2			
8	3	24	609.6	1	9.5	3	23.4	10.5			
8	3	27	685.8	1	9.5	3	23.4	10.5			
8	3	30	762	1	9.5	3	23.4	10.5			
9	3	33	838.2	1	8.5	3	26.7	11.8			
9	3	36	914.4	1	8.5	3	26.7	11.8			
								Average Base CBR			21.8
								Approximate Thickness (ft)			NA

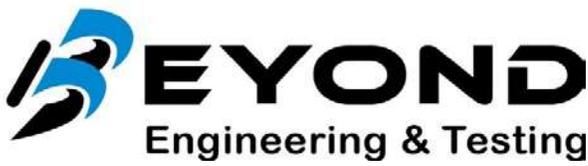
Date: January 28, 2021							Field Tech: Dough T & Buzzy A				
Test Location ID: P4C1-B10-Subgrade							Comments				
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100m m)	SILTY SAND (SM)		
12	3	3	76.2	1	6.4	3	36.8	15.7			
12	3	6	152.4	1	6.4	3	36.8	15.7			
10	3	9	228.6	1	7.6	3	30.0	13.1			
6	3	12	304.8	1	12.7	3	16.9	7.9			
5	3	15	381	1	15.2	3	13.8	6.6			
4	3	18	457.2	1	19.1	3	10.8	5.2			
4	3	21	533.4	1	19.1	3	10.8	5.2			
3	3	24	609.6	1	25.4	3	7.8	3.9			
3	3	27	685.8	1	25.4	3	7.8	3.9			
3	3.5	30.5	774.7	1	29.6	3	6.6	3.4			
3	3	33.5	850.9	1	25.4	3	7.8	3.9			
3	3	36.5	927.1	1	25.4	3	7.8	3.9			
								Average Base CBR			16.1
								Approximate Thickness (ft)			NA

Dynamic Cone Penetrometer Test Data - Subgrade

Project: Midland County 2021 Roadways Reconstruction & Rehabilitation Program							BEYOND Job #: GT2101001		
Client: Dunaway Associates, L.P.									
Phase: Precinct 4 Cluster 1									
Date: January 28, 2021							Field Tech: Dough T		
Test Location ID: P4C1-B11-Subgrade							Comments		
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100m m)	SILTY, CLAYEY SAND (SC-SM)
20	3	3	76.2	1	3.8	3	65.3	26.2	
26	4	7	177.8	1	3.9	3	63.5	25.6	
Average Base CBR								64.4	
Approximate Thickness (ft)								NA	

Date: January 28, 2021							Field Tech: Dough T		
Test Location ID: P4C1-B12-Subgrade							Comments		
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100m m)	SILTY SAND (SM)
3	3	3	76.2	1	25.4	3	7.8	3.9	
3	3	6	152.4	1	25.4	3	7.8	3.9	
2	3	9	228.6	1	38.1	3	5.0	2.6	
Average Base CBR								7.4	
Approximate Thickness (ft)								NA	

Date: January 28, 2021							Field Tech: Dough T		
Test Location ID: P4C1-Trench 1							Comments		
Number of Hammer blows	Penetration (inches)	Cumulative Penetration (inches)	Penetration (mm)	Hammer Weight 1)17.6lbs 2) 10.1 lbs	DCP index B=(mm/blow)	Soil Type 1=CL(CBR<10); 2=CH; 3=Other	Correlated CBR (%)	DPI Index (DCP blow/100m m)	SILTY SAND (SM)
11	3	3	76.2	1	6.9	3	33.4	14.4	
20	3	6	152.4	1	3.8	3	65.3	26.2	
23	3	9	228.6	1	3.3	3	76.3	30.2	
Average Base CBR								36.3	
Approximate Thickness (ft)								NA	



TO: Dunaway Associates, L.P.
Jason Kelliher, P.E.

Midland County 2021 Roadways
PROJECT: Reconstruction & Rehabilitation Program
W County Rd 40
Midland County, Texas

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PROJECT NO.: WT2101001

PROJECT MANAGER: Amar Kadam
TECHNICIAN: Alejandro C.

DATE AND TIME: March 18, 2021

REPORT NO.:

PDF ID:

COMPACTION TEST					
TYPE OF SOIL	TEST LOCATION	ASTM D 6938			PERCENT COMPACTION
		WET DENSITY LBS/CU FT	PERCENT MOISTURE	DRY DENSITY LBS/CU FT	
Caliche Base	<u>Trench 1 Base - 2 in. probe depth</u>	114.7	12.8	101.7	88.7
	<u>Trench 1 Base - 4 in. probe depth</u>	117.9	12.4	104.9	91.5
SPECIFICATIONS					
Minimum Density Requirement NA					
Moisture Requirement NA	AREA: Testing on Existing Base Material near Trench 1 (W County Rd 40)				
GAUGE NO.: 1825		DENSITY STANDARD: 2839			
MODEL NO.: Instrotek 3500		MOISTURE STANDARD: 839			
TRANSMISSION: Method A		DEPTH, INCHES:			

MDC DETERMINED IN ACCORDANCE WITH: D-1557
MD CURVE REFERENCE:

MAXIMUM DENSITY (pcf): 114.6
OPTIMUM MOISTURE (%): 13.0

Beyond Engineering and Testing, LLC

Quality Review

TO: Dunaway Associates, L.P.
 Jason Kelliher, P.E.

Midland County 2021 Roadways
PROJECT: Reconstruction & Rehabilitation Program
 W County Rd 40
 Midland County, Texas

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PROJECT NO.: WT2101001

PROJECT MANAGER: Amar Kadam
TECHNICIAN: Alejandro C.

DATE AND TIME: March 19, 2021

REPORT NO.:

PDF ID:

COMPACTION TEST					
TYPE OF SOIL	TEST LOCATION	ASTM D 6938			PERCENT COMPACTION
		WET DENSITY LBS/CU FT	PERCENT MOISTURE	DRY DENSITY LBS/CU FT	
Native Subgrade	<u>Trench 1 Subgrade - 6 in. probe depth</u>	108.2	5.0	103.0	90.0
SPECIFICATIONS					
Minimum Density Requirement NA					
Moisture Requirement NA	AREA: Testing on Subgrade Material near Trench 1 (W County Rd 40)				
GAUGE NO.: 1825		DENSITY STANDARD: 2839			
MODEL NO.: Instrotek 3500		MOISTURE STANDARD: 839			
TRANSMISSION: Method A		DEPTH, INCHES: 6			

MDC DETERMINED IN ACCORDANCE WITH: D-698
MD CURVE REFERENCE:

MAXIMUM DENSITY (pcf): 114.5
OPTIMUM MOISTURE (%): 9.2

Photographic Records of Asphalt Cores - Precinct 4 Cluster 1



P4C1 B-1 - 1 3/4 in Asphalt Core



P4C1 B-2 - 1 1/2 in Asphalt Core



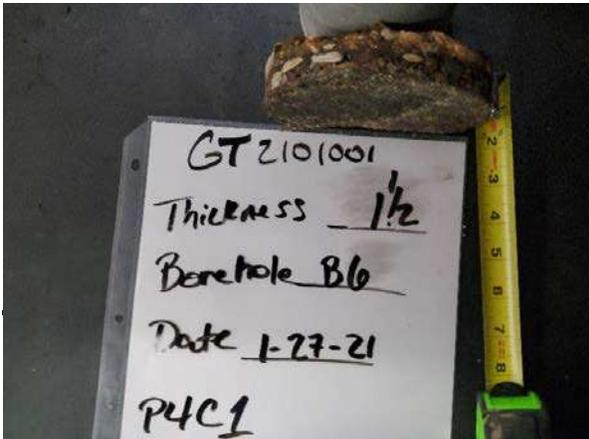
P4C1 B-3 - 1 1/2 in Asphalt Core



P4C1 B-4 - 3/4 in Asphalt Core



P4C1 B-5 - 1 in Asphalt Core

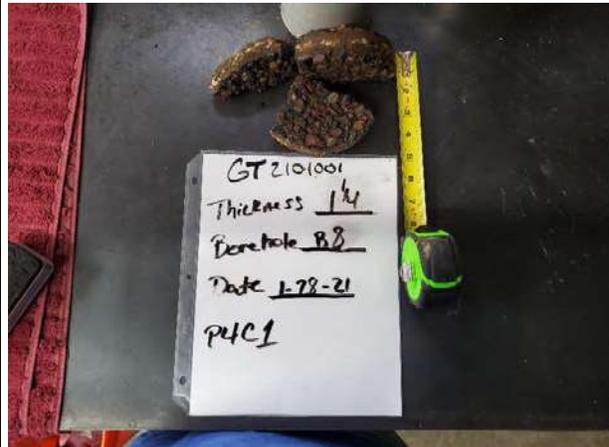


P4C1 B-6 - 1 1/2 in Asphalt Core

Photographic Records of Asphalt Cores - Precinct 4 Cluster 1



P4C1 B-7 - 1 1/4 in Asphalt Core



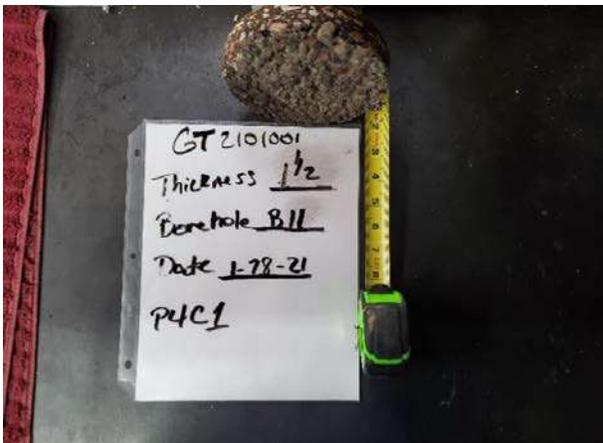
P4C1 B-8 - 1 1/4 in Asphalt Core



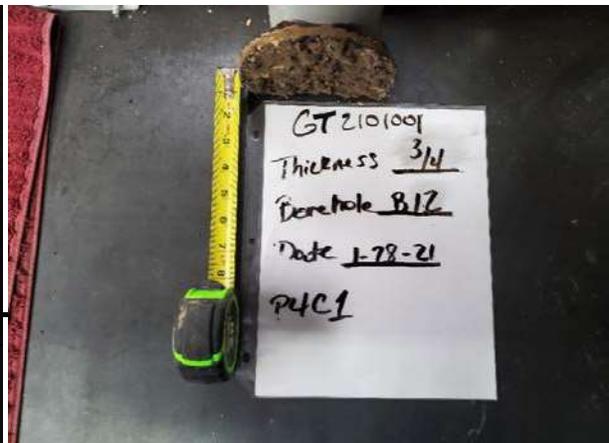
P4C1 B-9 - 1 3/4 in Asphalt Core



P4C1 B-10 - 1 1/2 in Asphalt Core



P4C1 B-11 - 1 1/2 in Asphalt Core



P4C1 B-12 - 3/4 in Asphalt Core

PART D

BID QUANTITIES

Reconstruction of Precinct 4 - Year 2 Cluster 1 Roads

Roadway Improvements to Serve Midland County					
		Quantity	Unit	Unit Price	Total
Base Bid					
Item	Description				
1	Preparation of R.O.W.	165	Sta.		
2	Tree Removal	18	Ea.		
3	Sawcut Existing Asphalt (full depth)	504	L.F.		
4	Asphalt Excavation - 1.7 inch depth (average)	2,230	C.Y.		
5	Asphalt Haul Off	2,230	C.Y.		
6	Earthwork*	15,263	C.Y.		
7	Haul Off*	15,263	C.Y.		
8	Subgrade Preparation	65,672	S.Y.		
9	Prime Coat**	16,849	Gal.		
10	Flexible Base (Roadway)	15,040	C.Y.		
11	HMA Pavement - 3" thickness - Type D**	9,689	Ton		
12	Concrete Pavement at Intersections and Cul de Sac	2,212	S.Y.		
13	6" Concrete Commercial Driveways	6	Ea.		
14	3" HMA on 8" Base Commercial Driveway	8	Ea.		
15	8" Compacted Base Commercial Driveway	30	Ea.		
16	8" Compacted Base Residential Driveway	28	Ea.		
17	6" Concrete Residential Driveways	10	Ea.		
18	3" HMA on 8" Base Residential Driveway	14	Ea.		
19	Proposed 18" Driveway Culvert	217	L.F.		
20	Proposed Driveway Culvert End Treatment	6	Ea.		
21	Telephone Manhole Adjustment	1	Ea.		
22	Vertical Adjustments for Exist. Water Valve Boxes	20	Ea.		
23	Vertical Adjustments for Exist. Fire Hydrants	3	Ea.		

Reconstruction of Precinct 4 - Year 2 Cluster 1 Roads

Roadway Improvements to Serve Midland County				Unit Price	Total
Base Bid		Quantity	Unit		
Item	Description				
24	Water Service Lowering	1	Ea.		
25	Water Main Lowering	3	Ea.		
26	60'X5' Pipeline Cap	7	Ea.		
27	Reinforced Concrete Box (RCB) - 3' x 2' ***	160	L.F.		
28	Safety End Treatments with 60° Wing Walls (1 - RCB 5'x2')(HW=3)(3:1)	6	Ea.		
29	Safety End Treatments with 60° Wing Walls (1 - RCB 5'x2')(HW=3)(5:1)	4	Ea.		
30	Reflective Marking (Type 1) 4" Double Yellow Striped	36	Sta.		
31	Reflective Marking (Type 1) 4" Broken Yellow Striped	116	Sta.		
32	Reflective Marking (Type 1) 4" White Striped	300	Sta.		
33	18" Stop Bar Pavement Marking	292	L.F.		
34	Surface Preparation for Pavement Marking	300	Sta.		
35	IN SM RD SN SUP&AM TY10BWG(1) SA (P)	39	Ea.		
36	Aluminum Signs	243	S.F.		
37	Mailbox Relocations	19	Ea.		
38	Erosion Control	1	L.S.		
39	Traffic Control	1	L.S.		
40	Mobilization	1	L.S.		
TOTAL BASE BID					
CONSTRUCTION START DATE					
TOTAL CALENDAR DAYS					

Contractor shall notify the Engineer of Record of any discrepancies in quantities prior to the commencement of construction.

* Quantities do not include factors for compaction and expansion.

** Rates used for calculation purposes only:

Prime Coat: 0.3 Gal/SY

HMA Pavement - 3" thickness - Type D: 115 lb/SY*in

*** Contractor to provide lowest bid between precast culverts and cast-in-place culverts.