



NON-PROJECT / NON-TASK SPECIFIC MATERIAL TESTING AND GEOTECHNICAL

SCOPE OF WORK

CONTRACT ADMINISTRATION:

REGION TRANSPORTATION DIRECTOR:

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General administration of this contract will be delegated to the respective Program Engineer involved with this consultant selection process. Active day to day administration and monitoring of contract task orders will be delegated to the Region(s) Resident Engineers responsible for the work described within each task order.

COLORADO DEPARTMENT OF TRANSPORTATION

***SCOPE OF WORK FOR:**

- **I. Project Materials Testing and Inspection**
- **II. CDOT Materials Laboratory Testing**
- **III. Highway Materials Evaluation**
- **IV. Preliminary Roadway Materials Engineering**
- **V. Voids Acceptance Laboratory**
- **VI. Geotechnical Work**
- **VII. Independent Assurance Testing**
- **VIII. Profiling**
- **IX. Traffic Control**
- **X. Mobile Deflection Testing Operations**
- **XI. Other Services**

NOTE: No Construction Management Services

Note: This Scope of Work has been carefully reviewed by the Department and reflects an approach based on the known goals of the Regions. The Consultant's analysis of the project goals, its evaluation of the work elements, and its formulation of the work plan, coupled with its understanding of and sensitivity to the key issues may produce new approaches or modifications to the project's work elements. Therefore, the final Scope of Work for the project may change in some details to incorporate the Consultant's input.

GENERAL REQUIREMENTS

WORK DURATION:

The time period for the work described in this scope will be 5 years from the execution of the contract. Work may be required: night or day; weekends; holidays; or on a split shift basis.

AUTHORIZATION TO PROCEED:

Work shall not commence until the consultant receives the written Notice to Proceed. Work shall be completed within the allotted contract time. Time charged shall be exclusive of time lost for:

- Reviews and approvals
- Responses/direction from CDOT

BACKUP SERVICES:

The consultant shall name at least two additional firms as part of their team, their proposal and each task order, that can provide the same services should the consultant be unable to provide the services for any reason.

ROUTINE REPORTING AND BILLING:

The consultant shall provide the following on a routine basis:

- Coordination of all contract activities by the Consultant's Project Manager when required

STATUS OF PROJECT:

The consultant shall monitor the status of work, and advise the CDOT Project Engineer/Manager or Resident Engineer of any potential need for supplementing their contract related to scope, additional personnel, and funding. Failure to monitor work status and provide timely notification may result in discontinuing the consultant's services relative to the task order until a supplemental agreement can be affected. Work performed beyond the scope of the task order, after task order funds have been exhausted, or after task order time has expired may be subject to non-payment. If a task order is allowed to expire, no time extension can be made. Rather, an entirely new task order must be initiated and processed. The importance of monitoring task order expiration dates is strongly emphasized.

PROJECT STANDARDS:

All sampling, testing, and documentation shall be in accordance with *the Colorado Department of Transportation (CDOT) Field Materials Manual, Construction Manual, CDOT M&S Standards*

and applicable Project and Standard Special Provisions in the construction project contract and the applicable *CDOT Standard Specifications for Road and Bridge Construction*. The applicable *CDOT Field Materials Manual*, including *Colorado Procedures and Colorado Procedure-Laboratory*, shall be the one currently in use when the construction project is advertised. If the required method is not described in the *CDOT Field Materials Manual*, the required work shall be completed in accordance with the current *AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing* (as revised and supplemented) or the *ASTM Standards and Tentatives*. Proposed work procedures shall be coordinated with the CDOT Project Engineer prior to the start of work.

I. GENERAL WORK DESCRIPTION FOR PROJECT MATERIALS TESTING AND INSPECTION:

The consultant shall sample, test and inspect those specified materials utilized in construction. Test results and inspection observations shall be documented and approved by the Project Engineer in accordance with the references cited above under PROJECT STANDARDS. Project specific work will be defined by task order, prior to work commencing. The consultant shall direct, coordinate, supervise, monitor, manage and administer all materials sampling and testing to ensure that the required sampling, materials testing and documentation is obtained in a timely manner and maintained in accordance with the Materials Manual and Contract requirements to verify the quality of the work performed by the construction contractor.

MANAGEMENT OF CONSULTANT PROJECT MATERIALS TESTING:

The consultant shall follow the requirements of CP-16 to meet, coordinate and schedule the required work with the Project Engineer, Resident Engineer and Residency Head Tester/Region Materials Documentation Coordinator. The consultant shall complete all work in accordance with their approved schedule. The consultant materials testing evaluation form will be completed by the CDOT Project Engineer or Resident Engineer and head tester, and distributed as described in CP-16. The Project Engineer shall forward a copy of the completed Pre-Testing Meeting Agenda for Consultant Materials Testing to the Materials Engineer.

Materials Engineer means either the Regional Materials Engineer or the Materials & Geotechnical Program Engineer

PROJECT STAFFING AUTHORITY:

The Project Engineer is in direct charge of the work and is responsible for administration of the project contract as defined in the CDOT Standard Specifications. This includes approving and setting work hours for both project construction and the materials testing. The consultant is not authorized to sign Contract Modification Orders or to approve Estimates in the CDOT Transport application.

LABOR, MATERIALS, AND EQUIPMENT:

The consultant shall furnish all personnel, materials, and equipment required to perform the work,

including cell phones, testing equipment, vehicles and computers with software, capable of interfacing with CDOT software/hardware.

CDOT will provide a field laboratory for many of the construction projects and the required traffic control for all of the construction projects. The CDOT Project Engineer or Resident Engineer will advise the consultant on the availability of the field laboratory. When the consultant is required to use a field laboratory, he/she shall follow the Laboratory Qualification Program requirements contained in the applicable CP-10. When a field laboratory is not provided, the consultant shall use his own facilities (**Note: For Asphalt Voids Acceptance projects see V. Voids Acceptance Laboratory**). When the consultant is required to use his own facility, he/she shall follow the Laboratory Qualification Program requirements contained in the applicable CP-10.

The following equipment and supplies shall be furnished by the consultant for each project in sufficient quantity to ensure performance of all work required in a timely manner. Such equipment and supplies shall remain the property of the consultant.

1. A.C. content gauge and/or extraction equipment and solvents
2. Nuclear Moisture/Density gauge
3. Concrete air meter, slump cone, and other concrete testing equipment
4. Concrete Super Air Meter (when required by Task Order)
5. Sieves for aggregates and soil gradations
6. Scales (accuracy to 0.01 grams for Atterberg limits)
7. Sample containers and small tools
8. Proctor equipment for soil curves and 1 point tests (meeting requirements of AASHTO T99 and/or T180.
9. Atterberg equipment (per AASHTO T88 and T89)
10. Sample drying equipment
11. Miscellaneous equipment for performing the required soils, concrete and asphalt field tests
12. Concrete cylinder molds, which conform to AASHTO requirements, except that PAPER MOLDS SHALL NOT BE USED, AND PLASTIC MOLDS SHALL NOT BE REUSED. The costs for plastic molds used will be reimbursed by CDOT, if included in the consultant's billing.
13. Concrete Flexural Strength Beam Molds (when required by Task Order)
14. Cell Phone for each tester
15. Computer and printer for each test lab (CDOT or Consultant). This equipment needs to have
16. capability to operate all current CDOT project software as defined in the current migration plan. This includes Site Manager and an email account.
17. Ignition Oven for determining asphalt binder content and RAP gradations meeting specifications of CP-L5120.
18. Computers and software as required for the performance of duties
19. HMA sample containers meeting the requirements of CP-41. The cost for HMA sample containers used will be reimbursed by CDOT, if included in the consultant's billing.
20. Asphalt Binder sample containers minimum 1qt. in size sampled as per AASHTO T-40. The
21. cost for binder sample containers used will be reimbursed by CDOT, if included in the

consultant's billing.

22. All required CDOT Forms required to complete and Final the Form 250. These forms include, but are not limited to the Form 82, 83, 84, 411, 1304, etc.
23. Colorimeter meeting the requirements of CP-L2103 for Sulfate testing.
24. Digital Titrator and Delivery Tube meeting the requirements of CP-L2104 for Chloride Ion Content in Soil testing.

Personnel staffing level and qualifications of testing personnel and laboratories for the project shall be subject to the approval of the CDOT Project Engineer or Resident Engineer. The CDOT Project Engineer or Resident Engineer shall receive and review the testing personnel and consultant laboratory qualifications prior to commencement of testing on the project.

Sampling and testing personnel qualifications shall be in conformance with the requirements of the applicable CP-10. Additionally, the tester must possess a current and valid Colorado Driver's license.

The Consultant's work shall be under the direction of, and shall be reviewed, stamped and signed by a Professional Engineer registered in the State of Colorado when necessary. The Professional Engineer shall be available to review work, resolve problems, and make decisions in a timely manner as requested by the CDOT Project Engineer or Resident Engineer, and must be experienced and competent in road and bridge construction materials testing.

Copies of the tester's required certifications and a resume including his/her materials testing experience shall be provided to the CDOT Project Engineer or Resident Engineer upon request, and prior to a task order being initiated.

The materials testing technician(s) shall be thoroughly familiar with CDOT testing procedures, forms and documentation requirements. If the consultant testers supplied to CDOT projects are in need of additional assistance, support, or oversight for SiteManager/LIMS, the consultant company shall immediately provide a qualified individual to provide any necessary oversight/support. If oversight is necessary, the consultant shall provide the supervision and guidance needed for completion of the work. Such oversight required by the consultant will not be paid for by CDOT.

The materials testing technician(s) shall be thoroughly familiar with CDOT computer programs including SiteManager/LIMS/CAR, as well as other common computer programs such as MS Excel, and MS Word

The materials testing technician(s) shall have completed and passed the CDOT Basic Highway Math, Basic Highway Surveying, Basic Highway Plan Reading, CDOT Finals Materials Documentation, Erosion Control Supervisor, and SiteManager/LIMS training classes. Specialty certifications such as LabCAT Level E - Asphalt Inspector or CDOT/ACPA Concrete Pavement Inspector Training & Certification may be required as determined by the Resident or Project Engineer. All testers shall also have completed and passed the e-learning course for Materials Technician Training available through the CDOT Transportation Engineering Training Program.

Personnel provided by the consultant who do not meet all of the specified requirements, or who fail to perform their work in an acceptable manner, shall be removed from the project when

determined and directed by the CDOT Project Engineer or Resident Engineer. Failure to perform the testing and documentation processes may result in termination of the task order as determined by the Task Order Administrator (Project Manager).

SPECIFIC TESTING REQUIREMENTS:

The consultant shall sample, test, inspect, and document all materials generated and produced on the project. This includes: materials delivered to the project that are listed in the Summary of Approximate Quantities in accordance with the SCHEDULE (Quality Assurance) in the Field Materials Manual; materials listed on the Owner Acceptance Sampling & Testing Checklist (Form 250) materials items listed on the Certification Checklist Report, materials that may be added to the project through contract modification; and altered material quantities whether increased or decreased. The consultant's Project Manager, field tester(s) and the Project Engineer shall be required to review project quantities on a monthly basis to ensure that sufficient tests have been performed for the material placed to date. The consultant shall also provide any other services as requested by the CDOT Project Engineer or Resident Engineer.

Testing of materials that are specifically designated to be pre-inspected or pretested by this or any other Department of Transportation shall remain the responsibility of CDOT. The consultant shall document and transport samples of any and all materials to the CDOT Central Laboratory that are required to be tested by CDOT regardless of pre-inspection or pretesting responsibilities. The items and test frequencies of Department tested materials shall be in accordance with the column titled "Central Laboratory" in the SCHEDULE.

DOCUMENTATION:

Documentation for the project shall be done in accordance with the Field Materials Manual that coincides with the advertisement date of the project. The Consultant tester shall set up the Project Materials Electronic Folder to store the documentation for the project as detailed in the FMM. Each of the consultant's field testers shall maintain a daily diary for each day the tester performs work on the project. They may use CDOT's Form 103, Project Diary, or a form as approved by the CDOT Project Engineer or Resident Engineer. The contents of the diary shall be brief and accurate statement of progress and conditions encountered during the prosecution of the work.

Editorial comments are not to be incorporated in the diaries or on any written correspondence applicable to the project. A copy of the daily diary shall be given to the Project Engineer within three working days of its date. Test results, sample submittals and inspection documentation transmitted to CDOT's Region or Central Laboratory shall be recorded on appropriate CDOT Forms, if requested. The consultant's Project Manager and field tester(s) shall be required to review project quantities on a weekly basis to ensure that sufficient tests have been performed for the material placed to date. The consultant may use CDOT worksheets or worksheets approved by the CDOT Project Engineer or Resident Engineer. CDOT Forms and worksheets are available online for download/printing through the CDOT Forms Catalog.

The consultant shall complete a Quality Level Report and a CDOT Form 626 – Field Laboratory Test Results - and route for signature to the CDOT Project Engineer and the Contractor daily. The consultant tester shall also submit If requested, the consultant shall also furnish the Project Engineer with copies of all worksheets on a daily basis. Concrete strength test results (7 and 28 day) shall be

distributed to the engineer within two days following testing.

The consultant shall be required to enter all project data and samples into the required CDOT materials acceptance programs including, but not limited to SiteManager/LIMS and any other required programs.

The consultant shall also review and coordinate for Independent Assurance Testing on all items listed on the Independent Assurance Sampling & Testing Checklist (Form 379) at the appropriate frequency. Coordination shall be done through the Residency Head Tester, or directly with the Region IAT personnel if a Residency Head Tester has not been identified.

SUBMITTAL OF FINAL DOCUMENTATION:

Final documentation shall be submitted to the CDOT Project Engineer or Resident Engineer within 30 days after project acceptance. Failure to submit final documentation as required may result in withholding any and all consultant payments.

II. GENERAL WORK DESCRIPTION FOR REGIONS 1, 2, 3, 4, 5 and HQ MATERIALS LABORATORY TESTING (Including the Voids Acceptance Tester):

This work consists of materials testing at the Region Materials Laboratory, the Regions' mobile laboratories (potentially located anywhere in the Regions) Staff Materials Laboratory, or an approved laboratory furnished by consultant or contractor. Materials testing could involve a wide range of projects consisting of, but not limited to, resurfacing, reconstruction, maintenance and new construction projects. When the consultant is required to use his own facility (Note: For Asphalt Voids Acceptance see V. Voids Acceptance Laboratory), he shall follow the Laboratory Qualification Program requirements contained in the applicable CP-10.

MANAGEMENT OF CONSULTANT REGION LABORATORY MATERIALS TESTING:

The consultant, Materials Engineer and CDOT Materials Lab Manager shall meet, coordinate and schedule the required work. The consultant shall complete all work in accordance with their approved schedule.

PROJECT STAFFING AUTHORITY:

The CDOT Materials Engineer is in direct charge of the work in the Materials Lab and is responsible for administration of the project contract as defined in the CDOT Standard Specifications. This includes approving and setting work hours for the materials testing.

PROJECT STANDARDS:

The consultant tester(s) must meet the requirements of CP-10 and Chapter 800 of the Field Materials Manual, be a minimum of 19 years of age and possess a personal monitoring device (dosimeter). Personnel staffing level and qualifications of testing personnel and laboratories for the project shall be subject to the approval of the CDOT Project Manager. The CDOT Project

Manager shall receive and review the testing personnel qualifications prior to commencement of the work. When required, the consultant tester's work may be required to be under the direction of a Professional Engineer licensed in the State of Colorado. The Professional Engineer shall be available to review work, resolve problems, and make decisions in a timely manner as requested by the Materials Engineer. Personnel Staffing level and qualifications of testing personnel and laboratories for this work shall be subject to the approval of the Materials Engineer. The Materials Engineer shall receive and review the testing personnel and consultant laboratory qualifications prior to commencement of testing.

Activities will include sampling, sample reducing, and testing materials supplied to and/or produced on the projects. This includes but is not limited to performing the following tests:

1. Rice Test (CP 51)
2. Gradations of aggregate (CP 31)
3. Bulk Specific Gravity of cores and/or compacted mix (CP 44 and CP-L 5103)
4. Fine aggregate angularity (CP-L 5113)
5. Standard Method for Preparing and Determining the Density of Bituminous Mixture Test Specimens by Means of the Superpave Gyratory Compactor (and CP-L 5115)
6. Hveem Stability (CP-L 5106)
7. Lottman Testing (CP-L 5109)
8. AC Content by Nuclear Method (CP 85)
9. AC Content by Ignition Method (CP-L 5120)
10. Sand Equivalent Test (AASHTO T-176)
11. Liquid Limit and Plasticity Index of Soils (AASHTO T-89, T-90)
12. Moisture Density Relations of Soils (AASHTO T-99, T-180)
13. Determining the Sulfate Ion Content in Water or Water Soluble Sulfate Ion Content in Soil (CP-L2103)
14. Determining Water-Soluble Chloride Ion Content in Soil (CP-L2104)
15. Specific Gravity and Absorption of Coarse Aggregate (AASHTO T85)
16. Specific Gravity and Absorption of Fine Aggregate (CP-L 4102)
17. Various Bituminous Materials Testing, as requested, in accordance with Section 702 of the CDOT Standard Specifications

Assist with documentation, general cleanup and routine laboratory equipment upkeep as needed. The consultant may enter results into a computer database. The tester(s) may assist CDOT Materials personnel (using mobile drill rig) in the collection of soil profile data and samples.

Tests will be performed in accordance with the applicable CDOT Field Materials Manual, CDOT Laboratory Manual of Test Procedures, and/or AASHTO and ASTM Test Procedures. The Region Materials Engineer will determine testing frequency.

The contract tester(s) may be allowed the use of CDOT Materials Laboratory and all equipment, except for nuclear moisture density gauges and nuclear AC content gauges, in order to conduct the required testing, when deemed necessary by the Materials Engineer. Unless designated, the consultant tester will conduct his/her testing services in the lab provided.

The Materials Engineer may designate a member of his/her staff to represent him/her in the contract.

SPECIAL QUALIFICATIONS OF CDOT LABORATORY MATERIALS TESTER(S)

Tester(s) must have a working knowledge, a minimum of 320 hours relevant experience, and possess and maintain current relevant certifications in the following programs for the duration of the task order:

- *CAPA (LabCAT) asphalt technician Certification in Levels A, B (and C if Voids Acceptance)*
- *WAQTC Embankment & Base Testing Technician Certification*
- *ACI Concrete Field Testing Technician Grade 1*
- *ACI Concrete Strength Testing Technician*
- *ACI Concrete Laboratory Testing Technician – Level 1 (if required by Task Order)*
- *Tester(s) must possess a current and valid Colorado Driver's License.*

III. GENERAL WORK DESCRIPTION FOR HIGHWAY MATERIALS EVALUATION:

The scope includes all necessary work to assess product performance relating to material utilization on highway projects.

The purpose of the highway materials work is to accomplish field investigation, literature review or technical evaluation to determine suitability of material for inclusion or exclusion pertaining to highway projects. This work may be accomplished in a preliminary phase, construction phase or post-project investigation. The processes necessary to conduct Materials work may include, but are not limited to, the following activities: material source investigation (aggregate pit processing methods, quality verification), recommendations on aggregate pit suitability and involvement with maintaining and concluding pit permits, material additive issues (e.g. lime), test result variance, material property correlation with test results, review of construction techniques as they affect material properties, roadway distress evaluation, value engineering proposal evaluation, selection of pavement types and determination of typical sections for the pavement structure.

MANAGEMENT OF CONSULTANT HIGHWAY MATERIALS EVALUATION

The consultant and CDOT Region Material Engineer shall meet, coordinate and schedule the required work.

DOCUMENTATION:

The final product of Material work will be reports containing problem descriptions and recommendations for solutions or a synopsis of the issues. Included in reports may be appropriate test results and analysis of findings.

Project specific work will be defined by task order, prior to work commencing.

IV. GENERAL WORK DESCRIPTION FOR PRELIMINARY ROADWAY MATERIALS ENGINEERING

The purpose of the preliminary roadway engineering is to accomplish the preliminary soil survey, design the required pavement rehabilitation, design the new pavement structure, conduct a Life Cycle Cost Analysis for equivalent pavement sections, complete a pavement justification report, and/or submit a pavement design report, or any combination of the above as designated in the task order. On a limited basis the Region may direct a special investigation of a project under design or construction within the Region.

The consultant will report results of all testing and investigations, as detailed below, to the Region's Materials Engineer. The locations will all be within the state and are selected from the future resurfacing project list, as well as design and construction projects.

The processes necessary to conduct the preliminary roadway engineering may include, but are not limited to, the following activities. Project specific work will be defined by task order, prior to work commencing.

I. Accomplish the Preliminary Soil Survey

A. Destructive Sampling

1. Determine test hole locations and depth through coordination with the appropriate Region Materials Engineer.
2. Record GPS coordinates of all test hole locations (Latitude and Longitude).
3. Obtain cores of the roadway pavement. Pictures of the cores shall be taken in electronic format and shall have a label indicating Highway, Lane, Direction, and Milepost.
4. Collect subgrade soil samples and test for:
 - a. Classification per AASHTO M 145 using gradation (CP 21) and Atterberg Limits (AASHTO T 89 and T90)
 - b. Soil moisture-density relationship per AASHTO T-99 or T-180 (dependent on soil classification per Section 203 of the Standard Specifications).
 - c. Resistance value AASHTO T190
 - d. Swell consolidation testing, ASTM D 4546 at 250 psf surcharge, or as directed by the Region Materials Engineer.
 - e. Soil Chemistry, CP-L 2103, CP-L 2104, G51 & G57
5. Collect base samples for information and testing:
 - a. Thickness
 - b. Gradation (CP-21), PI and LL (AASHTO T 89 and 90)
 - c. Resistance value (AASHTO T190)
6. Collect pavement samples for information and testing:
 - a. Thickness
 - b. Structural layer coefficient/modulus
7. Fill all sample holes. Provide and place patching material similar to the existing surface or as approved.



8. Provide documentation of Sample locations and other necessary details, similar to what is required in CDOT Forms #554 and #555 or as approved excluding test results.
 9. Provide Methods for Handling Traffic (MHT's) to provide traffic control per MUTCD and CDOT Standard Plans for all planned operations. MHT's should be submitted to the appropriate Region personnel for comment/approval prior to implementation.
 10. When required, coordinate with Region ROW personnel to obtain necessary landowner permission to trespass. For example, if the proposed horizontal alignment is outside the existing Right of Way and an investigation is required on the new alignment, then written permission to trespass will be required before work will be performed on the private property.
 11. Obtain necessary utility clearance or locations prior to start of work. Sample locations may be adjusted to avoid conflict with existing utilities.
 12. Analyze the test data to determine the pavement's structural capability.
 13. Prepare and submit a soils investigation report with recommendations to the appropriate Region Materials Engineer for review. Refer to the latest edition of the CDOT Pavement Design Manual, Chapter 4, Field Materials Manual, section on Preliminary Soil Survey.
- B. Non-Destructive Testing with the Falling Weight Deflectometer (FWD)
1. Provide electronic data from FWD measurements capable of being analyzed with existing CDOT software. The FWD shall have been calibrated at the CDOT FWD Calibration Center.

On a divided highway, the FWD tests the pavement every 0.10 miles. The testing is conducted in the right-hand wheel path of the outermost lane. The required minimum traffic control is described in the MUTCD (Manual on Uniform Traffic Control Devices). Typical Application #35 Mobile Operation on Multi-Lane Road is used.

On a two-lane highway, the FWD tests the pavement every 0.20 miles in each direction, staggering the test locations so that there is 0.10 miles between test points. The testing is conducted in the right-hand wheel path of the lane. The required minimum traffic control is described in the MUTCD. Typical Application #17 Mobile Operations on Two-Lane Road is used.
 2. The data should include the deflection profiles, maximum deflections, deflection basin, differential deflections at transverse joints for PCC pavements, in-placed determination of the appropriate modulus for the pavement structure and the subgrade.
 3. Provide existing asphalt pavement thickness and samples (cores), base thickness, etc., necessary for determination of future structural requirements and construction strategy. Asphalt pavement samples will be collected at an approximate frequency of one (1) sample per one-half mile of roadway. The



determination of base thickness will also be at the approximate rate of one (1) per one-half mile.

- C. Non-Destructive Testing with Ground Penetrating Radar - If requested, the Consultant shall conduct a Ground Penetrating Radar (GPR) Survey along portions of roadways as specified in the individual task orders for the purpose of determining pavement and base course thickness. This work will include collection of field data, reduction of data, and preparation of a report/spreadsheets detailing the pavement/base course thickness along the roadway. Data shall be collected as per follows:
1. Collect data in the direction(s) requested using an air-coupled or air-horn Ground Penetrating Radar GPR unit with a 600-800 MHz and 2.0-2.4GHz antennas. The device used for data collection shall be capable of collecting data at highway speeds and at any length or time interval specified to determine the pavement component thicknesses in a non-destructive manner. Georeferenced data will be collected continuously and simultaneously with the GPR data collected. The georeferenced data will be automated and integrated with the GPR data collection process with a +/- 5 foot accuracy by the GPR software.
 2. Core thickness information shall be taken along the roadway prior to data analysis for the purpose of calibrating/verifying the GPR data collection device.
 3. Data will be collected at 100-foot intervals unless a different interval is specified in the task order.
 4. The information collections will be used to identify pavement thickness, base course thicknesses where present, and stripped layers within existing asphalt pavements.
 5. Prepare a report summarizing and presenting the data obtained. Electronic copies of each report will be submitted. Field work, data analysis, and report preparation will be conducted under the supervision of a registered professional engineer.

Deliverables shall include:

- a. .kmz files of the GPR data to be opened on Google Earth.
- b. Pavement thickness spreadsheet shown at intervals of 100-feet. The table will include approximate latitude and longitude information in decimal degrees, for the location information, with accuracy as noted in Item 1 above, as well as roadway intersection/milepoint.

II. Design Required Pavement Rehabilitation

A. Obtain Design Traffic Data

For existing pavement, determine the design traffic (ESALs) that the existing pavement can carry. Estimate the traffic loading experienced by the existing pavement. Obtain the projected traffic loading for the rehabilitation pavement design period.



- B. Perform a distress survey per the latest revision of the CDOT Pavement Design Manual.
Determine the types of distress present in the pavement. Determine the extent of each distress type. Refer to Pavement Evaluation Checklist (Flexible) Figure 5-16 and (Rigid) Figure 5-17 in the CDOT Pavement Design Manual. Develop a distress map for the existing pavement. Determine the drainage conditions of the existing surface and subsurface. Determine the cause of the existing distresses utilizing tests and analysis required.
- C. Design the feasible alternatives for the required rehabilitation (and widening if appropriate) utilizing the above investigations and test results.
- D. The design of the feasible alternatives shall be checked against the following criteria:
- the basic cause of distress shall be corrected
 - effect of distress on future deterioration
 - effect on surface characteristics
 - basic constructability under traffic
- III. Design New Pavement Structure
The feasible alternatives of new pavement structure shall be designed utilizing procedures accepted by the appropriate Region Materials Engineer.
- IV. Complete the Pavement Justification Report
- A. The basic factors that shall be included are the desired life expectancy, the required maintenance activities and the ability and commitment to accomplish them, and the basis for performance life assigned to the alternatives.
- B. The life cycle cost analysis of the selected alternatives needs to be accomplished. The analysis must include unit costs, maintenance costs and user cost. A net present worth analysis shall be done in accordance with the latest CDOT Pavement Design Manual. The alternatives must be compared over the same life span. The recommended alternative and basis for the recommendation shall be included.
- V. Submit the Pavement Design Report
The Pavement Design Report shall include all the above tests, investigations, analyses, and calculations requested in the scope of work. The report shall be submitted to the Region Materials Engineer for review. After the review comments are addressed, the report shall be submitted to the Region Materials Engineer for acceptance.
- VI. Develop Materials Portion of the Plans
- A. Prepare and submit the materials special provisions.
- B. Review the Pavement Design Report and the Field Inspection Review plans to verify the pavement and stabilization design is valid.
- C. Plot the roadway test hole locations on the plan and profile sheets and label locations by stationing and offsets with a log of the laboratory test results. Items to include:
- boring number
 - depth limits of material strata



- description
- percent passing sieves
- Atterberg limits
- AASHTO soil classification
- Percent moisture
- Percent compaction
- R-value, resilient modulus
- Swell index
- Water-soluble sulfates
- PH
- Corrosion Resistance Level

The above tasks shall include all necessary labor, equipment, and vehicles necessary to perform the required investigations. This may include, but is not limited to: coring machine, drill rig, FWD, and all necessary equipment and devices required for each piece of equipment and activity performed.

References:

1. CDOT Pavement Design Manual
2. CDOT Standard Specifications for Road and Bridge Construction Manual
3. CDOT Field Materials Manual
4. CDOT Laboratory Manual of Test Procedures
5. CDOT Life Cycle Cost Analysis State-of-the-Practice, Report No. CDOT-R1-R-00-3
6. CDOT Guidelines for Selection of Rehabilitation Strategies for Asphalt Pavement
7. MUTCD Manual
8. AASHTO Manuals
9. ASTM Manuals

The CDOT Materials Engineer may designate a member of his staff to represent him in the contract.

V. GENERAL WORK DESCRIPTION FOR VOIDS ACCEPTANCE LABORATORY

At the direction of the CDOT Materials Engineer, the consultant shall furnish and equip an operable voids acceptance laboratory at a location deemed acceptable to CDOT. The purpose of the laboratory is to provide a working environment for the consultant's tester or for a CDOT tester to perform volumetric testing on asphalt samples for the purpose of Owner Acceptance (OA) testing. It is expected that all equipment will be operated in the lab to generate sample results. Testing documentation will be generated and distributed from the voids acceptance laboratory. The traveling distance from the project site to the voids acceptance laboratory will be deemed to be of paramount importance in obtaining timely test results.

MINIMUM REQUIREMENTS FOR VOIDS ACCEPTANCE LABORATORY

The Voids Acceptance Laboratory (Voids Lab) will be subject to the approval of the Project Engineer and must meet the requirements of CDOT Field Materials Manual CP-10 and pass

inspection by a CDOT representative as provided by CDOT Field Materials Manual CP 10. The Voids Lab must be temperature controlled to provide a suitable working environment for the testing personnel and applicable ambient temperatures for testing. Space must be adequate to provide for safe and reasonable testing conditions.

An acceptable **Voids Lab** should have a minimum of 384 Square Feet of space such as 48 feet long by 8 feet wide trailer.

The minimum amount of operational equipment should be as follows:

- Water bath (circulating 140 F)
- Water bath (circulating 77 F)
- Forced Draft Oven 4 cu ft. (minimum of 3)
- Scale (Min. of 35 lbs. capacity and equipped with under-hook weighing device and under counter water reservoir of sufficient capacity for weighing compacted asphalt samples.)
- Incubator 6 cu ft.
- Freezer 4.7 cu ft.
- Thermometer (293 to 401 F) certified
- Thermometer (203 to 311 F) certified
- Thermometers (-8 to 30 F)
- Thermometers (daily use)
- Desiccating Crystals
- Compression Testing Machine with electro-mechanical operation.
- Super Pave Gyratory Compactor and Accessories for Gyratory—3 molds (100 mm), Calibration Kit, printer
- Vacuum Pump
- Vibro de-aerator tables
- Mechanical Splitter
- Quartermaster---Gilson (with moveable fingers)
- Manometer
- Fine Aggregate Voids Device CPL 5113
- Sieves—12-inch brass
- Hveem Stabilometer
- Lottman Breaking Head
- Ignition Furnace CPL 5120
- Microwave Oven—1.1 cu ft., 10 power levels
- Puck extractor
- Computer for CDOT Asphalt software (SiteManager/LIMS)
- Potable water supply and water pressurization/distribution system and email
- Supporting equipment e.g. glassware, scoops, cooling fans, gloves etc.

VI. GENERAL WORK DESCRIPTION FOR GEOTECHNICAL WORK

The scope includes all necessary work for Geotechnical work directed by the CDOT Materials Engineer. Project specific work will be defined by task order, prior to work commencing. The purpose of the Geotechnical work is to accomplish field investigation, geotechnical design,

drilling services and laboratory testing services for structural foundations, landslides and rockslides, hazardous waste, settlement and ground water problems. The processes necessary to conduct Geotechnical work may include, but are not limited to, the following activities. Perform laboratory tests and geophysical analysis, analyze findings and test results, and prepare reports containing problem descriptions and recommendations for solution. Provide design for landslides, rockslides, steepened slopes, and other highway related geotechnical features or evaluations, such as pavement distress and/or embankment failures or settlement. Prepare design drawings including geology sheets when required. Perform subsurface drilling, sampling, and testing.

Project specific work will be defined by task order, prior to work commencing.

The CDOT Materials Engineer may designate a member of his staff to represent him in the contract.

VII. GENERAL WORK DESCRIPTION FOR INDEPENDENT ASSURANCE (IA) TESTING

The purpose of the IA testing is to accomplish the work necessary to meet the requirements of the Independent Assurance Program in the CDOT Field Materials Manual Schedule (Independent Assurance) and other related services as determined by the Region Materials Engineer. Project specific work will be defined by task order, prior to work commencing.

The CDOT Materials Engineer may designate a member of his staff to represent him in the contract.

VIII. GENERAL WORK DESCRIPTION FOR PROFILING

The selected Consultant will identify two pavement smoothness testing contractors (PSTC) to be used in the Regions.

The PSTC shall supply:

A high speed profiler (HSP) and operator certified in accordance with CP 78

The ability to update to and use the latest CDOT profile specifications as they are revised

The PSTC shall be capable of mobilizing to a Project within 7 days upon notification by the Department.

The PSTC will collect pavement smoothness data on a Project following the procedures of CP 74 and in compliance with CDOT specifications. The PSTC shall notify the department a minimum of two weeks prior to the planned smoothness data collection by sending an email to DOT_profiles@state.co.us.

Following collection of the smoothness data, the PSTC will submit the pavement smoothness data file to the Department by emailing the appropriate files to DOT_profiles@state.co.us within 24 hours after it was collected. The data may be submitted on either a CD or thumb drive. If the PSTC utilizes a HSP manufactured by International Cybernetics Corp (ICC) the data shall be

submitted in the native ICC file format. If the PSTC does not utilize an ICC HSP, the data shall be submitted in a format recognizable by ProVAL 3.5. Along with the pavement smoothness data, the PSTC shall submit a detailed log identifying the location of each exclusion area.

The Consultant shall select which PSTC will be used on a Project with consultation with the Concrete and Physical Properties Unit of the CDOT Materials and Geotechnical Branch. The PSTC shall not perform both QC and QA work on a Project.

PSTC time will be paid hourly to include mobilization time, testing time, demobilization & processing time.

IX. GENERAL WORK DESCRIPTION FOR TRAFFIC CONTROL

CDOT / CDOT Consulting staff will be conducting pavement investigations, surveying, materials sampling, and other activities along Colorado State highways which will require single-lane closure or multi-lane closures on arterials and freeways. The Traffic Control services will include all labor, equipment, and materials for traffic control services on as needed basis. All work shall conform to the most recent edition of the MUTCD and M&S Standards, for Interstate, Freeways/Expressways, Major Arterials, Minor Arterials, Major, and Minor Collectors and any additional requirements described below. The person in charge of the work shall be certified as a worksite Traffic Control Supervisor by either the American Traffic Safety Services Association (ATSSA) or the Colorado Contractors Association (CCA) and shall have a current flagger's certificate. The TCS must also be onsite at all times during operations. If flagging is required for an extended amount of time in one location, a typical lane closure set up will be required as per the MUTCD part 6.

Prior to performing any traffic control related operations, Methods of Handling Traffic should be developed and submitted to the CDOT Task Order Manager for comment/review and approval prior to implementation.

X. GENERAL WORK DESCRIPTION FOR MOBILE DEFLECTION TESTING OPERATIONS:

1. Distinction between moving and mobile operations.
 - a. Moving operations are work activities where workers and equipment move along the road without stopping. Usually at slow speeds.
 - b. Mobile operations are work activities that make frequent short stops, up to a 15-minute period, such as litter clean up or pothole patching and are similar to stationary operations.

2. Description of work activity engaged in.
 - a. Mobile non-destructive roadway testing using a Falling weight Deflectometer (FWD).
 - b. The control/tow vehicle comes to a complete stop in the right wheel path of the roadway. The operator commands the test equipment to apply a predetermined load to the roadway, capturing nine unique deflection measurements and departs the test location within 60 to 90 seconds.

- c. The FWD vehicle proceeds at 15-20 mph to the next test location, generally 1/10 or 2/10 of a mile away.
 - d. The length of the traffic control zone varies between 1 - 10 miles, with 3 miles being the average.
 - e. The environment that the FWD operates in varies between multi-lane interstates to major and principal state highways with heavy traffic volume.
3. Safety/Traffic Control incorporated in the FWD vehicle.
- a. Strobe emergency warning lights on the truck.
 - b. Communications equipment consisting of: a Highway Band Radio, a CB Radio, 2 hand-held CB transceivers, and 2 PA Speakers.
4. Shadow Vehicle, description and responsibilities.
- a. Moving operations need traffic controls that move with the work operations. Need for a shadow vehicle depends on the speed of traffic compared to the speed of the work vehicle, exposure to traffic of workers and type of work activity.
 - b. Moving maintenance is usually conducted by personnel using a series of vehicles called a caravan, each vehicle in this caravan having a specific purpose.
 - c. Shadow vehicles shall have operational communication equipment, either Highway Band Radio or CB Radio, and operational warning lights.
 - d. Hold –and Release Flagging Operation.
 Within a Traffic control zone the presence of the caravan will close the lane between the advance shadow vehicle and the primary shadow vehicle. Control must be established so that no two opposing vehicles are in that one open lane at the same time.

The Advance Shadow Vehicle

Moves forward to a point where adequate sight distance and adequate stopping sight distance exist for both the flag person and the drivers of the vehicles in the opposing lane. The driver and/or flag person of the advance shadow vehicle shall inform the primary shadow vehicle of the type of car or truck to expected at the end of a string, holding (stopping) all other vehicles.

The Primary shadow vehicle

Moves behind the FWD to a point where adequate sight distance and adequate stopping distance exists for both the flag person and the drivers of the vehicles in the lane occupied by the caravan. This flag person holds all traffic behind him until he identifies the vehicle indicated by the advance flag person. The primary flag person then releases the vehicles behind the caravan, informing the advance vehicle of the last vehicle type released before he holds the traffic once again.

The FWD will move through the work zone, causing the pocket between the advance shadow vehicle to shorten and the pocket between the primary shadow vehicle to expand. The advance shadow vehicle will reposition itself again keeping

in mind sight and stopping distance while the primary shadow vehicle maintains a hold on traffic. If uncertainty exists at any point during the traffic control operation, hold all traffic until communication between the shadow vehicles clarifies the right of way. If a hold-and release flagging operation cannot be properly performed, such as due to side road traffic, then the primary shadow vehicle shall hold all vehicles behind the caravan until the FWD has moved sufficiently forward.

Normally the driver of the shadow vehicles can act as the flag person; however, if traffic volume or sight distance can potentially create a problem, use of hand-held radios will be required or the presence of an additional person in each shadow vehicle.

- e. An Optional Auxiliary Shadow Vehicle will be required as traffic volume dictates. The purpose of this vehicle shall be to make oncoming traffic aware of what lies ahead and/or to provide additional protection.

XI. Other Services

As requested by the Regions and specified in the task orders, other services not specified above may be requested on an as-needed basis. The scope of work for these services will include the details of the needs.

Note: The CDOT Project Manager will use the cover sheet on the following page, together with the Contract Scope, in order to provide a consistent Task Order request template. The CDOT Project Manager will fill in the Task Order #, the Scope request date, and the other Project information. The CDOT Project Manager will also indicate the requested services for the Task Order by marking one or more of the listed materials services, and will also attach any additional project-specific details or information necessary to complete the Scope package for the Task Order.



1. Scope of Work

Task Order # _____ Region 1, 2, 3, 4, 5, & HQ

Materials Testing Services Date: _____ Project Number:

_____ Project Location: _____

Scope of Work For:

- **I. Project Materials Testing**
- **II. CDOT Materials Laboratory Testing**
- **III. Highway Materials Evaluation**
- **IV. Preliminary Roadway Materials Engineering**
- **V. Voids Acceptance Laboratory**
- **VI. Geotechnical Work**
- **VII. Independent Assurance Testing**
- **VIII. Profiling**
- **IX. Traffic Control**
- **X. Mobile Deflection Testing Operations**
- **XI. Other Services**
-

Active day – to – day administration of this contract will be delegated to:

NAME: _____

TITLE: _____

ADDRESS: _____

TELEPHONE NUMBER: _____