

APPENDIX "A" 2020

Services to be furnished by CONSULTANT:

The CONSULTANT shall complete the necessary geotechnical tasks as directed by the INDOT Director of Geotechnical Services Division.

Prior to entering upon private property for performing the work, the CONSULTANT shall follow IC 8-23-7-26 through IC 8-23-7-28. A copy of these instructions is on file with INDOT and is incorporated by reference.

The work shall be performed in accordance with the requirements set out in the current INDOT Geotechnical Manual.

The consultant may be required to do all work per project or only a portion thereof, as determined by the INDOT Geotechnical Services Division. All services may not be required at all times.

For the services of Item Nos. 15, 16.a.ii, 32, 35, and 37, the Geotechnical CONSULTANT needs to obtain at least three (3) cost estimates before selecting the lowest bidder to perform the work. These estimates shall be submitted to INDOT Geotechnical Services Division with the invoices for the payment purposes.

The CONSULTANT shall obtain and preserve samples of the subsoil as required, perform the necessary laboratory tests, perform the required geotechnical engineering analyses, and prepare and furnish the necessary reports covering the information obtained. If the CONSULTANT is requested to perform the laboratory test on the soil samples and rock cores, these samples shall be delivered to its laboratory no later than at the end of each work week. If the samples are to be tested by INDOT they shall be delivered to the INDOT Geotechnical Services Division, 120 S. Shortridge Road, Indianapolis, Indiana, no later than the following Monday of each work week. Each soil sample and rock core shall be clearly marked as to project number, contract number, structure number, road number, station, offset, boring number, sample number, core number, and blow count depth. INDOT shall determine who will do the laboratory testing and engineering during the drilling operations.

Upon completion of the laboratory testing all soil samples and rock cores shall become the property of INDOT and shall be disposed of as directed by INDOT.

Borings shall be made to the depth specified through whatever type of material is encountered, including boulders, fill, or other types of obstructions. No measurements or payment will be made for borings abandoned or lost before reaching the specified depth except as provided below for "false starts". No boring shall be abandoned without first obtaining the approval from INDOT.

If a boring cannot be completed due to encountering underground utilities or structures, the existence and location of which were not previously known, the boring will be considered a "false start" for which payment will be made. The depth of the false start will be measured and paid for at the unit price per foot established by this contract for the appropriate type drilling.

Sounding items in this contract when used for determining the depth and limits of questionable weak subsurface soils shall only be used when the questionable weak subsurface soils are buried. Other type borings shall be used in order to more accurately determine their extent, after approval has been given by INDOT.

The groundwater level shall be measured upon completion of the drilling, at 24 hours after completion of the drilling, and at any later convenient times. After measuring the groundwater level at completion of the borings, the bore holes shall be suitably covered, so that there will be no hazard to people, animals, or equipment. After 24 hours or later, when the groundwater level has been measured and all other observations, records, and information have been obtained, the holes shall be filled in accordance with INDOT's current "Aquifer Protection Guidelines" located on the Geotechnical Services Division Website.

The CONSULTANT shall perform the following services as directed by INDOT:

GEOTECHNICAL FIELD

In certain locations, INDOT may require the CONSULTANT to perform geotechnical field drilling operations during the night. Work performed at night shall be paid under the item "Night Time". Any work that is not performed at night shall be paid under the Standard item. No night time drilling shall be performed without obtaining INDOT Geotechnical Services Division approval except when required by the Highway Congestion Policy, when required by INDOT permit, or when requested by the Traffic Management Center.

1. a, b, & c. MOBILIZATION OF DRILLING, CORING EQUIPMENT AND MILEAGE

This work shall consist of mobilization of equipment to and from the drilling site and shall be paid for from the State Capitol Building on the basis of the mileage shown on the current official highway map to the nearest town. This item shall consist of a lump sum fee plus a mileage charge. If more than one site is to be drilled, INDOT may schedule the order in which the sites are to be drilled to minimize the total road mileage.

If a combination of truck mounted and skid/ATV-mounted borings exist on any project and each type of equipment is actually mobilized, then two mobilization fees shall be paid. If the additional cost of doing the truck borings with the skid rig is less than the additional cost of the second mobilization, then all borings will be paid as skid borings, and only one rig will be mobilized. The most cost-effective method should be used. However, if more than one rig type will be needed, a prior approval from INDOT is required.

If a site or a portion thereof is inaccessible due to flooding at the time of rig arrival or by the time other drilling that can be done is accomplished, and INDOT does not wish to eliminate or relocate the boring location to an accessible location, remobilization will be paid if it is necessary to do the boring at a later date.

Remobilization shall be paid only with prior approval from INDOT. Mobilization of barge (skid) drilling equipment is excluded from this item as it is part of the cost of barge set-up expense. It shall be the responsibility of the CONSULTANT to determine the equipment needs of each site and to mobilize equipment needed to perform the necessary work.

CPT rig and coring equipment mobilization shall be lump sum plus mileage charge as described above.

d. FIELD COORDINATION

This work shall consist of marking test borings and pavement core locations in the field, required field checks, coordinating the field work with utilities and subcontractors, obtaining required permits other than railroad permits. Tasks for this item will be paid in accordance with the hourly rate schedule included in Section 3 of Appendix D and as defined in Section 4 of Appendix D for non-salary costs.

e. FIELD COORDINATION WITH PROPERTY OWNERS

This item will be considered for payment if a boring is located on a private property, including railroad property, and will be paid in accordance with the hourly rate schedule included in Section 3 of Appendix D and as defined in Section 4 of Appendix D for non-salary costs.

Crop damage will be compensated as per Geotechnical Manual.

HAND AND TRUCK DRILLING

2. TRUCK MOUNTED BORINGS WITH SPLIT SPOON SAMPLING

This work shall consist of using a truck mounted drill rig to advance a hole of sufficient diameter for the purpose of taking 2.0 in. outside diameter (O.D.) split spoon samples and making standard penetration tests at 2.5 ft. intervals for the first 10 ft. and at 5 ft. intervals thereafter, including a sample at the bottom of the boring with the possibility of taking a 3 in. O.D. Shelby Tube and a 2 in. diameter rock cores. This work shall be performed in accordance with AASHTO T-206 using an automatic hammer. Payment will be made from the ground surface to the maximum depth of penetration of the augers or casing. Drilling fluid or other authorized practices shall be used in circumstances where sand heaves into the casing or as directed by INDOT. Any unusual sampling procedures or results shall be noted on the boring logs.

Driving of the split spoon will be discontinued when blow-counts reach one hundred for a penetration of 12 in. or less.

If a sample is not recovered upon retraction of the sampler, one additional attempt with appropriate trap shall be made in order to retrieve a sample for visual classification. No payment will be made for non-recovered samples, unless an additional attempt at recovery is made and recorded on the boring log.

3. TRUCK MOUNTED BORINGS USING DRILLING FLUID

This work shall consist of advancing an uncased hole using a Hawthorne rotary drag bit, Tri Cone Roller bit, and drilling fluid to keep the hole open to a specified elevation for the specific purpose of obtaining undisturbed samples, or rock core samples.

4. TRUCK MOUNTED ROCK CORE DRILLING

This work shall consist of using a truck mounted drill rig for rock core drilling. Standard diamond core bits and series "NWG" or "NX" or larger double-tube or triple tube core barrels shall be required for making rock core borings. The minimum size of core shall be 2 in. diameter, except INDOT may permit obtaining a 1.6 in. diameter core if adequate recovery can be obtained. All solid rock shall be drilled with a diamond or saw tooth core bit. Depth of penetration shall be as directed by INDOT. This work shall be performed in accordance with AASHTO T 225.

5. TRUCK MOUNTED BORINGS

a. TRUCK MOUNTED BORING THROUGH BEDROCK, BOULDERS, OR CONCRETE PAVEMENT

This work shall consist of advancing a hole using truck mounted equipment through bedrock, boulders, or concrete for subgrade investigation. This may require a Hawthorne Rotary Drag Bit, Tri-Cone Roller bit, or any suitable equipment and method to keep the hole open for the purpose of taking SPT or undisturbed samples.

b. BRIDGE DECK CORING AND RESTORATION

This work shall consist of penetrating a bridge deck with coring equipment or other means for the purpose of extending the augers through the deck. The work shall include restoring the bridge deck by patching with quick set concrete or other equivalent means of restoration. A quantity of one shall be paid for each location of coring.

6. CONE PENETROMETER TESTING (CPT)

Cone penetrometer test consists of pushing an instrumented penetrometer into the ground while continuously recording the sleeve friction (f_s), cone resistance (q_c), pore pressure, and shearwave velocity. Cone penetrometer testing shall be performed in accordance with ASTM D 5778-12. CPT shall be performed if requested by INDOT along with SPT boring. Pore water pressure measurement will only be performed when requested. Following items shall be applicable to truck mounted CPT exploration services.

a. CPT: SET-UP

This item shall be paid for each set-up of the CPT truck.

b. CPT: SUBSURFACE PROFILING

This item shall consist of penetration cone resistance profiling and providing computer boring logs and ratio in addition to required geotechnical parameters such as soil types, undrained strength, relative density, and angle of shearing resistance. This shall be measured from the surface to the cone top and paid for in linear foot.

c. CPT: PROFILING WITH PORE PRESSURE MEASUREMENT

This work shall consist of adding a pressure transducer to the CPT penetrometer for measuring soil pore water pressure response to penetration along with other geotechnical parameters.

- i. Piezometer Saturation – This work shall consist of meeting all of the requirements of penetrometers as set out in ASTM D-5778.
- ii. This item shall be similar as described in 6 (b).
- iii. This work consists of determination of pore water pressure dissipation rate and will be paid for at an hourly rate.
- iv. This work consists of determination of horizontal hydraulic conductivity and consolidation coefficient. This shall be paid for as each test.

d. CPT: PROFILING WITH SHEAR WAVE VELOCITY MEASUREMENT

This work shall consist of determining shear wave velocity in addition to geotechnical parameters and will be measured in linear feet from the surface to the cone top.

e. CPT: SAMPLE

This work shall consist of taking soil samples at the required depth which shall be paid for each sample. It shall not be paid if unsuccessful attempt was made.

7. HAND OR TRUCK SOUNDINGS

This work shall consist of making continuous auger borings with a truck mounted rig, or with a hand auger, for the purpose of determining the depth to rock, the depth through surficial peat, other exposed unstable materials, or man-made waste deposits.

This item shall also include borings advanced for the express purpose of making core borings in rock or obtaining undisturbed samples at a certain depth in which a casing or drilling fluid is not used to keep the hole open. Measurement shall be from the ground surface to the depth augured.

This item shall also include hand borings made in ponds or lakes for the purpose of determining the depth and thickness of unstable sediments. Measurement shall be made from the top of water

to the maximum depth of drilling bit penetration and payment thereof shall be full compensation for the drilling work. It shall be the CONSULTANT's responsibility to determine the elevation and depth of the water at the time the drilling is performed.

8. HAND AUGER DRILLING

This work shall consist of using a hand auger, 1 in. (25 millimeters) retraction piston sampler, or a peat sampler to obtain samples for determination of the geotechnical profile. A hand guide power auger may be used for this item with prior approval from INDOT. This work shall be performed in accordance with AASHTO T-306.

SKID DRILLING

The following items (9 through 13) are to be used when site conditions are such that a skid mounted, dozer-mounted, or all-terrain vehicle drill rig is required to obtain the boring. Borings shall also be considered as one of these items when the CONSULTANT is required to use a dozer to get a truck rig to the boring location. If the CONSULTANT chooses to use a skid-mounted, dozer-mounted, or all-terrain vehicle rig to obtain borings which could have been obtained by a truck rig, they shall be considered as truck borings.

9. SKID MOUNTED BORINGS WITH SPLIT SPOON SAMPLING

This work shall be the same as described in Item No. 2, except for the drilling equipment required.

10. SKID MOUNTED BORINGS USING DRILLING FLUID

This work shall be the same as described in Item No. 3, except for the drilling equipment required.

11. SKID MOUNTED ROCK CORE DRILLING

This work shall be the same as described in Item No. 4, except for the drilling equipment required.

12. SKID MOUNTED BORING THROUGH BEDROCK OR BOULDERS

This work shall be the same as described in Item No. 5a, except for the drilling equipment required.

13. SKID MOUNTED SOUNDING

This work shall be the same as described in Item No. 7, except for the drilling equipment required.

14 SKID MOUNTED CONE PENETROMETER TESTING (CPT)

This work shall be the same as described in Item No. 6, except for the drilling equipment required.

BARGE DRILLING

The following items (15 through 21) are to be used when flotation equipment is required to make borings over water. Flotation equipment is described as a barge, raft, boat, or platform of sufficient size to support properly and safely the drilling equipment and have sufficient work area for the storage of the necessary tools and supplies required to make water borings. The barge and drilling equipment shall be of sufficient size to operate on any body of water within, or bordering, the State of Indiana and be able to penetrate to depths as required by INDOT. The equipment shall also be capable of obtaining 3 in. O.D. Shelby Tube samples at depths requested by the CONSULTANT and approved by INDOT. Water borings shall be generally defined as those where water is 12 in. or more in depth and it is not feasible to doze or build a ramp to the boring location, all subject to prior INDOT approval. It shall be the Consultant's responsibility to determine the elevation and depth of the water at the time the drilling is performed.

15. FURNISHING OF A BOAT

This work shall consist of furnishing a boat for the purpose of making hand borings in streams, ponds, or lakes. The charges for the services will be actual cost and detailed documentation should be provided to support the charges.

16. BARGE SET-UP EXPENSE

This item shall consist of mobilization, demobilization, equipment rental, and setting up of equipment required for barge boring at a drilling site. Only one barge set-up will be allowed per drilling site, unless two different barges are required (i.e., one type for navigable water and one type non-navigable water) in which case two barge set-ups will be allowed. A drilling site is defined for this item as one or more barge borings located less than 5 miles from any other barge boring. The drilling site shall be considered as being on navigable water or non-navigable water as defined by the jurisdiction of the United States Coast Guard.

a. NAVIGABLE WATER

i. BARGE SET-UP

ii. RENTAL OF SUPPORT EQUIPMENT AND/OR BOAT

This item shall consist of the rental of support equipment required to perform barge borings on navigable water. Support equipment such as the tug boats, cranes and additional special equipment, shall be reimbursed at the actual invoice cost. The CONSULTANT shall obtain the written approval from INDOT before incurring

any Support Equipment expenses.

iii. DRILL RIG DOWN TIME

This item shall include the down time required to move the barge from one boring to the next boring on navigable water. This does not include the initial barge set-up on the first boring or the movement of the barge from the final boring (these moves shall be part of Item 16.a.i). This work will be reimbursed on a per hour basis.

b. BARGE SET-UP NON-NAVIGABLE WATER

Rental of support equipment for drilling borings on non-navigable water and the down time required to move the barge from one boring to the next boring are included in this item and will not be paid for separately.

17. ADDITIONAL DISASSEMBLY AND REASSEMBLY

a. NAVIGABLE WATER

This item shall consist of disassembly, moving and reassembly of barge equipment when the borings are not located on a continuous body of water. Navigable waters will be defined by the jurisdiction of the United States Coast Guard.

Each such move required will be considered as one additional disassembly and reassembly and INDOT will pay an additional lump sum for each such move required.

b. NON-NAVIGABLE WATER

This item shall consist of disassembly, moving, and reassembly of barge equipment when the water is too shallow within the drilling site to float the barge from one drill location to the next if borings are not located on a continuous body of water. Each such move required will be considered as one additional disassembly and reassembly and INDOT will pay an additional lump sum for each such move required.

18. BARGE MOUNTED BORING WITH SPLIT SPOON

This work shall be the same as described in Item No. 2, except for the drilling equipment required.

19. BARGE MOUNTED ROCK CORE DRILLING

This work shall be the same as described in Item No. 4, except for the drilling equipment required.

20. BARGE MOUNTED BORING THROUGH BEDROCK AND BOULDERS

This work shall be the same as described in Item No. 5a, except for the drilling equipment required.

21. BARGE MOUNTED SOUNDINGS

This work shall consist of working a machine powered continuous flight auger boring from a barge for the purpose of determining the depth to bedrock, the depth and thickness of surficial peat, and other exposed unstable materials or man-made waste deposits. Measurement shall be made from the top of the underlying ground to the depth penetrated. Hand auger or probe soundings may be made from a barge, but payment will be made as set out in Item No. 7.

22. CASING THROUGH WATER

This item shall consist of furnishing and installing casing for water holes. The casing may be either a hollow stem auger or a driven casing for borings into the underlying material through water. Measurement for this item shall be from the water surface to the top of the underlying ground surface.

23. UNCASED SOUNDING THROUGH WATER

This item shall consist of that portion of barge soundings from the top of water to the top of underlying ground. Measurements of this item shall be from top of water to top of underlying ground.

24. SET-UP FOR BORINGS AND MACHINE SOUNDINGS

a. BORINGS AND MACHINE SOUNDINGS LESS THAN 20 FT. DEEP

This work shall consist of rig set-up for any borings or machine soundings less than 20 ft. deep.

b. ROCK CORING

This work shall consist of setting up equipment for rock core borings.

25. ADDITIONAL 2 IN. SPLIT SPOON SAMPLES

This item shall consist of obtaining additional 2 in. O.D. split spoon samples as specified in Item No. 3 by the Standard Penetration Test Procedure in accordance with AASHTO T-206. Payment shall be for split spoon samples obtained in addition to those required in Item Nos. 2, 9, and 18, unless otherwise approved by INDOT.

26. 3 IN. SPLIT SPOON SAMPLES

The requirements listed in Item 3 shall apply except the split spoon shall have a 3 in. O.D.

27. 3 IN. SHELBY TUBE SAMPLES

This work shall consist of obtaining undisturbed samples by pressing a 3 in. O.D. thin walled tube into soil with a steady push. An attempt shall be made to push the tube 24 in. Payment will be made only when recovery is 50% or greater, with a minimum of 12 in., unless otherwise approved by INDOT. This work shall be performed in accordance with AASHTO T 207.

28. BAG SAMPLES

This work shall consist of obtaining disturbed samples of soils by any conventional equipment and preparing for lab testing (if outsourced for testing) for moisture density relations, Resilient Modulus, or other test. The total wet weight of sample shall not be less than (a) 25 lbs. or (b) 5 lbs. The sample shall be placed in appropriate bags and suitably labeled with identifying information.

If the top of the layer to be sampled lies within 5 ft. of the ground surface, a quantity of one will be paid. An additional quantity of one will be paid for each additional 5 ft. penetrated to reach the top of the layer of the material to be sampled.

29. FIELD VANE SHEAR TEST

This work shall consist of performing field vane shear tests in accordance with AASHTO T-223. A quantity of one will be paid for each test performed.

30. 4 ½ IN. CASED HOLE

This work shall consist of advancing a cased hole through soil, shale or rock to a specified elevation for installing field instrumentation. Either hollow stem augers or driven casing may be used. Measurement shall be from the top of the ground to the depth of casing penetration. Larger diameter casing will be permitted at no additional cost to INDOT.

31. INSTALLATION OF GEOTECHNICAL INSTRUMENTS

a. INCLINOMETER CASING INSTALLATION

This work shall consist of providing all the tools and equipment, for installing inclinometer casing at locations and depths specified by the State in accordance with the Aquifer Protection Guidelines located on the INDOT Geotechnical Services Division Website, and/or Contract Supplemental Specifications. A plastic flush-jointed casing of 2.75 in OD, or equivalent may be used. This item shall be paid for at the unit price per lineal foot of casing installed. The appropriate type of drilling used for the borehole, as specified by the State, will be paid for as a separate item. Backfilling around the casing shall be tremied neat cement grout and paid for by the item for Borehole Backfilling (Item No. 34) in accordance with the Aquifer Protection Guidelines located in the INDOT Geotechnical Services Division Website.

If the installation is in an area of proposed fill under construction, then the length of pipe added shall be not more than 5 feet at a time as the fill height progresses. Lifts of fill around the casing shall be "B" borrow, structure backfill No. 30 and No. 4, or sand. A metal protective outer cover for inclinometer casing shall be installed as described in Item Number 31, Section d.

b. PIEZOMETER INSTALLATION UP TO 25 FT. BELOW THE SURFACE.

This work shall consist of providing all tools and equipment for installing piezometers at locations and depths specified by the State in accordance with the INDOT Specification 204.04 and/or Contract Unique Special Provisions. These piezometers may be of the pneumatic type or of the hydraulic Casagrande type. The hydraulic type must have provisions for attaching a Bourdon Gauge in case the pore pressure increases enough to raise the water level to above the top of the standpipe. If the piezometer installation is to be of the Casagrande type and in an area of proposed fill under construction, then sections of standpipe not longer than five feet shall be added as the fill height progresses, so that the piezometric water level can be measured at any time. Backfill around the standpipes in lifts of embankment shall be of "B" borrow material or sand. Each installation shall be marked with the words, "Monitoring well, do not fill". The installation shall be supplied with a Metal Protective Outer Covers for Piezometer Casing and shall be installed as described in Item 31, Section d. The appropriate type of drilling used for the borehole, as specified by the State, will be paid for as a separate item.

c. PIEZOMETER INSTALLATION DEEPER THAN 25 FT., BELOW THE SURFACE.

This item is same as Item b above except for depth involved and the pay item amount. The appropriate type of drilling used for the borehole, as specified by the State, will be paid for as a separate item.

d. METAL PROTECTIVE OUTER COVER FOR INCLINOMETER AND PIEZOMETER CASINGS.

This work shall consist of providing and installing a metal protective outer covers for inclinometer and piezometer installations. These shall be a minimum of 4 in. diameter pipe, or square metal casing, approximately 3 ft. long, and shall be anchored in a concrete pad 3 ft. in diameter and 1 ft. thick, and shall have less than 2 ft. exposed above the ground surface and shall be supplied with a lockable metal cap. The top of the inclinometer casing or the piezometer tubes shall be between 2 in. to 4 in. below the inside of the cap of the metal protective outer cover. In instances where installation must be flush with the surface, such as in roadways or sidewalks, then standard water meter-type handhole boxes may be used, instead of the casing described above for the metal protective outer cover. This item shall be paid for at the unit price per each and shall include a metal lid and padlock. One key to the padlock shall be supplied to the INDOT Geotechnical Services Division at completion of the installation. The keys shall be numbered with the Boring Number-associated with the installation. Each installation shall be permanently marked with the words "Monitoring

well, do not fill”.

32. RAILROAD EXPENSE

Actual cost invoiced by the railroad for railroad permits, flagmen, and/or right of entry and actual costs associated with or invoiced for, required railroad protective liability insurance. The CONSULTANT shall obtain the written approval from INDOT before incurring any railroad expense.

33. TWENTY-FOUR HOUR WATER LEVELS

a. FIELD MEASUREMENTS

This work shall consist of obtaining 24 hour water levels for any boring where it is considered essential for proper design such as pavement improvement projects. These shall include structure boreholes not under ponded water (bridge or retaining wall) for cut sections where seepage and/or slope stability may be a problem or for embankment areas where slope stability analysis may be required.

b. PVC SLOTTED PIPE

In cases where the borehole caves in, a slotted PVC pipe shall be installed before the casing is pulled. A 24 hour water level is critical in cut and at grade areas if cohesive soils are encountered in borings. In these cases, soundings shall be located outside of the shoulder in the median or behind the curb. The slotted PVC pipe shall be installed before augers are to be pulled. The hole shall be backfilled as per INDOT Aquifer Protection Guidelines after recording the 24 hour water elevation. A quantity of one shall be paid per borehole for item 33. a, and the slotted PVC pipe will be paid per foot for item b.

34. BOREHOLE BACKFILLING

The work in items a and b shall be accomplished in strict compliance with INDOT’s current “Aquifer Protection Guidelines” dated November 26, 2019 except where the borehole caves in. In this case the borehole shall be backfilled from the top of the cave-in to the ground surface using the “Aquifer Protection Guidelines”. The paid depth is determined from the cave-in depth of the borehole at the time of backfilling.

a. 0 TO 15 FT

Boreholes from 0.0 ft. to 15 ft. deep; backfilled in accordance with section 3.2.1 Of the Aquifer Protection Guidelines. Includes all equipment, material and labor to complete the task.

i. SPT/ or Powered auger

ii. CPT

b. MORE THAN 15 FT

Boreholes greater than 15 ft., backfilled in accordance with Section 3.2.2 of the Aquifer Protection Guidelines. Includes all equipment, material and labor to complete the task.

i. SPT

ii. CPT

c. PAVEMENT RESTORATION

This work shall include restoring pavement after coring or drilling. Concrete pavement shall be patched with quickset concrete. Asphaltic pavement shall be patched with an asphalt mix. A quantity of one shall be paid at each location.

35. EQUIPMENT RENTAL

This item shall entail the procurement of a qualified subcontractor to provide and operate the necessary equipment for clearing site, constructing pathways, and benches for drill rig set-ups when applicable. Payment under this item will also be made for restoration of the site as required by the property owner, INDOT, or any other regulatory agency. The charge for this service will be actual cost. An invoice copy for the contractor's services will be required to verify the charges. This item shall be used only with INDOT's prior approval.

36. TRAFFIC CONTROL

This work shall consist of providing traffic control services according to the INDOT "Work Zone Safety Manual", when traffic flow must be restricted in order to conduct drilling or coring operations. The charge for this service shall be a daily rate computed to the nearest one half day. All warning signs, traffic cones, or buffer trucks that are required to meet applicable safety standards, shall be provided by the CONSULTANT and paid by INDOT at actual cost.

a. FLAG CREW

As required per guidelines in "Work Zone Safety" manual, paid per crew, daily rate computed to nearest ½ day.

b. EQUIPMENT RENTAL AND PROFESSIONAL TRAFFIC CONTROL SERVICES

As required per guidelines in "Work Zone Safety" Manual, paid at actual cost.

c. FLAG CREW WITH EQUIPMENT

This includes the flag crew and the equipment owned by the company. This item can be used on two lane roadways only. The traffic control set up shall be in accordance with INDOT's Work Zone Safety manual.

d. TRAFFIC COORDINATION WITH SUBCONTRACTOR

This work shall consist of coordinating the field work with traffic control subcontractors. This item will be paid in accordance with the hourly rate schedule included in Section 3 of Appendix D and as defined in Section 4 of Appendix D for non-salary costs.

37. CENTERLINE SURVEYING

This work shall consist of locating the centerline of the road to accurately locate structure and roadway borings, with the use of instrumentation and a qualified survey crew when requested by the CONSULTANT and approved by INDOT. The charges for these services will be the actual invoice cost from the SUB-CONSULTANT.

38. PERCOLATION TEST

Percolation test shall be performed in accordance with the "INDOT Percolation and Infiltration Testing Guidelines" available on the Geotechnical Services Division website.

- a. Granular soils (A-1, A-2, A-3 based on AASHTO M 145)
- b. Cohesive soils (A-4, A-5, A-6, A-7 based on AASHTO M 145)

GEOTECHNICAL LABORATORY

39. SIEVE ANALYSIS FOR SOILS

This work shall consist of determining the gradation of a sample in accordance with AASHTO T 88. Sieves used shall be U.S. Sieve sized 3.0 in., 2.0 in., 1.50 in., 1.0 in., 0.75 in., 0.5 in., and U.S. Sieve Nos. 4, 8, 10, 40, 200, and 270, decanted over #270. A grain-size distribution curve shall be provided for this item.

40. HYDROMETER ANALYSIS

This work shall consist of performing the hydrometer analysis in accordance with AASHTO T 88. The test also includes a specific gravity determination. A grain size distribution curve shall be provided for Items 39 and 40 combined when both are performed.

41. SIEVE ANALYSIS FOR AGGREGATES

This work shall consist of performing sieve analysis to determine the gradation of aggregate particles and the amount of material finer than a 75- μ m (No. 200) sieve in accordance with:

- a. Analysis by washing per AASHTO T-11.
- b. Analysis by using AASHTO T-27.

The coefficient of uniformity and curvature shall also be reported.

42. LIQUID LIMIT

This work shall consist of the determination of the liquid limit in accordance with AASHTO T-89, mechanical method only. Three points shall be determined, and no payment will be made for non-plastic (N.P.) soil.

43. PLASTIC LIMIT AND PLASTICITY INDEX

This work shall consist of the determination of the plastic limit and plasticity index in accordance with AASHTO T-90.

44. LIQUID LIMIT RATIO (LLR)

This work shall consist of the determination of liquid limit ratio in accordance with ASTM D-2487. The liquid limit ratio is an index-factor used to classify organic soils for engineering purposes. This ratio is obtained (LLR) by dividing the liquid limit of oven dried soil with the Liquid Limit of non-oven dried soil.

45. pH TEST

This work shall consist of performing the pH test in accordance with AASHTO T 289. The test should be performed on all classification test samples and others as necessary. When the test is performed on moderate to non-organic material, samples size should be 0.7 oz. of material passing the No. 4 sieve (4.75 mm). The samples shall be prepared in accordance with AASHTO R 58.

46. LOSS-ON-IGNITION TEST

This work shall consist of the determination of the loss-on ignition (organic content) in accordance with:

- a. Conventional method (AASHTO T-267)
- b. Determining the percentage of calcium carbonate by sequential method (ITM-507).
- c. Organic determination is based on AASHTO T 21.

47. TOPSOIL TESTS

- a. PHOSPHORUS

This test shall consist of determining Phosphorus in topsoil and shall be performed in accordance with North Central Regional. Research Publication 221, Chapter 6, Mehlich 3 data Bray P equivalent. The result shall be reported in ppm.

b. POTASSIUM

This test shall consist of determining Potassium in topsoil and shall be performed in accordance with the North Central Regional Research publication 221, chapter 7: The result shall be reported in ppm.

48. MOISTURE CONTENT TEST

This work shall consist of the determination of moisture content in accordance with (a) AASHTO T-265 (Conventional) and (b) ITM-506 (Microwave).

49. EXPANSION INDEX OF SOILS

This work shall consist of determining the expansion potential of soils in accordance with ASTM D-4829.

50. SPECIFIC GRAVITY TEST

This work shall consist of the determination of the Specific Gravity in accordance with AASHTO T-100.

51. UNIT WEIGHT DETERMINATION

This work shall consist of the determination of the unit weight by measurement of the length and diameter as performed in accordance with the appropriate part of AASHTO T-233.

52. HYDRAULIC CONDUCTIVITY

This test is conducted to determine the rate of flow of water through the soil mass. Hydraulic conductivity and is determined to evaluate the drainage property of subgrade, base, and subbase materials. It is determined as the following:

a. CONSTANT HEAD

Constant head test, as described in detail in AASHTO T-215 (ASTM D-2434), is generally used to determine the hydraulic conductivity of granular materials. The sample for testing is selected and compacted into the mold. (The compactive efforts affect the hydraulic conductivity). It is then saturated under vacuum to assure that there is no air in the sample.

b. FALLING HEAD

The falling head test shall be performed in accordance with ASTM D-5084. The sample should be compacted and saturated as above for the constant head test.

53. UNCONFINED COMPRESSION TESTS ON SOILS & ROCKS

a. UNCONFINED COMPRESSION TEST (SOILS)

This work shall consist of performing the unconfined compression test in accordance with AASHTO T-208. Unconfined strength at 1%/min strain rate will also be paid under this item.

b. REMOLDING OF SOIL SAMPLES WITH CHEMICAL ADMIXTURES IN CHEMICAL SOIL MODIFICATION/STABILIZATION

This work shall consist of remolding of three blended specimens. Remolding of three samples shall be paid as one unit. If additional samples are necessary, INDOT must approve the quantity prior to the preparation of samples. Any additional samples will be paid at one third of this rate. These remolded samples could also be prepared for other test requirements.

c. POINT LOAD STRENGTH INDEX OF ROCK

This work shall consist of determining point load strength index of rock in accordance with ASTM D-5731 and it is used to classify rock strength.

54. COMPRESSIVE STRENGTH AND ELASTIC MODULI OF INTACT ROCK

This work shall consist of determining the strength of intact rock core specimens in uniaxial (compressive strength) and triaxial (Elastic Moduli) in accordance with ASTM D-7012. This is a very common method for the determination of uniaxial compressive strength and deformability.

55. CONSOLIDATION TEST

This work shall consist of performing the consolidation test in accordance with AASHTO T 216, except the initial load shall be 125 psf. This test also includes Specific Gravity, initial and final moisture contents, initial and final Degree of Saturation and Unit Weight (density) and will not be paid. Time curves for all load increments and e-log-p curve shall also be furnished.

56. TRIAXIAL TEST

This work shall consist of performing the triaxial test in accordance with AASHTO T 296 or 297. Each test shall consist of three points for plotting a Mohr Failure Envelope and determining the strength parameters. This test shall include initial and final moisture contents, initial, and final degree of saturation and initial and final unit weights (densities). The test shall include a specific gravity determination. The specific type of triaxial test performed shall be as directed by INDOT. The test shall be the (a) Unconsolidated-Undrained (UU) test, (b) Consolidated Undrained (CU) test, (c) Consolidated-Drained (CD) test, or (d) Pore Pressure Measurement with the UU or CU test and use of back pressure for saturation.

57. DIRECT SHEAR TEST

This work shall consist of determining the consolidated drained shear strength of a sandy to silty soil in accordance with AASHTO T-236.

58. MOISTURE-DENSITY RELATIONSHIP TEST

This work shall consist of performing Standard or Modified Moisture-Density Relationship in accordance with Method A or Method C, whichever is applicable as part of AASHTO T-99 or AASHTO T-180. A minimum of four points on this curve with at least two points on each side of optimum shall be performed.

59. SOIL SUPPORT TESTING

a. SUBGRADE RESILIENT MODULUS (MR) ON REMOLDED SOILS

This work shall consist of determination of the resilient modulus test in accordance with AASHTO T 307. This test shall be performed in accordance with the laboratory procedure manual. This test shall be performed based on the following:

- i. Testing shall be performed on remolded samples.
- ii. Two (2) remolded samples shall be tested to determine the modulus of either chemically modified soils or natural soils. Remolded samples shall be prepared to 95% of Maximum dry density and optimum moisture content. MR test on each sample shall be paid.

b. SUBGRADE RESILIENT MODULUS (MR) ON SHELBY TUBE

This work shall consist of determination of the resilient modulus test on undisturbed sample (Shelby Tube) in accordance with AASHTO T 307. MR Test on each sample shall be paid as one test.

MR test shall show the stress sequences. Data sheet includes: confining stress, deviator stress, resilient strain, permanent strain, resilient modulus, height and diameter of specimen, specimen preparation method, and water content before and after the test, initial dry density, and wet density.

Plot of deviator stress vs. resilient modulus with respect to each confining stress shall be submitted.

Based on the resilient modulus test, 3 regression equations as per the geotechnical manual to predict resilient modulus shall be provided.

60. COLLAPSE POTENTIAL EVALUATION TEST

This work shall consist of measuring free swell, swell pressure, and the magnitude of a one dimensional swell or collapsed of-cohesive soils such as expansive clay in accordance with ASTM D-4546.

61. WATER SOLUBLE SULFATE TEST

This work shall consist of determining the sulfate ion content in soil in accordance with ITM 510.

This test is used with clayey soils when chemical modification /or stabilization is performed. When sulfate tests are performed for corrosion, AASHTO T 290 shall be performed.

62. WATER SOLUBLE CHLORIDE TEST

This work shall consist of determining the chloride ions content in the soil in accordance with AASHTO T-291, if the presence of sea or brackish water is suspected.

63. SOIL RESISITIVITY TEST

This work shall consist of determining the electric conduction potential of the subsurface environment. The resistivity test shall be performed in accordance with AASHTO T-288.

64. ROCK DURABILITY TESTS

These tests are used to define weathering behavior (rock disintegration) when it is subjected to drying and wetting conditions.

a. SLAKE DURABILITY INDEX TEST

This work shall consist of determining slake durability index of a shale or other similar rock in accordance with ASTM D-4644.

b. JAR SLAKE TEST

Jar Slake test per ITM 511.

GEOTECHNICAL ENGINEERING

The work described in Geotechnical Engineering (Items 65 through 73) shall include all tasks required to execute the services requested by INDOT to meet the prescribed project objectives, INDOT criteria (including requirements contained in the Geotechnical Manual) and to generate a geotechnical report that meets INDOT requirements and standards, and other geotechnical engineering considerations. These services shall include, but not limited to, review of available mapping and plans, scoping, meetings, and teleconferences, as required with the project team including the design consultants, other project consultants and INDOT. Engineering analysis shall be performed after the CONSULTANT has determined an analysis is necessary and has discussed the rationale for the analysis with INDOT. All communication collecting information from, and coordinating with, other consultants, INDOT employees, and other parties involved in the project shall be included under these engineering items.

All pay items considered under “Geotechnical Engineering” will be paid in accordance with the hourly rate schedule included in Section 3 of Appendix D and as defined in Section 4 of Appendix D for non-salary costs.

65. GEOTECHNICAL REPORT

This work includes a discussion of project identification and background, scope and procedure,

topography, geology, drainage, field and laboratory investigation procedures, proposed pavement cross section, general and specific analyses and recommendations, as well as any other items needed to make a geotechnical report. Appendices to the report shall include roadway and bridge subsurface geotechnical profiles and cross-sections at key locations within the project limits with stratigraphic and geological interpretation. Appendices shall also include boring location plans, summaries of the results of all laboratory tests performed, all boring and sounding logs, pavement core data, sketches and computation for all structure, settlement, and stability analyses.

After the report is accepted, and the design has been completed, the CONSULTANT will review the contract documents such as foundation review, final check prints, specification changes to see that the design is in accordance with the geotechnical recommendations. The costs of these services will be paid in accordance with the hourly rate schedule included in Section 3 of Appendix D and as defined in Section 4 of Appendix D for non-salary costs.

If a pavement soil subgrade investigation is required, it shall be performed in accordance with the requirements of INDOT Geotechnical Services Division, "Geotechnical Manual" and the results shall be included in the geotechnical report. This work includes a discussion of field and laboratory investigation procedures, proposed pavement, cross-section, and possible causes of subgrade problems under the existing pavements, general and specific analyses and recommendations, soil subgrade investigation drawings.

A pdf copy of the geotechnical report shall be furnished to INDOT. The review process shall follow utilization of SharePoint and ERMS formats. **The format for the reports and drawings/logs should be a Windows based version and compatible with INDOT's existing programs and should be as specified in the Geotechnical Manual with the addition that all borings shall have latitude and longitude coordinates. Scanning should be kept to a minimum unless absolutely necessary such as hand calculations and drawings.**

When a Geotechnical Report is not required, the CONSULTANT shall furnish INDOT with a pdf copy of the Roadway and/or Structure Borings. Geotechnical Report shall be differentiated in accordance with the following:

a. WITHOUT SOIL SUBGRADE INVESTIGATION

This shall include geotechnical reports that include investigation and recommendations for structures only.

b. WITH SOIL SUBGRADE INVESTIGATION

This shall include geotechnical reports that include investigations and recommendations for both structures and pavement subgrade.

c. SOIL SUBGRADE INVESTIGATION (ONLY)

This shall include geotechnical reports that include investigations and recommendations for only pavement subgrade.

d. SOIL PROFILE DRAWING

This item shall only be used for soil profile drawings completed in Microstation for inclusion in the final letting plans.

e. DEVELOPMENT OF UNIQUE SPECIAL PROVISION

This item shall be used for the development of a new specification for a unique item in accordance with INDOT template. This item will also be used for work required for necessary modifications, additions, and revisions of an existing specification/recurring special provision as required to make the specification compatible with the specific project.

66. GEOTECHNICAL DATA REPORT AND TECHNICAL MEMORANDA FOR DESIGN BUILD PROJECTS

Geotechnical documents provided as part of a design-build or design-build best value or public-private partnership (PPP) projects shall include the Geotechnical Data Report (GDR), Technical Memoranda (TM), and other related reference information documents.

A GDR shall present factual geotechnical and geological information obtained through site investigation, subsurface investigation, and laboratory testing. Data gathered shall not include interpretive information.

TM and reference documents include other geotechnical information, interpretations, and preliminary designs that were used as the basis for evaluating the feasibility of the project design concept, possible design alternatives, and to assess areas of geotechnical risk.

67. SETTLEMENT ANALYSIS AND RECOMMENDATIONS FOR EMBANKMENT

This work shall consist of performing settlement analysis at a specified embankment cross-section based on consolidation test results. The CONSULTANT shall furnish computations for total estimated settlement (cross section of up to 3 points if requested), a plot of percent total estimated settlement vs. time (at the centerline) assuming the most likely drainage conditions, for each of the following types of analysis:

a. PROPOSED EMBANKMENT

b. PROPOSED AND EXISTING EMBANKMENT

68. GROUND MODIFICATION DESIGN

This work shall consist of an analysis and recommendations for a ground improvement technique such as wick drains, pressure grouting, stone columns. The CONSULTANT shall furnish all the information needed for a complete design.

69. SLOPE STABILITY ANALYSIS

This work shall consist of slope stability analyses (sliding block or rotational) at specified sections to analyze proposed or existing conditions. All corrective measures shall be defined as to the limits of the correction.

Factor of safety computations shall be made until a minimum factor of safety has been established.

70. BRIDGE FOUNDATION ANALYSIS AND RECOMMENDATIONS

This work shall consist of bridge foundation analysis and recommendations as per current INDOT's LRFD foundation design policy. All models will be approved by INDOT prior to performance of the analyses.

a. SPREAD FOUNDATION

This item shall include all analyses and computations required to make recommendations for a satisfactory spread foundation to support the proposed loading conditions at each pier location, except for settlement analysis. Spread foundations shall include mat foundations.

b. DEEP FOUNDATION

- i. This item shall include all analyses and computations required to make recommendations for a satisfactory deep foundation to support the proposed loading conditions including axial and lateral analyses at each bent or pier location, except for settlement analysis. Deep foundations are defined as any elements not considered spread foundations.
- ii. This item shall include a wave equation analyses using latest "GRLWEAP" and computations required to evaluate pile drivability. One analysis shall be performed per structure. Any additional analyses shall be approved by the Engineer in writing.
- iii. This item shall include all analyses and computations required to evaluate liquefaction potential for each bridge structure, where necessary.

If required for design, this item shall include a design stage Group analysis.

c. SETTLEMENT ANALYSIS FOR BRIDGE PIER FOUNDATIONS

This work shall consist of performing Settlement Analysis (cross section if requested by INDOT) at a specified bridge pier foundation based on consolidation test results. The CONSULTANT shall furnish computations for total estimated settlement, a plot of percent total estimated Settlement vs. Time assuming the most likely drainage conditions, for each of the following conditions:

- i. BRIDGE PIER
- ii. EMBANKMENT-PLUS-PIER
- iii. EMBANKMENT-PLUS PIER-PLUS ALL OTHER LOADS

d. FOUNDATION ON BEDROCK

This work shall consist of making bridge recommendations when the foundation should be placed on bedrock, whether the foundations are deep or shallow. This item will be used only when no analysis is required for any support of the bridge structure.

71. RETAINING STRUCTURE ANALYSIS AND RECOMMENDATIONS

This work shall consist of Retaining Structure Analysis and Recommendations. Included are conventional retaining walls, bridge abutments, piles or drilled-in piers, or any other retaining type structures. The analyses and recommendations shall include all computations necessary to assure the stability of the retaining structure, except for settlement analysis.

a. CONVENTIONAL RETAINING STRUCTURE

Conventional retaining structures including cantilever concrete retaining walls, bridge abutments, and other retaining-type structures such as MSE Walls or binwalls, except for pile or drilled-in-pier types.

i. SPREAD FOUNDATION

This item shall include all analyses and computations required to make recommendations for a satisfactory spread foundation to support the proposed loading conditions at each section, except for settlement analysis.

ii. DEEP FOUNDATION

This item shall include all analyses and computations required to make recommendations for a satisfactory deep foundation to support the proposed loading conditions at each section, except for settlement analysis. Deep foundation is defined as piles, drilled-in piers.

iii. SETTLEMENT ANALYSIS FOR RETAINING WALL FOUNDATIONS

This work shall consist of performing Settlement Analysis (cross section if requested) at a specified section based on consolidation test results. The CONSULTANT shall furnish computations for total estimated settlement, a plot of percent total estimated Settlement vs. Time assuming the most likely drainage conditions.

b. PILE RETAINING STRUCTURE ANALYSIS AND RECOMMENDATIONS

i. FREE STANDING STRUCTURE

This item shall include the analyses and computations required to determine the lateral loads which will be imposed on the structure elements and the depth of embankment required for stability of typical section. The final recommendations shall include the station limits of the structural elements, their offsets, penetration depths, and the soil and/or rock stresses for which the elements of the retaining structure should be designed. Any other design parameters which are pertinent to the recommendations for such a retaining structure should also be included as part

of this item.

ii. RETAINING STRUCTURE WITH TIE-BACK SYSTEM

This work shall be the same as described above under Item 71 (b-i) except for the additional recommendations pertaining to a tie-back system. The recommendations for the tie-backs shall include the capacity of the tie-backs, the penetration required for stability, the spacing of the tie-backs, any other design parameters pertinent to the tie-back system recommendations.

c. DRILLED-IN-PIER RETAINING STRUCTURE ANALYSIS

i. FREE-STANDING STRUCTURE

This item shall include the analyses and computations required to determine the lateral loads which will be imposed on the structural elements and the depth of embedment required for stability of a typical section. The final recommendations shall include the station limits of the structural elements, their offsets, penetration depths, and the soil and/or rock stresses for which the elements of the retaining structure should be design. Any other design parameters which are pertinent to the recommendations for such a retaining structure should also be included as part of this item.

ii. RETAINING STRUCTURE WITH TIE-BACK SYSTEM

This work shall be the same as described above under Item 71 (c-i) except for the additional recommendations pertaining to a tie-back system. The recommendations for the tie-backs shall include the capacity of the tie-backs, the penetrations required for stability, the spacing of the tie-backs, any other design parameters pertinent to the tie-back system recommendations.

d. SOIL NAILING WALL

This work shall consist of analyses and recommendations for a soil nailing wall. The analyses shall consider all the forces and moments acting on the wall and the nailing system. The recommendations shall include the required resistance and spacing of the nails.

72. SEEPAGE ANALYSIS

This work shall consist of performing seepage analysis including recommendations at specific sections to estimate the quantity of seepage through and/or underneath the embankment. Stability against piping and any other related analyses shall be analyzed as a part of the seepage analysis. However, prior approval must be obtained before performing the analysis.

The CONSULTANT shall furnish computations for estimated seepage, calculated factor of safety against piping and all necessary curves and sketches. Additional analysis will be authorized for corrective measures at specific sections.

Quantity of seepage factor of safety against piping, shall be made until tolerable limits of seepage and an adequate factor of safety are achieved while analyzing a corrective measure.

73. DEEP DYNAMIC COMPACTION ANALYSIS

This work shall consist of deep dynamic compaction analysis including recommendations. This shall include all necessary analyses and computations required to make recommendations for a satisfactory foundation to support the proposed loading of the embankment and/or to minimize the future settlement to a tolerable limit. Prior approval must be obtained before performing the analysis.

The CONSULTANT shall furnish computations for densification of foundation soils or material and all necessary curves and sketches. The CONSULTANT shall prepare the curves to show the relationship between the weight, height and number of drops, and the densification of the soil or material to facilitate the operation during construction.

CONSTRUCTION INSPECTION AND MONITORING

Under this section, the consultant will provide services in the field during construction to inspect, perform compaction testing, and monitor geotechnical related construction activities. The inspector shall be a qualified for these tests in accordance with INDOT guidelines on Geotechnical Services Division Website.

This work shall consist of:

- a. Furnishing qualified inspectors in the field during construction of specialized geotechnical structures such as drilled piers and tie-back walls.
- b. Monitoring geotechnical instruments such as piezometers inclinometers and settlement plates.
- c. Integrity testing such as crosshole sonic logging, thermal integrity profile, impulse response spectrum test, video logging, and pile dynamic load tests.
- d. Compaction testing such as dynamic cone penetration (DCP) testing and light weight deflectometer (LWD) testing.

The CONSULTANT will be reimbursed for this work in accordance with the following items:

74. PRESSUREMETER TEST (PMT)

The pressuremeter test is performed to obtain specific strength and deformation properties in accordance with ASTM D 4719. These services include the mobilization, equipment, testing, the entire incidental and its interpretation. A graph for pressure verses volume shall be plotted for each test. This item will be paid for each day of testing.

75. MOBILIZATION OF TESTING EQUIPMENT

This work shall consist of mobilization of equipment needed to perform the required testing and/or inspecting construction activities. This item shall be paid as a lump sum fee. The mileage shall be included in this item. One mobilization shall be considered for each project.

76. MONITORING GEOTECHNICAL INSTRUMENTATION

a. MONITORING GEOTECHNICAL INSTRUMENTATION

This work shall consist of recording data from instruments installed for monitoring the subsurface conditions and the performance of geotechnical structures. This work shall also consist of geotechnical engineering services required to reduce the data, summarize the data, evaluate the data and to provide engineering consultation and recommendations to the design consultant and/or INDOT.

This item will be paid in accordance with the hourly rate schedule included in Section 3 of Appendix D and as defined in Section 4 of Appendix D for non-salary costs.

b. FIELD INSPECTOR

This work shall consist of furnishing an approved inspector for field work. The inspector will have a minimum of five years of experience in the same field, inspecting or supervising construction of structures similar to the structures under contract. Prior approval will be required for each inspector before construction.

The inspector's duties should include sampling, testing, inspecting, and assisting the INDOT Project Supervisor in approving the Contractor's work.

This work shall be paid in accordance with the hourly rate schedule included in Section 3 of Appendix D and as defined in Section 4 of Appendix D for non-salary costs. The time accepted for payment shall be rounded to the nearest half hour.

For payment, the CONSULTANT will prepare an itemization of pay quantities, get it approved by the INDOT Project Supervisor/Field Engineer, and submit it to the INDOT Geotechnical Services Division.

77. INTEGRITY TESTING

This work shall consist of the performance of special tests to ensure the integrity of drilled shaft foundations during construction. These tests may include cross-hole sonic logging (CSL), thermal integrity profile (TIP), impulse response spectrum (IRS) test, and video logging.

The consultant shall be reimbursed at the actual cost including furnishing the testing instruments, after-test analysis, and preparation of the report.

78. FIELD COMPACTION TESTING

This work shall be paid in accordance with the hourly rate schedule included in Section 3 of Appendix D and as defined in Section 4 of Appendix D for non-salary costs.

a. DYNAMIC CONE PENETRATION (DCP) TEST

This work shall consist of measuring the in-situ strength of subgrade soils in accordance with ITM-509.

b. LIGHT WEIGHT DEFLECTOMETER (LWD)

This work shall consist of measuring the deflection and estimating a modulus value of in-situ soil and aggregate in accordance with ITM-508.

79. DYNAMIC PILE ANALYSIS

This work shall consist of performing a wave equation analysis using a computer program (GRLWEAP 2010 or latest version or others as approved by INDOT) and writing recommendations. This shall include all analyses and computations required to make recommendations for an adequate pile driving system at each bridge structure for the proposed loading conditions.

All necessary curves shall be prepared for each pile driving system with a specific pile to show the conditions during driving operations. "Blows per foot" vs. "nominal resistance" and "blows per foot" vs. "driving stress" shall be plotted. An adequate pile driving system shall be recommended based on the maximum allowable compressive stress, blow count per foot at ultimate resistance, and the minimum driving time required to achieve nominal driving resistance. Also, any other information or recommendations required by INDOT shall be provided.

INDOT will provide the CONSULTANT information on the proposed pile driving system to adequately fill out the upper portion of Form 2 (driving system, pile, and soil data). The CONSULTANT will determine soil parameters based on the Geotechnical Investigation.

Each pile driving system analyzed at a bridge shall be considered as one analysis, with prior approval from INDOT.

When this work is complete as a part of Item 81 (Dynamic Pile load test), it will not be paid for separately.

80. STATIC LOAD TEST

This work shall be done under the supervision of a professional geotechnical engineer and shall consist of observing and monitoring a static load test on a designated foundation (such as a pile or drilled shaft) according to INDOT Standard Specifications, Section 701. The work shall include review of the test procedures and load test assembly, observing the load test set-up, providing gauges to measure movement of the test pile, conducting, observing and monitoring the performance of the test up to the prescribed loads,, The services will include preparing and submitting a report summarizing the results of the load test along with detailed tabulation of the results of the load test.

The services will be paid in accordance with the hourly rate schedule included in Section 3 of Appendix D and as defined in Section 4 of Appendix D for non-salary costs.

81. DYNAMIC PILE LOAD TEST

This work shall be done by a professional geotechnical engineer and shall consist of a dynamic pile load test done with PDA (pile driving analyzer) according to INDOT Standard Specifications, Section 701. The work shall include furnishing the PDA instrument and necessary accessories such as transducers and wires, attaching the transducers to the test pile and connecting them to the PDA, operating the PDA during pile driving up to the required load and recording the data on magnetic tape or a computer disk. After the initial driving is over, a restrike will be done after a minimum of 24 hours or up to 168 hours and a dynamic load test will be required. This work shall include doing the CAPWAP analysis in accordance with the requirements in this appendix and the WEAP analysis as per Item 79 herein. The work shall also include submitting the report on the dynamic test as per Standard Specification, Section 701 and a computer disk containing the results of PDA, CAPWAP and WEAP, all within 72 hours after restrike. The report shall conform to ASTM-D 4946 and shall include the evaluation of hammer and pile driving system performance, pile driving stresses pile structural integrity, and load bearing capacity of the pile.

A quantity of one shall be paid for each pile tested for furnishing the instrument, the after-test analysis and preparation of test report. The presence of the test engineer in the field for the test shall be included in this item.

82. CAPWAP-C ANALYSIS REQUIREMENTS

Each test pile receiving a dynamic pile load test shall also receive a case pile wave analysis program, or CAPWAP-C analysis. This analysis shall be performed on a single blow from the original pile driving and shall be compared to the analysis done on one of the first 2 blows of the restrike test. The cost of this analysis shall be included in the cost of dynamic measurements and analysis.

Each CAPWAP-C analysis shall include the information as follows:

- i. Graph showing the bearing capacity versus blow count and pile stress versus blow count.
- ii. Simulated static load test curves for the tip and the top of the pile, if applicable.
- iii. Re-evaluation of the soil parameters used in the original wave equation analysis by means of matching the measured and computed values of forces, velocities, and displacements.
- iv. Static resistance distribution along the length of the pile.

83. FINAL CONSTRUCTION INSPECTION REPORT

This work shall consist of preparing a report summarizing the scope of the work, the results of construction inspection and monitoring, recommendations made for proposed changes during construction, and copies of geotechnical test reports (load tests and integrity tests) for the entire project. This work will be paid in accordance with the hourly rate schedule included in Section 3 of Appendix D and as defined in Section 4 of Appendix D for non-salary costs.

FOUNDATION EVALUATION BY NON-DESTRUCTIVE METHODS

84. FOUNDATIONS

The problem of unknown foundation is of major concern for the Department of Transportation. Bridge inventory does not have design, as-built plans available to document the type, depth, geometry, or material incorporated in the foundation of bridges or other highway structures. This evaluation is also needed for scour. Without foundation type and depth information, it is impossible to evaluate accurately the scour potential of these structures. This work consists of foundation depth, type, geometry, materials, integrity and stiffness around the foundation and preparation of a final report. Non-destructive evaluation (NDE) may include ultra-seismic vertical profiling, parallel seismic, GPR, and parallel seismic with cone penetrometer performed by a qualified and approved engineer. These evaluations may be performed by the surface borehole method and/or the surface testing method. Both methods shall be paid per pier or foundation and only as actual invoice cost. This work shall be reported in electronic format (Windows version) with drawings and sketches.

An appropriate or combination of methods may be used for successful evaluation. Other proven methods may be considered if approved by the Director of the Geotechnical Services Division. If requested, the proven method shall require a case history of similar work, location, personnel qualifications, and experience. Payment will be paid in accordance with the hourly rate schedule included in Section 3 of Appendix D and as defined in Section 4 of Appendix D for non-salary costs. Other items associated with this work, such as drilling, and sampling shall be paid for in accordance as described in the Geotechnical Field and Laboratory Sections.

GEOPHYSICAL INVESTIGATIONS

85. GEOPHYSICAL INVESTIGATIONS

This work shall consist of performing the required geophysical investigation by using surface geophysical and/or borehole geophysical methods (such as: shear wave seismic reflection or refraction, and/or GPR, etc.) or combination of methods which may be used for successful evaluation. This work shall be reported in electronic format (Windows version) with drawings and sketches. This work shall be performed by the CONSULTANT or by a qualified geophysical SUB-CONSULTANT when requested by the CONSULTANT and approved by INDOT.

The geophysical SUB-CONSULTANT shall submit a case history of similar work, location, personnel qualifications and experience. Other proven methods may be considered if approved by the Manager of INDOT Geotechnical Services Division.

Payment for work performed by the CONSULTANT will be paid in accordance with the hourly rate schedule included in Section 3 of Appendix D and as defined in Section 4 of Appendix D for non-salary costs. Payment for services performed by a SUBCONSULTANT will be the actual invoice cost from the SUBCONSULTANT. Other items associated with this work, such as drilling, sampling, shall be paid for in accordance as described in the Geotechnical Field and Laboratory Sections. This item shall be used only with INDOT's prior approval.

GEOTECHNICAL PROJECT MANAGEMENT

This work consists of managing the Geotechnical Investigation on a project and shall be performed by a Lead Geotechnical CONSULTANT. The Geotechnical Project Management will be the responsibility of the Lead Geotechnical CONSULTANT where the work is carried out by more than one Geotechnical CONSULTANT. The Lead Geotechnical CONSULTANT shall be responsible for providing a set of recommendations for the design and construction of the project. The management includes project coordination, general oversight, updating information on the project website (ProjectWise /SharePoint/similar site), scheduling, prioritizing, monitoring scheduled performances, providing general and technical support, and review of all geotechnical analyses and recommendations prepared by other team members (Geotechnical CONSULTANTS). All the work shall be performed in accordance with the latest INDOT guidelines and procedures.

All pay items considered under “Geotechnical Project Management” will be paid in accordance with hourly rate schedule included in Section 3 of Appendix D and as defined in Section 4 of Appendix D for non-salary costs.

86. PROJECT MANAGEMENT

a. PROJECT COORDINATION

This work shall consist of coordinating with INDOT, design team consultants, other geotechnical consultants within the team, and specialty consultants, (such as surveyors and, geophysical work specialists) in order to complete the project in accordance with the Department’s guidelines and procedures in an efficient and timely manner.

b. PROJECT WEBSITE

This work shall consist of updating the information on a shared ProjectWise, SharePoint, or internet website this may include posting minutes of meetings, technical memorandum, schedule of geotechnical investigations, geotechnical investigation data, revisions, other project related information, geotechnical plans and profiles; as appropriate.

87. GEOTECHNICAL REVIEW

a. STRUCTURE REPORT

This work shall consist of preliminary review by the lead geotechnical CONSULTANT of the work performed by the other team members (geotechnical consultants) before submitting to the INDOT Geotechnical Services Division for their review and approval.

b. ROADWAY REPORT

This work shall consist of preliminary review by the lead geotechnical CONSULTANT of the work performed by the other team members (geotechnical consultants) before submitting to the INDOT Geotechnical Services Division for their review and approval.

PAVEMENT INVESTIGATION

88. MOBILIZATION OF CORING EQUIPMENT

This work shall consist of mobilization of coring equipment to and from the project site. This item will be used when pavement cores are obtained independently of geotechnical sampling.

89. MOBILIZATION MILEAGE FOR CORING EQUIPMENT

This work shall consist of the travel mileage of the coring equipment. The authorized mileage will be the distance from the CONSULTANT'S home base to the middle of the project site. This item will be used when pavement cores are obtained independently of geotechnical sampling.

90. PAVEMENT CORE (PARTIAL DEPTH)

This work shall consist of obtaining pavement cores to the depth of asphalt overlay on Portland Cement Concrete pavements.

91. PAVEMENT CORE (FULL DEPTH)

This work shall consist of obtaining pavement cores the full depth of pavement such as a Portland Cement Concrete pavement, a Portland Cement Concrete pavement with the asphalt overlay, or a full depth asphalt pavement.

92. SUBBASE SAMPLE

This work shall consist of sampling of the subbase. This work is to be accomplished in conjunction with full depth pavement cores.

93. PORTLAND CEMENT CONCRETE PAVEMENT CORE DENSITY DETERMINATION

When required, the hardened concrete unit weight of the Portland cement concrete portion of the core shall be determined in accordance with ASTM C-642. Prior to the determination of the density, the specimen shall be submerged in lime-saturated water for at least 24 hours. The density shall be determined by bulk specific gravity after immersion, except boiling of the specimen will not be required. The report shall include the core number, the weight of the surface dry sample in air after immersion, the weight of the sample in water after immersion, the unit weight of the sample to the nearest 1.0 pcf, and the presence of reinforcing steel shall be noted, if present in the tested sample.

94. CEMENT CONCRETE CORE COMPRESSIVE STRENGTH TEST

When required, the compressive strength of the Portland cement concrete portion of the core shall be determined in accordance with ASTM C-42, and if a 2:1 height/diameter ratio is not achieved, the compressive strength shall be adjusted. Prior to testing, the specimen shall be submerged in lime-saturated water for at least 40 hours. The report shall include the core number, the core diameter, the capped core height, the adjustment factor (when required), the maximum load in pounds, the compressive strength calculated to the nearest 10 psi and any defects in either the

specimens or caps.

95. BITUMINOUS EXTRACTION TEST

This work shall consist of performing a quantitative extraction of bitumen from asphalt paving mixtures in accordance with Indiana Test Method No. 571.

96. SIEVE ANALYSIS OF EXTRACTED AGGREGATE TEST

This work shall consist of the following:

After the bitumen content has been determined, as specified in Pavement Investigation Item 95, a sieve analysis of the extracted aggregate shall be made using the following procedure:

- a. Nest the sieves in sequence, No. 200 (0.0029 in.) on the pan, then the #100 (0.0059 in.) #50 (0.0118 in.), #30 (0.0236 in.), #16 (0.046 in.), #8 (0.093 in.), and #4 (0.187 in.). Place the coarse aggregate sieves, in sequence from the smallest to the largest used, on top of the fine aggregate sieves. The largest sieve used will be the one controlling the maximum size of the coarse aggregate being used in the mixture.
- b. Carefully pour the sample on the top sieve, attach the cover and fasten the assembly to the mechanical shaker.
- c. Shake the sample for ten minutes. In no case shall fragments in the sample be turned or manipulated through the sieves by hand.
- d. Starting with the largest sieve used, weigh and record the aggregate weight retained on each individual sieve, including that in the pan. If you have more than 7.0 ounces retained on an 8 in. round sieve then the sieves are overloaded. The sample should then be split and rerun.
- e. Using results obtained in (d) above, calculate and record the percentage passing each sieve to the nearest one tenth percent (0.1%).

97. RECOVERY OF ASPHALT FROM SOLUTION BY ABSON METHOD

This work shall be accomplished in accordance with AASHTO T-170 for the Abson Method, AASHTO T-49 for the Asphalt Penetration Test and AASHTO T-201 and T-202 for the Asphalt Viscosity Test.

98. THEORETICAL MAXIMUM SPECIFIC GRAVITY TEST

This work shall be accomplished in accordance with AASHTO T-209.

99. BULK SPECIFIC GRAVITY TEST

This work shall be accomplished in accordance with AASHTO T-166.

100. AIR VOIDS CALCULATIONS

This work shall be accomplished in accordance with AASHTO T-269.

101. CORE REPORT

The recovered core shall be reassembled and photographed with a measuring tape or ruler such that the thicknesses of the various materials, such as asphaltic concrete, Portland Cement Concrete, location, and size of any reinforcing steel are clearly visible and discernable. The photograph shall be oriented to show relevant detail. Photos shall also be taken of the coring location prior to coring, the cored hole following core extraction, and recovered subbase sample. All four photographs shall be included in the final core report. The total core depth shall be measured from the recovered core in accordance with INDOT Standard Specifications, Section 501.26. Additionally, individual layers within the core shall be measured and recorded. Each core shall be numbered and the location shall be determined for each core including; route, route post, latitude, longitude, direction of traffic, and lane. A description of the subbase sample shall also be included. The core hole shall be adequately patched using Portland Cement Concrete mix design in accordance with INDOT Standard Specifications, Section 506.10 or an equal INDOT approved procedure. In addition to the core report all data shall be collected and submitted utilizing the Departments ArcGIS "Collector" application. Data collected within the application shall be in accordance with the requirements set forth in this pay item and the Core Collector Guidance document. The CONSULTANT shall retain all core samples for a period of one year after coring, or as directed by the Department, in an easily identifiable state and shall notify INDOT prior to disposal of the core samples. Payment shall be made per each core report furnished.

102. PAVEMENT ANALYSIS AND REPORT

The CONSULTANT shall make a general evaluation of the existing pavement conditions, the cores obtained, and the results of all laboratory tests performed and evaluate their impact on the proposed design. This analysis will be performed only with prior approval from INDOT Pavement Engineer. Upon completion and final approval of the work by INDOT, the CONSULTANT shall deliver to INDOT the following, which shall become the property of INDOT. Payment will be paid in accordance with hourly rate schedule included in Appendix D. The report shall include:

- a. A final electronic copy of the soils report and the soils profile for the roadway soil survey shall be submitted to INDOT on each project. **The format for the reports and drawings/logs should be a Windows based version and compatible with INDOT's existing programs.**
- b. An electronic copy of the structure boring report at each site including the following: **The format for the reports and drawings/logs should be a Windows based version and compatible with INDOT's existing programs.**
- c. A plan showing the location of all holes referenced to the survey centerline.
 - i. A true cross section of each boring showing thickness, soils classification, and position and penetration resistance of each soil stratum found between the surface and the bottom of the hole.

- ii. Free water elevations at completion and 24 hours after completion of the drilling.
- d. Reports covering special tests and analysis are to be furnished in quantities as designated by INDOT at the time the work is authorized.

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