REPORT OF GEOTECHNICAL INVESTIGATION

I-35 PAVEMENT AND SUBGRADE SURVEY
MCCLAIN COUNTY, OKLAHOMA

35589(04)

PROJECT NO. 22118

APPENDICES

REPORT OF GEOTECHNICAL INVESTIGATION

I-35 PAVEMENT AND SUBGRADE SURVEY
MCCLAIN COUNTY, OKLAHOMA

35589(04)

PROJECT NO. 22118

INTRODUCTION

General

This report presents the results of the geotechnical investigation performed for the potential overlay or reconstruction of the existing pavement of the I-35 mainline along the current alignment from 1.0 mile south of Ladd Road extending north approximately 4.7 miles in McClain County, Oklahoma.

Proposed Construction

The proposed project will include the potential overlay or reconstruction of the existing pavement of the I-35 mainline along the current alignment from 1.0 mile south of Ladd Road extending north approximately 4.7 miles in McClain County, Oklahoma. The project also includes the widening of the existing pavement of I-35 in the center median and outside lanes to accommodate adding one lane of traffic in each direction.

The purpose of this investigation is to evaluate the existing pavement, base and subgrade materials at the site and to provide information pertaining to the geotechnical aspects of the proposed project.

Scope of Work

The scope of this investigation includes the following:

1. Review of previous geotechnical and geological information of sites near this site. This was augmented with data obtained during the field investigation phase of the project.

2. Evaluation of the existing pavement using Falling Weight Deflectometer (FWD) testing

3. Investigation of the subsurface soils of the mainline pavement by coring, drilling, sampling and testing a total of 46 boreholes within the planned project area

4. A laboratory testing program consisting of moisture content, Atterberg limits, and full sieve tests on the soils encountered

FIELD AND LABORATORY INVESTIGATIONS

Field Exploration

Falling Weight Deflectometer (FWD) testing was performed by Naji Khoury on December 6th, 2022 along the existing I-35 in accordance with Oklahoma Department of Transportation's (ODOT) Geotechnical Specifications for Roadway Design (2011). The tests were performed in the outside wheel path of the outside lane approximately every 500 feet or less per lane, staggered at a spacing of 250 feet or less between the northbound and southbound lanes. After completing the FWD testing, the data was analyzed and the structural properties of the pavement and subgrade layers were provided for each testing location. The full FWD report is presented in Appendix D.

Following the FWD testing, the subsurface exploration program consisted of coring and sampling 46 borings in the roadway. The subsurface exploration was performed by Red Rock Consulting on December 16th, 19th, 20th, 27th and 28th, 2022. The borings were located in the field by a representative of Red Rock Consulting by using GPS coordinates that correlated with marked locations that were provided by Naji Khoury. The GPS coordinates of each boring is included in the Core Logs in Appendix C. The locations of the borings should be considered accurate only to the degree implied by the methods used to define them.

Twenty three (23) borings were located within the pavement of I-35 northbound and twenty three (23) borings within the pavement of I-35 southbound. The roadway borings were located at selected FWD test locations, which were recommended by Naji Khoury. The approximate locations of the borings are shown on the Boring Location Diagrams in Appendix A.

The pavement at each boring location was cored with a 4-inch barrel using a coring machine which was mounted on the back of a trailer for the 4-inch samples. Measured pavement thicknesses are shown on the Pavement Core Data and Subgrade Soils Chart in Appendix B. Photographs of the cores and existing pavement are included on the Core Logs and Pavement Photographs in Appendix C. Correlation between the pavement thickness, FWD test locations and stations along the project length are included in the FWD report in Appendix D.

Following the coring of the pavement, the roadway boring locations were then drilled to depths of approximately 36 inches or refusal beneath the existing pavement. The borings were drilled using a HD99 Hydraulic Earth Drill.

Representative samples of the subgrade materials were obtained from the auger cuttings at depths shown on the Pavement Core Data and Subgrade Soils in Appendix B.

Samples were collected and transported back to the lab for further classification and testing. The final Pavement Core Data and Subgrade Soils Chart was developed from the draft logs, observations and test results of the samples returned to the laboratory. The stratigraphic contacts indicated are only for the specific dates and locations reported, and therefore, are not necessarily representative of other locations and times.

Laboratory Testing

Representative soil samples were tested to refine the field classifications and evaluate physical properties of the soils which may affect the geotechnical aspects of project design and construction.

The laboratory testing program included the following:

- Moisture content (AASHTO T265)
- Liquid limit (AASHTO T89)
- Plastic limit (AASHTO T90)
- Particle size analysis of soils (AASHTO T88)

The results of the physical laboratory tests conducted on the subgrade soils are shown on the Pavement Core Data and Subgrade Soils Chart in Appendix B. The laboratory results in entirety are included in Appendix E.

The above laboratory tests were performed in general accordance with applicable AASHTO procedures, or generally accepted practice. It should be noted that reference to AASHTO procedures does not imply that all cross-referenced procedures in AASHTO standards have been used, or that all AASHTO procedures used have been followed exactly. Only those AASHTO procedures and/or portions of procedures, which, in the professional judgment of the geotechnical engineer of record for this report, are applicable, appropriate, and necessary for this particular project, have been used or followed.

SITE DESCRIPTION

Surface Conditions

At the time of the field exploration, I-35 was a four lane divided Asphalt Concrete paved roadway with a grass median for the entire length of the project. The project area was partially developed with a few businesses and a small airport near the SH 74 interchange. Continuing south along I-35 was primarily agricultural fields and a few residences. The town of Goldsby was located towards the northern end of the job.

Traffic was high on I-35 during drilling operations. Large trucks consisted of approximately half of the traffic. Traffic control was required to drill the borings.

The existing pavement was in fair to good condition. A recent asphalt overlay was observed across the northern half of the project length along the northbound and southbound lanes. Minor to moderate transverse cracking and minor longitudinal cracking were observed.

For the Boring Location Diagrams, refer to Appendix A. For more detailed descriptions of the pavement distress, refer to the notes column in the Pavement Core Data and Subgrade Soils Chart in Appendix B and the Pavement Photographs in Appendix C. For photographs of the pavement cores and the existing pavement, refer to Appendix C.

Site Geology

The geology of the project site was researched using the “Division Three Engineering Classification of Geological Materials”, published by the Oklahoma Department of Transportation (ODOT) and the Geologic Map of the “Hydrologic Atlas 4 of Oklahoma,” Reconnaissance of the Water Resources of the Oklahoma City quadrangle, central Oklahoma,” by Roy H. Bingham and Robert L. Moore, U.S. Geological Survey, 1975.

ODOT PUBLICATION

Division Three of the “Engineering Classification of Geological Materials”, published by the Oklahoma Department of Transportation (ODOT) indicates the project site consists of Alluvium (Qas) and Terrace deposits (Qts) underlain by the Hennessey Unit (Phy).

Terrace deposits consist of sand, silt, clay, gravel, or mixtures of these. These materials were deposited by streams or wind and may be found adjacent to most streams.

The Hennessey unit consists of red platy to blocky clay shales and mudstone. The mudstones are hard and appear blocky. The red clay shale of the Hennessey unit is characterized by numerous bands or streaks of gray, white, or light green color ranging from a few inches to four feet in thickness. Small spheres of light green color up to 10 inches in diameter are an odd characteristic of the unit.

The total thickness of the unit varies from 400 to 600 feet. The Hennessey unit outcrops in a 5 to 20 mile wide north-south band across Cleveland, McClain, and Garvin Counties in Division three.

Topographically, the unit is near level to gently rolling prairies, but most of the more level outcrops of the unit are cultivated.

USGS MAP

According to the USGS geologic map, the project consists of Alluvium (Qal) and Terrace deposits (Qt) which are underlain by Purcell Sandstone (Pp).

Terrace deposits consist of lenticular beds of sand, silt, clay, and gravel. Thickness ranges from a few feet to about 100 feet and probably averages about 50 feet along major streams. These deposits are major aquifers along Cimarron, Canadian, and North Canadian Rivers.

Purcell Sandstone consists of red-brown to maroon fine- to coarse-grained sandstone, mudstone conglomerate, and red-brown shale. Thickness, 150 feet.

Subsurface Conditions

Information collected from the core locations explored indicates that the existing pavement of I-35 along the project consisted of Asphalt Concrete. The total thickness of the full depth asphalt concrete in the roadway cores ranged between 9.25 to 16.5 inches. A cement stabilized subgrade was encountered underneath cores C-1 to C-18 and C-29 to C-46, ranging from 4.5 to 10 inches. Aggregate base was encountered underneath the remaining cores C-19 to C-28, ranging from 6 to 10 inches.

The condition of the existing surface pavement and the pavement cores are described in the Pavement Core Data and Subgrade Soils Chart in Appendix B and the Core Logs in Appendix C.

Beneath the pavement section, the subgrade materials consisted of silty, clayey sand with various amounts of gravel, clayey sand, sandy silt, silty sand with various amounts of gravel and lean clay with various amounts of sand and silt. The subgrade materials encountered in the borings classified as A-1-b, A-2-4, A-4 and A-6 soils. The subgrade materials extended to the boring termination depth of 36 inches below the pavement, except for borings C-4, C-5, C-21 to C-23, C-37, C-40 and C-41 where auger refusal was encountered between 17.5 and 52 inches below the pavement. The subgrade materials appeared to be native to the site. The subgrade in borings C-19 and C-20 had an organic smell. Subsurface conditions are described in greater detail on the Pavement Data and Subgrade Soils Chart in Appendix B and on the Core Logs in Appendix C. Laboratory results of the subsurface materials tested are included in Appendix E.

Groundwater Conditions

Groundwater conditions were monitored in the borings during and following coring/boring and sampling. Groundwater was not encountered in any of the borings during these times.

To obtain more accurate groundwater level information, long-term observations in a well or piezometer that is sealed from the influence of surface water would be needed. Fluctuations in groundwater levels can occur due to seasonal variations in the amount of rainfall, runoff, altered drainage paths, and other factors not evident at the time borings were advanced. Consequently, the contractor should be aware of this possibility while constructing this project.

CLOSURE

The data presented in this report are based on the negotiated scope for this project and site conditions as they existed at the time of the field exploration. The conditions encountered in the exploratory borings are assumed to be representative of the subsurface conditions within the study area.

This report was prepared for the exclusive use of Olsson Associates, ODOT, and their agents and consultants. It should be made available to prospective contractors for information and factual data only and not as a warranty of subsurface conditions similar to those interpreted from the Pavement Core Data and Subgrade Soils Chart or discussions presented herein.

APPENDIX A

APPENDIX B

APPENDIX C

APPENDIX D

APPENDIX E

APPENDIX F

RED ROCK CONSULTING

GENERAL NOTES

SOIL PROPERTY ABBREVIATIONS

N	Uncorrected SPT Penetration, blows per foot
N_{60}	Corrected SPT Penetration, blows per foot
Q_u	Unconfined Compressive Strength, psf
Mc	Moisture Content, %
LL	Liquid Limit, %
PL	Plastic Limit, %
PI	Plasticity Index, %

DRILLING & SAMPLING ABBREVIATIONS

BS	Bag Sample
SPT	Split Spoon Sample
ST	Shelby Tube Sample
AU	Auger Sample
TC	Texas Cone Penetrometer
DCP	Dynamic Cone Penetrometer

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)
-- used to classify all soils unless otherwise noted --

Major Divisions			Group Symbol	Typical Names
Course-Grained Soils >50% retained on #200 sieve	**Gravels** 50% + of course fraction retained on #4 sieve	Clean Gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		Gravels with Fines	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands 50% + of course fraction passes #4 sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		Sands with Fines	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils <50% passes #200 sieve	**Silts and Clays** Liquid Limit ≤ 50%		ML	Inorganic silts, very fine sands, rock four, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly/sandy/silty/lean clays
			OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays Liquid Limit > 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays or high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, muck, and other highly organic soils

Prefix: G = Gravel, S = Sand, M = Silt, C = Clay, O = Organic **Suffix:** W = Well Graded, P = Poorly Graded, M = Silty, L = Clay, LL < 50%, H = Clay, LL > 50%

PLASTICITY OF COHESIVE SOIL

Degree of Plasticity	Plasticity Index	Swell Potential
None	0 to 4	Very Low
Slight	5 to 9	Low
Medium	10 to 19	Low to Medium
High	20 to 39	Medium to High
Very High	40+	Very High

MOISTURE OF COHESIVE SOIL

Description	Condition	Moisture Content
Dry, Dusty	Dry	0 to 10%
Damp	Moist	10 to 30%
Free Water	Wet	30 to 70%

CONSISTENCY - COHESIVE SOILS

Consistency	SPT
Very Soft	<2
Soft	2 to 4
Medium Stiff	5 to 8
Stiff	9 to 14
Very Stiff	15 to 30
Hard	31+

DENSITY – COHESIONLESS SOILS

Relative Density	SPT
Very Loose	<4
Loose	4 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51+

ROCK HARDNESS

SPT (in/50)	TCP (in/100)	Rock Description
6+	6+	Very Soft / Very Poorly Cemented
5 - 6	3 - 6	Soft / Poorly Cemented
4 - 5	2 - 3	Moderately Hard / Cemented
3 - 4	1 - 2	Hard / Well Cemented
<3	<1	Very Hard / Very Well Cemented

ROCK CORE QUALITY

Core Quality	RQD
Excellent Quality	90 – 100%
Good Quality	75 – 90%
Fair Quality	50 – 75%
Poor Quality	25 – 50%
Very Poor Quality	<25%