SECTION II

Geology of the Project

Nemaha Ridge

The Nemaha Ridge has resulted in a rather steep easterly dip in the bedrock. Differential compaction of the sediments over the Nemaha Ridge plus some faulting has resulted in a rather complex structure. Several small faults were noted near the project along with a number of minor anticlinal structures. The bedrock to the south of Havensville is dipping to the southeast and gradually swings around to the east near the Nemaha-Pottawatomie County Line.

Stream erosion

Prior to the advance of the Kansas Glacier a major stream eroded a channel across the northern end of the project to a depth of one-hundred feet or more. Station 165+00 is near the south edge of the stream channel. To the north of Station 165+00 there are only occasional bedrock remnants near the surface.

Glacial Sediments

The melt waters along the leading edge of the glacier clogged the stream channel and later filled the valley with glacial sediments. For the most part, the glacial sediments found along the project consist of sands and clays with only a few boulders of more than a foot in diameter. Right of Station 40+00 is a deposit of coarse glacial gravels and left of Station 220+00 there are indications of gravel deposits. The remainder of the glacial deposits consist of typical tills with occasional sand and gravel lenses.

SECTION III

Geo-Engineering Aspects

CUT SECTION STATION 5+00 to 18+00

Backslopes

The right backslope will cut into the Pony Creek shale and the weathered remnants of the Brownsville limestone at the top of the cut. The present backslope is about 3.5 feet high and is on a 1:1 slope which is supporting an abundant vegetative growth. Since the top of the backslope will be capped with the weathered Brownsville limestone and the Pony Creek shale has not weathered excessively, it is felt that a 1:1 backslope would prove satisfactory in a cut up to ten feet in depth at this location. The ground slopes off to the left of center line in such a manner that there will not be a left backslope.

Excavation

All excavation through this location will be classed as common.

CUT SECTION STATIONS 24+00 to 34+00

Backslopes

The backslopes will be influenced by the thin mantle and weathered shale section in the upper limits, by the Brownsville limestone and Pony Creek shale in the lower portion. Because of the weathered condition of the shale above the Brownsville limestone, it is suggested that slopes of not less than 2:1 be used. Where the Brownsville is not present, between stations 24+00 and 26+50 and between stations 29+50 and 34+00, 2:1 backslopes are suggested for the entire backslope. Between stations 26+50 and 29+50 where the Brownsville limestone is present 1:1 backslopes below this formation should prove satisfactory. The present backslopes are on a 1:1 and have slumped considerably in the areas not protected by the Brownsville limestone. Where the Brownsville Limestone is present there is some spalling of the shales; however, not enough to be damaging. There is enough seepage from the backslopes to acquire a rather abundant growth of Cottonwood trees along the ditches.

Excavation

The top of the Brownsville Limestone (where present between stations 26+50 and 29+50) will mark the upper limits of rock excavation in this cut section. On both ends of the cut beyond the outcrop of the Brownsville the rock and common line will be about ten feet below the normal ground line. The present backslopes have about three feet of slumped material along the toe of the slope which feathers out about ten feet above the ditches. The shales in the present backslopes have weathered to common to a depth of about one foot normal to the slope.

CUT SECTIONS STATIONS 186+00 to 253+00

Backslopes

Observed mantle backslopes in cuts up to 20 feet deep indicate that a 2:1 slope is very near the steepest slope that will support a protective vegetative cover. 2:1 slopes in some of the deeper cuts show some tendency to slump in the deeper portion of the cut; this is probably due to the additional time required to develop a productive soil for plant growth. Where slopes steeper than 2:1 have been used, the backslopes tend to slump out at the base and take on a near vertical face which during wet seasons blocks off and slides into the ditches. From all indications a 2½:1 backslope which has been protected from surface run-off would be the most stable in the deeper cuts.

Since the cut sections between stations 186/00 and 232/00 will be relatively shallow and will encounter a sandy mantle, 3:1 backslopes are suggested.

Between stations 247/00 and 253/00 backslopes of 2:1 should prove satisfactory; however, the stability would be increased considerably if a 2½:1 slope is used.

Ditches

The mantle throughout this area is quite easily eroded, hence the liberal use of wash checks is suggested.

CUT SECTION STATIONS 291/00 to 298/00

Backslopes

Backslopes of 1:1 are suggested for the Salem Point shale, and ½:1 or vertical slopes for the Burr and Neva limestones. 3:1 backslopes are suggested for the mantle between stations 294/00 and 298/00.

Excavation

Rock excavation with a minor amount of overbreakage is expected in the Burr limestone between stations 291/00 and 292/00. The Salem Point shale between stations 292/00 and 294/50 will be weathered to common excavation. The Neva Limestone between stations 293/50 and 295/00 is weathered; however, the lower two feet will be classed as rock excavation.

SECTION IV

Hydrology

Stations 25+00 to 34+00

Since the Pony Creek shale has a number of thin sandstone lenses carrying water from left to right across center line and the grade line will be on a rather steep slope either a series of step drains or a blanket drain will be required. If a step drain is used it would require six laterals plus one longitudinal down the left side, starting at station 26+00 and continuing to station 34+00. A blanket drain for this location should cover the area between stations 25+00 and 34+00. See figure I.

Stations 83+00 to 86+00

Seepage from the sandstones in the Langdon shale is expected along the right ditch. However, if the grade line remains above the present ground line no problems are anticipated. If the grade line falls below the present ground line a special right ditch section should give adequate protection, since the bedrock-mantle contact drops abruptly to the left.

Stations 113+50 to 118+00

The water moving from left to right along the shale-mantle contact will be intercepted by the left ditch if the grade line remains at an elevation of 1190 or below at station 115+00.

Stations 145+00 to 150+00

Free water was found to be moving along the base of the weathered Dover limestone between stations 145+00 and 150+00. Since there is a rather steep dip in the bedrock to the right at this location and as the ground line slopes to the left, the ground water is apparently moving to the left along the mantle-shale contact and collecting in the weathered remnants of the Dover limestone and glacial gravels. If the proposed grade line remains at or above the present ground line no hydrology problems are anticipated. However, if the proposed grade line is three or more feet lower than the present ground line a longitudinal drain placed into the Langdon shale along the right side of the road would be required.

Stations 154+00 to 158+00

The hydrology problem at this location is quite similar to those in the preceding case, that is mantle water moving in from the right and collecting in the upper limestone of the Langdon shale. The right ditch along the present road is cut into the shale and has collected enough water to support a crop of cattails right of station 157+00. A portion of the water makes its way into the upper limestone of the Langdon shale and finally reaches the surface where the present ditch cuts through the limestone right of station 158+00. If the proposed ditches encounter this limestone it is suggested that a longitudinal drain be placed along the right side of the road below the upper limestone in the Langdon shale extending from station 156+00 to 158+00.

Stations 170+00 to 177+00

The left ditch of the present road which will be just right of the proposed center line has cut into a fine silty sand which has given rise to an abundant flow of water. The source of the water is from an area of glacial sands and gravels to the left of center line, so that the supply area is rather extensive. Since the sands are so fine and uniform the water is not localized to any one point but is seeping from the ditch and backslope from station 170+00 to station 173+00. Since the present ditch line slopes to the left, the ground water is apparently moving to the left along the mantle-shale contact and collecting in the weathered remnants of the Dover limestone and glacial gravels. If the proposed grade line remains at or above the present ground line no hydrology problems are anticipated. However, if the proposed grade line is three or more feet lower than the present ground line a longitudinal drain placed into the Langdon shale along the right side of the road would be required.

Stations 154+00 to 158+00

The hydrology problem at this location is quite similar to those in the preceding case, that is mantle water moving in from the right and collecting in the upper limestone of the Langdon shale. The right ditch along the present road is cut into the shale and has collected enough water to support a crop of cattails right of station 157+00. A portion of the water makes its way into the upper limestone of the Langdon shale and finally reaches the surface where the present ditch cuts through the limestone right of station 158+00. If the proposed ditches encounter this limestone it is suggested that a longitudinal drain be placed along the right side of the road below the upper limestone in the Langdon shale extending from station 156+00 to 158+00.

Stations 170+00 to 177+00

The left ditch of the present road which will be just right of the proposed center line has cut into a fine silty sand which has given rise to an abundant flow of water. The source of the water is from an area of glacial sands and gravels to the left of center line, so that the supply area is rather extensive. Since the sands are so fine and uniform the water is not localized to any one point but is seeping from the ditch and backslope from station 170+00 to station 173+00. Since the present ditch shows little draw down effect on the water levels and as there are no tight zones in the mantle to place a drain complete drainage would not be obtained. However, unless some method is used to dewater this area a fill would undoubtedly clog the seep area and force the water levels higher until they found another means of relief. See figures II and III. This drain arrangement is only intended to prevent a build-up of water under the road rather than complete interception. Since a considerable amount of water will be moving under the road it is suggested that a low capillary material be used throughout this section.

Station 291/75

A lateral drain is suggested for the Burr limestone at station 291/75. Since the final grade line was not known at the time of this report the exact location could not be determined. However, the lateral should be designed in such a manner as to intercept water moving from the bases of both the upper and lower Burr limestones. The lateral should be placed at an elevation of 1219.0. An outlet can be obtained on either side at station 290/50.