# APPENDIX E

# GEOTECHNICAL

## GENERAL

This report provides a description of the existing soil conditions likely to be encountered at the project site. The following description on the geology and physiography is from the publication "Section 205 Local Flood Damage Report Farmer's Branch, White Settlement, Texas, March 2002," Appendix A – Geomorphology by Dr. Peter Allen, Ph.D. The City of White Settlement drilled two borings near Las Vegas Trail Bridge on 26 April 2005; however, no soils laboratory testing of the borings was conducted. A geotechnical site visit was conducted on 1 March 2005, which surveyed visible surface soils at the project site, along the creek bank and the channel bottom. Field observations were used to approximate soil parameters for preliminary design. A geotechnical investigation will be required to support the design in plan and specifications. The subsurface investigation for Farmers Branch should incorporate drilling for soil/rock samples, laboratory testing for engineering properties, stability analysis for the factor of safety for the proposed channel slopes, and determination of the bearing strata and allowable end bearing for proposed bridge piers.

## GEOLOGY AND PHYSIOGRAPHY

The City of White Settlement lies within the Grand Prairie Province of the Western Gulf Coastal Plain within the Trinity River Watershed. The Goodland Formation underlies the City and can be seen in many road cuts and stream banks throughout the area (see Figure 1). The Goodland Limestone was deposited in shallow water with a muddy bottom, probably below wave base during the Early Cretaceous transgression. The formation is about 116 feet thick in the Lake Worth Area of Tarrant County. The strike and dip of the Goodland Limestone formation based on maps prepared by the Fort Worth Geological Society for the City of Fort Worth show the local dip in the vicinity of White Settlement to be about 26 feet per mile or about 0.28 degrees. The geologic formations strike North 10-12 degrees East and dip to the East-South-East (perpendicular to the strike).

The Goodland formation consists of a white, fossili ferous, micritic limestone. The unit has low clay content (less than 12 percent). Fossils include ammonites, pelecypods, gastropods, and heart shaped urchins. Locally, in Farmers Branch Creek, the nodular, massively bedded limestone is seen to outcrop along the channel bottom and is exposed at numerous locations along the creek. Upon weathering, the more massive beds break down into more nodular pieces. These pieces are subsequently eroded from the channel banks and are entrained as bed load material (see Figure 2). Megaripples were seen at several locations along the creek. These wavy beds are thought to be formed by bottom currents that run parallel to the ripples during deposition (Cretaceous).

The more recent history of the streams in the area is complex. Following retreat of the seas at the end of the Cretaceous, erosion of the landscape began. Streams developed, deepened their valleys, and grew headward up the gradual slope of the previously deposited marine rocks. Probably in late Tertiary time (Pliocene), the Trinity River became the dominant stream in the area (Montgomery, 1993). As the Trinity River cut down through overlying shales and limestones, tributaries of the Trinity, extended headward from the main stem. The major streams draining the

City of White Settlement flow into the West Fork of the Trinity River. This process of downcutting was episodic and often interrupted by intermediate periods of deposition in response to changing climates.

Figure 1 - Goodland Limestone Outcrop along Farmers Branch. (Station 100+00).

Channel and flood plain cross sections and geology change as one proceeds downstream. This change is due the combined increase in drainage area and discharge, as well as, the related incision of the channel into the soils and underlying rocks which comprise the local landscape. Typically, the smaller headwater streams in the City flow through residual soils formed from the marine chalks. These are black-brown clayey textured soils, which range in thickness from 3-6 feet. As one progresses down stream, the channel becomes more incised into the limestone. The stream-banks are composed of silty clay and clay loam, which is underlain by discontinuous, lenses of limestone gravel, or in some areas outcrops of limestone.

This more recent history is complex and not well understood. In general, the major incision into the present stream channels occurred during the last million years in response to remarkable shifts in the continental climate due to intermittent periods of glaciation. During glacial cycles, streams, which were linked to the coast, responded to large fluctuations in sea level (upwards of 300 feet) by either down cutting or filling their valleys. With the final retreat (melting of the glacial ice in the northern United States) about 18,000 years ago, the streams began to slowly equilibrate to the new climate. While the streams in the City of White Settlement were not directly linked to the sea, they certainly did feel the effects of climatic variations. During the last ten thousand years, the present channel and floodplain probably established their current cross sectional configurations.

Figure 2 - Typical Cross-section of Farmers Branch. The channel bottom is cut into the Goodland Formation limestone. The channel banks consist of limestone and overlying alluvium. Alluvial materials consist of silty clay with interbedded limestone gravel and sands.

**GEOTECHNICAL SITE VISIT**

A geotechnical site visit was conducted on 1 March 2005, which visually surveyed surface soils and exposed stratums in the channel bottom in the proximity of bridge crossings along the project site between Las Vegas Trail and White Settlement Road. Brown to grayish clay along both channel banks was measured to have bank angles of 38 to 60 degrees. These banks observed at the Farmers Branch project area, overlaid shale and/or limestone and/or cemented caliche at the bottom of the channel. Outcroppings of these hard materials were observed to be intermittent along the entire project channel length and appear to vary from the channel invert to vertically upwards of several feet above the invert. Based on the visual soil appearance and local soils common in this area according to the "Soil Survey of Tarrant County, Texas by U.S. Dept. of Agriculture SCS", the overlaying soil appears to be mostly Sanger clay (CH, CL). Sanger Clay has the following properties:

| Percent Passing | Sieve No. |
|---|---|
| 95 – 100 | 4 |
| 5 – 10 | 10 |
| 90 – 100 | 40 |
| 80 – 95 | 200 |

Liquid Limit: 40 – 60
Plasticity Index: 28 – 42

The outcroppings are described accordingly. The light-gray shale was weathered, weak, and fractured in intermittent areas along the bottom of the channel. The limestone areas exposed to the surface was highly fractured. The intermittent caliche at the channel bottom was cemented and hard when encountered. At Meadow Park Bridge the bottom of the channel is 11 feet below the north side top of bank. The bottom of the channel has an outcropping of weak, weathered, light-gray shale just downstream of the bridge. The shale stratum appears to be horizontal to the bottom of the channel. Upstream of Meadow Park Bridge is a concrete channel. At Las Vegas Trail Bridge, the bottom of the channel has three outcroppings of hard-cemented caliche within 150 feet downstream of the bridge. The City of White Settlement drilled two borings near Las Vegas Trail Bridge on 26 April 2005. B1 was drilled at the northeast corner of the intersection at approximately five feet north of the center of the radius of the curb and gutter of the intersection. B2 was drilled at the southwest corner of the intersection at approximately fifty feet west of the radius of the curb and gutter at this intersection, or about ten feet south of the curb on Ronald Street. Materials found at B1 was: the first 3 feet was broken limestone with brown clay layers and rocks, from 3 to 12 feet was brown hard clay (4.5 tsf) with limestone, from 12 to 22 feet was tan limestone, and from 22 to 40 feet was gray limestone. Materials found at B2 was; the first 4 feet was brown clay, at 5 feet was brown clay with tan limestone layers, from 6 to 12 feet was tan limestone with brown clay layers, from 12 to 18 feet was tan limestone, from 18 to 22 feet was gray shale, and from 22 to 40 feet was gray limestone. No soils laboratory testing of the borings was conducted.

**GEOTECHNICAL RECOMMENDATIONS**

A geotechnical investigation is recommended consisting of performing subsurface explorations and obtaining representative soil and rock samples, laboratory testing of the samples, and analysis of the test results. Results of the field and laboratory testing programs will be used to characterize the foundation conditions with respect to the competency of the proposed embankments and proposed channel construction. Using the aforementioned test data, engineering analyses will be performed for the design phase of this project. Base on the measured existing channel slope angles, the proposed 3H:1V design slope is expected to be stable. A stability analysis for the factor of safety for the proposed channel slopes should be conducted. The surface materials at the channel invert at the bridge locations, does not necessary indicate the pier bearing material at depth is the same (as this area is stratified). The bearing material may be expected to be limestone, shale, or clay. A reinforced concrete straight-shaft drilled pier may be used for end bearing on limestone or shale. A reinforced concrete drilled and underreamed pier may be used for bearing in clay. The bearing depth and allowable end bearing capacity can be determined from the results of the subsurface soils investigation. A survey locating the extent of rock outcrops along the channel bottom should be conducted where channel widening/deepening is required for the project, as this may have an affect on project costs. Hydrology and Hydraulics Section used “depth-average local velocity” method to size the 24” riprap. Recommend the use of Pyramat reinforcement matrix, where seeding is placed on the slope before the installation of the erosion control matting or the use Landlok TRM 1060 matrix where seeding is hydro-seeded through the erosion matting after matting installation. When vegetated, these matrixes will be able to resist 14ft/sec flows for 50 hours.