Subsurface Exploration and Pavement Analysis
Proposed New Streets
Weatherwood, Phase 3
San Antonio, Texas

InTEC Project No. S251291
October 23, 2025

FORESTAR
16500 San Pedro Avenue, Suite 400
San Antonio, Texas 78232

Integrated Testing and Engineering Company of San Antonio, L.P.
12028 Radium, San Antonio, Texas 78216—Phone: (210) 525 9033—Fax: (210) 525 9032—www.InTEC-SA.com

October 23, 2025

Forestar Group, Inc.
16500 San Pedro Avenue, Suite 400
San Antonio, Texas 78232

Attention: **Mr. Matt Florence**
Email: mattflorence@forestar.com

Re: Subsurface Exploration and Pavement Analysis
Proposed New Streets
Weatherwood, Phase 3
San Antonio, Texas

InTEC Project No. S251291

Ladies & Gentlemen:

Integrated Testing and Engineering Company of San Antonio (InTEC) has completed a **subsurface exploration and pavement thickness evaluation report** at the above referenced project site. The results of the exploration are presented in this report.

We appreciate and wish to thank you for the opportunity to be of service to you on this project. If we can be of additional assistance during the foundation explorations, and materials testing-quality control phase of construction, please call us.

Sincerely,
InTEC of San Antonio

Murali Subramaniam, Ph. D., P.E.
Vice President

STATE OF TEXAS
MURALI SUBRAMANIAM
102417
LICENSED
PROFESSIONAL ENGINEER
InTEC of SAN ANTONIO
F-7623

10/24/2025

EXECUTIVE SUMMARY

The soil conditions at the location of the **proposed new streets at Weatherwood, Phase 3 in San Antonio, Texas** were obtained from **drilling eight borings to a depth of 12 feet each**. Laboratory tests were performed on selected specimens to evaluate the engineering characteristics of various soil strata encountered in the borings.

- The subsurface soils at the boring locations consist of dark brown clays to brown clays, dark brown clays, tan clays to tan calcareous clays, tan marl, and limestone with caliche and gravel.
- The results of our exploration, laboratory testing, and engineering evaluation indicate that the underlying soils consist predominantly of **moderately plastic to highly plastic clays**, with potential for shrink-swell behavior due to changes in moisture content.
- **Estimated potential vertical rise (PVR)** using TxDOT Test Method TEX-124-E ranges from **1 ½ to 2 ½ inches** at the current site grades. These values are based on standard modeling assumptions and **should not be interpreted as exact predictions of future movement**.
- The proposed pavements at this site may be supported by flexible pavement sections.
- Cut and fill information is not available for our review at this time. Marl / Limestone subgrades are anticipated.
- At the time of construction, if the final street subgrade consists of material other than encountered in our test pits, the recommendations may have to be revised. Pavement section recommendations for Local type streets are presented.
- **Groundwater was not encountered** in the borings at the time of drilling.
- The effectiveness of the recommended foundation system depends on **proper drainage, moisture control, construction practices**, and long-term **post-construction maintenance**. Some slab tilt and cosmetic cracking may still occur due to natural variability in subsurface conditions and soil behavior.

This summary is intended for general guidance only. **Detailed descriptions, analysis, assumptions, and recommendations** are included in the full report and should be reviewed in their entirety. The contents of this report are based on **site conditions at the time of exploration**, and **any deviation from those conditions may require reevaluation** by the geotechnical engineer.

Summary Table A – Input Parameters used in Asphalt Pavement Section Calculation

	Local Type A (no bus traffic)	**Local Type A** (with bus traffic)	**Local B**
ESAL	100,000	1,000,000	2,000,000
Reliability Level	R-70	R-70	R-90
Initial and Terminal Serviceability	4.2 and 2.0	4.2 and 2.0	4.2 and 2.0
Standard Deviation	0.45	0.45	0.45
Service Life	20 years	20 years	20 years
If heavy truck traffic is anticipated, please contact InTEC with anticipated traffic data for revised recommendations.			

Summary Table B – Minimum Flexible Pavement Recommendations – CBR = 2.5

Classification	Asphaltic Concrete			Aggregate Base, inches	Geogrid	Subgrade, inches	Structural Number
	Type D, inches	Type C, inches	Type B, inches				
Local A (with NO bus traffic)	3.00	-	-	8.00	No	6" LS	2.92
	2.00	-	-	10.00	No	6" LS	2.76
	2.00	-	5.00	-	No	6" LS	3.06
Local Type A (with bus traffic)	3.00	-	-	13.00	No	8" LS	3.78
	3.00	-	-	11.00	Yes	8" LS	3.83
	3.00		5.50	-	No	8" LS	3.83
Local Type B	2.00	3.00	-	13.00	No	8" LS	4.66
	2.00	2.00	7.00	-	No	8" LS	4.78

Design Notes:

- Pavement design follows the *City of San Antonio Pavement Design Guidelines*.
- Input parameters are summarized in **Table No. 3 (Summary Table A)**.
- Design California Bearing Ratio (CBR) = **2.5**.
- Recommendations are provided for **local Type A and Type B streets**.
- Laboratory testing and engineering evaluation indicate **highly plastic clays** at shallow depths. Estimated **Potential Vertical Rise (PVR)** at existing grade is **1 ½ to 2 ½ inches**.
- For **repetitive or heavy truck traffic**, contact InTEC for revised pavement design recommendations using appropriate traffic inputs.

Subgrade Notes:

- Subgrade soils are anticipated to consist of **brown clays or marl to limestone.**
- **Cut and fill information** is not available at this time.
- Fill used to raise the grade in clay areas:
  - approved fill material free should have a minimum CBR value of 2.5 and a maximum Plasticity Index value of 50. Lime application rates should be re-evaluated and tested for sulfate content prior to use of the fill material.
  - The fill material should be approved by the geotechnical engineer, free of deleterious material, and the gravel size should not exceed 3 inches in size. The material should be placed and compacted as per applicable city / county guidelines.
  - The subgrade, prior to placement of fill, should be proof rolled to identify weak areas. Any identified weak areas should be recompacted.
- Fill used to raise the grade in marl areas:
  - Existing clays should be removed to marl / limestone stratum prior to placement of fill.

  - approved fill material free should have a minimum CBR value of 5.0 and a maximum Plasticity Index value of 20.
- **Proof-roll** subgrade prior to fill placement to identify and recompact weak zones.

Subgrade Stabilization:

- **If the subgrade Plasticity Index values are less than or equal to 20, as per City of San Antonio or Bexar County requirements, subgrade stabilization is not needed.**
- Subgrade should be stabilized using lime or cement. Lime application rates are presented here. Please contact InTEC for cement application rates.
- Test subgrade soils for **sulfate content** prior to stabilization.
  - If **sulfate > 3,000 ppm**, alternate procedures may be required.
- **Lime** stabilization recommended.
  - Recommended **lime application rate = 7.5%**.
  - Equivalent lime application weights:
    - ✓ 6-inch stabilization: **32 lb/sy**
    - ✓ 8-inch stabilization: **43 lb/sy**
  - Target **Unconfined Compressive Strength (UCS) ≥ 160 psi** for lime-stabilized subgrade.

Pavement and Drainage Notes:

- Pavement design is based on **CBR = 2.0** and parameters in Table 3.
- Cracking and deformation may occur due to **shrink-swell behavior** of expansive clays.
- **Moisture control** beneath pavement is critical:
  - Prevent rain or irrigation water from infiltrating beneath the asphalt and base.
  - Consider **curbs extending ≥ 6 inches into subgrade** or backfilling with **compacted clay** against curb edges.
  - Ensure **lot grading and home construction** prevent trapped water near pavements.

Geogrid:

- Install **one layer of geogrid (Tensar Triax 130 or equivalent)** directly on top of the stabilized subgrade, following manufacturer's installation guidelines.

Aggregate Base:

- Use TxDOT Item 247 A1-2 aggregate base
- Place in uniform lifts and compact to specified density and moisture content per city / county guidelines.

Asphalt:

- Provide asphalt materials and placement in accordance with City of San Antonio / TxDOT guidelines.

Verification:

- During construction, **InTEC personnel should verify subgrade preparation and stabilization** prior to base placement.

Summary Table C – Summary of Pavement Materials

Pavement Section	Material	Stabilization or Treatment	Thickness
Subgrade	Tan Calcareous Clay, Marl to Limestone (Plasticity Index <= 20)	Moisture conditioned clays	-
	Clays (Plasticity Index > 20)	Stabilized Subgrade	6 or 8 inches
Base	TxDOT Item 247 A1-2	-	As recommended in pavement options (maximum of 6 inches per lift)
Asphalt	Type B, C, D	-	As recommended in pavement options
Geogrid	Tensar Triax TX130 or better	One layer	As per manufacturer's recommendations

See report for more details

Summary Table D – Applicable procedures and minimum density and moisture percentages

All applicable City of San Antonio Standard Specifications for Construction, June 2008, should be followed. Some of the relevant procedures are shown below.

Pavement Material	Procedure	Density and Moisture Control
Subgrade fill (maximum 6 inch thick lifts)	Item 107	As per construction specifications
Stabilized Subgrade (8 inch thick lift)	Item 108- lime	As per construction specifications
Aggregate Base TxDOT Item 247 A1-2 (maximum 6 inch thick lift)	Item 200	As per construction specifications
Asphalt HMAC Type B, C, D	Item 205, 206	As per construction specifications
Geogrid	Manufacturer's Guidelines	-

(*) City of San Antonio Standard Specifications for Construction, June 2008

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INTRODUCTION

General

This report presents the results of our **subsurface exploration and pavement thickness evaluation** for the **proposed new streets at Weatherwood, Phase 3 in San Antonio, Texas.** This project was authorized by **Mr. Matt Florence.**

Purpose and Scope of Services

The purpose of our subsurface investigation was to evaluate the site's subsurface and ground water conditions and provide pavement thickness recommendations for the development phase of the project. Our scope of services includes the following:

1) drilling and sampling of eight borings – to a depth of 12 feet each;
2) evaluation of the in-place conditions of the subsurface soils through field penetration tests;
3) observing the ground water conditions during drilling operations;
4) performing laboratory tests such as Atterberg limits, California Bearing Ratio (C.B.R.), and Moisture content tests;
5) review and evaluation of the field and laboratory test programs during their execution with modifications of these programs, when necessary, to adjust to subsurface conditions revealed by them;
6) compilation, generalization and analyses of the field and laboratory data in relation to the project requirements;
7) estimate of potential vertical movements;
8) preparation of pavement guidelines;
9) preparation of a written geotechnical engineering report for use by the members of the design team in their preparation of construction, contract, and specifications documents.

The Scope of Services **did not include slope stability or any environmental assessment** for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site. Any statements in this report or on the Boring Logs regarding odors, colors or unusual or suspicious items or conditions are strictly for the information of the client.

Project Description

The proposed project involves the development of new streets at Weatherwood, Phase 3 in San Antonio, Texas.

- The proposed pavement areas are anticipated to include Local type streets. Marl / Limestone subgrades are anticipated.
- Cut and fill information is not available at this time.
- A review of the aerial map indicates numerous trees / dense vegetation within the site.
- Review of the topographic map indicates the site generally slopes from north to south.
- Review of the geologic map indicates the site is located within Kau, Austin Chalk, and Qle, Leona Formation.
- Limestone and limestone seams were encountered in some of the borings. Karst features are formed in limestone, dolomite, or gypsum by dissolution. A geophysical study of the site may indicate the presence and potential impact of Karst features, caves, or significant cavities on the building performance and construction delays. The thickness of the Stratum I clay is likely to vary across the site. Geophysical study is not within the scope of this investigation.

SUBSURFACE EXPLORATION

Scope

The field exploration to determine the engineering characteristics of the subsurface materials included a reconnaissance of the project site, drilling the borings, performing Standard Penetration Tests, and obtaining Split Barrel samples.

Eight soil test borings were drilled at the locations of the new residences at the project site. Approximate boring locations are shown in the boring location plan in the Illustration section of this report. These borings were **drilled to a depth of 12 feet below the presently existing ground surface**. Boring locations were selected by the project geotechnical engineer and established in the field by the drilling crew using normal taping procedures.

Drilling and Sampling

The soil borings were performed with a drilling rig equipped with a rotary head. Conventional solid stem augers were used to advance the hole and samples of the subsurface materials were obtained **using a Split Barrel sampler.** The samples were identified according to boring number and depth, encased in polyethylene plastic wrapping to protect against moisture loss, and transported to our laboratory in special containers.

Field Tests and Water Level Measurements

Penetration Tests – During the sampling procedures, **Standard Penetration Tests were performed** in four borings in conjunction with the split-barrel sampling. The standard penetration value (N) is defined as the number of blows of a 140-pound hammer, falling thirty inches, required to advance the split-spoon sampler one foot into the soil. The sampler is lowered to the bottom of the drill hole and the number of blows recorded for each of the three successive increments of six inches penetration. The "N" value is obtained by adding the second and third incremental numbers. The results of the standard penetration test indicate the relative density and comparative consistency of the soils, and thereby provide a basis for estimating the relative strength and compressibility of the soil profile components.

Water Level Measurements – Ground water was not encountered in the borings at the time of drilling. In relatively pervious soils, such as sandy soils, the indicated elevations are considered reliable ground water levels. In relatively impervious soils, the accurate determination of the ground water elevation may not be possible even after several days of observation. Seasonal variations, temperature and recent rainfall conditions may influence the levels of the ground water table and volumes of water will depend on the permeability of the soils.

Field Logs

A field log was prepared for each boring. Each log contained information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as silt, clay, gravel or sand and observations of ground water. It also contained an interpretation of subsurface conditions between samples. **Therefore, these logs included both factual and interpretive information.**

Presentation of the Data

The final logs represent our interpretation of **the contents of the field logs for the purpose delineated by our client.** The final logs are included on **Plates 2 thru 9** included in the Illustration section. A key to classification terms and symbols used on the logs is presented on **Plate 10.**

LABORATORY TESTING PROGRAM

Purpose

In addition to the field exploration, a supplemental laboratory testing program was conducted to determine additional **pertinent engineering characteristics** of the subsurface materials necessary in evaluating the soil parameters.

Laboratory Tests

All phases of the laboratory testing program were performed **in general accordance with the indicated applicable** ASTM Specifications as indicated in Table No. 1.

Table No. 1 – Laboratory Test Procedures

Laboratory Test	Applicable Test Standard
Liquid Limit, Plastic Limit and Plasticity Index of the Soils	ASTM D 4318
Moisture Content	ASTM D 2216
California Bearing Ratio	ASTM D 1883

In the laboratory, each sample **was observed and classified by a geotechnical engineer.** As a part of this classification procedure, the natural water contents of selected specimens were determined. Liquid and plastic limit tests were performed on representative specimens to determine the plasticity characteristics of the different soil strata encountered.

Presentation of the Data

In summary, the tests presented were conducted in the laboratory to evaluate the engineering characteristics of the subsurface materials. The results of all these tests are presented on appropriate Boring Logs. These laboratory test results were used to classify the soils encountered generally according to the Unified Soil Classification System (ASTM D 2487).

GENERAL SUBSURFACE CONDITIONS

Soil Stratigraphy

The soils underlying the site may be grouped into **two generalized strata** with similar physical and engineering properties. The lines designating the interface between soil strata on the logs represent approximate boundaries. Transition between materials may be gradual. The soil stratigraphy information at the boring locations are presented in **Boring Logs, Plates 2 thru 9.** The soil conditions in between borings may vary across the site. We should be called upon at the time of construction to verify the soil conditions between our borings.

The engineering characteristics of the underlying soils, based the results of the laboratory tests performed in selected samples, are summarized and presented in the following paragraph.

The underlying dark brown clays to brown clays, dark brown clays, tan clays to tan calcareous clays, tan marl, light tan marl, and light tan marl to limestone are moderately plastic to highly plastic with tested liquid limit values varying from 24 to 72 and plasticity index values ranging from 09 to 49. The results of Standard Penetration Tests performed within these soils varied from 14 to greater than 50 blows per foot.

The above description is of a generalized nature to highlight the major soil stratification features and soil characteristics. The Boring Logs should be consulted for specific information at each boring location.

Soil stratigraphy may vary between boring locations. If deviations from the noted subsurface conditions are encountered during construction, they should be brought to the attention of InTEC. We may revise the recommendations after evaluating the significance of the changed conditions.

Ground Water Observations

Ground water was not encountered in the borings at the time of drilling. Short term field observations generally do not provide accurate ground water levels. The contractor should check the subsurface water conditions prior to any excavation activities. The low permeability of the soils would require several days or longer for ground water to enter and stabilize in the bore holes. Ground water levels will fluctuate with seasonal climatic variations and changes in the land use.

It is not unusual to encounter shallow groundwater during or after periods of rainfall. The surface water tends to percolate down through the surface until it encounters a relatively impervious layer.

PAVEMENTS ON EXPANSIVE SOIL

General

There are many plastic clays that swell considerably when water is added to them and then shrink with the loss of water. Pavements constructed on these clays (such as if thicker clays are encountered or if clayey trench backfills are used) are subjected to large uplifting forces caused by the swelling.

In the characterization of a pavement site, two major factors that contribute to potential shrink-swell problems must be considered. Problems can arise if a) the soil has expansive and shrinkage properties and b) the environmental conditions that cause moisture changes to occur in the soil.

Evaluation of the Shrink-Swell Potential of the Soils

Subsurface sampling, laboratory testing and data analyses are used in the evaluation of the shrink-swell potential of the soils under the pavements.

The Mechanism of Swelling

The mechanism of swelling in expansive clays is complex and is influenced by a number of factors. Basically, expansion is a result of changes in the soil-water system that disturbs the internal stress equilibrium. Clay particles in general have negative electrical charges on their surfaces and positively charged ends. The negative charges are balanced by actions in the soil water and give rise to an electrical interparticle force field. In addition, adsorptive forces exist between the clay crystals and water molecules, and Van Der Waals surface forces exist between particles. Thus, there exists an internal electro-chemical force system that must be in equilibrium with the externally applied stresses and capillary tension in the soil water. If the soil water chemistry is changed either by changing the amount of water or the chemical composition, the interparticle force field will change. If the change in internal forces is not balanced by a corresponding change in the state of stress, the particle spacing will change so as to adjust the interparticle forces until equilibrium is reached. This change in particle spacing manifests itself as a shrinkage or swelling.

Initial Moisture Condition and Moisture Variation

Volume change in an expansive soil mass is the result of increases or decreases in water content. The initial moisture content influences the swell and shrink potential relative to possible limits, or ranges, in moisture content. Moisture content alone is useless as an indicator or predictor of shrink-swell potential. The relationship of moisture content to limiting moisture contents such as the plastic limit and liquid limit must be known.

If the moisture content is below or near plastic limit, the soils have high potential to swell. It has been reported that expansive soils with liquidity index* in the range of 0.20 to 0.40 will tend to experience little additional swell.

The availability of water to an expansive soil profile is influenced by many environmental and manmade factors. Generally, the upper few feet of the profile are subjected to the widest ranges of moisture variation, and are least restrained against movement by overburden. This upper stratum of the profile is referred to as the active zone. Moisture variation in the active zone of a natural soil profile is affected by climatic cycles at the surface, and fluctuating groundwater levels at the lower moisture boundary. The surficial boundary moisture conditions are changed significantly simply by placing a barrier such as a building floor slab or pavement between the soil and atmospheric environment. Other obvious and direct causes of moisture variation result from altered drainage conditions or man-made sources of water, such as irrigation or leaky plumbing. The latter factors are difficult to quantify and incorporate into the analysis, but should be controlled to the extent possible for each situation. For example, proper drainage and attention to landscaping are simple means of minimizing moisture fluctuations near structures, and should always be taken into consideration.

Man Made Conditions That Can Be Altered

There are a number of factors that can influence whether a soil might shrink or swell and the magnitude of this movement. For the most part, either the owner or the designer has some control over whether the factor will be avoided altogether or if not avoided, the degree to which the factor will be allowed to influence the shrink-swell process.

Antecedent Rainfall Ratio This is a measure of the local climate and is defined as the total monthly rainfall for the month of and the month prior to laying the pavement divided by twice the average monthly rate measured for the period. The intent of this ratio is to give a relative measure of ground moisture conditions at the time the pavement is placed. Thus, if a pavement is placed at the end of a wet period, the pavement should be expected to experience some loss of support around the perimeter as the wet soils begin to dry out and shrink. The opposite effect could be

* LIQUIDITY INDEX = (NATURAL WATER CONTENT - PLASTIC LIMIT) / (LIQUID LIMIT - PLASTIC LIMIT)

anticipated if the pavement is placed at the end of an extended dry period; as the wet season occurs, uplift around the perimeter may occur as the soil at the edge of the slab pavement in moisture content.

Age of Pavement The length of time since the pavement was cast provides an indication of the type of swelling of the soil profile that can be expected to be found beneath the pavement.

Drainage This provides a measure of the slope of the ground surface with respect to available free surface water that may accumulate around the pavement. Most builders are aware of the importance of sloping the final grade of the soil away from the pavement so that rain water is not allowed to collect and pond against or adjacent to the pavement. If water were allowed to accumulate next to the pavement, it would provide an available source of free water to the expansive soil underlying the pavement. Similarly, surface water drainage patterns or swales must not be altered so that runoff is allowed to collect next to the pavement.

Pre-Construction Vegetation Large amount of vegetation existing on a site before construction may have desiccated the site to some degree, especially where large trees grew before clearing. Constructing over a desiccated soil can produce some dramatic instances of heave and associated structural distress and damage as it wets up.

Post-Construction Vegetation **The type, amount, and location of vegetation that has been allowed to grow since construction can cause localized desiccation. Planting trees or large shrubs near a building can result in loss of foundation support as the tree or shrub removes water from the soil and dries it out.** Conversely, the opposite effect can occur if flowerbeds or shrubs are planted next to the foundation and these beds are kept well-watered or flooded. This practice can result in swelling of the soil around the perimeter where the soil is kept wet.

Site Grading, Lot Slopes, and Earthwork Effects In addition to the environmental and man-made factors described above, the grading and earthwork operations performed during site development can significantly influence the potential for shrink-swell movement at any given lot.

Cut and Fill Conditions During site development, many residential lots are brought to design grade through cut and fill operations. Fill soils, if not properly compacted at the time of placement, may experience post-construction volume changes due to wetting, drying, or consolidation. When fill soils overlay natural undisturbed expansive clays, the combination of differing material types and histories can create non-uniform movement potential across the building pad. Transition zones, where cut and fill areas meet within the foundation footprint, are particularly sensitive and may result in localized differential movement under changing moisture conditions.

Lot Slopes and Surface Water Drainage The slope of the lot also plays a role in the long-term performance of foundations on expansive soils. Sloped lots may result in preferential surface water runoff toward one side of the structure, increasing the risk of moisture accumulation and differential heave if drainage is not properly controlled. Additionally, on sloped sites underlain by expansive soils, lateral soil movement may occur over time due to creep and shrink-swell cycles. This movement is typically oriented downslope and may contribute to gradual lateral displacement of light foundation systems unless proper design measures are incorporated.

As with other moisture-related factors, careful attention to site grading, uniform pad preparation, and positive drainage away from structures are critical elements in mitigating the effects of expansive soils. Special consideration should be given to areas of deep fill, slope transitions, or where cut/fill differentials exist within the foundation footprint.

Utilities Underneath the Pavement The utilities such as sewer, water, electricity, gas, and communication lines are often installed underneath the streets. The sewer utility construction, for example, typically involves trenching to the desired depth, installing gravel a gravel bed underneath the sewer main, installing primary backfill (gravel), and placing back the secondary backfill (generally excavated soils). The secondary backfill material is compacted in lifts. In addition, sewer service lines run laterally from each house (for a typical subdivision, approximately every 50-ft). These trenches with gravel and onsite material backfill are conducive to carrying water. In addition, the sewer service lines can carry water from behind the curb. Occasionally, the sewer line may be encased in concrete which will cause ponding of any travelling water within the sewer trenches. Any water travelling within these trenches can cause expansive clays to swell. If the backfill is not adequately compacted or if excessive water is flowing in these trenches, the trench backfill can potentially settle.

Summation

It is beyond the scope of this investigation to do more than point out that the above factors have a definite influence on the amount and type of swell to which a pavement is subjected during its useful life. The design engineer must be aware of these factors as he develops his design and make adjustments as necessary according to the results of special measurements or from his engineering experience and judgment.

DESIGN ENGINEERING ANALYSIS

Pavement Design Considerations

Review of the borings and test data indicates that the following factors will affect the pavement design and construction at this site:

1) The underlying shallow soils are moderately plastic to highly plastic. Structures supported at shallow depths will be subjected to potential vertical movements on the order of **1 ½ to 2 ½ inches** at the existing grade elevation of the borings.

2) The strengths of the underlying soils are adequate to support the proposed new streets.

3) Based on the stratigraphy observed at this site the final street subgrade is anticipated to be in clay or Marl / Limestone subgrades. The final street subgrade should be observed and delineated by InTEC at the time of construction.

4) Ground water was not encountered in the borings at the time of drilling.

Vertical Movements

The potential vertical rise (PVR) for slab-on grade construction at the location of the structures had been estimated using Texas Department of Transportation Procedure TXDOT-124-E. This method utilizes the liquid limits, plasticity indices, and in-situ moisture contents for soils in the seasonally active zone, estimated to be about ten feet at the project site.

The estimated PVR value is based on the proposed floor system applying a sustained surcharge load of approximately 1.0 lb. per square inch on the subgrade materials. **Potential vertical movement on the order of 1 ½ to 2 ½ inches was estimated at the existing grade elevations at the boring locations.** These PVR values will be realized if the subsoils are subjected to **moisture changes from average soil moisture conditions to wet soil moisture conditions.**

The PVR values are based on the current site grades. If cut and fill operations in excess of 6 inches are performed, the PVR values could change significantly. Higher PVR values than the above mentioned values will occur in areas where water is allowed to pond for extended periods.

If proper drainage is not maintained (allowing subgrade moisture content to change significantly) and / or if the pavement is underlain by utility trenches, resulting (a) potential vertical movements will be much greater than 2 to 3 times the anticipated vertical movements and (b) the subgrade strength may be reduced significantly reduced.

If the finish grade elevation is higher than the existing grade, compacted select fill should be used to raise the grade level. Any select fill should be placed and compacted as recommended under *Select Fill* in the "Construction Guidelines" section of this report. Each lift should be compacted and tested by InTEC to verify Compaction Compliance.

Expansive Clays

Given the **highly plastic and expansive nature** of the site soils and placed lot fills, there exists a **significant risk of differential movement**.

- Even with uniform loads, **slab tilt and cracking** may occur if expansive soils are **not appropriately mitigated**. These movements are influenced by **unpredictable site-specific moisture variations** that can affect soil behavior long after construction.

- The **subsurface conditions** encountered consist of expansive clays that undergo **substantial volume change**—shrinkage during drying and swelling during wetting. These moisture-driven volume changes can result in **total and differential movements** of foundations, floor slabs, pavements, utilities, and other improvements.

- While the potential for movement can be **reduced** through appropriate design and construction measures, **it cannot be entirely eliminated**. Therefore, all parties involved should understand that **residual movement risk** is an inherent condition of construction in expansive clay areas such as this.

InTEC recommends that the **design, construction, and maintenance** of structures on this site incorporate the following elements:

- Effective site grading and surface drainage to direct water away from structures

- Landscape design that avoids moisture imbalance (e.g., trees too close to foundations)

- Moisture control measures such as irrigation management and barrier systems
- Post-construction vigilance including leak detection, drainage upkeep, and landscaping maintenance

These actions are essential to help **mitigate the effects of expansive soils**. However, they do **not eliminate all risk**, and some movement-related distress, such as asphalt cracks, pavement heave, or cosmetic damage, should be anticipated. Owners should plan accordingly and consult with the design team and geotechnical engineer during construction and beyond. <u>Coping with problems of shrink/swell due to expansive clays is a "fact of life" in the Texas region of south western U.S.A.</u>

PAVEMENT GUIDELINES

General

Pavement areas at this site are expected to include **Residential Local and Collector** streets. The following recommendations are provided as **guidelines for pavement design and construction**.

These recommendations are based on:

1. The City of San Antonio Design Manual (June 2008).
2. **InTEC's experience** with subgrade soils similar to those encountered at this site;
3. **Pavement sections** that have performed successfully under comparable design and traffic conditions; and
4. The assumption that **final pavement grades will provide positive drainage**, preventing surface or edge infiltration from landscape areas, surface ponding, or poorly maintained joints and cracks.

Pavement Design

Pavement designs provide an adequate thickness of structural sections over a particular subgrade (in Pavement design provides sufficient **structural thickness** to distribute wheel loads to the underlying subgrade without exceeding its support capacity. The **support characteristics** of the subgrade are based on the **strength** of the subgrade soils and not their shrink–swell behavior.

Accordingly, pavement sections that are **structurally adequate** may still experience **cracking or distortion** due to shrink–swell movements of the expansive clays.

If the proposed pavements will carry **temporary construction traffic or repeated heavy truck loads**, thicker sections may be required. Please contact **InTEC** to discuss alternate design options.

It is essential to **minimize moisture fluctuations** in the subgrade to reduce shrink–swell movement. Pavement and adjacent areas must remain well drained, and **cracks should be sealed promptly** to prevent water infiltration.

In our experience:

- The majority of pavement distress observed over expansive clays can be attributed to **changes in subgrade moisture** or **prolonged saturation of the base layer**, which reduce subgrade support and induce movement.
- Pavements designed with a **minimum longitudinal grade of 1% or greater** generally perform better than flatter pavements, primarily because improved drainage minimizes surface ponding and moisture infiltration.
- Pavements constructed **without underlying utility trenches** tend to perform better, as utility backfill zones often act as **preferential moisture paths** and **differential support zones**, leading to localized settlement and cracking.
- Pavements situated at **slightly higher elevations than adjacent lots** typically exhibit better performance due to **improved surface drainage** and **reduced risk of edge moisture intrusion** from landscaped or irrigated areas.
- Any **design or construction measure** that limits **surface, edge, or subsurface moisture penetration** into the pavement system will significantly enhance long-term performance and durability.

“Alligator” Type Cracks

A layer of aggregate base is typically placed **beneath the concrete curb** surrounding pavement areas. This base layer can serve as a **pathway for surface water infiltration**, particularly if water enters through curb joints or adjacent landscape areas. When coupled with construction traffic, this condition often leads to **“alligator” cracking**.

Increasing the **moisture content within the pavement layers** after construction will significantly reduce subgrade support and can accelerate this distress.

Embedding **curbs at least 6 inches into the native clay subgrade** helps reduce this type of infiltration. In addition, **French drains installed along the outside of curbs** can further improve drainage. Alligator-type cracking can also result from **isolated weak or poorly compacted zones** within the pavement section.

Longitudinal Cracks

In highly expansive soils, asphalt pavements often develop **longitudinal cracks** roughly **1 to 4 feet inside the pavement edge**, parallel to the curb. These cracks are caused primarily by **differential drying and shrinkage** of the underlying clays. Moisture content variation in the subgrade can be reduced by installing **moisture barriers**:

- **Vertical moisture barriers** along pavement edges, or
- **Horizontal barriers** such as adjacent sidewalks or geogrid layers beneath the base course.

Both approaches help **stabilize moisture conditions** and reduce the potential for longitudinal and reflective cracking.

Periodic Maintenance

Pavements constructed over **expansive clays** will experience **cyclic shrink–swell movements** over time. Proper maintenance is therefore critical.

- **Seal cracks** as soon as they develop to prevent further water intrusion.
- **Monitor drainage and surface grades** periodically to ensure positive runoff.
- **Repair localized failures promptly** to prevent distress from spreading.

Pavement Sections

Residential Local and Collector streets are typically designed as **flexible pavements**. Cut and fill information was not available at the time of this investigation; the **final street subgrade** is expected to consist of **clay soils**.

Minimum recommended flexible pavement sections for these anticipated subgrade conditions are presented in **Table No. 2** in the following page. Input parameters used for design are summarized in **Table No. 3**.

Table No. 2 – Minimum Flexible Pavement Recommendations – CBR = 2.5 **

Classification	Asphaltic Concrete			Aggregate Base, inches	Geogrid	Subgrade, inches	Structural Number
	Type D, inches	Type C, inches	Type B, inches				
Local A (with NO bus traffic)	3.00	-	-	8.00	No	6” LS	2.92
	2.00	-	-	10.00	No	6” LS	2.76
	2.00	-	5.00	-	No	6” LS	3.06
Local Type A (with bus traffic)	3.00	-	-	13.00	No	8” LS	3.78
	3.00	-	-	11.00	Yes	8” LS	3.83
	3.00		5.50	-	No	8” LS	3.83
Local Type B	2.00	3.00	-	13.00	No	8” LS	4.66
	2.00	2.00	7.00	-	No	8” LS	4.78

Design Notes:

- Pavement design follows the *City of San Antonio Pavement Design Guidelines*.
- Input parameters are summarized in **Table No. 3 (Summary Table A)**.
- Design California Bearing Ratio (CBR) = **2.5**.
- Recommendations are provided for **local Type A and Type B streets**.
- Laboratory testing and engineering evaluation indicate **highly plastic clays** at shallow depths. Estimated **Potential Vertical Rise (PVR)** at existing grade is **1 ½ to 2 ½ inches**.
- For **repetitive or heavy truck traffic**, contact InTEC for revised pavement design recommendations using appropriate traffic inputs.

Subgrade Notes:

- Subgrade soils are anticipated to consist of **brown clays or marl to limestone.**
- **Cut and fill information** is not available at this time.
- Fill used to raise the grade in clay areas:
  - approved fill material free should have a minimum CBR value of 2.5 and a maximum Plasticity Index value of 50. Lime application rates should be re-evaluated and tested for sulfate content prior to use of the fill material.
  - The fill material should be approved by the geotechnical engineer, free of deleterious material, and the gravel size should not exceed 3 inches in size. The material should be placed and compacted as per applicable city / county guidelines.
  - The subgrade, prior to placement of fill, should be proof rolled to identify weak areas. Any identified weak areas should be recompacted.
- Fill used to raise the grade in marl areas:
  - Existing clays should be removed to marl / limestone stratum prior to placement of fill.

- approved fill material free should have a minimum CBR value of 5.0 and a maximum Plasticity Index value of 20.

- **Proof-roll** subgrade prior to fill placement to identify and recompact weak zones.

Subgrade Stabilization:

- **If the subgrade Plasticity Index values are less than or equal to 20, as per City of San Antonio or Bexar County requirements, subgrade stabilization is not needed.**
- Subgrade should be stabilized using lime or cement. Lime application rates are presented here. Please contact InTEC for cement application rates.
- Test subgrade soils for **sulfate content** prior to stabilization.
  - If **sulfate > 3,000 ppm**, alternate procedures may be required.
- **Lime** stabilization recommended.
  - Recommended **lime application rate = 7.5%**.
  - Equivalent lime application weights:
    - ✓ 6-inch stabilization: **32 lb/sy**
    - ✓ 8-inch stabilization: **43 lb/sy**
  - Target **Unconfined Compressive Strength (UCS) ≥ 160 psi** for lime-stabilized subgrade.

Pavement and Drainage Notes:

- Pavement design is based on **CBR = 2.0** and parameters in Table 3.
- Cracking and deformation may occur due to **shrink-swell behavior** of expansive clays.
- **Moisture control** beneath pavement is critical:
  - Prevent rain or irrigation water from infiltrating beneath the asphalt and base.
  - Consider **curbs extending ≥ 6 inches into subgrade** or backfilling with **compacted clay** against curb edges.
  - Ensure **lot grading and home construction** prevent trapped water near pavements.

Geogrid:

- Install **one layer of geogrid (Tensar Triax 130 or equivalent)** directly on top of the stabilized subgrade, following manufacturer's installation guidelines.

Aggregate Base:

- Use TxDOT Item 247 A1-2 aggregate base
- Place in uniform lifts and compact to specified density and moisture content per city / county guidelines.

Asphalt:

- Provide asphalt materials and placement in accordance with City of San Antonio / TxDOT guidelines.

Verification:

- During construction, **InTEC personnel should verify subgrade preparation and stabilization** prior to base placement.

Table No. 3 – Input Parameters used in Asphalt Pavement Section Calculation

	Local Type A (no bus traffic)	**Local Type A** (with bus traffic)	**Local B**
ESAL	100,000	1,000,000	2,000,000
Reliability Level	R-70	R-70	R-90
Initial and Terminal Serviceability	4.2 and 2.0	4.2 and 2.0	4.2 and 2.0
Standard Deviation	0.45	0.45	0.45
Service Life	20 years	20 years	20 years
If heavy truck traffic is anticipated, please contact InTEC with anticipated traffic data for revised recommendations.			

Subgrade Preparation

It is important that any existing pavement and organic and compressible soils are removed and the exposed subgrade is properly prepared prior to pavement installation. The subgrade should be prepared as described in the applicable city / county Guidelines. Base course material should be placed immediately upon completion of the subgrade compaction operation to prevent drying of the soils due to exposure.

The finish grade elevation of the subgrade should be such that water drains downward freely towards a drainage area. At the drainage area, 3x5 rock may be provided at the subgrade level and the collected water at the drainage area should be taken out (such as into the existing concrete drainage channel). If any voids in the subgrade should be filled in with the same subgrade material and compacted in lifts.

The approved fill material should be placed in 8-inch lifts (6 inches compacted) and compacted as recommended in the Site Preparation section of the Construction Guidelines presented in this report.

Deeper Fills

If the fill depth exceeds **4 feet**, the potential for **subgrade settlement** should be evaluated. Fill materials shall **meet or exceed the design CBR** used for pavement design.

Expansive Clay Fills (PI > 40)

- Compact to **at least 95 percent** of the **maximum dry density** at a **moisture content between optimum and +3 percent** of optimum (Tex-114-E).

- These criteria apply at **all fill depths** to help reduce post-construction swell and shrinkage potential.

Granular or Low-Plasticity Fills (PI ≤ 20)

- For **fill depths ≤ 10 feet**, compact to **at least 98 percent** of the maximum dry density at a **moisture content not less than optimum** (Tex-114-E).

- For **fill depths > 10 feet**, compact each lift to **at least 100 percent** of the maximum dry density at a **moisture content within ±2 percent of optimum** (Tex-114-E).

General Requirements

- Place fill in **uniform lifts not exceeding 8 inches (loose)**.

- Apply the same compaction criteria at **culvert crossings and other deep backfill areas** to minimize post-construction settlement and differential movement adjacent to structures.

- Once **cut and fill information** is available, please contact **InTEC** so the effects of grade changes can be evaluated and **project-specific fill and compaction recommendations** provided.

Base Course

Based on the survey of locally available materials, a **crushed limestone aggregate or gravel base course** is considered the most practical material for the asphalt pavement section.

The base course should conform to the **Texas Department of Transportation (TxDOT) Standard Specifications, Item 247, Type A, Grade 1-2**, and should be installed in accordance with all applicable **City and County guidelines**.

At a minimum, the base material should be **moisture-conditioned to near optimum** and **compacted in uniform lifts** to not less than **95 percent of the maximum dry density**, as determined by **TxDOT Test Method Tex-113-E**, or to higher requirements if specified by the governing agency.

Asphaltic Concrete

The asphaltic concrete surface course material and installation shall conform to the City of San Antonio Standard Specifications for Construction (2008) and all applicable TxDOT and County requirements for the respective street classification.

At a minimum, the asphalt should be placed in uniform lifts, at the specified temperature range, and compacted to the minimum density required by the governing agency.

Proper attention should be given to surface drainage and edge protection to prevent moisture infiltration beneath the pavement, which can lead to premature cracking or deformation.

Perimeter Drainage

Proper perimeter drainage should be provided to minimize infiltration of surface water from compacted areas adjacent to the pavement. It is recommended that curbs extend a minimum of 6 inches into the subgrade layer to reduce the potential for water intrusion beneath the pavement edges. A flexible crack sealant compatible with both asphalt and concrete should be applied along all asphalt–concrete interfaces to prevent surface water entry.

Where significant grade transitions occur within the pavement area (for example, from slopes of 3–4 percent to < 1 percent), a 3- by 5-inch gravel subgrade layer with a subsurface drain system (such as Akwadrain® or equivalent) along the pavement edges, tied to an appropriate outlet, should be considered. This system will help intercept and remove infiltrating water, improving long-term pavement performance.

Please contact InTEC for project-specific perimeter and subsurface drainage recommendations.

CONSTRUCTION GUIDELINES

Construction Monitoring

As Geotechnical Engineer of Record, **InTEC** should be actively involved in monitoring **earthwork and pavement construction**. Proper pavement performance depends not only on design but also on consistent construction quality.
Contact **InTEC** prior to construction to incorporate **earthwork, subgrade, and pavement monitoring** into the project's quality control plan.

Site Preparation

Site preparation should include removal of **vegetation, organic material, and loose soils** to a minimum depth of **6 inches** within pavement areas.

- The exposed **subgrade should be proof-rolled** and approved by InTEC prior to fill or stabilization.
- Any soft or yielding areas should be **removed, replaced with approved fill**, and **recompacted**.
- The prepared subgrade should be **maintained in a moist condition** until subsequent materials are placed to prevent desiccation cracking.
- All **old underground utilities or structures** within pavement limits should be properly **removed or sealed**, and the resulting voids **backfilled and compacted** in 6-inch lifts to **at least 95 percent of maximum dry density** (ASTM D698).

Maintain **positive surface drainage** at all times to avoid ponding and deterioration of the prepared subgrade.

Proof Rolling

Proof-rolling should be performed using a **25-ton pneumatic roller** (approximately **90 psi ground contact pressure**) or other approved equipment.

- InTEC must **observe the proof-rolling operation**.

- Weak or pumping zones should be **excavated and replaced with select fill** compacted to the required density.
- Retest all repaired areas to verify compliance before proceeding with subsequent pavement layers.

Compaction and Fill Placement

If **low or disturbed areas** are encountered during grading, remove any **wet, loose, or deleterious soils** prior to fill placement.

- The sides of the excavation should be **squared**, not bowl-shaped, and the bottom **proof-rolled**.
- On-site material free of deleterious matter may be reused for fill if approved by InTEC.
- Fill should be **placed in uniform lifts not exceeding 8 inches (loose)** and **compacted to at least 95 percent of the maximum dry density** (ASTM D698) at a **moisture content within optimum to +3 percent**.
- Each lift should be **tested and approved by InTEC** before additional lifts are placed.
- The exposed subgrade should not be allowed to dry out prior to placement of the base course.

Select Fill

Use crushed limestone with LL < 40, PI = 5–20, and <30% passing No. 200 sieve. Max particle size: 3 inches. Place in 6-inch compacted lifts and compact to 95% of ASTM D 698 dry density within ± 2% of optimum moisture. Each lift must be tested and approved by InTEC.

General Fill

General fill refers to soil placed in non-structural and non-movement-sensitive areas—for example, behind curbs, within landscape zones, or in general site grading areas outside pavement and foundation limits. It is not intended to provide support for pavements, slabs, or other structures sensitive to movement.

General fill materials may consist of clean on-site soils, select fill, or imported materials that exhibit satisfactory compaction characteristics.

General fill should be free of deleterious matter, debris, and organics, with maximum particle size not exceeding 6 inches.

The purpose of general fill is to provide stable site grading and uniform surface elevation, not to serve as a load-bearing layer.

Because general fill is not designed for structural support, greater vertical or differential movements should be anticipated compared to select or structural fills.

General Fill Compaction

Place general fill in uniform lifts not exceeding 8 inches (loose).

Compact each lift to a minimum of 95 percent of the maximum dry density (ASTM D698) at a moisture content within ±3 percent of optimum.

Each lift should be tested and approved by InTEC before placement of the next lift.

Compaction criteria may be modified in consultation with the Owner and Geotechnical Engineer based on site conditions and performance expectations.

Ground Water and Drainage Considerations

Groundwater was not encountered at the time of drilling; however, **minor seepage** may occur during or after grading, particularly following heavy rainfall.

- If seepage is observed within pavement areas, it should be **intercepted using subsurface drains** or other approved dewatering methods.
- **Temporary drainage provisions** should be maintained throughout construction to minimize water infiltration into prepared subgrades.
- Standing water should be **removed promptly by pumping**, and the affected areas should be allowed to dry and re-proof-rolled before proceeding.

Construction Slopes

Cut and fill slopes associated with pavement and site grading should be constructed to provide long-term stability and positive drainage.

Temporary Slopes: For short-term construction excavations in cohesive soils (Stratum I and II clays), temporary slopes up to 1H:1V are generally stable, provided they are not left exposed to prolonged rainfall.

Fill Slopes: Compacted fill slopes should not be steeper than 1H:1V and should be benched and keyed into firm material. Fill should be placed and compacted in lifts not exceeding 3–5 feet vertically.

Permanent Slopes: Permanent exterior slopes should not exceed 3H:1V. Where pedestrian access or maintenance traffic is anticipated, flatter slopes such as 5H:1V are preferred for safety and erosion control.

Erosion Protection: All permanent slopes should be protected against erosion using vegetation, rock riprap, or other approved surface stabilization methods.

Control Testing and Field Observation

Subgrade preparation, stabilization, base placement, and asphalt paving should be **monitored by InTEC** or its authorized representative.

- As a guideline, perform **at least one in-place density test every 100 linear feet of roadway**, or more frequently as required by the governing agency.
- A **minimum of three density tests per lift** is recommended for each distinct pavement area.
- Any areas not meeting the required compaction shall be **recompacted and retested** until compliance is achieved.

Time of Construction

Pavement should not be constructed over subgrade or base materials that are excessively wet, dry, eroded, or otherwise disturbed.

If the pavement is installed after an extended dry period, subsequent re-wetting from rainfall or irrigation may cause heave, edge movement, or cracking. Conversely, if the pavement is installed immediately following a wet period, later drying may cause shrinkage and surface deformation.

Following significant rainfall events, special attention should be given to the condition of both the subgrade and the base course. Even if these layers were previously tested and approved, surface runoff can erode, soften, or reduce compaction, particularly along curb lines, edges, and low-lying areas.

Any areas showing signs of erosion, pumping, or softening must be regraded, moisture-conditioned, and recompacted prior to asphalt placement. InTEC should be notified to re-inspect and verify the condition of the subgrade and base before paving resumes.

Failure to perform these steps may result in premature edge distress, rutting, or cracking shortly after construction.

DRAINAGE AND MAINTENANCE

Proper **drainage** and long-term **moisture management** are critical to pavement performance, particularly in areas underlain by **expansive clay soils**. Seasonal or localized changes in soil moisture can lead to **pavement cracking, edge movement, and differential heave**, especially if surface or subsurface water is allowed to infiltrate beneath the pavement or along curb lines.

Surface Drainage

- Pavements should be graded to maintain a **minimum surface slope of 2%** to ensure rapid runoff of rainfall and irrigation water.
- **Depressions or birdbaths** where water can pond should be avoided or corrected immediately.
- **Curb and gutter sections** should be constructed to prevent water from seeping beneath the pavement edge; consider curbs that **extend at least 6 inches into the subgrade** for improved moisture cutoff.
- At **driveway tie-ins and intersections**, positive drainage must be maintained to prevent water from standing or flowing across the pavement surface.

Edge and Perimeter Protection

- Per typical standard details, the **aggregate base extends approximately 18 inches beyond the back of curb** to provide full support. However, this extended base zone can act as a **moisture pathway** if not properly sealed.
- To reduce the risk of **water infiltration beneath the pavement**, the area **behind the curb** should be **backfilled with compacted, low-permeability clay** or treated with an appropriate **sealant cutoff** against the exposed base.
- Proper **surface grading** should also be maintained to direct water away from the curb line and prevent ponding at the back of curb.

Subsurface Drainage

- In areas with **steep grade transitions** (e.g., slope breaks from 3–4% to < 1%) or where water tends to collect, consider providing a **subsurface drain system** such as **Akwadrain®** or equivalent along pavement edges, tied to a suitable outlet.
- Subsurface drains should be installed **below the base course** elevation and surrounded by **free-draining gravel** wrapped in geotextile filter fabric.
- All drain outlets should be **daylighted** and protected with **rodent screens** and **riprap aprons** to ensure positive discharge.

Utility Trenches

- **Utility trenches** that cross or parallel pavement sections can act as **conduits for subsurface water flow**.
- Trench backfill should be **compacted as per applicable agency guidelines** (such as SAWS, TxDOT, or governing municipality) to ensure uniform support and reduce future settlement.
- Where feasible, **include clay plugs or cutoff collars** at intervals to prevent water migration beneath the pavement.
- Poorly compacted trench backfill often leads to **localized settlement** and **longitudinal cracking** along utility alignments.

Long-Term Maintenance

- Maintain all **surface and subsurface drainage systems** in good working order. Clogged inlets, outlets, or broken drain lines can quickly lead to moisture buildup and pavement distress.
- **Inspect and seal cracks** regularly to limit moisture entry into the base and subgrade.
- During dry seasons, avoid excessive irrigation near pavement edges that can induce **moisture differentials**.

- If evidence of **edge softening, rutting, or pumping** is observed, the affected areas should be **evaluated and repaired promptly** to prevent further deterioration.
- The performance estimates and design recommendations in this report assume that **proper drainage is installed and maintained**. Neglect or alteration of these systems can significantly increase pavement movement and reduce service life.

LIMITATIONS

The analyses and recommendations submitted in this report are based upon the data obtained from **eight borings drilled at the site**. Subsurface conditions can vary between boring locations and may change over time; therefore, the conditions encountered during construction may differ from those described herein.

The **pavement recommendations** in this report should be **reviewed and confirmed during construction**, particularly in relation to actual **cut and fill conditions** observed in the field. If subsurface conditions differ from those assumed, **InTEC must be notified immediately** to evaluate whether revisions to the recommendations are necessary.

The data, analyses, and interpretations provided represent **InTEC's professional judgment and opinion**, based on limited sampling and currently available information. They should not be considered an exact or complete representation of all subsurface conditions.

This report is **not intended to dictate construction means, methods, equipment selection, or scheduling**. Use of the report for purposes such as **bidding, cost estimating, or contractor logistics** is at the sole risk of the user.

Revisions to this report may be required if any of the following occur:

- Changes to the **proposed grading or pavement design**;
- Alteration of **drainage patterns or site use**;
- Significant **cut or fill activities** not previously anticipated; or
- A substantial **delay between field exploration and construction**.

InTEC affirms that the findings and recommendations herein are consistent with the **standard of care** exercised by geotechnical engineers practicing under similar conditions in this region. **No other warranties, express or implied, are made.**

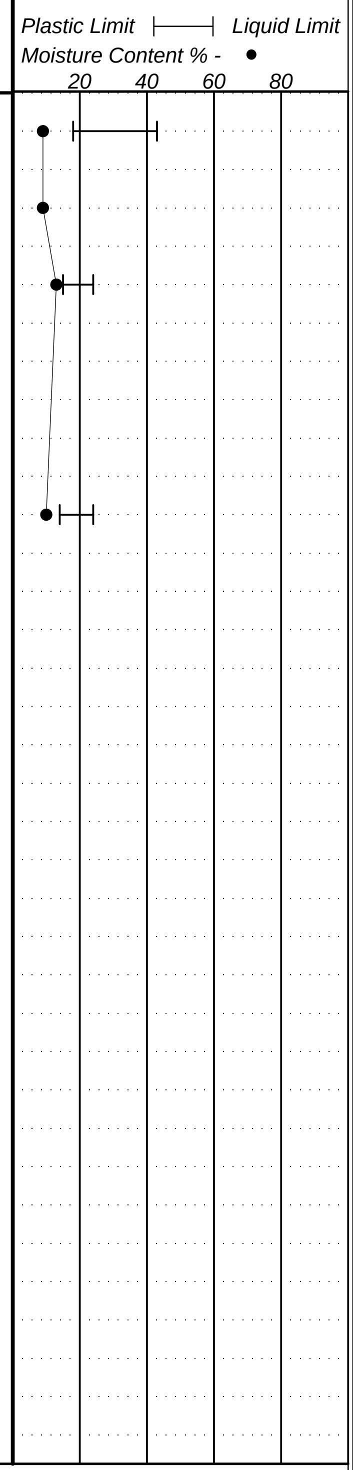
This report has been prepared for the exclusive use of **Forestar Group, Inc.** for pavement thickness evaluation for the **proposed new streets at Weatherwood, Phase 3 in San Antonio, Texas.**

PROJECT: **Weatherwood, Phase 3**
LOCATION: San Antonio, Texas
CLIENT: Forestar Group, Inc.

PROJECT NO: **S251291**
DATE: 10/01/2025

BORING NO. B-1

DEPTH (feet)	SYMBOL	SAMPLES	SOIL DESCRIPTION	% MINUS 200 SIEVE	UNIT DRY WT IN PCF	S.S. BY P.P	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
0		SS	Dark Brown Clay -with Gravel				24		43	25
		SS	Light Tan Marl -with Caliche -with Limestone Seams -with Tan Sandy Clay Seams				54			
5		AU							24	09
10		AU							24	10
15										
20										
25										
30										
35										



Notes:

Ground Water Observed: No

Completion Depth (ft): 12

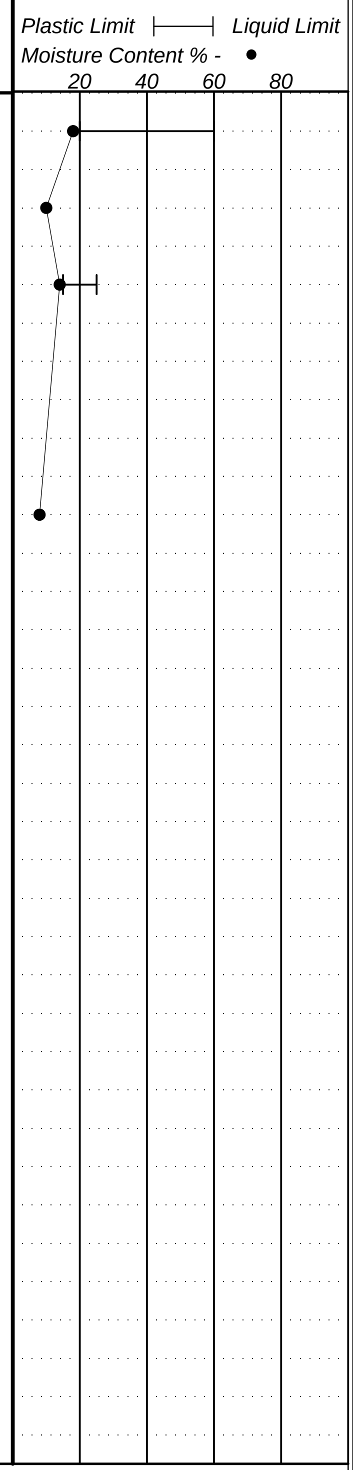
S.S by P.P - Shear Strength in TSF by Hand Penetrometer
S.S. - Split Spoon Sample
S.T. - Shelby Tube Sample
HA - Hand Auger
AU - Auger Sample

PROJECT: **Weatherwood, Phase 3**
LOCATION: San Antonio, Texas
CLIENT: Forestar Group, Inc.

PROJECT NO: **S251291**
DATE: 10/08/2025

BORING NO. B-2

DEPTH (feet)	SYMBOL	SAMPLES	SOIL DESCRIPTION	% MINUS 200 SIEVE	UNIT DRY WT IN PCF	S.S. BY P.P	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
0 – 1		SS	Dark Brown Clay				72/10"		60	40
1 – 12		AU	Tan Marl -with Limestone Seams -with Clay Seams							
		AU							25	10
		AU								



Notes:

Ground Water Observed: No

Completion Depth (ft): 12

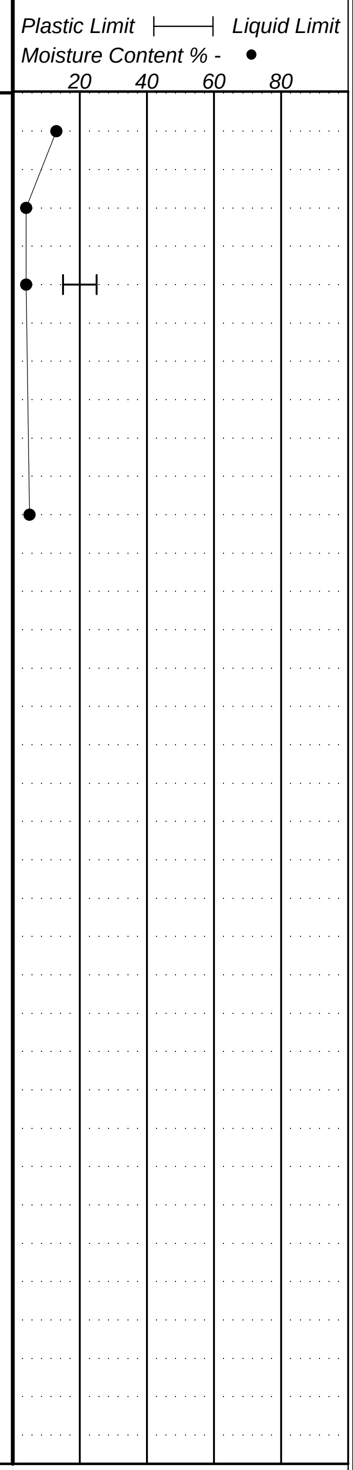
S.S by P.P - Shear Strength in TSF by Hand Penetrometer
S.S. - Split Spoon Sample
S.T. - Shelby Tube Sample
HA - Hand Auger
AU - Auger Sample

PROJECT: **Weatherwood, Phase 3**
LOCATION: San Antonio, Texas
CLIENT: Forestar Group, Inc.

PROJECT NO: **S251291**
DATE: 10/08/2025

BORING NO. B-3

DEPTH (feet)	SYMBOL	SAMPLES	SOIL DESCRIPTION	% MINUS 200 SIEVE	UNIT DRY WT IN PCF	S.S. BY P.P	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
0			Dark Brown Clay							
		SS	Light Tan Marl to Limestone -with Caliche				39			
		SS					50/4"			
5		AU							25	10
10		AU								
15										
20										
25										
30										
35										



Notes:

Ground Water Observed: No

Completion Depth (ft): 12

S.S by P.P - Shear Strength in TSF by Hand Penetrometer
S.S. - Split Spoon Sample
S.T. - Shelby Tube Sample
HA - Hand Auger
AU - Auger Sample

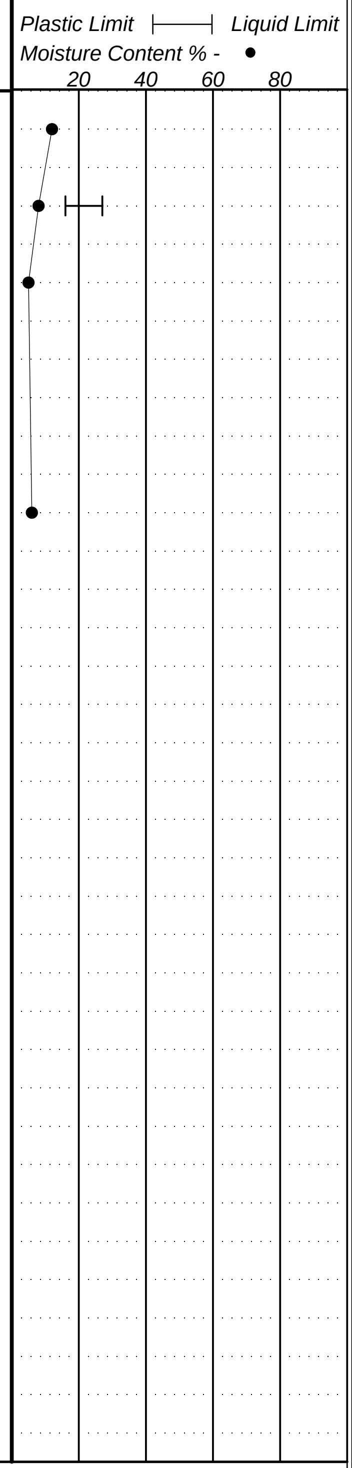
PROJECT: **Weatherwood, Phase 3**
LOCATION: San Antonio, Texas
CLIENT: Forestar Group, Inc.

PROJECT NO: **S251291**
DATE: 10/08/2025

inTEC

BORING NO. B-4

DEPTH (feet)	SYMBOL	SAMPLES	SOIL DESCRIPTION	% MINUS 200 SIEVE	UNIT DRY WT IN PCF	S.S. BY P.P	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
0			Dark Brown Clay							
		SS	Light Tan Marl to Limestone -with Caliche				58/10"			
		AU							27	11
5		AU								
10		AU								
15										
20										
25										
30										
35										



Notes:

Ground Water Observed: No

Completion Depth (ft): 12

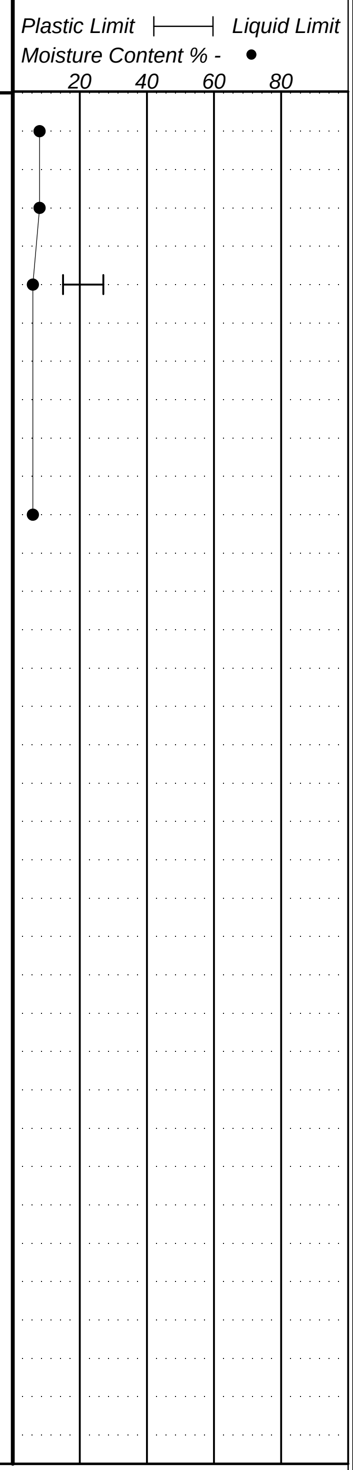
S.S by P.P - Shear Strength in TSF by Hand Penetrometer
S.S. - Split Spoon Sample
S.T. - Shelby Tube Sample
HA - Hand Auger
AU - Auger Sample

PROJECT: **Weatherwood, Phase 3**
LOCATION: San Antonio, Texas
CLIENT: Forestar Group, Inc.

PROJECT NO: **S251291**
DATE: 10/08/2025

BORING NO. B-5

DEPTH (feet)	SYMBOL	SAMPLES	SOIL DESCRIPTION	% MINUS 200 SIEVE	UNIT DRY WT IN PCF	S.S. BY P.P	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
0			Dark Brown Clay							
		SS	Light Tan Marl -with Caliche -with Limestone Seams				50/8"			
		AU								
5		AU							27	12
10										
		AU								
15										
20										
25										
30										
35										



Notes:

Ground Water Observed: No

Completion Depth (ft): 12

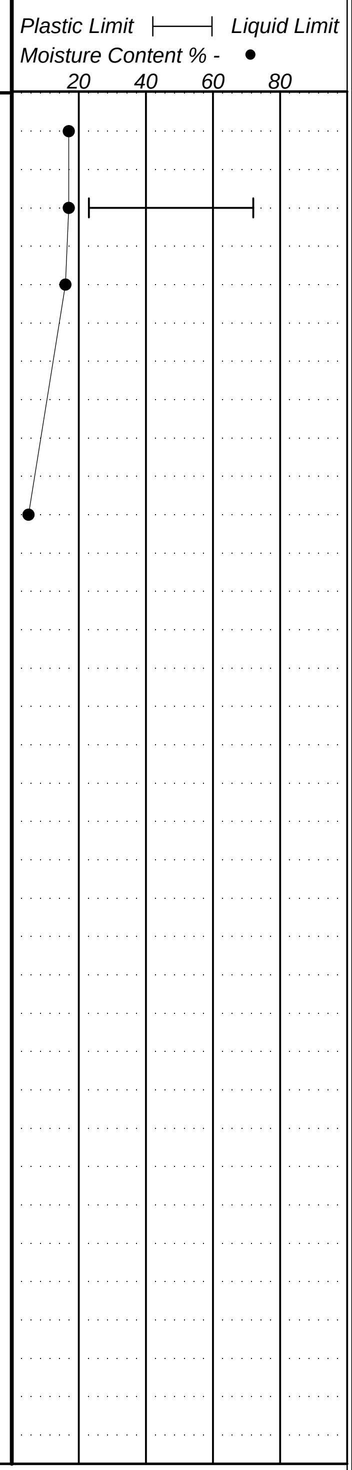
S.S by P.P - Shear Strength in TSF by Hand Penetrometer
S.S. - Split Spoon Sample
S.T. - Shelby Tube Sample
HA - Hand Auger
AU - Auger Sample

PROJECT: **Weatherwood, Phase 3**
LOCATION: San Antonio, Texas
CLIENT: Forestar Group, Inc.

PROJECT NO: **S251291**
DATE: 10/09/2025

BORING NO. B-6

DEPTH (feet)	SYMBOL	SAMPLES	SOIL DESCRIPTION	% MINUS 200 SIEVE	UNIT DRY WT IN PCF	S.S. BY P.P	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
0		SS	Dark Brown Clay to Brown Clay -with Gravel				14			
		SS					16		72	49
5		SS	Tan Clay to Tan Calcareous Clay -with Caliche and Gravel -with Marl Seams				20			
10		AU								
15										
20										
25										
30										
35										



Notes:

Ground Water Observed: No

Completion Depth (ft): 12

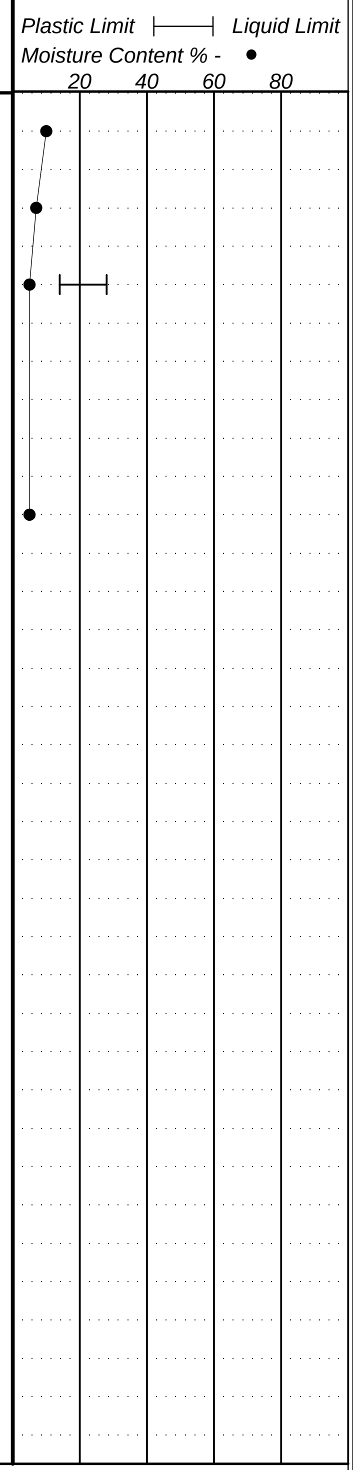
S.S by P.P - Shear Strength in TSF by Hand Penetrometer
S.S. - Split Spoon Sample
S.T. - Shelby Tube Sample
HA - Hand Auger
AU - Auger Sample

PROJECT: **Weatherwood, Phase 3**
LOCATION: San Antonio, Texas
CLIENT: Forestar Group, Inc.

PROJECT NO: **S251291**
DATE: 10/09/2025

BORING NO. B-7

DEPTH (feet)	SYMBOL	SAMPLES	SOIL DESCRIPTION	% MINUS 200 SIEVE	UNIT DRY WT IN PCF	S.S. BY P.P	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
0			Dark Brown Clay							
		SS	Tan Calcareous Clay to Marl -with Caliche -with Gravel				33			
		SS					61			
5		AU							28	14
10										
		AU								
15										
20										
25										
30										
35										



Notes:

Ground Water Observed: No

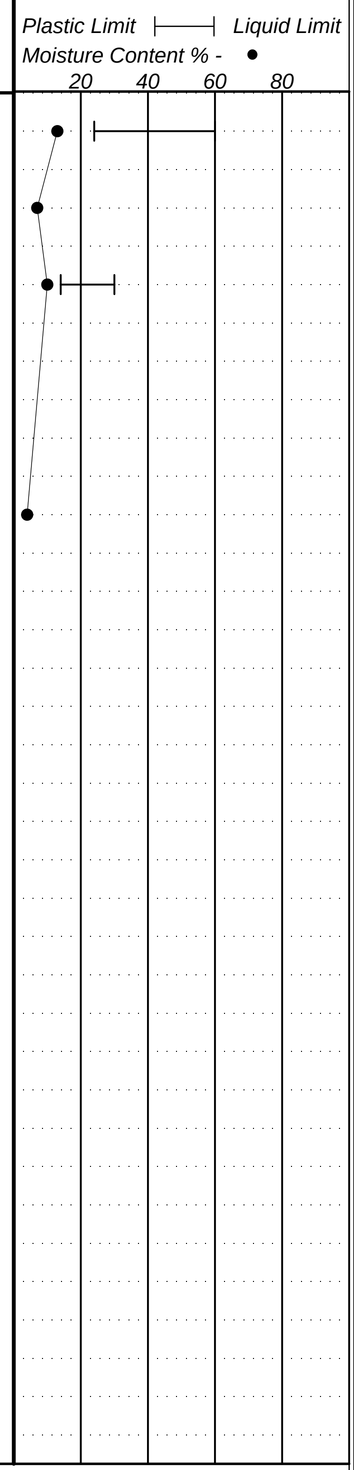
Completion Depth (ft): 12

S.S by P.P - Shear Strength in TSF by Hand Penetrometer
S.S. - Split Spoon Sample
S.T. - Shelby Tube Sample
HA - Hand Auger
AU - Auger Sample

PROJECT: **Weatherwood, Phase 3** **PROJECT NO:** **S251291**
LOCATION: San Antonio, Texas **DATE:** 10/09/2025
CLIENT: Forestar Group, Inc.

BORING NO. B-8

DEPTH (feet)	SYMBOL	SAMPLES	SOIL DESCRIPTION	% MINUS 200 SIEVE	UNIT DRY WT IN PCF	S.S. BY P.P	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
0		SS	Dark Brown Clay -with Gravel				24		60	36
		AU	Tan Calcareous Clay to Marl -with Caliche -with Gravel							
5		AU							30	16
10		AU								
15										
20										
25										
30										
35										



Notes:

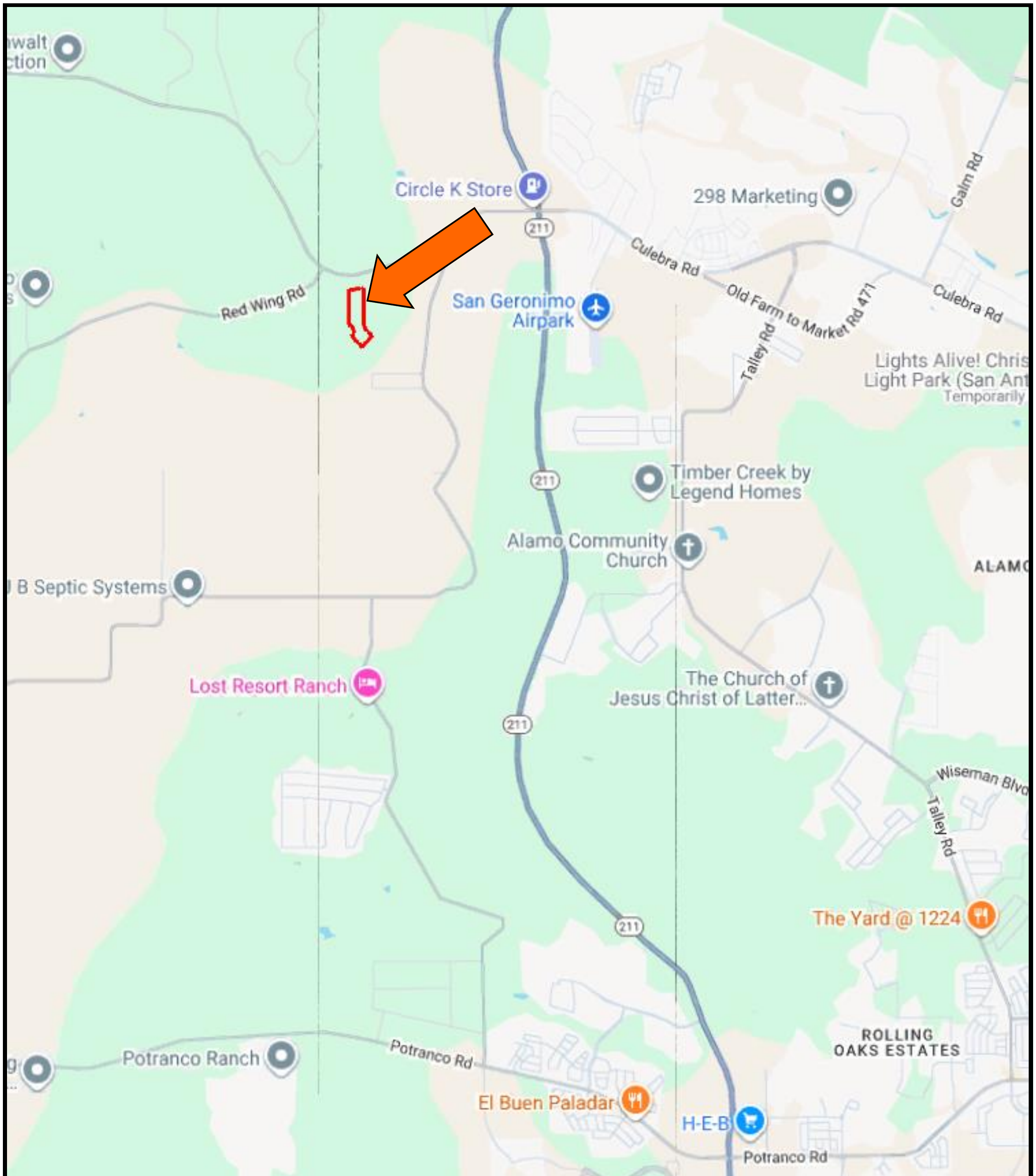
Ground Water Observed: No

Completion Depth (ft): 12

S.S by P.P - Shear Strength in TSF by Hand Penetrometer
S.S. - Split Spoon Sample
S.T. - Shelby Tube Sample
HA - Hand Auger
AU - Auger Sample

Illustration Section

Subsurface Exploration and Pavement Analysis Proposed New Streets Weatherwood, Phase 3 San Antonio, Texas	InTEC Project Number: **S251291**	Date: 09/16/2025

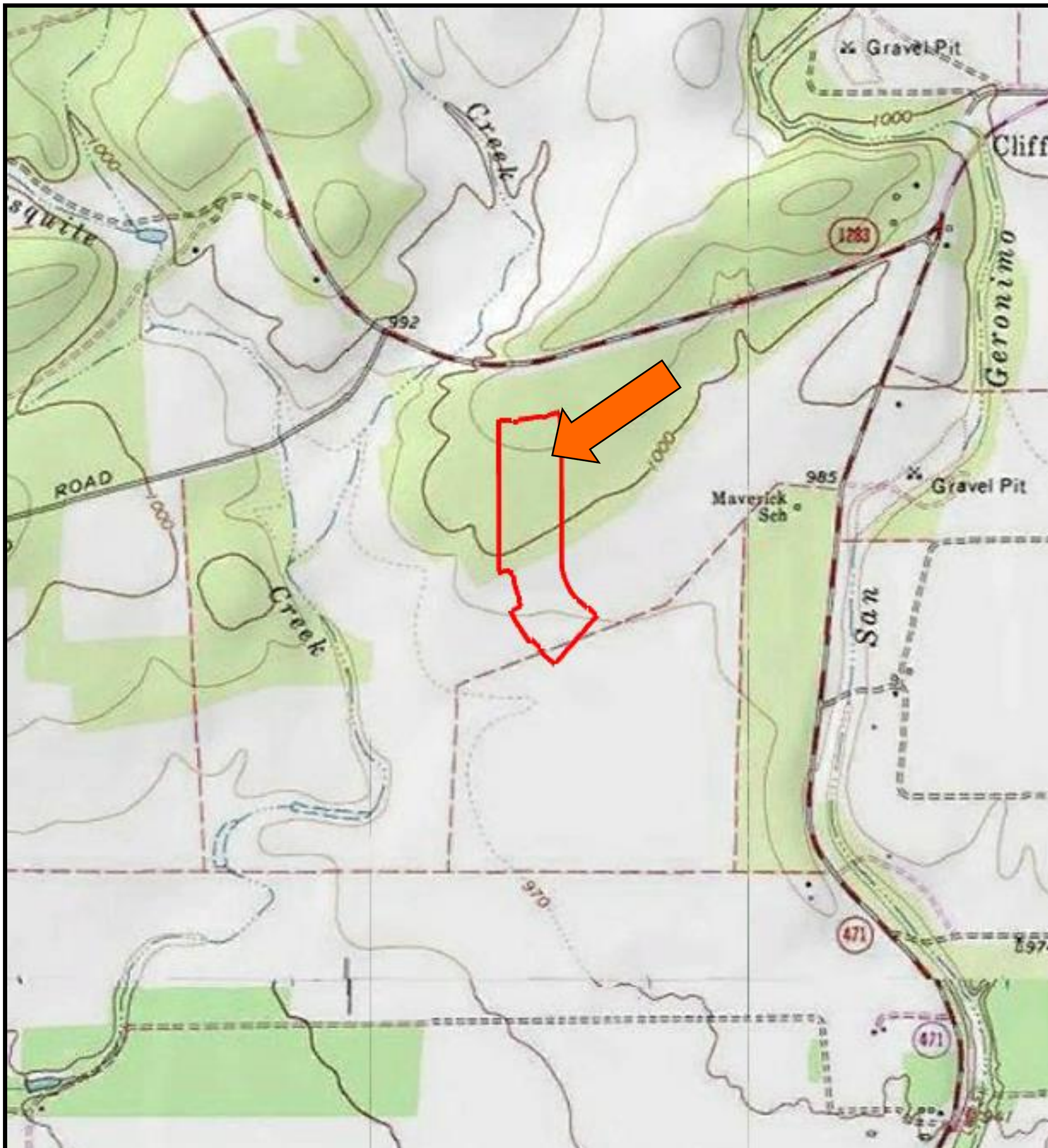


Subsurface Exploration and Pavement Analysis Proposed New Streets Weatherwood, Phase 3 San Antonio, Texas	**Vicinity Map**	
	InTEC Project Number: **S251291**	Date: 09/16/2025

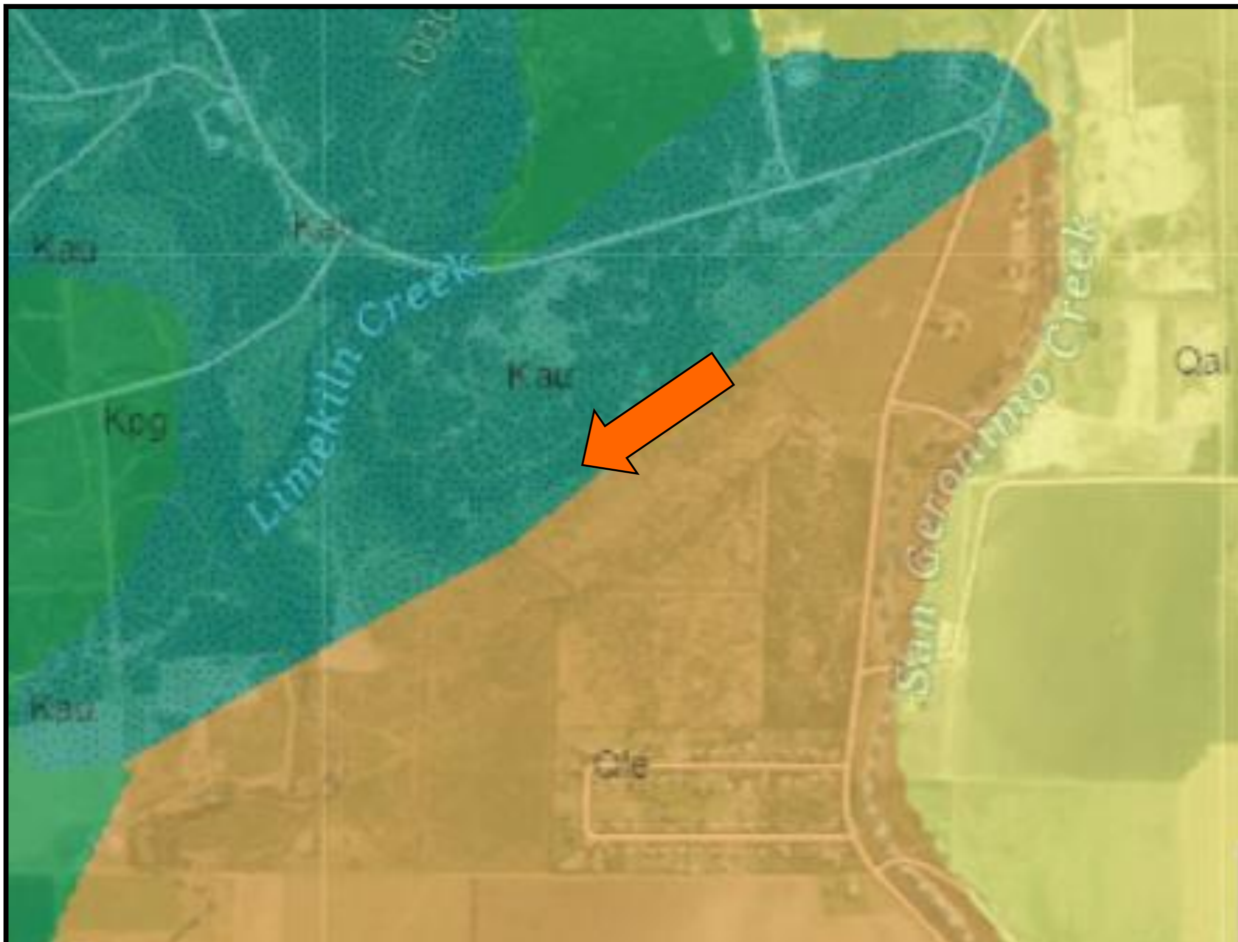
Subsurface Exploration and Pavement Analysis
Proposed New Streets
Weatherwood, Phase 3
San Antonio, Texas

Aerial Map—Approximate Location

InTEC Project Number:	Date:
S251291	09/16/2025



Subsurface Exploration and Pavement Analysis Proposed New Streets Weatherwood, Phase 3 San Antonio, Texas	**Topographic Map—Approximate Location**	
	InTEC Project Number: **S251291**	Date: 09/16/2025



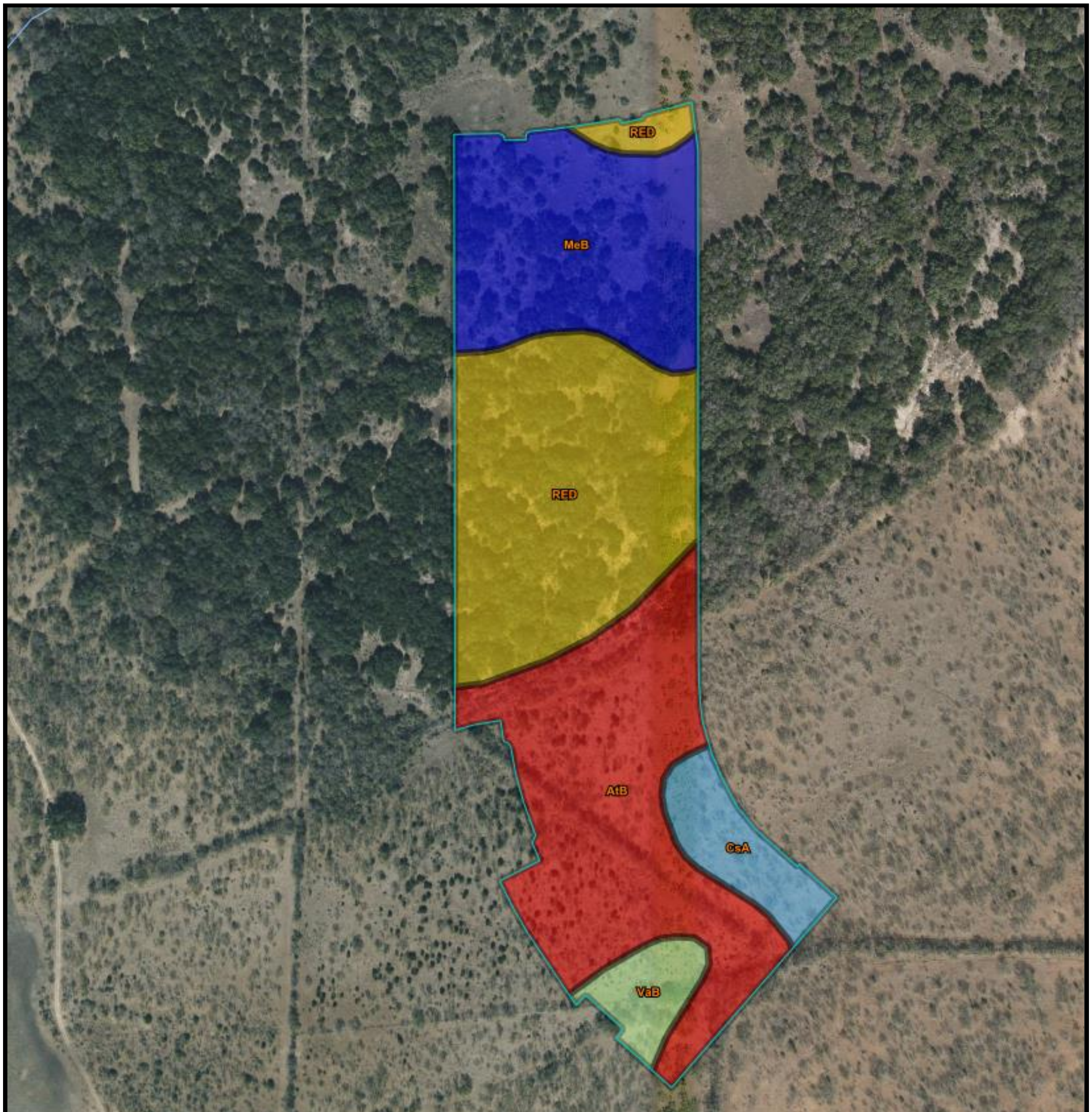
Kau—Austin Chalk

chalk and marl; chalk mostly microgranular ealcite with minor foraminifera tests and Inoceramus prisms, averages about 85 calcium carbonate, ledge forming, grayish white to white; alternates with marl, bentonitic seams locally, recessive, medium gray, sparsely glauconitic, pyrite nodules in part feathered to limonite common, occasional beds with large-scale cross-stratification; locally highly fossiliferous; thickness 350-580 feet, thickens westward

Qle—Leona Formation

Fine calcareous silt grading down into coarse gravel; type locality first wide terrace of Nueces and Leona Rivers below level of Uvalde Gravel. May correlate with Onion Creek Marl of Austin Sheet

Subsurface Exploration and Pavement Analysis Proposed New Streets Weatherwood, Phase 3 San Antonio, Texas	**Geologic Map—Approximate Location**	
	InTEC Project Number: **S251291**	Date: 09/16/2025



Medina County, Texas

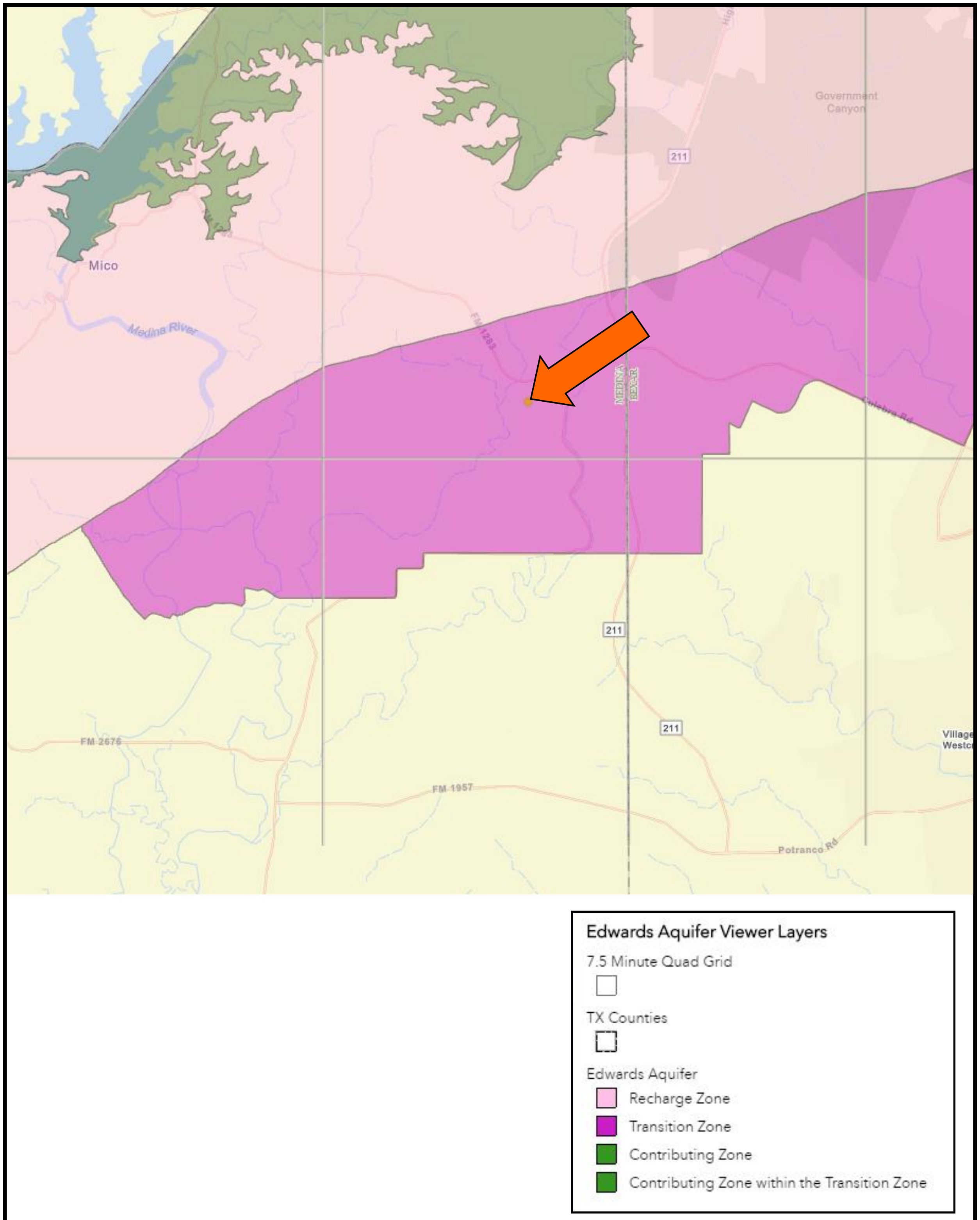
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H
AtB—Atco loam, 1 to 3 percent slopes														
Atco	90	B	0-9	Loam	CL-ML, CL, SM	A-4, A-6	0- 0- 0	0- 0- 0	94-96-100	89-92-100	72-82- 93	49-59- 71	17-26 -37	1-7 -14
			9-48	Sandy clay loam, loam	CL-ML, ML, SM	A-4, A-7-5	0- 0- 0	0- 0- 0	95-96-100	90-93-100	70-82- 96	45-59- 76	16-28 -46	1-7 -15
			48-75	Loam	CL-ML	A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	83-91- 95	61-71- 76	18-27 -35	2-5 -8

Subsurface Exploration and Pavement Analysis Proposed New Streets Weatherwood, Phase 3 San Antonio, Texas	**Soil Map—Approximate Location**	
	InTEC Project Number: **S251291**	Date: 09/16/2025

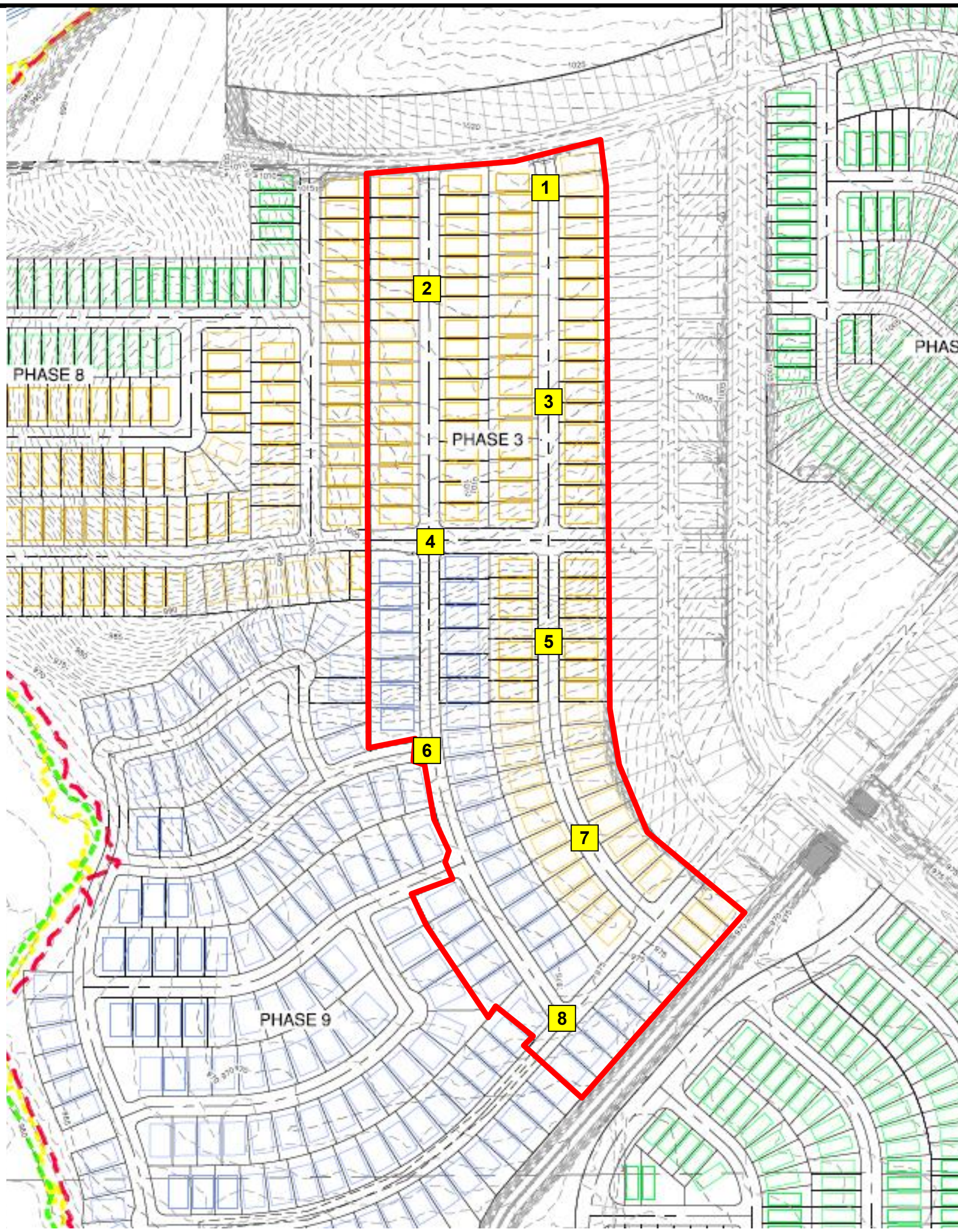
Medina County, Texas

Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
CsA—Castroville clay loam, 0 to 1 percent slopes														
Castroville	85	B	0-16	Clay loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	98-99-100	96-98-100	90-95-100	75-85- 95	33-42 -50	20-25-30
			16-52	Silty clay loam, clay, silty clay	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	98-99-100	96-98-100	90-95-100	75-85- 95	35-43 -50	15-22-28
			52-84	Silty clay loam, clay, silty clay	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	85-93-100	80-90-100	80-90-100	70-83- 95	30-38 -45	12-19-25
MeB—Stephen clay, 1 to 3 percent slopes														
Stephen	75	D	0-17	Clay	CH, CL	A-7-6	0- 1- 1	0- 3- 5	85-93-100	75-88-100	65-83-100	51-71- 90	45-58 -70	22-32-42
			17-80	Bedrock	—	—	—	—	—	—	—	—	—	—
RED—Real association, undulating														
Real	85	D	0-4	Gravelly clay loam	SC, SM, ML, GM, CL	A-4, A-6, A-7-6	0- 2- 3	1- 3- 5	65-78- 90	50-64- 77	45-55- 65	36-48- 60	30-43 -55	8-17-25
			4-13	Extremely gravelly loam, extremely gravelly clay loam, very gravelly clay loam	GC, SM	A-2-7, A-4, A-6, A-7	0- 2- 3	0- 8- 15	25-50- 75	20-35- 50	20-33- 45	20-30- 40	30-43 -55	8-17-25
			13-20	Bedrock	—	—	—	—	—	—	—	—	—	—
VaB—Valco clay loam, 0 to 2 percent slopes														
Valco	75	D	0-16	Clay loam	CL	A-6, A-7-6	0- 0- 0	0- 1- 2	90-95-100	85-93-100	70-83- 95	70-75- 80	34-39 -43	14-18-21
			16-19	Cemented material	—	—	—	—	—	—	—	—	0-7 -14	—
			19-40	Fine sandy loam, loam, sandy clay loam	CL, SC	A-6	0- 0- 0	0- 2- 3	80-89- 98	80-88- 95	65-80- 95	35-48- 60	20-30 -40	10-15-20

Subsurface Exploration and Pavement Analysis Proposed New Streets Weatherwood, Phase 3 San Antonio, Texas	**Soil Map—Continued**	
	InTEC Project Number: **S251291**	Date: 09/16/2025



Subsurface Exploration and Pavement Analysis Proposed New Streets Weatherwood, Phase 3 San Antonio, Texas	**Edwards Aquifer Map**	
	InTEC Project Number: **S251291**	Date: 09/16/2025



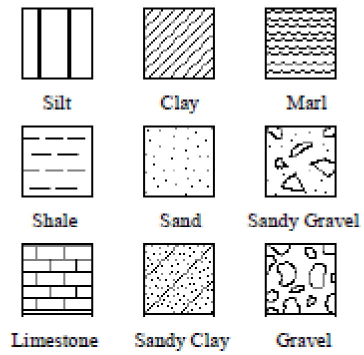
Subsurface Exploration and Pavement Analysis Proposed New Streets Weatherwood, Phase 3 San Antonio, Texas	**Approximate Boring Locations**	
	InTEC Project Number: **S251291**	Date: 09/16/2025

KEY TO CLASSIFICATIONS AND SYMBOLS

Soil Fractions

Component	Size Range
Boulders	Greater than 12"
Cobbles	3" - 12"
Gravel	3" - #4 (4.76mm)
Coarse	3" - ¾"
Fine	¾" - #4
Sand	#4 - #200 (0.074mm)
Coarse	#4 - #10 (2.00mm)
Medium	#10 - #40 (0.42mm)
Fine	#40 - #200 (0.074mm)
Silt and Clay	Less than #200

Soil or Rock Types
(Shown in symbols column)
(Predominate Soil Types Shown Heavy)



TERMS DESCRIBING SOIL CONSISTENCY

Description (Cohesive Soils)	Unconfined Compression TSF	Blows/Ft. Std. Penetration Test	Description (Cohesionless Soils	Blows/Ft. Std. Penetration Tests
Very Soft	0.25	<2	Very Loose	0 – 4
Soft	0.25 – 0.50	2 – 4	Loose	4 – 10
Firm	0.50 – 1.00	4 – 8	Medium Dense	10 – 30
Stiff	1.00 – 2.00	8 – 15	Dense	30 – 50
Very Stiff	2.00 – 4.00	15 – 30	Very Dense	50
Hard	>4.00	>30		

SOIL STRUCTURE

Calcareous	Containing deposits of calcium carbonate; generally nodular.
Slickenside	Having inclined planes of weakness that are slick and glossy in appearance.
Laminated	Composed of thin layers of varying color and texture.
Fissured	Containing shrinkage cracks frequently filled with fine sand or silt. Usually more or less vertical.
Interbedded	Composed of alternate layers of different soil types.
Jointed	Consisting of hair cracks that fall apart as soon as the confining pressure is removed.
Varved	Consisting of alternate thin layers of sand, silt or clay formed by variations in sedimentations during the various seasons of the year, of often exhibiting contrasting colors when partially dried. Each layer is generally less than ½" in thickness.
Stratified	Composed of, or arranged in layers (usually 1 inch or more)
Well-graded	Having a wide range of grain sizes and substantial amount of all intermediate particle sizes.
Poorly or Gap-graded	Having a range of sizes with some intermediate sizes missing.
Uniformly-graded	Predominantly of one grain size.

Subsurface Exploration and Pavement Analysis Proposed New Streets Weatherwood, Phase 3 San Antonio, Texas	InTEC Project Number: **S251291**	Date: 09/16/2025

Calculations

CBR = 2.5

Subsurface Exploration and Pavement Analysis Proposed New Streets Weatherwood, Phase 3 San Antonio, Texas	InTEC Project Number: **S251291**	Date: 10/17/2025

Asphalt Pavement

Design Analysis

Tensar
A Division of CMC

Design		**Reference**	
Project		**Location**	
Customer		**Designer**	Murali Subramaniam
Company	InTEC	**Date**	October 23, 2025

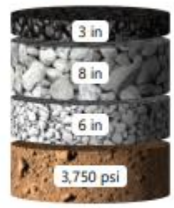
Method of analysis

The calculation method used to create this Tensar software output is the design method for flexible pavements given in the AASHTO Guide for Design of Pavement Structures 1993. The enhancement of performance due to the inclusion of Tensar geogrids in the stabilised layer is derived empirically from full scale pavement tests and trafficking trials carried out by independent authorities.

Results

Stabilized
426,300 ESALs

Unstabilized
186,600 ESALs



	Thickness	Coeff.	SN
HMA layer 1	3 in	0.440	1.320
Aggregate base (NX750)	7 in	0.284	1.988
Structural number (SN)			3.308

	Thickness	Coeff.	SN
HMA layer 1	3 in	0.440	1.320
Aggregate base	8 in	0.140	1.120
Subbase	6 in	0.080	0.480
Structural number (SN)			2.920

Parameters

Project Information

Target ESALs	Subgrade resilient modulus	Reliability	Standard deviation	Serviceability	
				Initial	Terminal
100,000	3,750 psi	70%	0.45	4.2	2

This report was prepared using Tensar+ (2.20.7)

Limitations of this Report
You undertake to only use the Tensar+ software tool and its output solely to evaluate the application of Tensar geogrids, and strictly according to the Terms of Use. The suitability of the software output and Tensar International's geogrids for any project is the sole responsibility of you, and your employees, contractors or other third parties who access the Tensar+ software tool and its output ("Your Associates"). The Tensar+ software output is merely illustrative and is not a detailed design. You will ensure that you and Your Associates have undergone all necessary training through Tensar International and/or have the necessary expertise and experience to use the Tensar+ software tool and its output correctly and safely. Copyright in the Tensar+ software output belongs to Tensar International. It may not be reproduced in whole or in part without the prior written permission of Tensar International except to Your Associates provided it is only disclosed for the purpose of evaluating the commercial application for the use of Tensar International's geogrids, and you are fully liable for Your Associates' acts or omissions. The Tensar+ software output does not form the whole or any part of a contract.

Subsurface Exploration and Pavement Analysis Proposed New Streets Weatherwood, Phase 3 San Antonio, Texas	**Local A—without Bus Traffic**	
	InTEC Project Number: **S251291**	Date: 10/17/2025

Tensar

SpectraPave4 PRO™
Pavement Optimization Design Analysis

Design Parameters for AASHTO (1993) Equation

Reliability (%)	= 70	Initial Serviceability	= 4.2
Standard Normal Deviate	= -.524	Terminal Serviceability	= 2.0
Standard Deviation	= 0.45	Change in Serviceability	= 2.2

Aggregate fill shall conform to following requirement:

D50 <= 27mm (Base course)

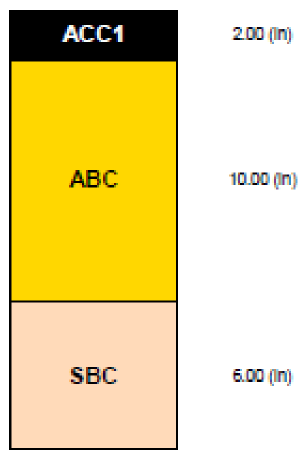
Unstabilized Section Material Properties

Layer	Description	Cost ($/ton)	Layer coefficient	Drainage factor
ACC1	Asphalt Wearing Course	70	0.440	N/A
ABC	Aggregate Base Course	20	0.140	1.0
SBC	Subbase Course	16	0.080	1.0

Stabilized Section Material Properties

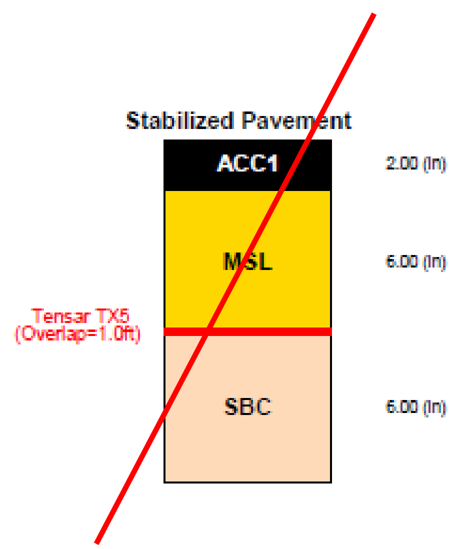
Layer	Description	Cost ($/ton)	Layer coefficient	Drainage factor
ACC1	Asphalt Wearing Course	70	0.420	N/A
MSL	Mechanically Stabilized Base Cour	20	0.273	1.0
SBC	Subbase Course	16	0.080	1.0

Unstabilized Pavement



Subgrade Modulus = 3,750 (psi)
Structural Number = 2.760
Calculated Traffic (ESALs) = 129,000

Stabilized Pavement



Subgrade Modulus = 3,750 (psi)
Structural Number = 2.968
Calculated Traffic (ESALs) = 203,000

LIMITATIONS OF THE REPORT

The designs, illustrations, information and other content included in this report are necessarily general and conceptual in nature, and do not constitute engineering advice or any design intended for actual construction. Specific design recommendations can be provided as the project develops.

Subsurface Exploration and Pavement Analysis Proposed New Streets Weatherwood, Phase 3 San Antonio, Texas	**Local A—without Bus Traffic**	
	InTEC Project Number: **S251291**	Date: 10/17/2025

Asphalt Pavement
Design Analysis

Tensar
A Division of CMC

Design		**Reference**	
Project		**Location**	
Customer		**Designer**	Murali Subramaniam
Company	InTEC	**Date**	October 23, 2025

Method of analysis

The calculation method used to create this Tensar software output is the design method for flexible pavements given in the AASHTO Guide for Design of Pavement Structures 1993. The enhancement of performance due to the inclusion of Tensar geogrids in the stabilised layer is derived empirically from full scale pavement tests and trafficking trials carried out by independent authorities.

Results

Stabilized
426,300 ESALs

Unstabilized
254,000 ESALs

Total HMA thickness should be within the same range on both pavement sections for accurate comparison: 2-3 in | 3-6 in | 6-14 in

	Thickness	Coeff.	SN
HMA layer 1	3 in	0.440	1.320
Aggregate base (NX750)	7 in	0.284	1.988
Structural number (SN)			3.308

	Thickness	Coeff.	SN
HMA layer 1	2 in	0.440	0.880
HMA layer 2	5 in	0.340	1.700
Subbase	6 in	0.080	0.480
Structural number (SN)			3.060

Parameters

Project Information

Target ESALs	Subgrade resilient modulus	Reliability	Standard deviation	Serviceability	
				Initial	Terminal
100,000	3,750 psi	70%	0.45	4.2	2

Tensar

SpectraPave4 PRO™
Pavement Optimization Design Analysis

Design Parameters for AASHTO (1993) Equation

Reliability (%)	= 70	Initial Serviceability	= 4.2
Standard Normal Deviate	= -.524	Terminal Serviceability	= 2.0
Standard Deviation	= 0.45	Change in Serviceability	= 2.2

Aggregate fill shall conform to following requirement:

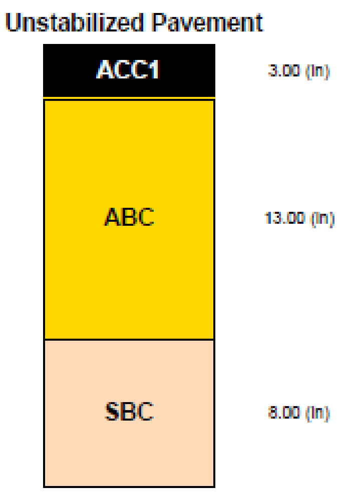
D50 <= 27mm (Base course)

Unstabilized Section Material Properties

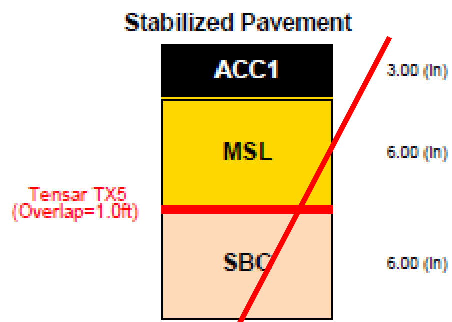
Layer	Description	Cost ($/ton)	Layer coefficient	Drainage factor
ACC1	Asphalt Wearing Course	70	0.440	N/A
ABC	Aggregate Base Course	20	0.140	1.0
SBC	Subbase Course	16	0.080	1.0

Stabilized Section Material Properties

Layer	Description	Cost ($/ton)	Layer coefficient	Drainage factor
ACC1	Asphalt Wearing Course	70	0.420	N/A
MSL	Mechanically Stabilized Base Cour	20	0.265	1.0
SBC	Subbase Course	16	0.080	1.0



Subgrade Modulus = 3,750 (psi)
Structural Number = 3.780
Calculated Traffic (ESALs) = 1,054,000



Subgrade Modulus = 3,750 (psi)
Structural Number = 3.330
Calculated Traffic (ESALs) = 446,000

LIMITATIONS OF THE REPORT

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Subsurface Exploration and Pavement Analysis Proposed New Streets Weatherwood, Phase 3 San Antonio, Texas	**Local A—with Bus Traffic**	
	InTEC Project Number: **S251291**	Date: 10/17/2025

Tensar

SpectraPave4 PRO™
Pavement Optimization Design Analysis

Design Parameters for AASHTO (1993) Equation

Reliability (%)	= 70	Initial Serviceability	= 4.2
Standard Normal Deviate	= -.524	Terminal Serviceability	= 2.0
Standard Deviation	= 0.45	Change in Serviceability	= 2.2

Aggregate fill shall conform to following requirement:

D50 <= 27mm (Base course)

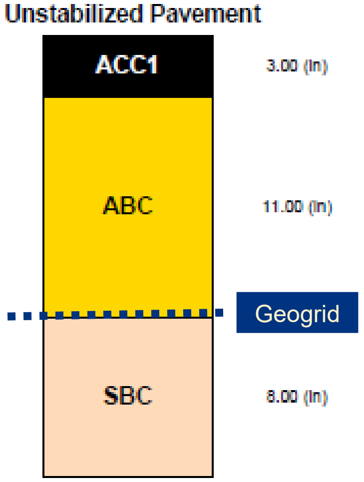
Unstabilized Section Material Properties

Layer	Description	Cost ($/ton)	Layer coefficient	Drainage factor
ACC1	Asphalt Wearing Course	70	0.440	N/A
ABC	Aggregate Base Course	20	0.170	1.0
SBC	Subbase Course	16	0.080	1.0

Stabilized Section Material Properties

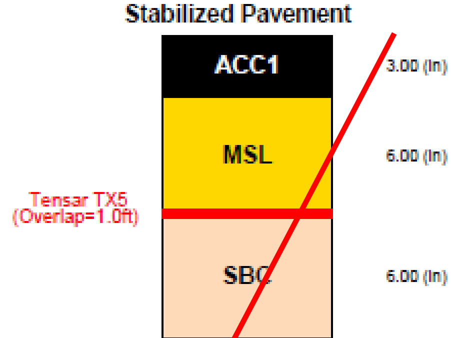
Layer	Description	Cost ($/ton)	Layer coefficient	Drainage factor
ACC1	Asphalt Wearing Course	70	0.420	N/A
MSL	Mechanically Stabilized Base Cour	20	0.265	1.0
SBC	Subbase Course	16	0.080	1.0

Unstabilized Pavement



Subgrade Modulus = 3,750 (psi)
Structural Number = 3.830
Calculated Traffic (ESALs) = 1,153,000

Stabilized Pavement



Subgrade Modulus = 3,750 (psi)
Structural Number = 3.330
Calculated Traffic (ESALs) = 446,000

Geogrid option calculated with adjusted structural coefficient value of 0.17

LIMITATIONS OF THE REPORT

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Subsurface Exploration and Pavement Analysis Proposed New Streets Weatherwood, Phase 3 San Antonio, Texas	**Local A—with Bus Traffic**	
	InTEC Project Number: **S251291**	Date: 10/17/2025

Asphalt Pavement

Design Analysis

Tensar
A Division of CMC

Design		**Reference**	
Project		**Location**	
Customer		**Designer**	Murali Subramaniam
Company	InTEC	**Date**	October 23, 2025

Method of analysis

The calculation method used to create this Tensar software output is the design method for flexible pavements given in the AASHTO Guide for Design of Pavement Structures 1993. The enhancement of performance due to the inclusion of Tensar geogrids in the stabilised layer is derived empirically from full scale pavement tests and trafficking trials carried out by independent authorities.

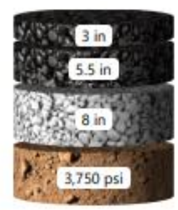
Results

Stabilized

1,036,400 ESALs

Unstabilized

1,153,400 ESALs



Total HMA thickness should be within the same range on both pavement sections for accurate comparison: 2-3 in | 3-6 in | 6-14 in

	Thickness	Coeff.	SN
HMA layer 1	3 in	0.440	1.320
Aggregate base (NX750)	9.5 in	0.258	2.451
Structural number (SN)			3.771

	Thickness	Coeff.	SN
HMA layer 1	3 in	0.440	1.320
HMA layer 2	5.5 in	0.340	1.870
Subbase	8 in	0.080	0.640
Structural number (SN)			3.830

Parameters

Project Information

Target ESALs	Subgrade resilient modulus	Reliability	Standard deviation	Serviceability	
				Initial	Terminal
1,000,000	3,750 psi	70%	0.45	4.2	2

This report was prepared using Tensar+ (2.20.7)

Limitations of this Report

You undertake to only use the Tensar+ software tool and its output solely to evaluate the application of Tensar geogrids, and strictly according to the Terms of Use. The suitability of the software output and Tensar International's geogrids for any project is the sole responsibility of you, and your employees, contractors or other third parties who access the Tensar+ software tool and its output ("Your Associates"). The Tensar+ software output is merely illustrative and is not a detailed design. You will ensure that you and Your Associates have undergone all necessary training through Tensar International and/or have the necessary expertise and experience to use the Tensar+ software tool and its output correctly and safely. Copyright in the Tensar+ software output belongs to Tensar International. It may not be reproduced in whole or in part without the prior written permission of Tensar International except to Your Associates provided it is only disclosed for the purpose of evaluating the commercial application for the use of Tensar International's geogrids, and you are fully liable for Your Associates' acts or omissions. The Tensar+ software output does not form the whole or any part of a contract.

Subsurface Exploration and Pavement Analysis Proposed New Streets Weatherwood, Phase 3 San Antonio, Texas	**Local A—with Bus Traffic**	
	InTEC Project Number: **S251291**	Date: 10/17/2025

Asphalt Pavement

Design Analysis

Tensar
A Division of CMC

Design		**Reference**	
Project		**Location**	
Customer		**Designer**	Murali Subramaniam
Company	InTEC	**Date**	October 23, 2025

Method of analysis

The calculation method used to create this Tensar software output is the design method for flexible pavements given in the AASHTO Guide for Design of Pavement Structures 1993. The enhancement of performance due to the inclusion of Tensar geogrids in the stabilised layer is derived empirically from full scale pavement tests and trafficking trials carried out by independent authorities.

Results

Stabilized

2,028,900 ESALs

Unstabilized

2,115,000 ESALs

	Thickness	Coeff.	SN
HMA layer 1	3 in	0.400	1.200
Aggregate base (NX750)	15.75 in	0.218	3.433
Structural number (SN)			4.633

	Thickness	Coeff.	SN
HMA layer 1	5 in	0.440	2.200
Aggregate base	13 in	0.140	1.820
Subbase	8 in	0.080	0.640
Structural number (SN)			4.660

Parameters

Project Information

Target ESALs	Subgrade resilient modulus	Reliability	Standard deviation	Serviceability	
				Initial	Terminal
2,000,000	3,750 psi	90%	0.45	4.2	2

This report was prepared using Tensar+ (2.20.7)

Limitations of this Report

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Subsurface Exploration and Pavement Analysis Proposed New Streets Weatherwood, Phase 3 San Antonio, Texas	**Local B**	
	InTEC Project Number: **S251291**	Date: 10/17/2025

Asphalt Pavement

Design Analysis

Tensar
A Division of CMC

Design		Reference	
Project		Location	
Customer		Designer	Murali Subramaniam
Company	InTEC	Date	October 23, 2025

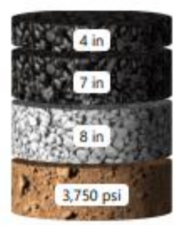
Method of analysis

The calculation method used to create this Tensar software output is the design method for flexible pavements given in the AASHTO Guide for Design of Pavement Structures 1993. The enhancement of performance due to the inclusion of Tensar geogrids in the stabilised layer is derived empirically from full scale pavement tests and trafficking trials carried out by independent authorities.

Results

Stabilized
2,028,900 ESALs

Unstabilized
2,547,700 ESALs



Total HMA thickness should be within the same range on both pavement sections for accurate comparison: 2-3 in | 3-6 in | 6-14 in

	Thickness	Coeff.	SN
HMA layer 1	3 in	0.400	1.200
Aggregate base (NX750)	15.75 in	0.218	3.433
Structural number (SN)			4.633

	Thickness	Coeff.	SN
HMA layer 1	4 in	0.440	1.760
HMA layer 2	7 in	0.340	2.380
Subbase	8 in	0.080	0.640
Structural number (SN)			4.780

Parameters

Project Information

Target ESALs	Subgrade resilient modulus	Reliability	Standard deviation	Serviceability	
				Initial	Terminal
2,000,000	3,750 psi	90%	0.45	4.2	2

This report was prepared using Tensar+ (2.20.7)

Limitations of this Report

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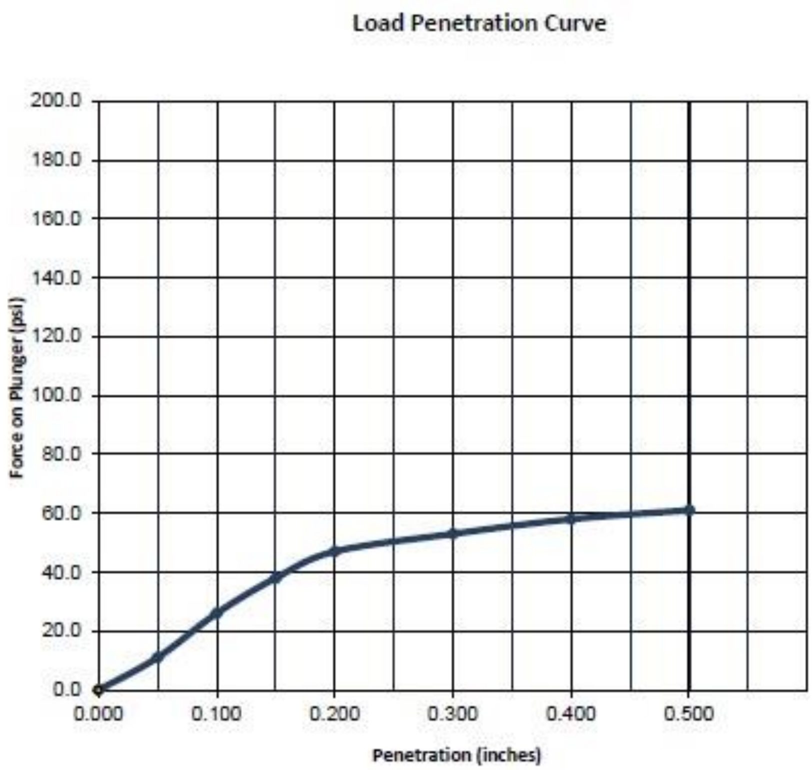
InTEC of San Antonio

ASTM D-1883 California Bearing Ratio Test Report



CBR Results

Results	A	B	C	D	Average
0.1 in Pen.	2.6				
0.2 in Pen.	3.1				
Moisture (%)	19.60				
Density (pcf)	100.80				
Final Moisture (%)	27.90				
Final Density (pcf)	86.10				

		Sample Location	
Project Number	S251291		
Project Name	Weatherwood, Phase 3	Specimen A	Vicinity of B-6
Date	10/16/2025		
Client	Forestar	Specimen C	
		Specimen D	
Job Ref.		Liquid Limit:	75.0
Sample Num.		Plastic Limit:	21.0
Remarks	Dark Brown Clay, Gravel		

Subsurface Exploration and Pavement Analysis
Proposed New Streets
Weatherwood, Phase 3
San Antonio, Texas

CBR Test Results (Clay Subgrade)

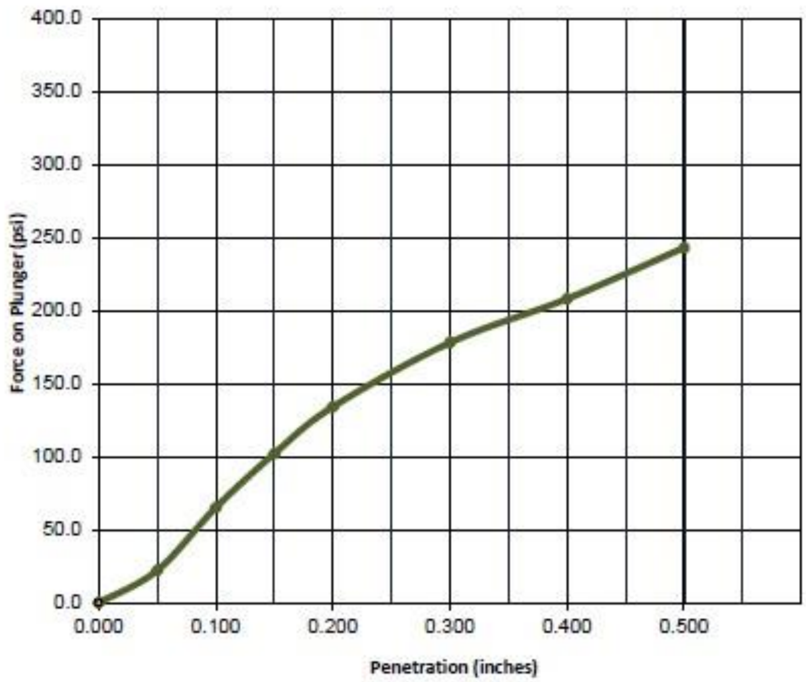
InTEC Project Number: **S251291**

Date: 10/17/2025

InTEC of San Antonio

ASTM D-1883 California Bearing Ratio Test Report

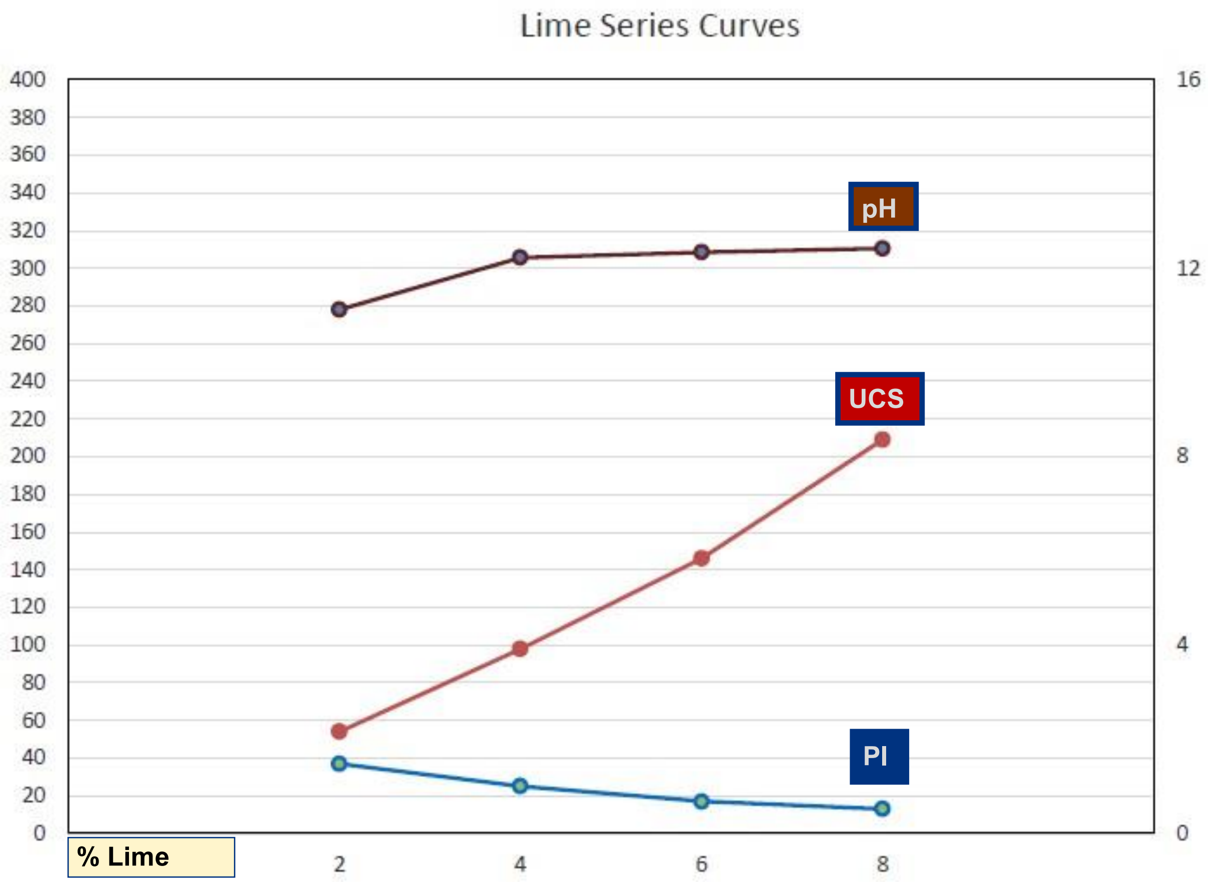
Load Penetration Curve



CBR Results					
Results	**A**	**B**	**C**	**D**	**Average**
0.1 in Pen.	6.5				
0.2 in Pen.	8.9				
Moisture (%)	12.90				
Density (pcf)	124.10				
Final Moisture (%)	18.60				
Final Density (pcf)	105.20				

Project Number	S251291	**Sample Location**	
Project Name	Weatherwood, Phase 3	Specimen A	Vicinity of B-5
Date	10/20/2025		
Client	Forestar	Specimen C	
		Specimen D	
Job Ref.		Liquid Limit:	75.0
Sample Num.		Plastic Limit:	21.0
Remarks	Marl, Caliche		

Subsurface Exploration and Pavement Analysis Proposed New Streets Weatherwood, Phase 3 San Antonio, Texas	**CBR Test Results (Marl Subgrade)**	
	InTEC Project Number: **S251291**	Date: 10/17/2025



Subsurface Exploration and Pavement Analysis Proposed New Streets Weatherwood, Phase 3 San Antonio, Texas	**Lime Series**	
	InTEC Project Number: **S251291**	Date: 10/17/2025

Appendix

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org