# TECHNICAL STANDARDS MANUAL

## The City of Garland, Texas

*May 2015 / Revised January 2019*

GARLAND

TEXAS MADE HERE

ENGINEERING ● WATER ● WASTEWATER

TRANSPORTATION ● STORMWATER

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## Record of Revision

Any revisions to the Technical Standards Manual shall be documented in this section, beginning with the adoption date of May 20, 2015.

| REVISION DATE | DESCRIPTION |
|---|---|
| May 2015 | Published and Adopted entire Technical Standards Manual (TSM) with adoption of Garland Development Code (GDC). |
| January 2019 | Published and Adopted new Section 9 regarding Pavement and Subgrade Design Requirements and addition of associated Appendices |
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# SECTION 9

## PAVEMENT AND SUBGRADE DESIGN REQUIREMENTS

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## Section 9 – Pavement and Subgrade Design Requirements

# Section 9 – Pavement and Subgrade Design Requirements

## 9.01 General

A. The following specifies standard requirements for the pavement and subgrade design for roadways and alleys within the City. These standards are not intended to replace the professional judgment of the Geotechnical Engineer for any specific project. The standards may need to be expanded or modified on a case-by-case basis as determined necessary and appropriate by the Geotechnical Engineer and the actual site conditions, and as approved by the Director of Engineering in writing.

B. Pavement design life shall be 40 years.

C. **Table 9.1** lists the City's standard pavement and subgrade requirements and are in accordance with the City's Standard Details. These standards meet or exceed the 40-year design life in accordance with the Pavement Design Input Values per **Table 9.5**.

**TABLE 9.1: Pavement and Subgrade Standards**

| Criteria | Thoroughfare Classification | | | | | | |
|---|---|---|---|---|---|---|---|
| | Types A and B | Types C and D1 | Type D2 | Type E | Type G (Residential) | Street Department Section | Alleys |
| Concrete Thickness (inches) | 11 | 10 | 9 | 10 | 6 | 6 | 8-5-8 Refer to City Standard Detail |
| Stabilized Subgrade Thickness (inches) and Rate (1,2) | 8<br>18#/SY Lime and 36#/SY Cement | 8<br>18#/SY Lime and 36#/SY Cement | 8<br>18#/SY Lime and 36#/SY Cement | 8<br>18#/SY Lime and 36#/SY Cement | 8<br>18#/SY Lime and 36#/SY Cement | 8<br>18#/SY Lime and 36#/SY Cement (3) | 8<br>18#/SY Lime and 36#/SY Cement (4) |
| Concrete Strength (psi) (5) | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 |
| Reinforcing Steel Size and Spacing | #4 on 18" C-C | #4 on 18" C-C | #4 on 18" C-C | #4 on 18" C-C | #4 on 18" C-C | #4 on 18" C-C | #4 on 18" C-C |

*(1) All sections shall have a minimum of 8" stabilized subgrade of either lime/cement, lime only, or cement only mix at rates specified by the geotechnical investigation to achieve a modulus of subgrade reaction of 300 pci, but in no case less than the standard.*

*(2) Refer to **Section 9.04** for allowable subgrade alternatives.*

*(3) Street Department residential street section may have an 8" stabilized subgrade of TxDOT Item 260 Type D crushed concrete with 5% cement slurry per current City criteria in lieu of 8" stabilized subgrade of lime/cement mix.*

*(4) In lieu of 8" stabilized subgrade of lime/cement mix, alley pavement may be placed on compacted subgrade contingent that a modulus of subgrade reaction of 300 pci can be achieved with existing materials which shall be proven out in the Geotechnical Report.*

*(5) Concrete strength of 4,000 psi shall be Class P1 per NCTCOG Item 303.*

D. All roadways and alleys (CIP and Development) shall have a geotechnical investigation and subgrade design performed meeting the following requirements. If after the geotechnical investigation, the soil parameters and standard subgrade result in a modulus

of subgrade reaction of 300 pci and all other parameters are applicable, the City's standard subgrade and pavement can be specified per **Table 9.1**. If not, a custom pavement design to achieve a 40-year design life will be required. If the soil parameters and standard subgrade exceed the parameters specified in this section, a pavement design may be performed to reduce the concrete thickness within the allowable reduction as defined in **Section 9.05**. Geotechnical investigations are not required for street maintenance projects and panel replacements.

1. Results of the geotechnical investigation, engineering analysis, and recommendations shall be presented in a Geotechnical Report for Roadways (Report). The Report and any subsequent re-evaluations and/or supplemental reports shall be signed and sealed by a Professional Engineer licensed in the State of Texas trained and qualified to provide geotechnical engineering analysis and pavement and subgrade design recommendations. A PDF of the report shall be required and submitted with the first submittal of Civil Engineering Construction Plans where any public roadway is being proposed or reconstructed. Not including a report with the first submittal of construction plans may deem the submittal incomplete and may be returned un-reviewed.

2. The Report shall address all items listed in the Geotechnical Report for Roadways Checklist (Checklist) in **Appendix 9A**. The Checklist shall be filled out completely and submitted with the Report. Any "N/A" response on the Checklist shall include a written explanation and adequate justification as deemed necessary by the Director of Engineering.

3. If the Standard Pavement Section in **Table 9.1** is not valid or electing to deviate from the standards, then the Summary of Geotechnical Recommendations Form (Form) in **Appendix 9B** shall be filled out completely and submitted with the Report.

4. City review of the Report will be conducted as a means to verify if the pavement and subgrade design has been performed in general conformance to the City's requirements and shall not be considered a detailed technical review of the pavement and subgrade design for adequacy, accuracy, or completeness. The Geotechnical Engineer performing the subgrade design (and pavement design, if applicable) shall remain responsible for the technical adequacy, accuracy, and completeness of the pavement and subgrade design and shall not be relieved of any responsibility for such as a result of the City's review.

5. The information and recommendations contained in the Report and any subsequent re-evaluation and/or supplement reports shall be accepted by the Director of Engineering in writing prior to Release of Construction.

E. The results of the geotechnical engineering analysis shall verify if the existing soils on-site can achieve the City's minimum standards. Refer to **Table 9.5** for applicable parameters that must be met. If soil parameters cannot achieve a 300 pci modulus of subgrade reaction, a pavement and subgrade design must be performed per **Section 9.05**.

F. Proposed median openings, turn lanes, and deceleration lanes on existing streets shall be designed in accordance with the Standard Details and do not require a geotechnical

investigation. In lieu of 8" stabilized subgrade of lime/cement mix, additional 2" of concrete can be used on compacted subgrade.

G. Alley paving shall be designed in accordance with the Standard Details contingent that a modulus of subgrade reaction of 300 pci can be achieved with existing materials which shall be proven out in the Geotechnical Report.

H. Expansion joints shall be at PC, PT, and intersections and shall be spaced at 600 feet maximum intervals for all roadways and alleys. Expansion joints shall have smooth dowels at 12" on-center spacing. The dowel size and length shall be in accordance with **Table 9.2**. Refer to the City's Standard Details for more information on jointing layouts.

**TABLE 9.2: Expansion Joint Dowel Size**

| Concrete Thickness (inches) | Dowel Size, Diameter (inches) | Dowel Length (inches) |
|---|---|---|
| 11 | 1.0 | 24 |
| 10 | 1.0 | 24 |
| 9 | 1.0 | 24 |
| 8 (and alleys) | 1.0 | 24 |
| 7 | 0.75 | 24 |
| 6 | 0.75 | 24 |

I. Saw and construction joint spacing and depth are based on concrete thickness. All sawcuts shall be 1/8" to 1/4" wide and one-fourth the depth of the concrete thickness. Refer to **Table 9.3**. Refer to the City's Standard Details.

**TABLE 9.3: Saw and Construction Joints**

| Concrete Thickness (inches) | Maximum Joint Spacing (feet) |
|---|---|
| 11 | 20 |
| 10 | 20 |
| 9 | 15 |
| 8 (and alleys) | 15 |
| 7 | 15 |
| 6 | 15 |

J. Refer to the City's Standard Details and the North Central Texas Council of Governments (NCTCOG) *Public Works Construction Standards North Central Texas* edition(s) currently adopted by the City and any City adopted amendments for additional specific requirements related to pavement and subgrade.

## 9.02 Existing Surface/Subsurface Investigation

A. Field investigation shall include the following:

1. Borings shall be drilled on center of proposed roadway, or within the center of proposed roadway widening, at maximum 500-foot spacing, along the roadway alignment to depths of at least 20 feet below finished subgrade or until competent

rock is encountered, whichever is shallower. If mass grading results in cuts greater than 10 feet, boring depths shall be increase 10 feet for each 10 feet of cut. Where existing roadways exist, borings may be taken just outside the limits of the existing roadway. Additional borings may be required between borings (< 500-foot spacing or > 20-foot depth) if anomalies exist at the discretion of the City, including, but not limited to, changed conditions, outcropping, creek crossings, trees, exposed rock, borrow/fill pits, groundwater, and/or history of subgrade and pavement failures. Refer to **Section 7.03** for boring requirements for structures. Additional borings may be requested by the Director of Engineering.

2. Geotechnical investigation must address heavily treed areas, where such trees are to be removed. Additional borings may be required in these areas.

3. Borings shall be sampled at 3-foot intervals (or less) to a depth of 10 feet below finished subgrade, and at 5-foot intervals or less thereafter.

B. Laboratory investigation shall include the following:

1. Moisture Content Tests (ASTM D 2216) shall be performed. When the samples are wetter than normally expected due to seasonal variability, the samples shall be air dried such that the samples represent the drier portion of the year.

    a. For samples taken during the months of July through October, use the mean swell percentage to determine the design swell percentage.

    b. For samples taken during the months of November through June, use the mean plus one standard deviation to determine the design swell percentage.

2. Soil types in each boring shall be classified including the following:

    a. Atterberg limits (ASTM D 4318);

    b. Percent Passing the No. 200 sieve (ASTM D 1140); and,

    c. Moisture/Density.

C. A geotechnical re-evaluation will be required if the following situations occur:

1. If more than two months occur between the end of initial grading and beginning of liming operations or otherwise approved by the Director of Engineering;

2. When conditions have changed significantly between initial grading and liming operations;

3. If material is encountered during construction that varies from the surrounding bore results (i.e. soft packets of sand or clay);

4. If public infrastructure is being placed on undocumented fill;

5. When Contractor and/or Owner have not properly maintained moisture content; or,

6. As deemed necessary by the Director of Engineering due to unseasonable drought or wet conditions.

D. Any undesirable materials within the City Right-of-Way (ROW) and easements shall be excavated, materials removed, and filled with compacted select fill. Undesirable materials to be removed include, but are not limited to, organic material, unstable material, or undocumented fill. All materials removed shall be disposed of according to the Health Department and TCEQ regulations. Select fill shall be provided, placed, and compacted in accordance with TxDOT current edition of *Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges* Item 132. Select fill shall be capable of forming a stable embankment from the required excavation and shall be granular material that is free from vegetation or other objectionable material and shall meet the requirements of TxDOT Item 132.2 Type A. The existing subgrade shall provide a stable working platform when the soil is compacted to a density of 95% of standard proctor at optimum moisture content according to ASTM D698.

E. If required, the re-evaluation shall include additional field and laboratory testing to either confirm recommendations are still acceptable or determine how to rectify the substandard condition prior to liming operations. Borings for the re-evaluation will be required on center of roadway at 1,000-foot spacing (or less) to a depth of at least 20 feet below finished grade or until competent rock is encountered, whichever is shallower.

## 9.03 Subsurface Design

A. Laboratory investigation elements shall include determining swell characteristics and movement potential using the Swell Test and the calculated Potential Vertical Rise (PVR) – TxDOT Tex-124-E methods for a 20-foot depth of moisture penetration. The results of both tests shall be included in the Report. The Geotechnical Engineer shall use the more conservative value in determining swell potential and depths of moisture treatment.

   1. Swell Test: Test for swell potential using swell test (ASTM D 4546) at least one sample per boring to approximate overburden pressure at the specific test depth to determine the average swell potential of the subgrade. If swell potential is greater than 2%, the Geotechnical Engineer shall provide recommendations to reduce the swell potential to 2% or less.

   2. PVR-TxDOT Tex-124-E: Test for swell potential using swell test (ASTM D 4546) necessary to calculate PVR for a 20-foot moisture penetration. The PVR shall be calculated based upon 20-foot moisture penetration and shall provide moisture treatment depth to limit PVR to 4.5 inches in accordance with TxDOT testing requirements.

B. The Geotechnical Engineer shall address transitions between zones of varying depths of moisture treatment. Zones shall remain at the most conservative depth 150 feet from the location of the boring resulting in the greatest depth, prior to transitioning to a zone with less moisture conditioning depth. In no case shall the transitions be greater than 1H:1V.

C. If street trees are proposed within 10-feet of the limits of the treated subgrade, the Geotechnical Engineer shall address this condition in the Report and specify the use of the City's Standard Detail and/or propose an alternate moisture/root barrier for the City's review.

D. If existing trees are removed within the limits of the treated subgrade, the Geotechnical Engineer shall address mitigation of this condition in the Report.

E. Geotechnical Report shall provide recommendations to mitigate for swell potential exceeding 2% (for Swell Test) or 4.5 inches (for PVR-TxDOT Tex-124-E), including moisture conditioning treatment.

F. All subsurface improvements shall be in accordance with a technical specification provided by the Geotechnical Engineer and shall be approved by the Director of Engineering.

## 9.04 Subgrade Design

A. The subgrade must achieve a modulus of subgrade reaction of at least 300 pci. If the existing soils meet a modulus of subgrade reaction of at least 300 pci, the minimums are still required unless rock is encountered. If rock is present, the Geotechnical Engineer must validate it is suitable to serve as a subgrade. The following subgrade types are acceptable (8" minimum thickness). The report shall provide analysis showing that the proposed subgrade improvements or the standard subgrade treatment per **Table 9.1** will achieve a modulus of subgrade reaction of 300 pci. If deviations from the standard subgrade treatment are proposed, the report shall meet all of the following requirements:

1. Lime/Cement – The City's standard application rate is 18 pounds per square yard lime and 36 pounds per square yard cement. All sections shall have a stabilized subgrade of lime/cement mix at rates specified by the geotechnical investigation, but in no case less than the standard, and in accordance with the City's Technical Specifications.

2. Lime – The City's minimum application rate is 8%. All sections shall have a stabilized subgrade at rates specified by the geotechnical investigation, but in no case less than the standard, and in accordance with the City's Technical Specifications.

3. Cement – The City's minimum application rate is 8%. All sections shall have a stabilized subgrade at rates specified by the geotechnical investigation, but in no case less than the standard, and in accordance with the City's Technical Specifications.

4. Crushed Concrete/Flexible Base – TxDOT Item 260 Type D crushed concrete with 5% cement slurry.

5. Approved Equal – Alternative subgrade types may be approved at the discretion of the Director of Engineering.

B. Laboratory investigation elements include:

1. Lime stabilization series for each soil type expected to be in the upper 12 inches of the subgrade. The Eades-Grimm method of pH testing shall be used to obtain a beginning point. Additional testing shall be performed for each soil type to determine lime content. Minimum design criteria are:

    a. pH = 12.4 (or maximum pH) after mellowing (ASTM D 2976)

b. Swell potential <1.0% under 125 psf stress test (ASTM D 4546)

c. The minimum lime content shall be the percentage, by weight, of hydrated lime as determined by lime stabilization series plus 1.0% and in no case be less than the City's standard requirements as listed in **Table 9.1**.

2. Test for sulfates in the upper 10 feet at one-foot intervals of the finished grade in each boring using TxDOT Tex-145-E with 20:1 dilution ratio. Provide testing to determine the levels of sulfate present in all soil types in the upper 10 feet.

3. Formations having between 3,000 and 8,000 ppm sulfates shall be lime stabilized using a double application method. Refer to the City's Technical Specifications for lime application methods.

C. Alternative subgrade options may be proposed by the Geotechnical Engineer and may be approved by the Director of Engineering.

D. All subgrade improvements shall be in accordance with the City's Technical Specifications unless otherwise approved by the Director of Engineering.

## 9.05 Pavement Design

A. If the Standard Pavement Section in **Table 9.1** is not valid or if the Geotechnical Engineer elects to deviate from the standards, then all requirements of this section shall be met. All concrete pavement shall be in accordance with City's Technical Specification, Standard Details, and General Notes unless otherwise approved by the Director of Engineering.

B. The Standard Pavement Sections listed in **Table 9.1** are based on the Pavement Design Input Values contained in **Table 9.5**. The Pavement Design Input Values are minimums. It is the Geotechnical Engineer's responsibility to ensure those input values are applicable based on actual conditions. Additional pavement reinforcing shall be evaluated and determined for all concrete pavement sections thicker than 13 inches.

C. If an alternate pavement section less than the City standard is considered (i.e., when rock is present or when a modulus of subgrade reaction of at least 300 pci can be achieved), a pavement design will be required and must be designed using the Pavement Design Input Values contained in **Table 9.5** with a higher modulus of subgrade reaction (based on actual conditions). The Geotechnical Engineer must validate the rock/subgrade they have encountered with a modulus of subgrade reaction of at least 300 pci is suitable to serve as a subgrade.

1. **Table 9.4** includes the maximum reduction of concrete thickness that will be considered.

2. The allowable reduction shall be based on a Geotechnical Engineer's recommendation and must be based on a 40-year design life.

3. All pavement thicknesses shall be rounded up to the nearest inch.

**TABLE 9.4: Maximum Allowable Pavement Thickness Reduction Amount**

| Thoroughfare Classification | Maximum Allowable Reduction Amount (inches) (1) |
|---|---|
| Types A and B | 3 |
| Types C and D1 | 2 |
| Type D2 | 2 |
| Type E | 3 |
| Type G (Residential) | 0 |

*(1) Refer to **Table 9.1** for standard concrete pavement thicknesses.*

D. Pavement design shall be based on American Association of State Highway and Transportation Officials (AASHTO) current edition of *Guide for Design of Pavement Structures* utilizing WinPAS, Pavement Analysis Software. A *Rigid Pavement Design* printout from the WinPAS software program showing all inputs and a section achieving a 40-year design life shall be required.

## TABLE 9.5: Pavement Design Input Values

| Pavement Design Inputs [1] | Type A | Type B | Types C and D1 | Type D2 | Type E | Type G (Residential) |
|---|---|---|---|---|---|---|
| Design Period (years) | 40 | 40 | 40 | 40 | 40 | 40 |
| Reliability, R (percent) | 90 | 90 | 90 | 90 | 90 | 85 |
| Overall Standard Deviation, $S_0$ (psi) | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 |
| Concrete Modulus of Rupture @ 28 days, $S'_C$ (psi) | 620 | 620 | 620 | 620 | 620 | 620 |
| Concrete Modulus of Elasticity @ 28 days, $E_C$ (psi) | 5,000,000 | 5,000,000 | 5,000,000 | 5,000,000 | 5,000,000 | 5,000,000 |
| Drainage Coefficient, $C_d$ | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Load Transfer Coefficient, J | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 |
| Initial Pavement Serviceability, $P_0$ | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
| Terminal Pavement Serviceability, $P_t$ | 2.5 | 2.5 | 2.3 | 2.3 | 2.3 | 2.0 |
| Thickness of Subgrade (inches) | 8 | 8 | 8 | 8 | 8 | 8 |
| Modulus of Subgrade Reaction, k (pci) [2] | 300 | 300 | 300 | 300 | 300 | 300 |
| Loss of Support, LS | 0 | 0 | 0 | 0 | 0 | 0 |
| Design Average Daily Traffic (ADT) | 45,000 | 45,000 | 29,000 | 17,500 | 17,500 | 5,000 |
| Traffic Growth Rate | 0% | 0% | 0% | 0% | 0% | 0% |
| Percent Trucks [3] | 4% | 3% | 2% | 2% | 3% | 0.5% |
| Lanes | 6 | 6 | 4 | 5 | 5 | 2 |
| Lane Distribution Factor | 0.7 | 0.7 | 1.0 | 1.0 | 1.0 | 1.0 |

*(1) Pavement design inputs based on AASHTO's current edition of Guide for Design of Pavement Structures. Refer to AASHTO's current edition of Guide for Design of Pavement Structures for further description and procedure.*

*(2) Modulus of subgrade reaction based on average soil condition with 8" Lime/Cement Mix of 18#/SY Lime and 36#/SY Cement, 8% Lime, 8% Cement, 8" Crushed Concrete, or 8" Flexible Base. Actual will vary based on site condition. Subgrade treatment must be provided to achieve at least a modulus of subgrade reaction of 300 pci.*

*(3) If anticipated percentage of trucks for the proposed roadway or development exceeds the minimum criteria shown in **Table 9.5**, the actual percentage based on traffic counts and a traffic study as approved by the Transportation Department shall be used. Trucks are defined as all vehicles 3 axle (48 kips, 1.48 design ESAL per vehicle) or greater.*

# APPENDIX

# Appendix – Index

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N/A

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N/A

**Appendix Section 9:**

9A Geotechnical Report for Roadways Checklist

9B Summary of Geotechnical Recommendations Form

## Appendix 9A: Geotechnical Report for Roadways Checklist

**Project Case Number:** _____ **Project Name:**_____

**Geotechnical Engineer/Firm:** _____

**Texas Firm Registration No.:** _____ **Report Date:** _____ **Date Received:**_____

A PDF of the report shall be required and submitted with the first submittal of Civil Engineering Construction Plans where any public roadway is being proposed or reconstructed. Not including a report with the first submittal of construction plans may deem the submittal incomplete and may be returned un-reviewed.

*Note: All roadways and alleys (CIP and Development) shall have a geotechnical investigation and subgrade design performed. All investigations must fulfill and comply to all components of **Section 9.01**, **9.02**, **9.03** and **9.04** of the TSM. The requirements of **Section 9.05** are only applicable if Standard Pavement Section in **Table 9.1** is not valid or electing to deviate from the standards in **Table 9.1** or **Table 9.5**. Any N/A response shall include a written explanation with adequate justification, as deemed necessary by the Director of Engineering.*

| COMPLETE | N/A | 1. SECTION 9.01 GENERAL |
|---|---|---|
| ☐ | ☐ | A. Include the *Summary of Geotechnical Recommendations Form* |
| ☐ | ☐ | B. Description of Project |
| ☐ | ☐ | C. Location of Project |
| ☐ | ☐ | D. Roadway type and classification |
| ☐ | ☐ | E. Grading plan and summary |
| ☐ | ☐ | F. Discussion of underground utilities within the Project limits |

| COMPLETE | N/A | 2. SECTION 9.02 EXISTING SURFACE/SUBSURFACE INVESTIGATION |
|---|---|---|
| ☐ | ☐ | A. Discussion of existing surface/subsurface conditions that may affect subgrade and pavement design or performance (i.e., ability to achieve 300 pci, vegetation, terrain, existing structures, existing pavement, etc.) |
| ☐ | ☐ | B. Discussion of geological conditions that may impact subgrade and pavement design or performance. Specify formation. |
| ☐ | ☐ | C. Surface/subsurface conditions with logs<br>• Sampling techniques (ex. borings meeting 9.02.A, etc…)<br>• Description of soil and rock encountered, including lab test details<br>• Discussion of water and groundwater conditions<br>• Discussion of seasonal variations in moisture content<br>• Atterberg limits (ASTM D 4318)<br>• Percent Passing the No. 200 sieve (ASTM D 1140) |
| ☐ | ☐ | E. All standards used in field and laboratory testing shall be identified. Any deviations to standard procedures shall be discussed. |

| COMPLETE | N/A | 3. SECTION 9.03 SUBSURFACE DESIGN |
|---|---|---|
| ☐ | ☐ | A. Expansive Soils Evaluation<br>• Percent swell calculation and test results<br>• Effect of cut/fills (i.e., long-term soil uplift in cut areas; settlement overburden pressure effects in fill areas)<br>• Identify soil movement estimates at each boring location<br>• Explanation of anomalous variations within the soil profile and between borings (i.e., Atterberg limits, PI, sulfates, clay to rock, etc.) |

☐ ☐ B. Soil Moisture Conditioning and/or Additional Subsurface Conditions

- Discussion of swell test results summary
- Recommended depth of moisture conditioning
- Address transition between zones of varying depth
- Discussion of possible variations during construction and mitigation thereof
- Discussion of techniques to maintain moisture in soil
- Discussion of methods to test soil moisture conditioning during construction (i.e., a second geotechnical investigation/re-evaluation may be required to specifically address soil moisture prior to lime operations)
- Address street trees

**COMPLETE N/A 4. SECTION 9.04 SUBGRADE DESIGN**

☐ ☐ A. Subgrade Stabilization

- Typical subgrade type and documentation validating subgrade type can achieve a subgrade reaction of 300 pci
- Explanation of anomalous soil conditions anticipated and discussion of potential variations to consider
- Construction techniques to implement
- Effects of rock/rock fragments encountered during construction and recommendations to abate

☐ ☐ B. Soluble Sulfates

- Identify soluble sulfate test results; summarize results and discuss variations
- Discussion of techniques during construction to mitigate sulfate-induced heaving
- Sulfate retesting during construction

**COMPLETE N/A 5. SECTION 9.05 PAVEMENT DESIGN** (Pavement Design only applicable if Standard Pavement Section in **Table 9.1** is not valid or electing to deviate from the standards)

☐ ☐ A. Identify roadway type(s) and classifications(s)

☐ ☐ B. Identify deviations from Pavement Design Input Values (Re: **Table 9.5**)

☐ ☐ C. Identify recommended pavement section

**COMPLETE N/A 6. APPENDIX**

☐ ☐ A. Geological Map

☐ ☐ B. Boring Locations

☐ ☐ C. Boring Logs

☐ ☐ D. Grading Plan (for non-linear projects)

☐ ☐ E. Cut vs. fill by station number or proposed road profiles (for linear projects)

☐ ☐ F. Printout from WinPAS pavement design software program (if applicable)

☐ ☐ G. Proposed typical section with dimensions showing pavement thickness, subgrade type and thickness, and moisture conditioning depth. If applicable, location of proposed trees and root barriers shall be shown.

**Geotechnical Engineer Printed Name:** _____

**Geotechnical Engineer Signature:** _____ **Date:** _____

## Appendix 9B: Summary of Geotechnical Recommendations Form

**Project Case Number:** _____

**Project Name:** _____

**Geotechnical Engineer/Firm:** _____

**Texas Firm Registration No.:** _____

**Report Date:** _____ **Date Received:** _____

*Note: Pavement Design only applicable if Standard Pavement Section in **Table 9.1** is not valid or electing to deviate from the standards in **Table 9.1** or **Table 9.5**. Geotechnical Engineer must fill out this form completely and submit with the Report.*

**1. Design Input Values:**

Thoroughfare Classification(s): _____

Geological Formation from Geological Atlas of Texas, Dallas Sheet (circle all that apply):

Ozan Formation (Clay or Lower Taylor Marl)

Austin Chalk

Alluvial and Terrace Deposits

Other/Explain: _____

Pavement Design Input Value Deviation(s) from **Table 9.5**: _____

**2. Design Recommendations**:

Moisture Conditioning Depth (inches): _____ *If yes, include plan layout depicting limits*

Subgrade Treatment: _____ *Lime/Cement, Lime, Cement, Crushed Stone*

Lime/Cement Thickness (inches): _____

Lime/Cement Application Rates: _____

Alternate Subgrade (Y/N): _____ *If yes, describe*

Concrete Thickness (inches): _____

**Miscellaneous Items and Notes:**

_____

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**Miscellaneous Items and Notes Continued:**

**Geotechnical Engineer Printed Name:** _____

**Geotechnical Engineer Signature:** _____ **Date**: _____

**Geotechnical Engineer Seal, Signature, and Date:**