2.2. GEOTECHNICAL

All projects require a geotechnical investigation of the soils. All soil reports must be submitted to Ivins City for review and concurrence.

2.2.1. MINIMUM LEVEL OF INVESTIGATION

A. Subdivisions and Site Developments:

1. Minimum required extent and depth of exploration shall be in accordance Ivins City Form 7039 Geotechnical Report Check List as provided for reference in appendix E.

2. This form shall be submitted with any geotechnical report (at preliminary plan for subdivisions, prior to submittal of construction drawings for site developments).

3. Subdivisions and Site Developments must also comply with minimum requirements for new construction of streets where applicable.

B. For New Construction or Reconstruction of Arterial and Major Collector Streets:

1. For new construction and reconstruction projects, the minimum sampling requirements are as follows:

   - Excavate test holes to a minimum depth of 5 feet below subgrade.
   - 3 test holes for the 1,000 feet and 1 for every 700 feet thereafter, or as soil type varies.

2. Calculate “R” values using AASHTO T 190-93 or ASTM D2844-69 (1975) using exudation pressure of 300 PSI (2070 Kpa) corrected to 2.50 inches (63.50 mm) specimen. Calculate “CBR” values using AASHTO T 193-93 three point using T 180 (Method D) for mold compaction with exceptions as listed in 5.1.1 through 5.1.3 of Test Method T193-93. Minimum testing frequency is:

   - 2 tests with at least 1 test per significant soil type for roadway lengths up to 1,000 feet.
   - 3 tests with at least 1 test per significant soil type for roadway lengths of 1,000 feet to 5,000 feet.
   - 4 tests with at least 1 test per significant soil type for roadway lengths of 5,000 feet to 16,000 feet.
   - 2 tests per 5,000 feet of roadway with at least 1 per significant soil type for any roadway over 16,000 feet.

3. Conduct sieve analysis using either AASHTO T27-91 or ASTM C136-95. Conduct a sand equivalent test to determine the presence or absence of plastic fine material using either AASHTO T176-86(1993) 4.3.2 alternate method No. 2, pre-wet 4.3.3

mechanical shaker or ASTM D2419-91 9.4.2 Procedure B, 11.6.1 mechanical shaker. Minimum testing frequency is:

- 1 test for each stratum.

4. Calculate density in place using the drive-cylinder method ASTM D2937-83 or nuclear method ASTM D2922-93. Minimum testing frequency is:

   - 2 tests per test hole.

5. Expansion index of soils shall be determined using the Standard 60 pound swell test method per Section 1802.3.3 of the Southern Nevada Amendments to the 2006 International Building Code.

   - This test shall be conducted whenever potentially expansive soils are encountered in a test hole.

6. The above testing and design requirements may be waived by the City's Representative providing a prior development has already performed the above testing, design and construction on the first half of the roadway in the same location. In this case the new development shall be equal to or greater than the existing roadway section.

2.2.2. PAVEMENT DESIGN

A. Pavement designs are based on traffic indices. The following table shows what traffic index should be used for each road functional classifications for the design of pavements. Also shown are minimum asphalt concrete (AC) thicknesses.

Table 2.2.2 Traffic Index Requirements

Road Functional Classification	Projected ADT	Traffic Index	Minimum AC Thickness (inches)	Minimum Base Thickness (inches)
Residential	10 to 1,250	5	2.5	6
Residential Collector	1,260 to 2,000	5	3.0	6
Minor Collector	1,260 to 2,000	5.5	3.0	6
Major Collector	2,010 to 6,000	6	3.0	8
Minor Arterial	6,000 to 20,000	7	4.0	8
Major Arterial	20,000 to 40,000	8	4.0	8
Local Commercial		10	4.0	8
Local Industrial		10	4.0	8

B. Pavement must be designed structurally by accepted Engineering design methods for flexible pavement (i.e. AASHTO, UDOT, CALTRANS).

2.2.3. ROAD SUBGRADES

The geotechnical engineer shall identify each type of soil involved in the project and recommend subgrade preparations in accordance with geotechnical best practices. Geotech shall classify soils in accordance with AASHTO T-27, determine “R” value or “CBR” value for each soil type and subgrade preparation requirements shall be as a minimum:

A. Class A-1, A-2, A-3 or A-4 Soils: The subgrade shall be scarified to a depth of 8 inches, moisture conditioned and compacted.

B. Class A-5 Soils: The subgrade shall be over-excavated a minimum of 8 inches, replaced with a Class B aggregate (Section 32 11 23).

C. Class A-6 or A-7 Soils: The subgrade shall be over-excavated and reconditioned in accordance with geotechnical recommendations.

AASHTO Soil Classification System Chart from AASHTO M 145 or ASTM D3282 is provided for reference:

Table 2.2.3 AASHTO Soil Classification System Chart

General Classification	Granular Materials (35% or less passing the 0.075 mm sieve)							Silt-Clay Materials (>35% passing the 0.075 mm sieve)			
Group Classification	A-1		A-3	A-2				A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6
Sieve Analysis, % passing											
2.00 mm (No. 10)	50 max	…	…	…	…	…	…	…	…	…	…
0.425 (No. 40)	30 max	50 max	51 min	…	…	…	…	…	…	…	…
0.075 (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)											
Liquid Limit	…		…	40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min[(1)]
Plasticity Index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min
Usual types of significant constituent materials	stone fragments, gravel and sand		fine sand	silty or clayey gravel and sand				silty soils		clayey soils	
General rating as a subgrade	excellent to good							fair to poor			

Note (1): Plasticity index of A-7-5 subgroup is equal to or less than the LL - 30. Plasticity index of A-7-6 subgroup is greater than LL - 30

2.2.4. UTILITY TRENCH BACKFILL MATERIAL

A. The geotechnical engineer shall classify materials for suitability of trench backfill material as follows:

Class I: Crushed Stone
Class II: Gravelly Sand (GW, GP, SW, SP, GW-GC, SP-SM, Non plastic SM*)
Class III: Sandy Silt (GM, GC, SM, SC)
Class IV: Inorganic clays (ML, CL, MH, CH)
Class V: Organic soils (OL, OH, PT)

Based on ASTM D2321 with a modification as noted with asterisk(*). Refer to Construction Specification Section 33 05 20 Backfilling Trenches as modified by Ivins City.

2.2.5. COLLAPSIBLE SOILS

A. Collapsible soils are common in Ivins City and design of pavements and structural foundations shall consider this serious soil hazard. All public streets and utilities constructed over collapsible soils shall employ mitigation techniques as recommended by the geotechnical engineer to ensure stable streets and utilities.

2.2.6. EXPANSIVE SOILS

A. Expansive soils are common in Ivins City and design of pavements and structural foundations shall consider this serious soil hazard.

B. All public streets and utilities constructed over expansive soils shall employ mitigation techniques as recommended by the geotechnical engineer to ensure stable streets and utilities.

2.2.7. GROUNDWATER

A. Shallow groundwater shall be considered as a potential problem in all areas where any of the following conditions exist:

1. Historic seepage of groundwater to the surface is evident by the presence of alkali salts on the ground surface.

2. Test pits or borings show any groundwater within 5 feet of the ground surface. Areas where soils are clayey shall install temporary piezometers to verify the absence of shallow groundwater.

3. The area has similar soils adjacent to an area with evident surface alkali salts.

B. Anywhere groundwater is considered a potential problem, a groundwater investigation shall be conducted prior to any subdivision or site development construction drawing approval. The groundwater investigation shall at a minimum:

1. Describe the risk of shallow groundwaters to surface.

2. Install a sufficient number of groundwater monitoring wells.

3. Determine an approximate contour map of the groundwater surface. Show the direction of flow.

4. Identify potential sources of the groundwater.

5. Determine the following chemical properties of the groundwater:

   - pH
   - Total dissolved solids
   - Sulfates
   - Hardness
   - Selenium

6. Determine measures to mitigate/prevent groundwater from surfacing within areas to be developed with any habitable structure or paved streets, sidewalks, curbs and gutters.

C. It is recommended that, prior to a groundwater investigation, the firm conducting the study submit a scope of work for City concurrence. If firm fails to submit scope, the City may require additional monitoring prior to approval of the study. Monitoring of the wells may be required for up to 1 year.

D. If a groundwater analysis is conducted, the drains to mitigate surface groundwater may be as designed by a professional geotechnical engineer and in accordance with a groundwater analysis. Basements may be considered as recommended by the geotechnical engineer.

E. No groundwater drainage system shall affect downstream private properties without written permission.

F. All groundwater drains shall discharge to an approved drainage facility in a location as approved by the City Engineer.

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