GEOTECHNICAL INFORMATION

I. Minimum Information required for a Geotechnical Report

A. Plan view showing boring locations
   1. Boring logs¹
      a. Elevation
      b. Drill or backhoe type
      c. Samples
      d. Field tests
      e. Ground water level fluctuations

B. Laboratory tests-Performed in general accordance w/ ASTM
   1. Sieve analysis
   2. Atterberg limits
   3. CBR
   4. Direct Shear
   5. Consolidation
   6. Identify soils according to USCS
   7. Moisture density curves(s)

C. Engineer Analysis and recommendations
   1. Foundations and Retaining Walls
      a. Allowable bearing capacity
      b. Lateral loads Friction coefficients
      c. Settlement
      d. Drainage - Backfill information
      e. Seismic loading
   2. Pavements
      a. Traffic
      b. Subgrade support value (CBR)
      c. Pavement, roadbase, and subgrade thickness
      d. Compaction requirements, including maximum lift thickness of backfill, and acceptability of backfill with native soils. Minimum requirements are set by City standards.
   3. Special Consideration
      a. Site preparation - use of on-site materials
      b. Expansive soils
      c. Collapsible soil
      d. Slope stability
      e. Shallow ground water level - drainage, etc.
      f. Surcharge / preloading (if used, developer needs to install settlement monitors and elevations benchmark.)

¹ - The number and depth of borings/pits are to be determined for each specific project. However, as a minimum, the depth should be deeper than any anticipated excavation (cuts, foundations, utilities, etc.). The number of borings shall be determined by the geotechnical engineer/geologist and shall be compatible with the complexity/simplicity of the geology, subsurface conditions and the type of project.
g. Identification of geological hazards

D. Following the construction of the utilities in the street within the development and prior to submittal of the Final Dedication Plat for signatures, the Developer may be required to submit written documentation from the consulting Geotechnical Engineer, the Design Engineer, and the Contractor, indicating that each have received and read the Geotechnical Report and have incorporated the recommendations into the design and construction of the development. (A standard form can be obtained from our Legal Department.)

II. Subgrade Soil Classification

A. The following table defines the soil classification:

<table>
<thead>
<tr>
<th>Subgrade Soil Classification</th>
<th>Characteristics of Soil</th>
<th>CBR Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Poor Subgrade Soil</td>
<td>Clay &amp; fine silt - Extremely soft and plastic when wet</td>
<td>&lt;3</td>
</tr>
<tr>
<td>Poor Subgrade Soil</td>
<td>Clay, fine silt and sandy soils – soft and plastic when wet</td>
<td>3 - 8</td>
</tr>
<tr>
<td>Medium subgrade soil</td>
<td>Silty sands and some clayey sand-gavels, retain moderate degree of firmness with moisture</td>
<td>8 - 17</td>
</tr>
<tr>
<td>Good to Excellent subgrade soil</td>
<td>Gravelly sand, sandy gavels, retains strength when saturated.</td>
<td>&gt;15</td>
</tr>
</tbody>
</table>

III. Armor coating or facing of soil slopes

Two acceptable types of armor facing

<table>
<thead>
<tr>
<th>Maximum Slope</th>
<th>Well graded pit run gravel</th>
<th>Sieve Size</th>
<th>Percent Passing</th>
<th>Angle H:V</th>
<th>Height</th>
<th>Height</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>8&quot;</td>
<td>90-100%</td>
<td>1½:1</td>
<td>&lt;6'</td>
<td>&gt;6'</td>
<td>&gt;12'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3&quot;</td>
<td>60-90%</td>
<td>1 3/4:1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1&quot;</td>
<td>40-80%</td>
<td>2:1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>½&quot;</td>
<td>30-50%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>#4</td>
<td>20-40%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>#200</td>
<td>0-10%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Maximum Slope

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent</th>
<th>Height</th>
<th>Angle H:V</th>
</tr>
</thead>
<tbody>
<tr>
<td>36&quot;</td>
<td>90-100%</td>
<td>&lt;6'</td>
<td>1:1</td>
</tr>
<tr>
<td>18&quot;</td>
<td>50-100%</td>
<td>&gt;6'</td>
<td>1¼:1</td>
</tr>
<tr>
<td>12&quot;</td>
<td>20-100%</td>
<td>&gt;12'</td>
<td>1½:1</td>
</tr>
<tr>
<td>4&quot;</td>
<td>0-90%</td>
<td>&lt;6'</td>
<td>1:1</td>
</tr>
<tr>
<td>2&quot;</td>
<td>0-20%</td>
<td>&gt;6'</td>
<td>1¼:1</td>
</tr>
<tr>
<td>#200</td>
<td>0-10%</td>
<td>&gt;12'</td>
<td>1½:1</td>
</tr>
</tbody>
</table>

#### IV. Use of Filter Fabric for Street Construction

Normal woven or non-woven filter fabric is a viable material to use when a separation layer is needed over a soft subgrade and beneath granular fill. These materials provide some minor reinforcing for supporting loads, but primarily act to prevent the movement of muck fines up into the overlying crushed base or other clean granular material.

If reinforcement of soft subgrade is desired, a geo grid should be designed for the intended purpose.

#### V. Flowable Fill

Utility excavations and subsequent backfill are the source of many problems for paved streets. It is extremely difficult to nearly impossible to place the utility, and backfill the trench, so that some subsequent differential settlement does not occur at the pavement surface. Cost associated with supplying, placing in lifts, and compaction of conventional backfill materials is high and results are unsatisfactory to marginal. Therefore, "flowable fill" is a preferential backfill alternative for many utility installations beneath paved streets. Flowable fill generally consists of the following mix design or mixture of materials:

- **Per Cubic Yard**
  - 50 pounds of Portland Cement
  - 200 to 400 pounds of Fly Ash
  - 70% sand, 30% gravel by weight
  - 35 to 40 gallons of water

This generally costs more than conventional backfill, but is worth the extra cost. Another alternative that now offers considerable advantage, in that utility cuts through the pavement are eliminated, is trench-less technology. Use flowable fill prior to the application of asphalt finished surface in all excavations of twelve inches (12”) or less in width.

#### VI. Trench-less Technology

With recent advances in trench-less technology/directional drilling, many utilities can be placed beneath streets without making a pavement utility cut. This procedure should be used whenever feasible. When potholes are used to determine the location of utilities, pothole repairs will need to be made by back filling the hole with flowable fill and using Perma-Patch or an equivalent for the top three (3) inches. Contractor may not pothole for utilities when
depths can be determined by lifting manhole or valve covers.

VII. Grading permit requirements.

A. Submit site plan for review and approval. The site plan must include a SWPPP; limits of excavation; re-vegetation plan; cut/fill sheet; site stabilization plan/truck route to haul material and location of haul site. Additional items may be required based on a review of the submitted items and size of grading site.

VIII. Infiltration Test Requirements

A. The measured infiltration rate of the underlying soil shall be determined using the double ring infiltrometer test (ASTM D 3385). Two infiltrometer tests shall be performed with at least one per basin. Basins in excess of 10,000 square feet shall perform one additional test per each additional 10,000 square feet.

B. Test pits and borings (ASTM D 1452) shall be used to determine the USCS serices and textural class (SM, CL, etc.) of the soil horizons throughout the depth of the boring log or pi, the thickness of the soil and rock strata, and estimate the historical groundwater depth. Test pits or boring logs shall be of sufficient depth to establish that a minimum of 5 feet of permeable soil exists below the infiltration basin and that there is a minimum of 10 feet between the bottom of the infiltration facility and the historical high groundwater mark. One test pit or boring shall be performed per each basin location.

C. The final report, prepared by a registered civil engineer, geotechnical engineer, certified engineering geologist or certified hydrogeologist shall be provided to the City which demonstrates though infiltration testing and/or soil logs that the proposed facility location is suitable for the proposed infiltration facility and an infiltration rate shall be recommended. In addition, any requirement associated with impacts to a landslide, erosion or steep slope hazard area should also be addressed in the final report. The signed/stamped report shall include discussion and records of the infiltration testing as well as boring log findings. Based on the results of these test, the report shal provide an estimate of the infiltration rate found at the location of each proposed infiltration facility in units of inches per hour. A factor of safety of 3 shall be applied to the interpreted test results to determine the design infiltration rate for each infiltration facility. In addition, the report shall include complete field record with the following information:

1. Location of the test site
2. Dates of test, start to finish
3. Weather conditions, start to finish
4. Name(s) of technician(s)
5. Description of the test site, including assessment of boring profile and USCS soil classification
6. Depth to the water table and a description of the soils to a depth of at least 10 feet below the proposed infiltration surface
7. Type of equipment used to construct the boreholes or test holes (such as backhoe, hollow stem auger, etc.)
8. Areas of the rings or test hole diameter
9. Volume constants for graduated cylinder or Mariotte tube (if used)
10. Complete field results in tabular format
11. A plot of the infiltration rate verses total elapsed time
12. A labeled keymap showing test and boring locations
13. Confirmation that the soil was pre-saturated in accordance with the testing methods herein

D. Test may be performed only by individuals trained and educated to perform, understand, and evaluate the field conditions. The individual(s) supervising this field work shall be named along with their education or training background in the final report.

E. Preliminary site grading plans shall be provided to the City showing the proposed facility locations along with section views through each facility clearly identifying the extents of cut/fill.

F. All infiltration tests shall be performed within the boundaries of the proposed infiltration facility and at the bottom elevation (infiltration surface) of the proposed infiltration facility.
IRRIGATION SYSTEM IMPROVEMENTS

I. Pressure irrigation systems
   A. In areas served by Kays Creek Irrigation Company, Weber Basin Water District or by Davis Weber Canal Company, the developer shall install the pressure irrigation system.
      1. The system shall be installed if water is available to the site or is in the future service area for secondary water.
      2. The system shall be installed if water is apportioned to the land.
         a. No water may be moved or transferred from the site without Layton City Council approval.
   B. Lines 8 inches and larger shall be installed in the asphalt adjacent to the lip of the curb on either side of the street to avoid crossing the centerline at street curves. Lines 6 inches and smaller shall be installed in the 7.5 foot park strip or in the asphalt adjacent to the lip of the curb as directed by the irrigation company. If the park-strip is 4.5 foot wide, the location of the lines will be determined by the City Engineer and Irrigation Company. The design shall be reviewed by the City Engineer and approved by the irrigation company.
      1. The City Engineer may direct the lines to be installed at depths or locations different than the irrigation company minimum standards.
      2. The irrigation company shall provide a written statement approving the drawings before any final submittal is presented.
      3. If the secondary water provider is Davis and Weber Canal Company or Kays Creek Irrigation Company, a copy of the signed application for service and proof of payment of a reasonable connection fee must be submitted for final approval in addition to approval of the drawings.
      4. Valve boxes shall have a triangle shape lid to distinguish from the circular culinary valve lid.
      5. PVC pipes shall be purple in color and tracing wire shall be coated black to distinguish from the blue culinary water lines.

II. Flood irrigation systems
   A. The developer shall provide adequate conveyance for flood irrigation wastewater to pass around a developed subdivision.
      1. The conveyance may be either a pipe system or a dug channel. Submit a written approval for the relocation of the system. A pipe will be required if the system crosses any street or access way.
      2. The City Engineer and the local user shall approve the conveyance system.
   B. The developer will be required to install a pipe system to convey any supply or waste ditch that passes through the proposed subdivision.
      1. The pipe size shall be determined and approved by the local user and City Engineer. The pipe system shall meet all standards and specifications defined for storm drain pipe systems.
      2. The pipe system shall be installed either in the park strip area or behind the sidewalk if there are any diversion or control structures.