Allan E. Seward Engineering, Inc., "Geological Evaluation, San Fernando Valley Spineflower Occurrences" (October 2002)

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October 1, 2002 Job No: 02-1155SF-2

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Attn: Mr. Mark Dillon

Subject: **GEOLOGIC EVALUATION**
San Fernando Valley Spineflower Occurrences

Project: Airport Mesa, Grapevine Mesa, and San Martinez Grande Canyon Areas
Newhall Ranch, Los Angeles County, California

Gentlemen:

The following report presents the results of our geologic evaluation of the San Fernando Valley spineflower occurrences which were discovered at Airport Mesa, Grapevine Mesa and San Martinez Grande Canyon on Newhall Ranch, in northwestern Los Angeles County.

1.0 INTRODUCTION

Three occurrences of the San Fernando Valley spineflower (*Chorizanthe parryi* var. *fernandina*) have been discovered on Newhall Ranch. However, because this plant was long thought to be extinct until its recent discovery on Ahmanson Ranch, little is known regarding the range of growing conditions within which the plant will germinate and reproduce. Limited descriptions indicate that the spineflower was previously found in sandy to gravelly soils in washes, riverbeds and upland areas primarily on the margins of the San Fernando Valley at the base of the Santa Susana Mountains, San Gabriel Mountains and Simi Hills. The following report presents the results of research and reconnaissance field observations that provide data on the geologic and geomorphic conditions of the known occurrences at Airport Mesa, Grapevine Mesa and San Martinez Grande Canyon on Newhall Ranch. The occurrences assessed during this investigation are based on field mapping in 2002 by Dudek and Associates, Inc. (Dudek). Details of the biologic aspects of the plant are being provided by Dudek under separate cover. Dudek's surveys found plants that germinated in 2002 and much more common remnants from plants that germinated in 2001 or earlier.

2.0 GEOLOGIC SETTING

The subject portions of Newhall Ranch are in the Transverse Ranges geomorphic province of southern California in the eastern portion of the Ventura depositional basin. The Ventura basin was produced by tectonic downwarping in the geologic past to produce a large-scale synclinal structure in which a thick sequence on Cenozoic sediments have accumulated. These sediments have been lithified into a sequence of sedimentary rock that have subsequently been uplifted, tilted and tectonically deformed in late Cenozoic times.

Bedrock underlying the San Martinez Grande Canyon area consists primarily of interbedded siltstone and sandstone of the Pliocene marine Pico Formation. The Pico Formation is conformably overlain by interbedded sandstone, siltstone and mudstone of the Plio-Pleistocene, non-marine Saugus Formation. Bedrock underlying the Grapevine Mesa area consists of the lower member, and the Airport Mesa area is underlain by the upper member of the Saugus Formation. At both mesas, the Saugus Formation is covered by late Quaternary, alluvial terrace deposits which consist of up to approximately 75 feet of interbedded sand, pebbly sand and sandy silt, with a cobble- to boulder-rich layer commonly present at the base. A thick, well developed soil has formed on the mesa surfaces. Slope areas at each occurence are typically underlain by a weathered zone with poor soil development. Accumulations of colluvium overlie portions of the slopes, particularly at the base of slopes and in narrow swales.

3.0 DISCUSSION OF SITE CONDITIONS

3.1 Introduction

Three occurrences of the San Fernando Valley spineflower have been discovered on Newhall Ranch at Airport Mesa, Grapevine Mesa and San Martinez Grande Canyon. The locations of these sites relative to Newhall Ranch are shown on the Index Map (Figure 1). The distribution of plants at each occurrence is illustrated with polygons on Figures 3, 4 and 5 as mapped by Dudek and Associates, Inc., with GPS survey control (see **Appendix**). The polygons are color coded to distinguish plants which germinated in 2002 from those that germinated in 2001 or earlier, based on surveys completed in 2002.

In order to provide data on the geologic and geomorphic conditions at each occurrence, we first reviewed published geologic maps and regional soil survey maps of the area, as well as geologic data previously obtained by this firm in the vicinity of each site. The

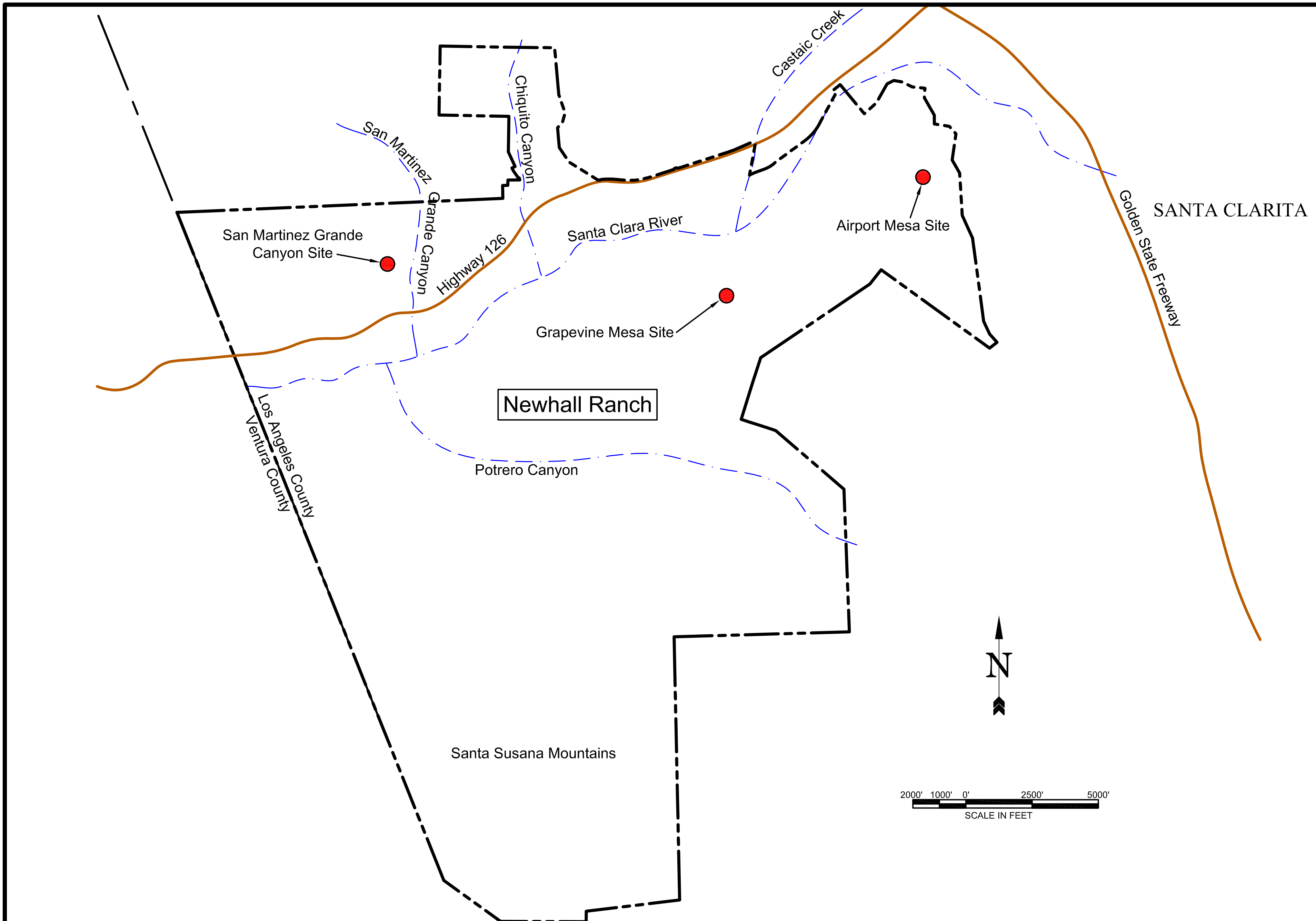

Figure 1. Index map of San Fernando Valley spineflower occurrences at Newhall Ranch.

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areal distribution of geologic formations at depth and the overlying soil unit (as defined in the soil survey for the Antelope Valley area by the USDA, 1969) are presented for each site on Figures 3, 4 and 5. The soil units are regional and variations occur within the mapped areas. General descriptions of each mapped formation and soil unit are presented in the explanation at the end of the **Appendix**.

Field observations were then completed to document the specific material types, colors, slope orientation, and surface conditions at each occurrence. A total of 96 plant stations were surveyed and the collected data are summarized in Table I (see **Appendix**). For ease of reference, subareas were defined for distinct polygons and for groups of closely spaced polygons and individuals at each of the three occurrences, based on discussions with Dudek. Past disturbance of the native vegetation by agricultural activities at or adjacent to the observed spineflowers was also noted. Data was collected at each subarea defining slope bearings and gradients, and material types specifically where the plant was observed. The goal of this survey was to define the range and limits of slope conditions where the plant occurs rather than a quantitative analysis. Because individual plants were commonly observed to grow on small benches on steeper slopes, both the overall (macro) slope gradient and the local (micro) slope gradient at each plant station were measured. Graphic summary plots of the measured slope bearings and gradients for the three occurrences are presented in Figure 2 and plots for each subarea are presented in Figures 6 to 11 in the **Appendix**. The soil material exposed at the surface at each station was defined in the field based on the Unified Soil Classification System (USCS) of Casagrande (1948). In order to avoid impacting the spineflower occurrences, no excavations were completed during this study. Therefore, no bulk samples have been collected for laboratory analysis, and site-specific soil stratigraphy descriptions have not been completed at this time.

3.2 Airport Mesa

San Fernando Valley spineflowers from both 2002 and 2001 or earlier were discovered on various slopes to the south of Airport Mesa at elevations ranging between 1095 and 1265 feet above sea level (see Figure 3). The mapped polygons were grouped into seven subareas (AM-1 through AM-7) for measurement purposes (see Table I in Appendix for details). Subarea 7 occurs above the upper member of the Saugus Formation (TQsu). The rest of the subareas overlie Quaternary terrace deposits (Qt) or Saugus Formation (TQs and TQsu) immediately downslope from Qt. Per USDA (1969), all of the subareas are on Castaic-Balcom silty clay loam (CmF), except for subarea 6, which is mapped as

Terrace escarpment (TsF). Subareas 4 and 6 are downslope from Airport Mesa proper, which is mapped as Zamora clay loam (ZaC). The organic (O) soil horizon is generally absent. Previous geologic investigations in the area indicate that the upper 1 to 5 feet of material on south-facing slopes underlain by Saugus Formation and terrace deposits is typically weathered and consists of colluvium and weakly developed soil.

Per the USCS nomenclature, the surface soil is dominantly silty sand (SM). Lag gravel weathered from the underlying terrace deposits was generally observed at the surface. Laboratory particle size analysis will be required to define the exact grain size distribution. The Munsell soil color (dry) is typically brown (10YR 5/3) and varies from dark grayish brown (10YR 4/2) to pale brown (10YR 6/3) and yellowish brown (10YR 5/4). The spineflower was generally observed on south-facing slopes with bearings ranging from S88W to S78E and macro-slope gradients ranging between 7° and 38° (see Figures 2 and 6 to 8 in **Appendix**). Micro-slope gradients are generally shallower (4° to 28°), but individual plants locally occur on steeper slope segments. Local, shallow, north-dipping gradients were observed along a road and on disturbed alluvium in subarea 3. Subareas 1, 2, 3, 6, and 7, have been used for cattle grazing in the recent past. Subareas 2, 3 and 5 were cleared of brush and grass in 2000 for agricultural purposes. Some plants were observed in subareas 3 and 5 growing on artificial fill (af) placed in the past during construction of access roads, oil well pads, and agricultural terracing. Vegetation in the undisturbed areas is typically sparse with a mixture of barren patches, small annual grasses and local buckwheat and sage bushes. Small animal burrows were common at all of the subareas except for subarea 7. The largest individual 2002 spineflowers were observed at subarea 2.

3.3 Grapevine Mesa

Spineflowers from 2002 and 2001 and earlier were mapped by Dudek and Associates, Inc. on the western margin of Grapevine Mesa between elevations of 1040 and 1290 feet above sea level (see Figure 4). The observed plants were grouped into six subareas (GM-1 through GM-6) for measurement purposes (see Table I). All of these plants are underlain by Quaternary terrace deposits (Qt), at depth. Plants at subarea 5 are underlain by Qt-derived colluvium at shallow depths. The soil unit at this occurrence is mapped as Terrace escarpment (Tsf) in USDA (1969), although some individuals were observed immediately adjacent to the mesa surface that is mapped as Zamora clay loam (Zac). The organic (O) soil horizon is generally absent.

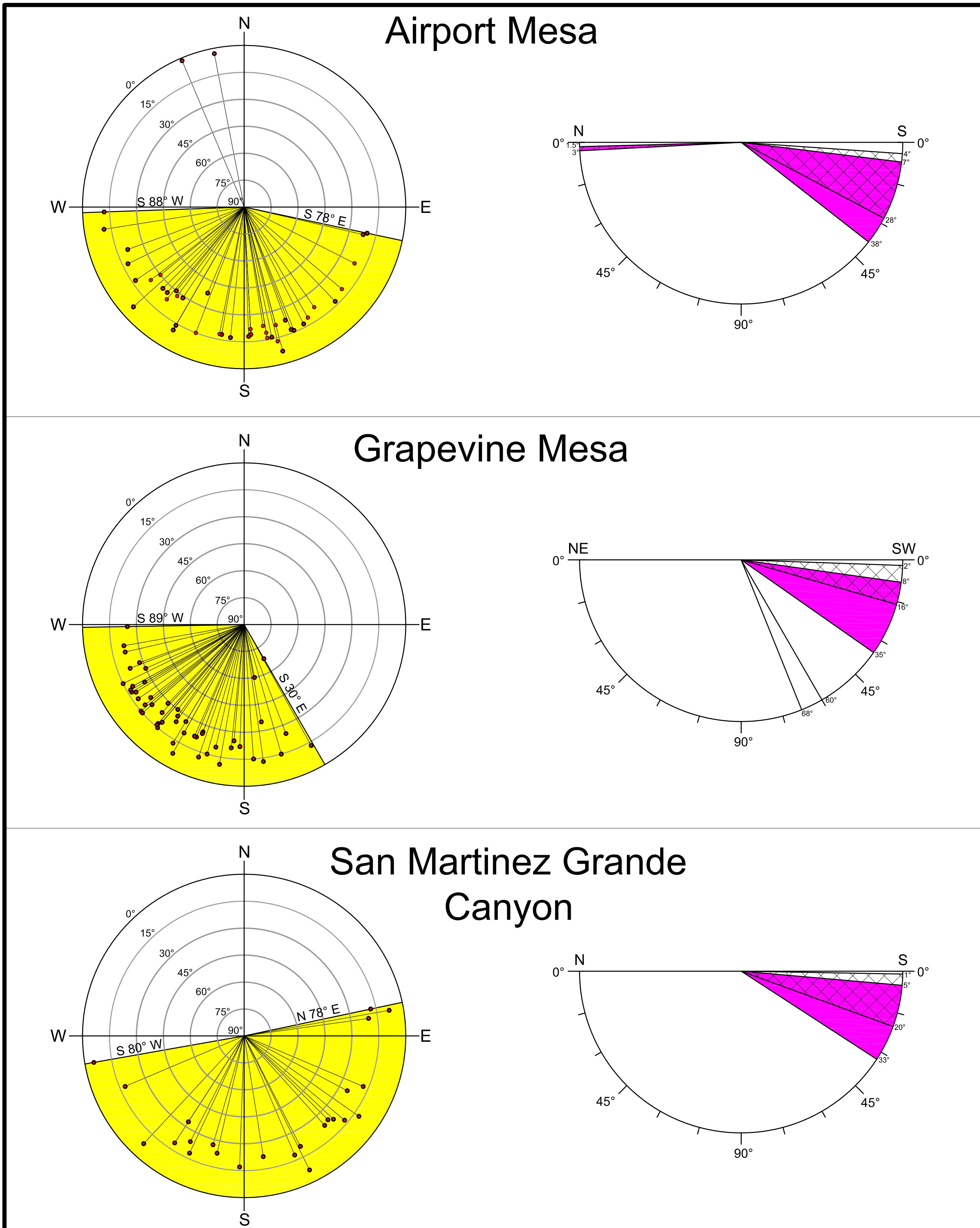

Figure 2. Overview plots of measured slope bearings and graphical slope gradient ranges (macro-gradients are colored and micro-gradients are hatched) for each occurrence (see appendix for subarea plots and detailed explanation on Figure 6).

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As at Airport Mesa, the surface soil is generally silty sand (SM), with slightly less lag gravel overall. The Munsell soil color is generally brown (10YR 5/3) and varies to grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2) near the top and base of the escarpment. The spineflowers primarily occur on south- to southwest-facing slopes (bearings ranging from S89W to S30E) with macro-slope gradients typically ranging between 8° and 35° (see Figures 2, 9 and 10). Micro-slope gradients are typically slightly shallower (2° to 16°), but are locally steeper, particularly at two measured locations in subarea 5 where 2001 plants were observed growing on the eroded banks of a dry creek bed, with slope gradients of 60° and 68°, respectively. The Grapevine Mesa occurrence is generally undisturbed by man, although some individuals were observed immediately adjacent to agricultural fields on the mesa surface and on an old dirt road. The vegetation is similar to Airport Mesa with bare patches, sparse annual grasses, and scattered bushes of primarily buckwheat and sage. Animal burrows were less common than at Airport Mesa and locally lacking entirely. The vast majority of spineflowers observed at Grapevine Mesa were from 2001 or earlier and the 2002 individuals were generally small.

3.4 San Martinez Grande Canyon

The third spineflower occurrence was mapped in the hills on the west side of San Martinez Grande Canyon between elevations of 1090 and 1235 feet above sea level (see Figure 5). The observed plants are primarily from 2001 and earlier, and were grouped into 3 subareas (SMG-1 though SMG-3) for measurement purposes. (See Table I for details). Subareas 1 and 2 are on elevated slopes underlain by a large, ancient landslide, that involves bedrock of the marine Pico Formation (see Table I explanation for formation description). Based on radiocarbon dating of landslides in the area with similar subdued geomorphic expression, this landslide is probably at least 10,000 years old. Subarea 3 is at the top of an adjacent ridgeline underlain by Pico Formation bedrock, that dips approximately 40° to 45° to the southeast. The Antelope Valley Soil Survey (USDA, 1969) maps the regional soil unit in this area as eroded Castaic-Balcom silty clay loam (CmF2). The organic (O) soil horizon is generally absent.

The surface soils at the San Martinez Grande Canyon occurrence are silty sands (SM) to sandy silts (ML). Sparse lag gravel is present at subareas 1 and 2, but is rare at subarea 3. Because subareas 1 and 2 are underlain by landslide material, which is more susceptible to erosion, coarser-grained materials may be more concentrated at the surface than in the original parent material. The dry Munsell soil color is typically brown (10YR 5/3) and varies from grayish brown (10YR 5/2) to pale brown (10YR 6/3). The surface soil developed on Pico Formation bedrock at subarea 3 ranged to light yellowish brown (2.5Y 6/4). The observed spineflowers generally occur on elevated slopes and along rounded ridge tops which face to the south or east with bearings ranging from S80W to N78E (see Figures 2 and 11). Observed macro-slope gradients range from 5° to 33° with micro-slope gradients being generally shallower (1° to 20°). The overall slope gradients at subareas 1 and 2 are shallower than adjacent slopes eroded in the bedrock owing to landslide movement and the softer nature of the landslide material. The three subareas are undisturbed by man, but extensive cattle grazing has occurred in the past. Vegetation is sparse with intermixed patches of bare ground, small annual grasses and scattered bushes of primarily buckwheat and sage. Animal burrows are generally uncommon.

4.0 CONCLUSIONS

The data obtained during this assessment indicate that there are a number of similar geologic and geomorphic conditions at each occurrence site:

1. Nearly all of the plants at Grapevine Mesa and Airport Mesa occur on granular, nonmarine terrace deposits or lithologically similar portions of the upper member of the Saugus Formation. A few plants germinated on artificial fill or alluvium derived from adjacent terrace deposits. The plants at San Martinez Grande Canyon occur primarily on old landslide debris.

2. Nearly all of the plants at the three sites occur on soils mapped by the USDA (1969) as slightly eroded to eroded Castaic-Balcom silty clay loam (30 to 50 percent slopes) or Terrace escarpments. Most of the plants at Grapevine Mesa and some at Airport Mesa are down slope of terrace surfaces capped by Zamora clay loam (2 to 9 percent slopes).

3. The vast majority of observed plants are growing on silty sand surface soils (SM per USCS classification). The percent sand ranges from approximately 40 to 80 percent with the remaining fraction being primarily silt with minor clay and variable concentrations of gravel.

4. The dry Munsell color of the surface soils is very consistent with a hue of 10YR, values ranging between 4 and 6, and the chroma ranging between 2 and 4.

5. With rare exceptions, the observed plants occur on slopes with a south-facing component. Bearings range from S89W to S78E at the two Mesa sites but extend to N78E on ridgelines at San Martinez Grande Canyon.

6. With rare exceptions, the overall (macro) slope gradients range from 5° to 38°. Local (micro) slope gradients at individual plants are typically shallower (1° to 28°) but sometimes occur on steeper slope segments. The rare plants observed on north-facing slopes at Airport Mesa were on disturbed areas with slope gradients of less than 3°.

7. All of the observed plants occur within an elevation range between 1040 feet and 1290 feet above sea level.

8. Plants were observed on both undisturbed and recently disturbed ground. However the 2002 plants were most common and robust in the disturbed areas at Airport Mesa (subareas 2 and 3).

9. In undisturbed areas, the plant consistently occurs in sparsely vegetated areas consisting of barren ground, small annual grasses, and scattered bushes of buckwheat and sage, and the organic (O) soil horizon is generally absent.

10. No evidence of surface seepage was observed in the field, and prevous geologic investigations and nearby water well data do not indicate the presence of shallow, static ground water conditions at any of the spineflower occurrences.

This opportunity to be of service is appreciated. If you have any questions concerning this report, please give us a call.

Respectfully,

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The following attachments and appendices complete this report.

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APPENDIX

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Appendix

EXPLANATION OF MAPPED GEOLOGIC AND SOIL UNITS

DESCRIPTION OF GEOLOGIC UNITS

Pico Formation (Tp)

Sediments of the Pico Formation were deposited in Pliocene times in a marine environment in the eastern Ventura Basin. At the San Martinez Grande Canyon site, the formation consists primarily of olive-gray to greenish-gray siltstone and mudstone with light yellowish-brown sandstone interbeds that typically strike N45E and dip 40° to 45° southeast. The contact with the overlying, nonmarine Saugus Formation is conformable but ranges from transitional (brackish deposits) to interfingering as a result of marine regression, basin filling, and uplift over time.

Saugus Formation (TQs, TQsl and TQsu)

The nonmarine Saugus Formation was deposited in a fluvial environment during late Pliocene to Pleistocene times between 0.7 and 2.5MA. Previous geologic mapping and geologic investigations by this firm indicate that the Saugus Formation on Newhall Ranch consists of two informal members, designated as the lower (TQsl) and upper (TQsu). The lower member, which is more indurated and has common, outcrop-forming sandstone interbeds, underlies the terrace deposits at Grapevine Mesa. The upper member and undifferentiated rocks of the Saugus Formation (TQs) underlie the terrace deposits at Airport Mesa. The upper member is less indurated, forms fewer outcrops and the coarse-grained interbeds south of Airport Mesa are lithologically similar to the overlying terrace deposits. The Saugus Formation typically consists of interbedded yellowish-gray to light-gray sandstone and pebbly sandstone, light yellowish-brown silty sandstone to sandy siltstone, and greenish-gray to reddish-brown siltstone and mudstone.

Terrace deposits (Qt)

Several large remnants of old, dissected alluvial deposits form large mesa landforms on Newhall Ranch. The mesas are up to 200 feet above the existing Santa Clara River alluvium. These deposits consist primarily of yellowish-gray sand, pebbly sand and silty sand, with interbeds of yellowish-brown silt, rare clay, and a basal cobble- to boulder-rich bed with a coarse, friable sand matrix. Total unit thickness typically ranges between 50 and 75 feet. A well-developed soil profile with a distinct, clay-enriched B horizon typically occurs in the upper 5 feet of the terrace surface (ZaC soil per USDA, 1969).

Landslide (Qls)

The mapped landslide consists of Pico Formation siltstone and mudstone with sandstone interbeds that have been disturbed, fractured and rotated by landslide movement. The surface geomorphology does not show features indicative of recent movement and radiocarbon dating of other landslides in the vicinity indicate that the landslide at San Martinez Grade Canyon is probably at least 10,000 years old.

Quaternary alluvium (Qal)

Quaternary alluvium includes recent and active river and floodplain deposits within the larger canyon areas. This material consists primarily of light yellowish-gray, poorly graded sand and gravelly interbeds and lenses with local interbeds of light-brown silty sand. The upper 1 to 2 feet of this material has locally been disturbed by agricultural activities.

Quaternary colluvium (Qcol)
Colluvium is a non-bedded, poorly sorted, heterogeneous accumulation of soil and weathered bedrock fragments deposited on slopes by rainwash, sheetwash or down-slope creep. Accumulations are typically thickest at the base of slopes and in narrow swales. The observed colluvium typically consists of grayish-brown to brown silty sand with pebbles and scattered cobbles. The slopewash composition varies depending on the up-slope parent materials. This unit is not shown on the geologic and soil unit maps.

Artificial fill (af)
Fill material placed during past construction of access roads, oil well pads, and agricultural activities. Consists of mixed sediments derived from the underlying and adjacent soils.

REGIONAL SOIL UNIT DESCRIPTIONS
(Modified from USDA, 1969)

Castaic series (CmF and CmF2)

- General
  The Castaic series consists of well-drained soils that formed in material from soft shale and sandstone on upland areas with slopes ranging from 2 to 65 percent (<1° to 33°). Vegetation consists mainly of annual grasses and forbs with local perennial grasses and brush. The average annual precipitation ranges from 14 to 16 inches, the average annual temperature is 63°F and the frost-free season ranges from 275 to 300 days. The typical soil profile consists of a surface layer of pale-brown silty clay loam approximately 9 inches thick underlain by yellowish-brown silty clay loam to a depth of approximately 26 inches that sits on soft shale and sandstone at depth.

- CmF – Castaic-Balcom silty clay loams, 30 to 50 percent slopes
  This unit consists in part of Castaic and Balcom silty clay loams. The surface layer (A horizon) is 10 to 12 inches thick and pale brown (10YR 6/3) with a blocky structure and a pH ranging from 6.6 to 7.8. The underlying C horizon layer consists of yellowish-brown (10YR 5/4) to pale-brown (10YR 6/3) blocky silty clay loam with a pH between 6.6 and 8.4. This land type is slightly eroded and well drained with moderately slow subdrainage, rapid runoff and 5.0 to 7.0 inches of available water capacity. This unit includes 10-to 20-acre areas where rill and sheet erosion are moderate and small areas of Saugus loam.

- CmF2 – Castaic-Balcom silty clay loams, 30 to 50 percent slopes, eroded
  These soils consist of 60 percent Castaic silty clay loam and 40 percent Balcom silty clay loam. The A horizon ranges from pale-brown (10YR 6/3) to yellowish-brown (10YR 5/4) silty clay loam with subangular blocky to locally massive structure, common micro pores, and neutral pH (6.7). The C horizon is generally more yellowish-brown (10YR 5/4) silty clay loam with angular blocky structure,

common micro pores and neutral pH (7.0) to locally slightly alkaline. The land type is well drained with moderately slow subsoil permeability and an available water holding capacity of 5.0 to 7.0 inches.

Terrace escarpments (TsF)
This land type consists of short, moderately steep to steep faces or breaks that separate the terrace surfaces from the lower-lying alluvial fans. The surface layer generally consists of brown, coarse sandy loam with a pH between 6.1 and 7.3. The subsoil is generally reddish-brown clay loam with a pH between 6.1 and 6.5. The underlying parent material is typically sandy with a pH between 7.4 and 7.9. Slope gradients are generally 35 percent, but range from 15 to 45 percent. The land type is well drained with moderately slow subsoil permeability, medium to rapid runoff, and 6.0 to 9.0 inches of available water capacity. The vegetation consists of annual grasses and forbs.

Zamora series (ZaC)

- General
  The Zamora series consists of well-drained soils that formed in old alluvium derived from material that was dominantly sedimentary. These soils are on terrace surfaces with slopes ranging from 2 to 15 percent. Vegetation consists primarily of grasses and oaks. The average annual precipitation ranges from about 14 to 16 inches, the average annual temperature is 63°F, and the frost-free season ranges from 240 to 300 days. The typical profile consists of a surface layer of grayish-brown loam to local clay loam about 11 inches thick which is underlain by brown and dark grayish-brown loam and clay loam to a depth of about 58 inches, below which is pale brown loam.

- ZaC-Zamora clay loam, 2 to 9 percent slopes
  The surface layer (A horizon) consists of approximately 11 inches of grayish-brown (10YR 5/2) to very dark grayish-brown (10YR 3/2), massive loam to heavy loam with a pH of 6.1 to 6.5. The underlying Bt horizon typically extends to a depth of 58 inches and consists of brown (10YR 5/3) to very dark grayish-brown (10YR 3/2) massive to subangular blocky loam, and silt loam to clay loam with high silt content and a pH ranging from 6.6 to 7.3. The C horizon consists of pale-brown (10YR 6/3) to brown (10YR 5/3) massive loam or sandy loam with a moderately alkaline pH (8.0). The parent material is pale-brown, massive loam with a pH of 7.9 to 8.4. The content of gravel in the soil profile ranges from 3 to 5 percent by volume. This land type is well drained with moderately slow permeability, slow to medium runoff and an available water capacity of 10.0 to 11.0 inches. At Airport and Grapevine Mesas, most of the ZaC soils have been disturbed by ongoing agricultural activities.

Miscellaneous
CmG2 Castiac-Balcom silty clay loam, 50 to 65 percent slopes, eroded
CnG3 Castaic and Saugus soils, 30 to 65 percent slopes, severely eroded
HcC Hanford sandy loam, 2 to 9 percent slopes

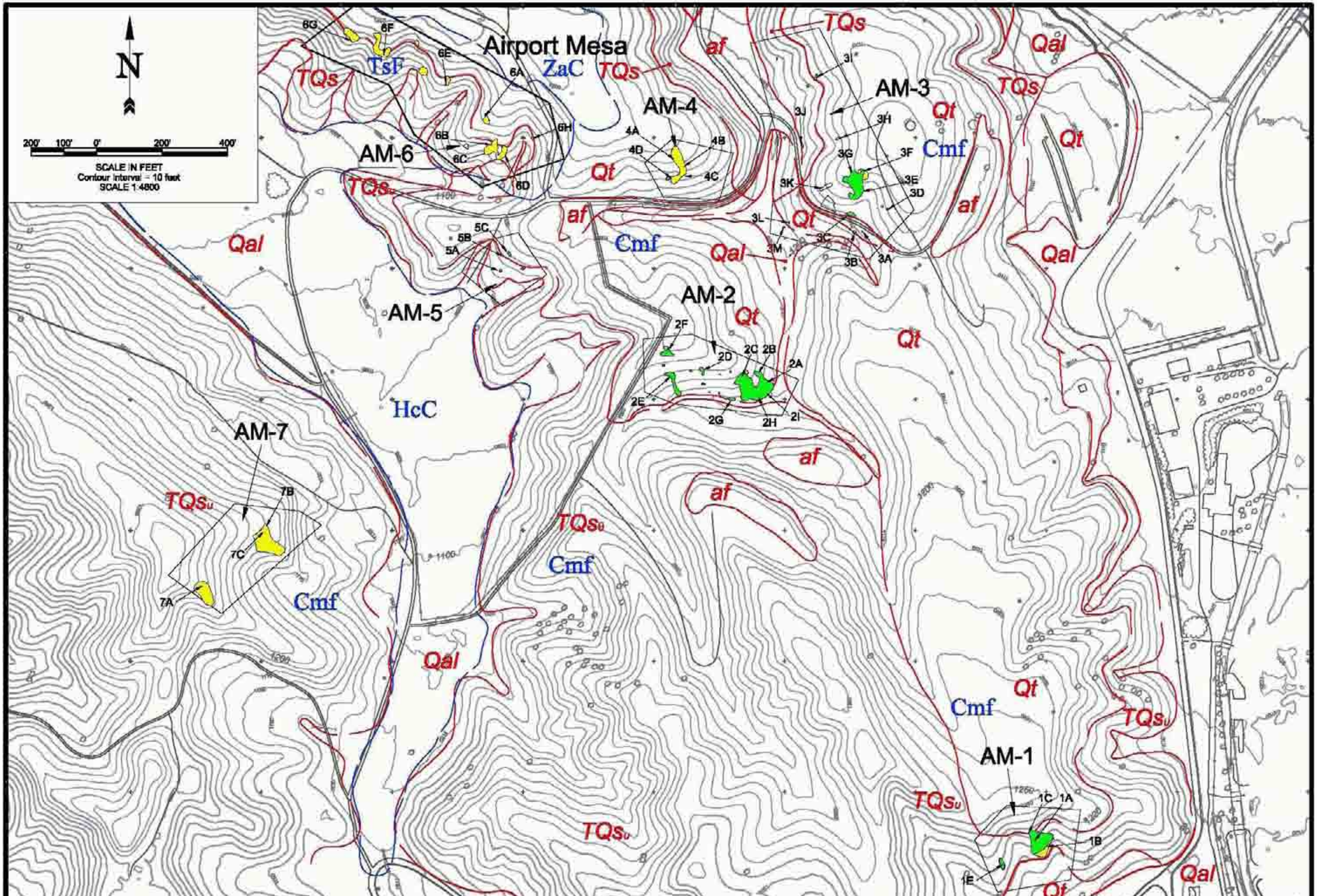

Figure 3. Geologic and soil unit map showing surveyed locations of spineflower polygons at the Airport Mesa occurrence. See Figure 5 for map legend.

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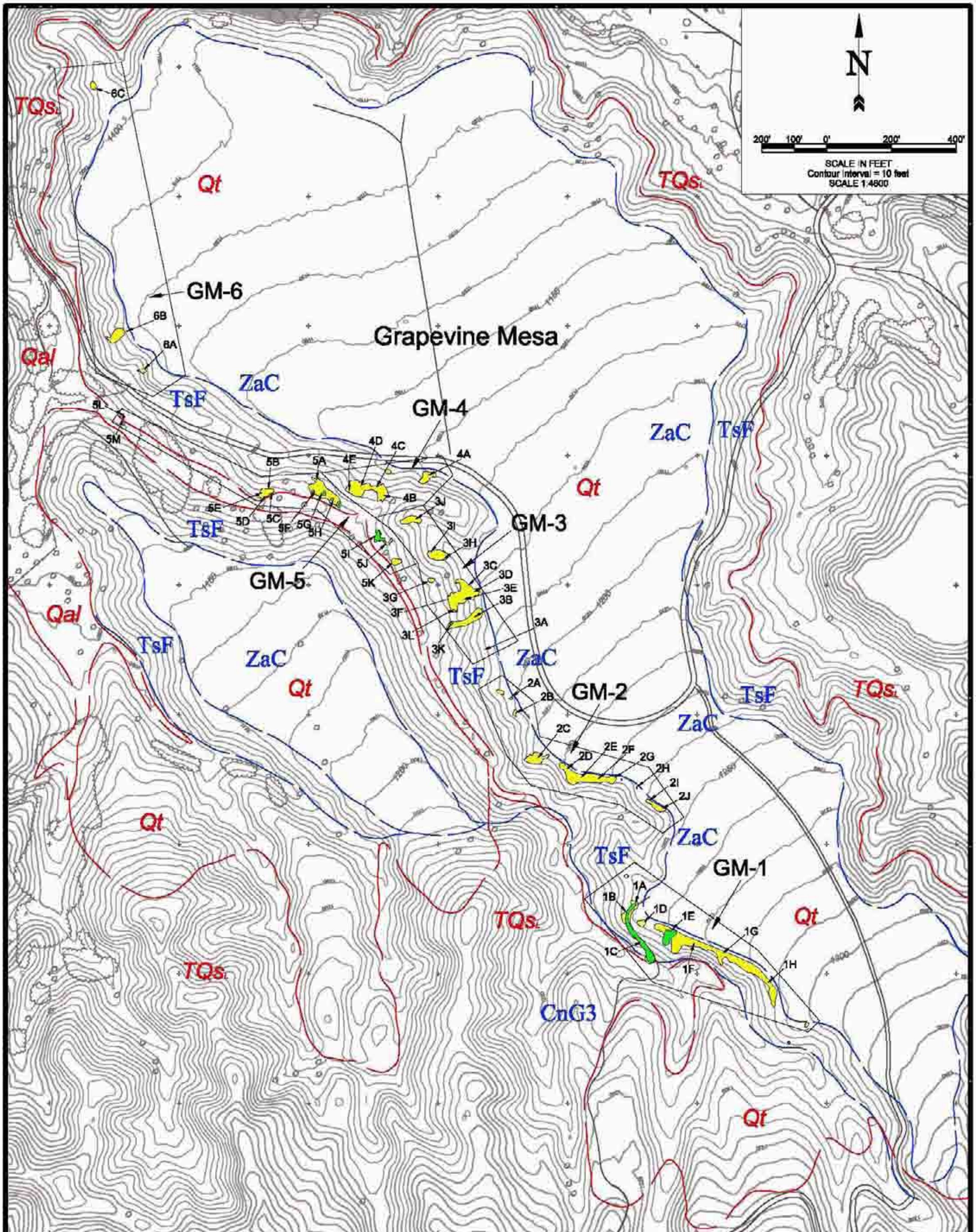

Figure 4. Geologic and soil unit map showing surveyed locations of spineflower polygons at the Grapevine Mesa occurrence. See Figure 5 for map legend.

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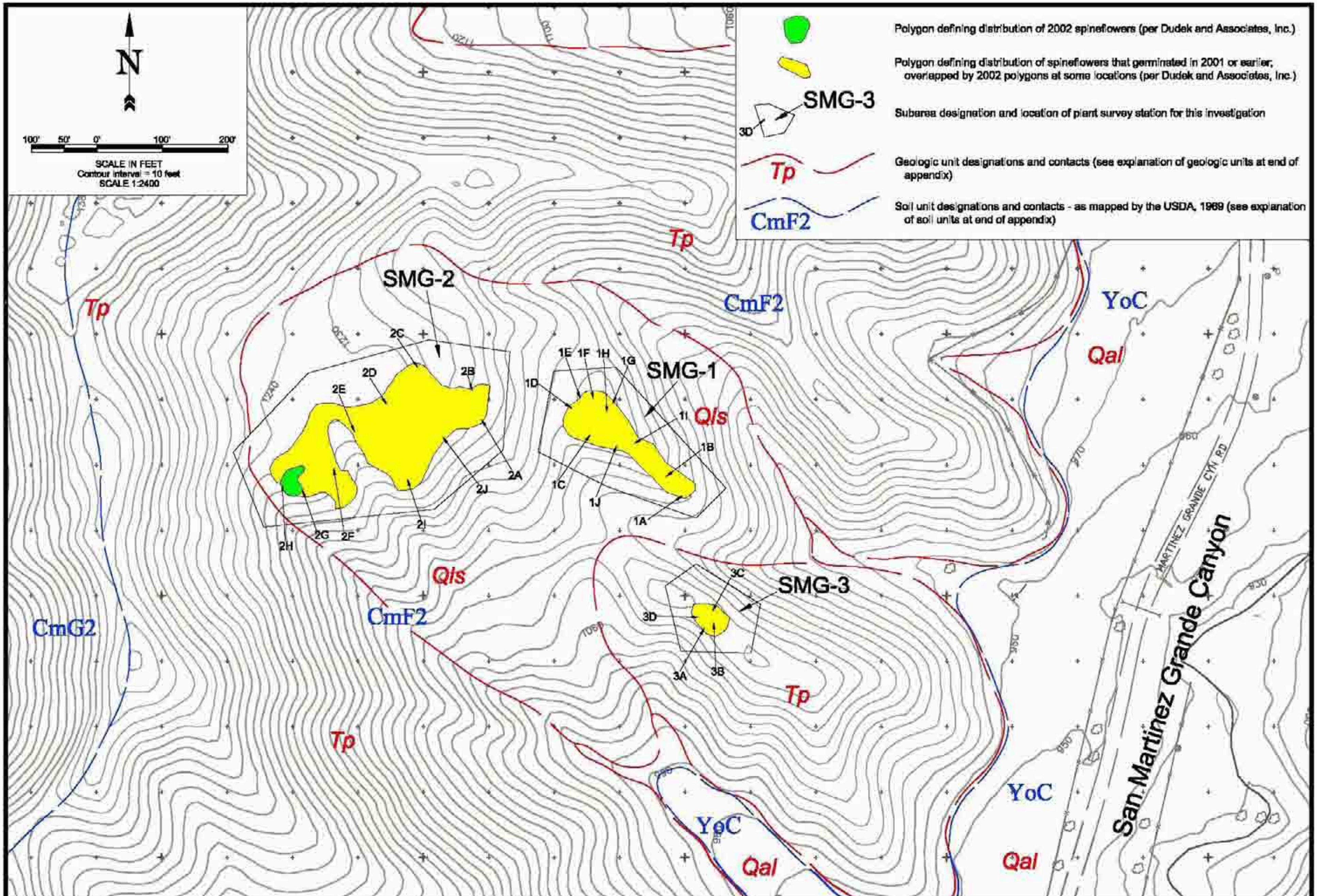

Figure 5. Geologic and soil unit map showing surveyed locations of spineflower polygons at the San Martinez Grande Canyon occurrence.

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TABLE I
SUMMARY OF OBSERVED FIELD CONDITIONS

GEOLOGIC/GEOMORPHIC SPINEFLOWER EVALUATION
AIRPORT MESA

Subarea Designation	Station No.	Year of Plant Germination[1]	Geologic Formation[2]	Regional Soil Unit[3]	Site Disturbed for Agriculture?	Surface Soil Description (USCS Classification)	Surface Munsell Soil Color (Dry)	Slope Bearing (Degrees)[4]	Slope Gradient Macro/Micro[5] (Degrees)
AM-1	AM-1A	2002	TQsu	CmF	No	SM	10YR 5/3	S35E	22/17
	AM-1B	2002	TQsu	CmF	No	SM	10YR 5/3	S63E	21/16
	AM-1C	2002	TQsu/Qt	CmF	No	SM/ML	10YR 5/3	S15E	22/15
	AM-1D	2002	TQsu	CmF	No	SM	10YR 4/2	S10E	16/8
	AM-1E	2002	TQsu	CmF	No	SM	10YR 4/2-4/3	S50E	19/23
AM-2	AM-2A	2002	Qt	CmF	Yes	SM	10YR 4/3-5/3	S78E	20/5
	AM-2B	2002	Qt	CmF	Yes	SM	10YR 4/3	S44E	17/12
	AM-2C	2002	Qt	CmF	Yes	SM	10YR 5/3	S3E	19/5
	AM-2D	2002	Qt	CmF	Yes	SM/ML	10YR 5/3	S10W	18/12
	AM-2E	2002	Qt	CmF	Yes	SM/ML	10YR 4/3-5/3	S2E	18/6
	AM-2F	2002	Qt	CmF	Yes	SM/ML	10YR 5/3	S12E	16/10
	AM-2G	2002	Qt (Qal)	CmF	Yes	SM/ML	10YR 5/3-4/3	S15E	7/5
	AM-2H	2002	Qt	CmF	Yes	SM	10YR 5/3	S6W	17/4
	AM-2I	2002	Qt	CmF	Yes	SM/ML	10YR 5/3	S21E	17/5
AM-3	AM-3A	2002	Qt (af)	CmF	Yes	SM	10YR 5/4	S42W	26/14

TABLE I
SUMMARY OF OBSERVED FIELD CONDITIONS

Subarea Designation	Station No.	Year of Plant Germination[1]	Geologic Formation[2]	Regional Soil Unit[3]	Site Disturbed for Agriculture?	Surface Soil Description (USCS Classification)	Surface Munsell Soil Color (Dry)	Slope Bearing (Degrees)[4]	Slope Gradient Macro/Micro[5] (Degrees)
	AM-3B	2002	Qt (af)	CmF	Yes	SM	10YR 5/4	S45W	26/<5
	AM-3C	2002	Qt (af)	CmF	Yes	SM	10YR 5/4-5/3	S48W	7/5
	AM-3D	2002	Qt	CmF	Yes	SM/ML	10YR 4/3	S70W	21/17
	AM-3E	2002	Qt	CmF	Yes	SM	10YR 5/4-4/3	S20E	23/6
	AM-3F	2002	Qt	CmF	Yes	SM/ML	10YR 5/3-4/3	S30W	11/9
	AM-3G	2002	Qt	CmF	Yes	SM/ML	10YR 4/3	S81W	11/8
	AM-3H	2002	Qt	CmF	Yes	SM	10YR 5/3-4/3	S64W	18/7
	AM-3I	2002	Qt	CmF	Yes	SM	10YR 5/3	S30W	14/6
	AM-3J	2002	TQs (af)	CmF	Yes	SM	10YR 6/3	N11W	3/3
	AM-3K	2002	Qt	CmF	Yes	SM/ML	10YR 4/3-5/3	S56W	17/10
	AM-3L	2002	Qt	CmF	Yes	SM/ML	10YR 5/3	S88W	12/5
	AM-3M	2002	Qal	CmF	Yes	SM	10YR 5/4	N23W	1.5/1.5
AM-4	AM-4A	2001	Qt	CmF	No	SM/ML	10YR 5/3	S14E	13/8
	AM-4B	2001	Qt	CmF	No	SM/ML	10YR 5/3-6/3	S3E	19/19
	AM-4C	2001	Qt	CmF	No	SM	10YR 5/3	S30E	19/12
	AM-4D	2001	Qt	CmF	No	SM/ML	10YR 5/3	S3W	22/12
AM-5	AM-5A	2002	TQsu	CmF	Yes	SM/ML	10YR 5/3-5/2	S23W	38/28

TABLE I
SUMMARY OF OBSERVED FIELD CONDITIONS

Subarea Designation	Station No.	Year of Plant Germination[1]	Geologic Formation[2]	Regional Soil Unit[3]	Site Disturbed for Agriculture?	Surface Soil Description (USCS Classification)	Surface Munsell Soil Color (Dry)	Slope Bearing (Degrees)[4]	Slope Gradient Macro/Micro[5] (Degrees)
	AM-5B	2002	Qt (af)	CmF	Yes	SM	10YR 6/4-5/3	S34W	29/26
	AM-5C	2002	Qt	CmF	Yes	SM	10YR 5/3-6/4	S39W	30/14
AM-6	AM-6A	2001	Qt	TsF	No	SM/ML	10YR 4/2	S21W	15/10
	AM-6B	2001	TQs/Qt	TsF	No	SM/ML	10YR 5/3	S51W	30/18
	AM-6C	2001	TQs	TsF	No	SM	10YR 5/4	S40W	23/17
	AM-6D	2001	TQs/Qt	TsF	No	SM	10YR 5/2-5/3	S10E	19/13
	AM-6E	2001	TQs	TsF	No	SM	10YR 5/3-4/2	S9E	23/14
	AM-6F	2001	Qt/TQs	TsF	No	SM	10YR 5/3-4/2	S52W	24/18
	AM-6G	2001	TQs/Qt	TsF	No	SM	10YR 5/3-5/4	S11W	18/13
	AM-6H	2002	Qt/TQs	TsF	No	SM	10YR 5/3	S37W	28/17
AM-7	AM-7A	2001	TQsu	CmF	No	SM	10YR 5/3	S77E	22/9
	AM-7B	2001	TQsu	CmF	No	SM	10YR 5/3-5/4	S22E	16/5
	AM-7C	2001	TQsu	CmF	No	SM	10YR 4/3-5/3	S27E	17/8

TABLE I
SUMMARY OF OBSERVED FIELD CONDITIONS

GEOLOGIC/GEOMORPHIC SPINEFLOWER EVALUATION
GRAPEVINE MESA

Subarea Designation	Station No.	Year of Plant Germination[1]	Geologic Formation[2]	Regional Soil Unit[3]	Site Disturbed for Agriculture?	Surface Soil Description (USCS Classification)	Surface Munsell Soil Color (Dry)	Slope Bearing (Degrees)[4]	Slope Gradient Macro/Micro[5] (Degrees)
GM-1	GM-1A	2001	Qt (af)	TsF	Yes	SM	10YR 5/3-6/3	S8E	13/6
	GM-1B	2002	Qt (af)	TsF	Yes	SM	10YR 5/3-6/3	S16E	15/4
	GM-1C	2001	Qt (af)	TsF	Yes	SM	10YR 5/3	S29E	13/5
	GM-1D	2001	Qt	TsF/ZaC	No	SM	10YR 5/3	S29W	8/5
	GM-1E	2002	Qt	TsF/ZaC	No	SM	10YR 5/3	S19W	12/6
	GM-1F	2001	Qt	TsF/ZaC	No	SM	10YR 5/2-5/3	S40W	19/9
	GM-1G	2001	Qt	TsF/ZaC	No	SM	10YR 5/2-5/3	S40W	15/2
	GM-1H	2001	Qt	TsF/ZaC	No	SM	10YR 4/2-5/3	S64W	15/8
GM-2	GM-2A	2001	Qt	TsF	No	SM	10YR 4/2-5/3	S59W	17/13
	GM-2B	2001	Qt	TsF	No	SM	10YR 4/2	S51W	19/11
	GM-2C	2001	Qt	TsF	No	SM	10YR 5/3	S31W	27/12
	GM-2D	2001	Qt	TsF	No	SM	10YR 4/2	S60W	26/15
	GM-2E	2001	Qt	TsF	No	SM	10YR 4/2-5/3	S2W	22/16
	GM-2F	2001	Qt	TsF/ZaC	No	SM/ML	10YR 4/2-3/2	S10W	11/9
	GM-2G	2001	Qt	TsF	No	SM	10YR 5/3	S23W	22/13
	GM-2H	2001	Qt	TsF/ZaC	No	SM	10YR 4/2	S61W	19/6
	GM-2I	2001	Qt	TsF/ZaC	No	SM/ML	10YR 4/2-5/2	S49W	22/14

TABLE I
SUMMARY OF OBSERVED FIELD CONDITIONS

Subarea Designation	Station No.	Year of Plant Germination[1]	Geologic Formation[2]	Regional Soil Unit[3]	Site Disturbed for Agriculture?	Surface Soil Description (USCS Classification)	Surface Munsell Soil Color (Dry)	Slope Bearing (Degrees)[4]	Slope Gradient Macro/Micro[5] (Degrees)
	GM-2J	2001	Qt	TsF/ZaC	No	SM/ML	10YR 4/2	S29W	21/7
GM-3	GM-3A	2001	Qt	TsF	No	SM	10YR 5/3	S52W	24/11
	GM-3B	2001	Qt	TsF	No	SM	10YR 5/3	S77W	22/11
	GM-3C	2001	Qt	TsF	No	SM/ML	10YR 4/3	S50W	15/4
	GM-3D	2001	Qt	TsF	No	SM	10YR 4/3	S43W	23/11
	GM-3E	2001	Qt	TsF	No	SM	10YR 5/3	S38W	30/12
	GM-3F	2001	Qt	TsF	No	SM	10YR 5/3	S66W	30/13
	GM-3G	2001	Qt	TsF	No	SM	10YR 5/3	S6W	21/15
	GM-3H	2001	Qt	TsF	No	SM	10YR 5/3-4/2	S21W	26/11
	GM-3I	2001	Qt	TsF	No	SM	10YR 4/2-4/3	S69W	22/10
	GM-3J	2001	Qt	TsF	No	SM	10YR 5/3	S24W	22/10
	GM-3K	2002	Qt	TsF	No	SM	10YR 5/2-5/3	S80W	22/8
	GM-3L	2002	Qt	TsF	No	SM	10YR 5/2-5/3	S41W	17/11
GM-4	GM-4A	2001	Qt	TsF	No	SM	10YR 4/2-5/3	S21W	25/8
	GM-4B	2001	Qt	TsF	No	SM	10YR 5/3	S10E	35/10
	GM-4C	2001	Qt	TsF	No	SM	10YR 5/3	S70W	28/5
	GM-4D	2001	Qt	TsF	No	SM	10YR 5/3	S21E	25/14

TABLE I
SUMMARY OF OBSERVED FIELD CONDITIONS

Subarea Designation	Station No.	Year of Plant Germination[1]	Geologic Formation[2]	Regional Soil Unit[3]	Site Disturbed for Agriculture?	Surface Soil Description (USCS Classification)	Surface Munsell Soil Color (Dry)	Slope Bearing (Degrees)[4]	Slope Gradient Macro/Micro[5] (Degrees)
	GM-4E	2001	Qt	TsF	No	SM	10YR 5/3	S36W	27/10
GM-5	GM-5A	2001	Qt (Qcol)	TsF	No	SM	10YR 5/3-5/2	S35W	24/10
	GM-5B	2001	Qt (Qcol)	TsF	No	SM	10YR 5/2	S4E	15/9
	GM-5C	2001	Qcol/Qal	TsF	No	SM	10YR 5/2	S30E	68/68
	GM-5D	2001	Qcol/Qal	TsF	No	SM	10YR 5/2	S11E	60/60
	GM-5E	2001	Qt (Qcol)	TsF	No	SM	10YR 5/2	S5W	25/11
	GM-5F	2001	Qt (Qcol)	TsF	No	SM	10YR 4/2-5/2	S16W	15/3
	GM-5G	2001	Qt (Qcol)	TsF	No	SM	10YR 5/2-4/2	S31W	13/3
	GM-5H	2002	Qt (Qcol)	TsF	No	SM	10YR 5/3-4/2	S44W	29/10
	GM-5I	2002	Qt (Qcol)	TsF	No	SM	10YR 5/3	S55W	18/7
	GM-5J	2001	Qt (Qcol)	TsF	No	SM	10YR 5/2-5/3	S13W	20/8
	GM-5K	2001	Qt (Qcol)	TsF	No	SM	10YR 5/2-5/3	S60W	17/8
	GM-5L	2001	Qt (Qcol)	TsF	No	SM	10YR 5/2-5/3	S89W	25/12
	GM-5M	2001	Qt (Qcol)	TsF	No	SM	10YR 5/3-5/2	S41W	16/12
GM-6	GM-6A	2001	Qt	TsF	No	SM	10YR 4/2	S49W	15/5
	GM-6B	2001	Qt	TsF	No	SM	10YR 5/3-5/2	S61W	19/8
	GM-6C	2001	Qt	TsF	No	SM	10YR 5/3	S58W	19/4

TABLE I
SUMMARY OF OBSERVED FIELD CONDITIONS

GEOLOGIC/GEOMORPHIC SPINEFLOWER EVALUATION
SAN MARTINEZ GRANDE CANYON

Subarea Designation	Station No.	Year of Plant Germination[1]	Geologic Formation[2]	Regional Soil Unit[3]	Site Disturbed for Agriculture?	Surface Soil Description (USCS Classification)	Surface Munsell Soil Color (Dry)	Slope Bearing (Degrees)[4]	Slope Gradient Macro/Micro[5] (Degrees)
SMG-1	SMG-1A	2001	Qls (Tp)	CmF2	No	SM/ML	10YR 5/3-6/3	S27E	21/14
	SMG-1B	2001	Qls (Tp)	CmF2	No	SM/ML	10YR 5/3-6/3	S42E	23/16
	SMG-1C	2001	Qls (Tp)	CmF2	No	SM	10YR 6/3-5/3	S16W	27/18
	SMG-1D	2001	Qls (Tp)	CmF2	No	SM/ML	10YR 5/3	S33W	19/10
	SMG-1E	2001	Qls (Tp)	CmF2	No	SM	10YR 5/3-5/2	S67W	18/11
	SMG-1F	2001	Qls (Tp)	CmF2	No	SM	10YR 5/3	S80W	5/1
	SMG-1G	2001	Qls (Tp)	CmF2	No	SM	10YR 5/3-6/3	N82E	20/12
	SMG-1H	2001	Qls (Tp)	CmF2	No	SM	10YR 5/3-6/3	S26E	7/7
	SMG-1I	2001	Qls (Tp)	CmF2	No	SM	10YR 6/3-5/3	S50E	7/9
	SMG-1J	2001	Qls (Tp)	CmF2	No	SM	10YR 6/3-5/3	S13W	23/23 (Variable)
SMG-2	SMG-2A	2001	Qls (Tp)	CmF2	No	ML	10YR 5/3-5/2	S45E	24/15
	SMG-	2001	Qls (Tp)	CmF2	No	SM	10YR 5/3-6/3	S67E	18/9

TABLE I
SUMMARY OF OBSERVED FIELD CONDITIONS

Subarea Designation	Station No.	Year of Plant Germination[1]	Geologic Formation[2]	Regional Soil Unit[3]	Site Disturbed for Agriculture?	Surface Soil Description (USCS Classification)	Surface Munsell Soil Color (Dry)	Slope Bearing (Degrees)[4]	Slope Gradient Macro/Micro[5] (Degrees)
	2B								
	SMG-2C	2001	Qls (Tp)	CmF2	No	SM	10YR 5/3	N78E	18/12
	SMG-2D	2001	Qls (Tp)	CmF2	No	SM/ML	10YR 5/3-5/2	S55E	12/10
	SMG-2E	2001	Qls (Tp)	CmF2	No	SM/ML	10YR 5/3-5/2	S33W	33/9
	SMG-2F	2001	Qls (Tp)	CmF2	No	SM	10YR 5/3-5/2	S62E	25/17
	SMG-2G	2002	Qls (Tp)	CmF2	No	SM/ML	10YR 5/3	S9E	22/7
	SMG-2H	2002	Qls (Tp)	CmF2	No	SM/ML	10YR 5/3	S25W	18/7
	SMG-2I	2001	Qls (Tp)	CmF2	No	SM	10YR 5/3-5/2	S23E	18/11
	SMG-2J	2001	Qls (Tp)	CmF2	No	SM	10YR 5/3	S47E	22/11
SMG-3	SMG-3A	2001	Tp	CmF2	No	SM-ML	10YR 6/3-2.5Y 6/4	S27W	24/20
	SMG-3B	2001	Tp	CmF2	No	SM-ML	10YR 6/3-2.5Y 6/4	S43W	8/3
	SMG-3C	2001	Tp	CmF2	No	SM-ML	10YR 5/3-2.5Y 6/4	N80E	8/12
	SMG-3D	2001	Tp	CmF2	No	SM-ML	10YR 5/3-6/3	S2W	17/9

TABLE I
SUMMARY OF OBSERVED FIELD CONDITIONS

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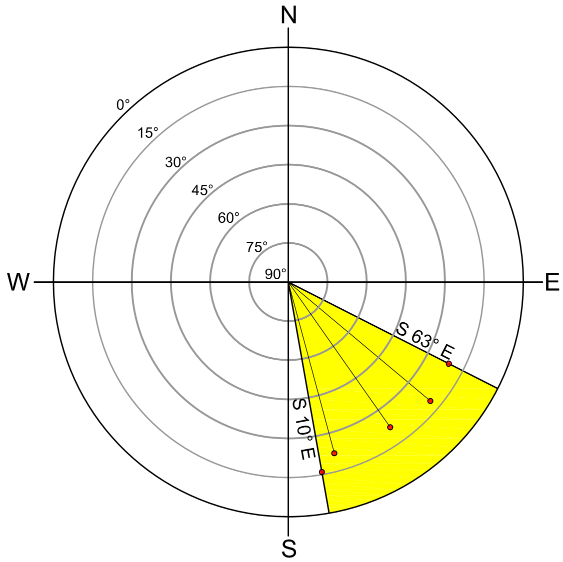
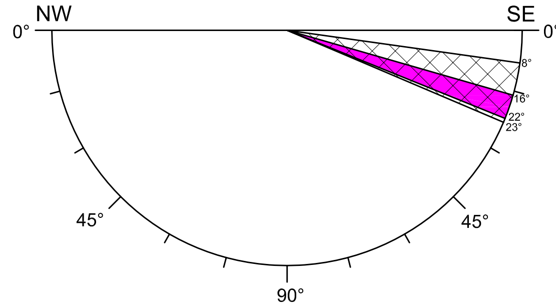
[1] 2002 indicates germination in 2002; 2001 indicates germination in 2001 or earlier (based on surveys by Dudek Associates, Inc., in 2002).
[2] Per AES, Inc. mapping (and published geologic maps); see unit descriptions below; units in parenthesis indicate shallow surficial unit or source formation of landslide (Qls).
[3] Per USDA Soil Survey of the Antelope Valley Area, 1969.
[4] Bearings relative to true north or south.
[5] Macro = Overall Slope Gradient; Micro = local gradient at specific, representative plant, but can vary between nearby plants.

AM-1



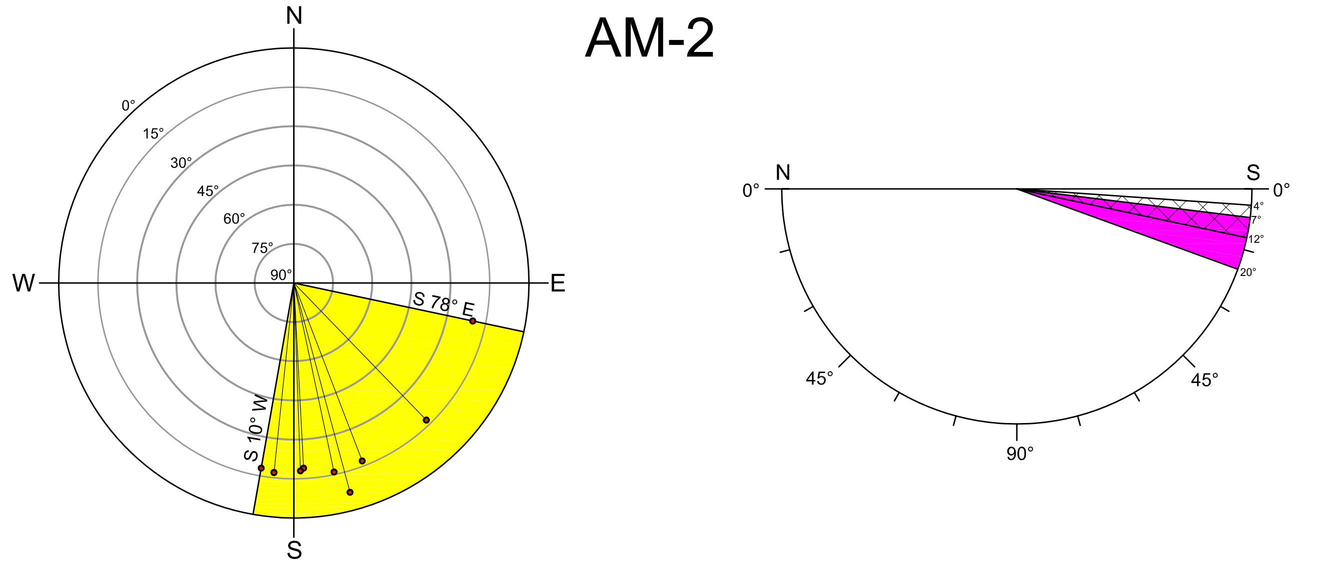


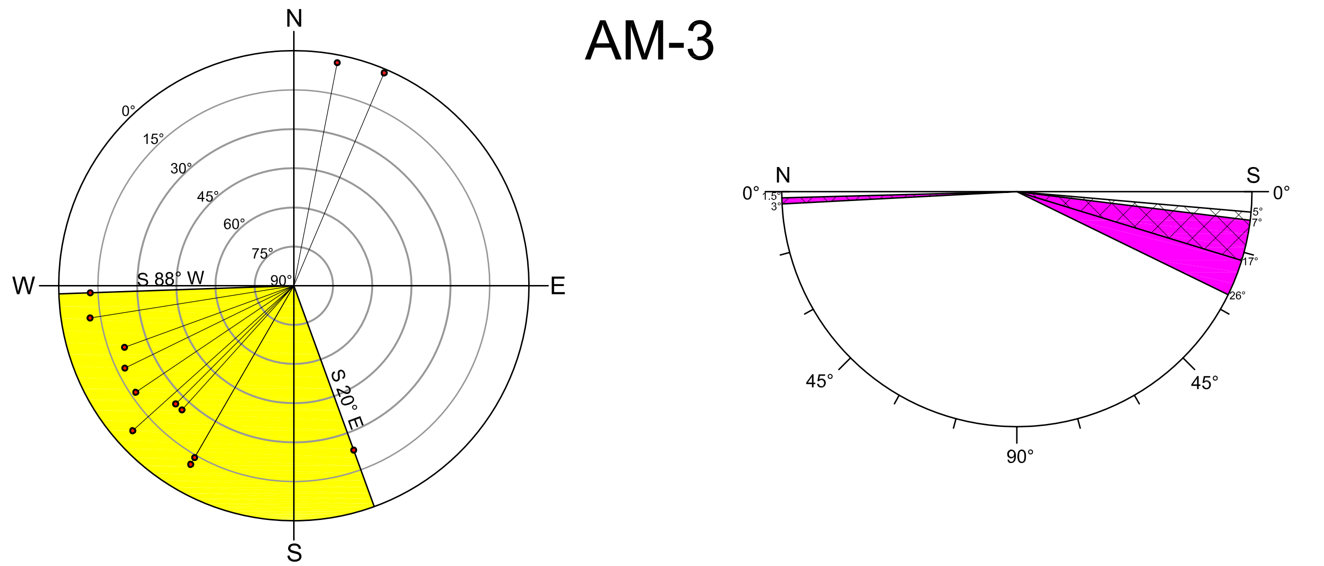
Explanation for Graphical Representations of Slope Geometry

The slope geometry at each site is represented by two figures. The plot on the left illustrates individual measured slope bearings relative to true north or south and the range of observed bearings is shaded in yellow. For each measured bearing, a red dot is shown at the outer end of the bearing line. This red dot corresponds to the slope gradient, as indicated by the concentric lines shown at 15° increments (0° = horizontal and 90° = vertical).

The plot on the right graphically illustrates the range of measured slope gradients for each hemisphere. The range of overall (macro) slope gradients at each measured plant is shown in maroon and the range of local (micro) slope gradients is shown with a hatch pattern.

Figure 6. Plots of measured slope bearings and graphical slope gradient ranges for subarea AM-1 at the Airport Mesa occurrence and the explanation for Figures 2 and 6 through 11.	ALLAN E. SEWARD ENGINEERING GEOLOGY, INC.	*Job No.:* 02-1155SF-9
	Date: 10/1/02	*Drawn by:* MBW





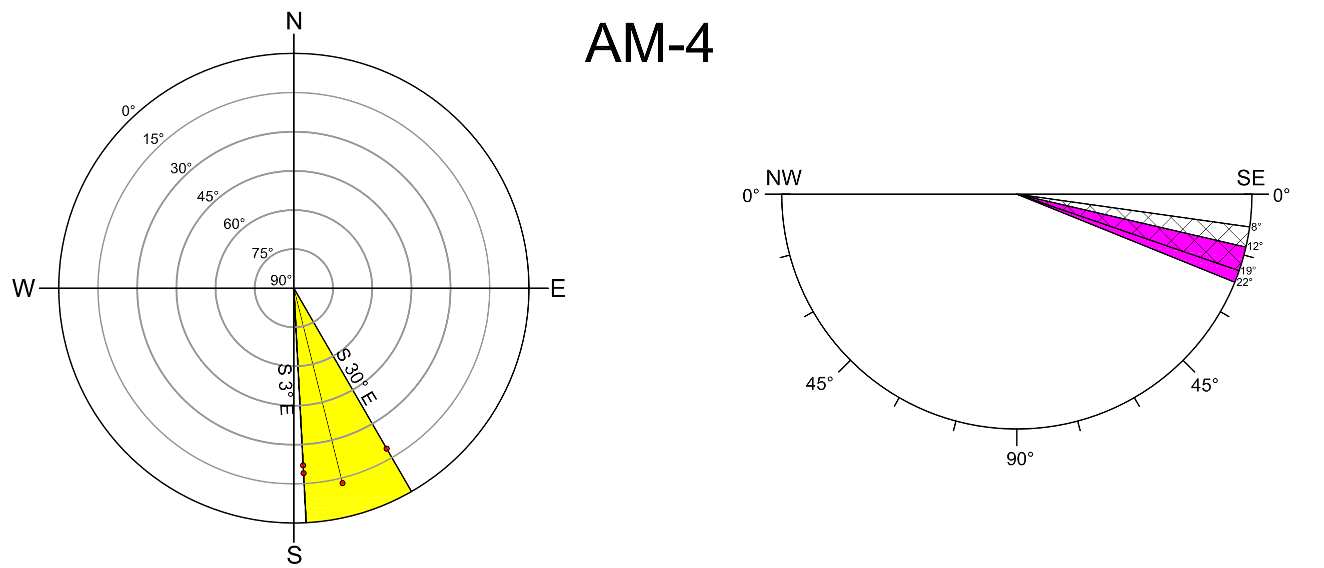


Figure 7. Plots of measured slope bearings and graphical slope gradient ranges for subareas at the Airport Mesa occurrence (see Figure 6 for explanation).	ALLAN E. SEWARD ENGINEERING GEOLOGY, INC.	*Job No.:* 02-1155SF-9
	Date: 10/1/02	*Drawn by:* MBW

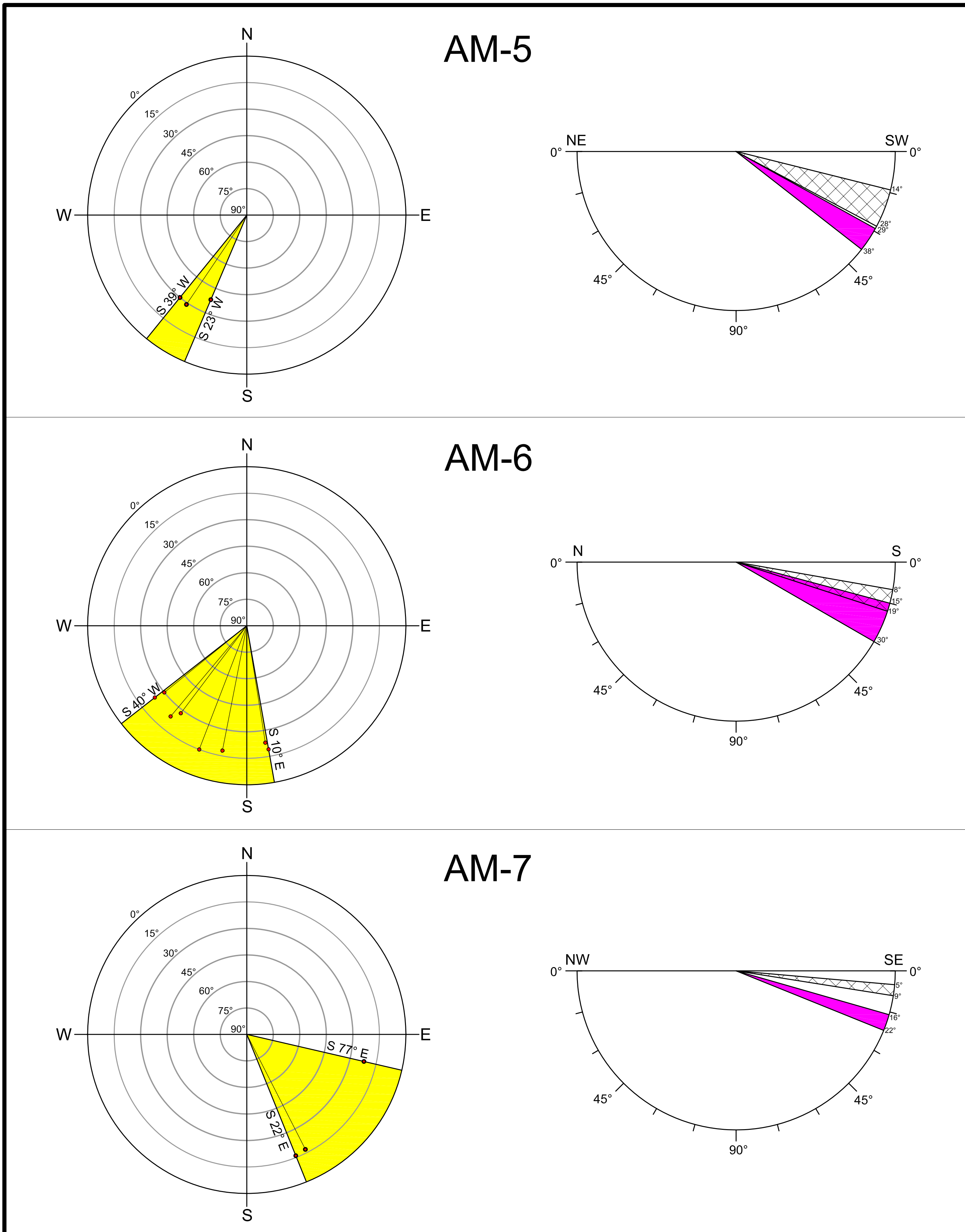


Figure 8. Plots of measured slope bearings and graphical slope gradient ranges for subareas at the Airport Mesa occurrence (see Figure 6 for explanation).

ALLAN E. SEWARD ENGINEERING GEOLOGY, INC.	*Job No.:* 02-1155SF-9
Date: 10/1/02	*Drawn by:* MBW

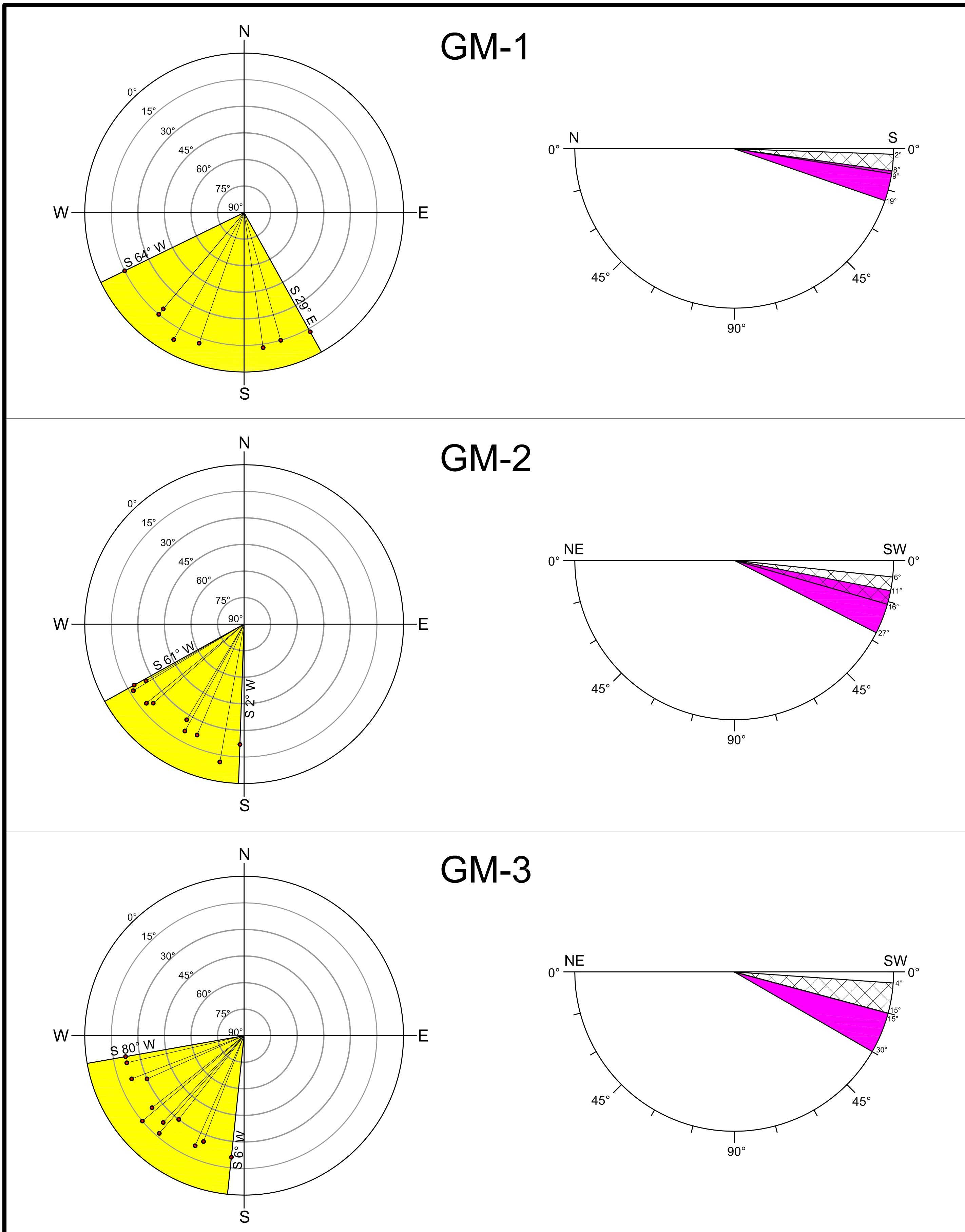


Figure 9. Plots of measured slope bearings and graphical slope gradient ranges for subareas at the Grapevine Mesa occurrence (see Figure 6 for explanation).

Figure 9. Plots of measured slope bearings and graphical slope gradient ranges for subareas at the Grapevine Mesa occurrence (see Figure 6 for explanation).	ALLAN E. SEWARD ENGINEERING GEOLOGY, INC.	*Job No.:* 02-1155SF-9
	Date: 10/1/02	*Drawn by:* MBW

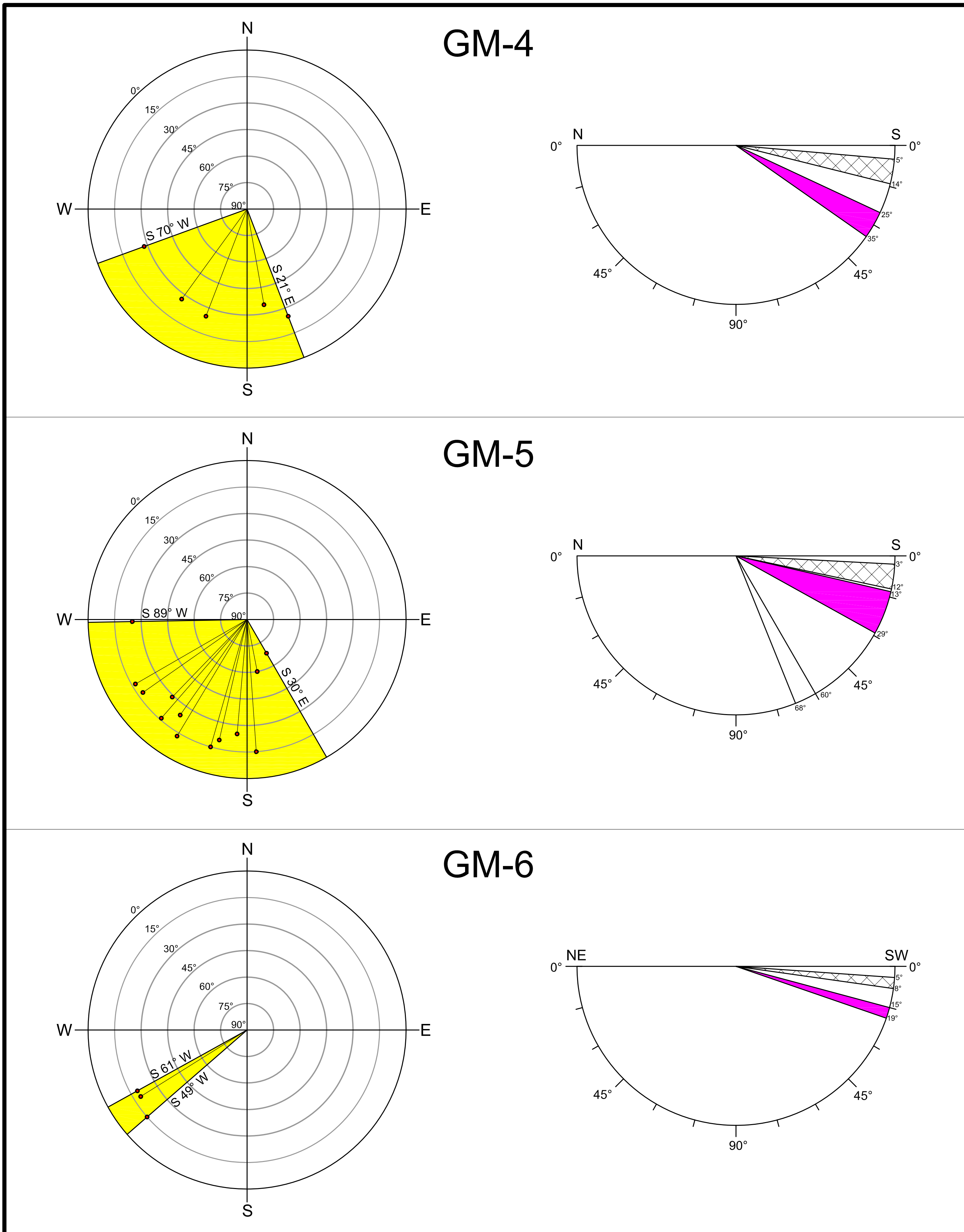


Figure 10. Plots of measured slope bearings and graphical slope gradient ranges for subareas at the Grapevine Mesa occurrence (see Figure 6 for explanation).

	ALLAN E. SEWARD ENGINEERING GEOLOGY, INC.	*Job No.:* 02-1155SF-9
	Date: 10/1/02	*Drawn by:* MBW

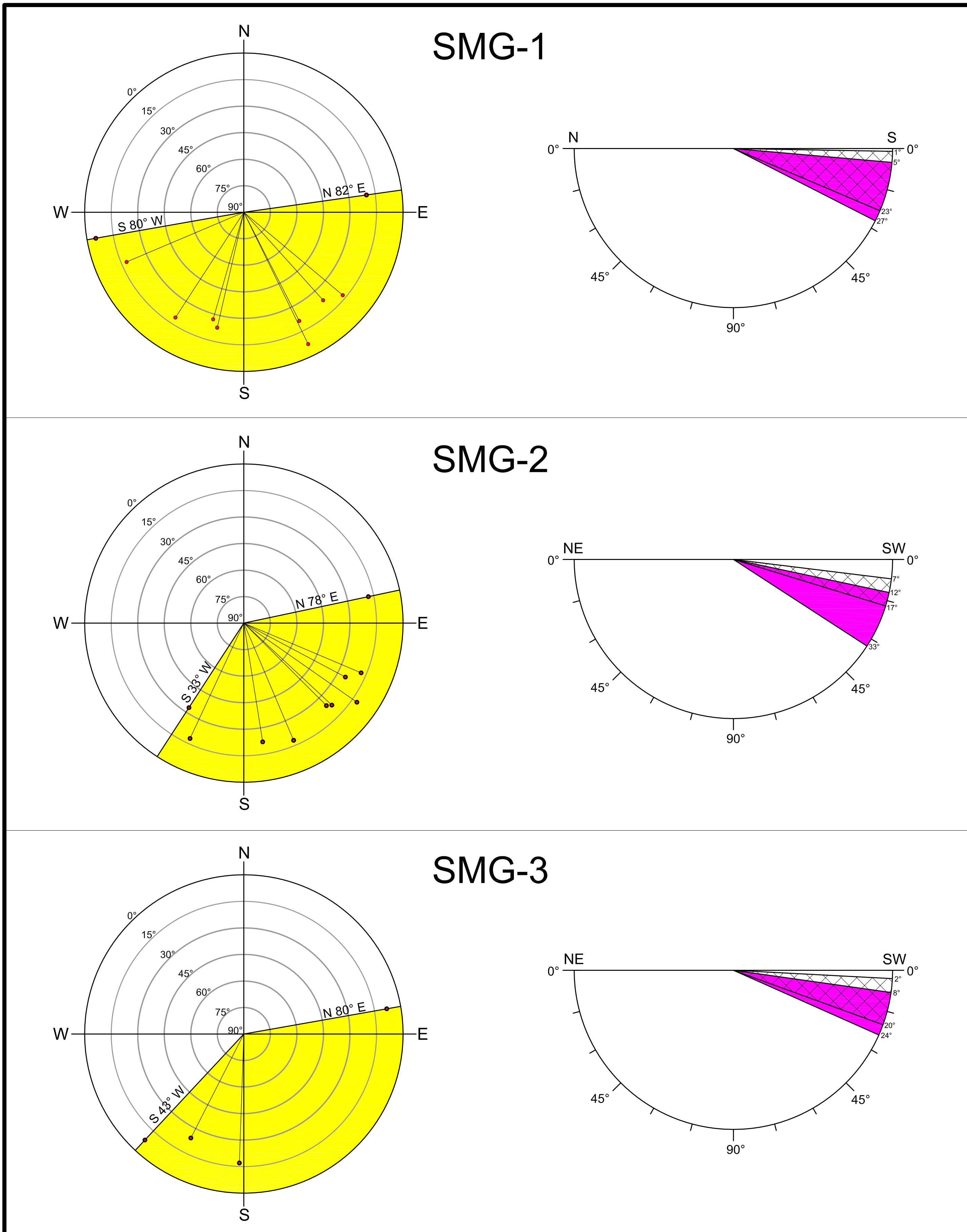


Figure 11. Plots of measured slope bearings and graphical slope gradient ranges for subareas at the San Martinez Grande Canyon occurrence (see Figure 6 for explanation).

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Date: 10/1/02	*Drawn by:* MBW	

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