

## APPENDIX 1. ALAMOGORDO NORTH QUADRANGLE STRATIGRAPHIC SECTIONS

This appendix presents four stratigraphic sections of latest Pleistocene and Holocene alluvium that were measured north and northwest of the city of Alamogordo. Colors of sediment are based on visual comparison of dry samples to the Munsell Soil Color Charts (Munsell Color, 1994). Grain sizes follow the Udden-Wentworth scale for clastic sediments (Udden, 1914; Wentworth, 1922) and are based on field estimates. Sand textures are abbreviated as in the following: very fine-lower, vFL; very fine-upper, vFU; fine-lower, fL; fine-upper, fU; medium-lower, mL; medium-upper, mU; coarse-lower, cL; coarse-upper, cU; very coarse-lower, vcL; very coarse-upper, vcU. Texture abbreviations are as follows: rounded, rnd; subrounded, subrnd; subangular, subang; angular, ang. Pebble sizes are subdivided as shown in Compton (1985). The term “clast(s)” refers to the grain size fraction greater than 2 mm in diameter. Clast percentages are estimated with the aid of percentage charts. Descriptions of bedding thickness follow Ingram (1954). Sandstone is classified according to Pettijohn et al. (1987). Soil horizon designations and descriptive terms follow those of the Soil Survey Staff (1992), Birkeland et al., 1991, and Birkeland (1999). Stages of pedogenic calcium carbonate morphology follow those of Gile et al. (1966) and Birkeland (1999). Each stratigraphic section was measured in arroyo exposures using a tape measure. Numerical unit designations were established up-section for measured section, but listed in descending stratigraphic order. Site locations are labeled on the geologic map.

**Dry Canyon stratigraphic section.** UTM coordinates of: 412,734 E, 3,647,585 N (NAD 27, zone 13)

Unit	Description of sediment	Description of soil	Thickness (cm)	
			(Unit)	(Total)
<b>Qf3-2</b>	<b>Local 10 cm-thick pebble bed.</b>		10	257
			Qf3c is 50-69 cm	
<b>Qf3-1</b>	<b>Silt, clay, and vFL-mL sand;</b> ~15% reddish brown clay beds (discontinuous and 1 cm-thick). Internally massive. Color of light brown (7.5YR 6/4). 1-3% pebbles. ). Lower contact is sharp and wavy over 3 cm. Soft.	<b>Weak Bty:</b> Peds are 2,c,subang blocky. V1fpf clay films. Gypsum speckles throughout (stage I+ gypsic horizon).	40	247
<b>G bed</b>				
<b>Qf2-3</b>	<b>Qf3b silt and fine sand:</b> Silt and vFL-fU sand and minor mL-cU sand. 15% scattered vf-vc pebbles. Internally massive. Color of light brown (7.5YR 6/4). Moderately hard.	<b>Weak Bty:</b> Peds are 2,c,subang-subrnd blocky and slightly hard. v1,f,pfbr clay films. Distributed gypsum in a stage I gypsic horizon.	19	207
<b>Qf2-2</b>	<b>Silty sand and pebbles:</b> Silty vFL-cL sand with ~15% cU-vcU sand. 15% lenticular pebble-fine cobbles lenses near base of exposure up to 10 cm-thick; gravel are locally imbricated. 15-20% scattered vf-vc pebbles above the pebble lenses. Sharp and scoured (3 cm of scour relief) lower contact. Relatively hard. Debris flow and fluvial sediment.	<b>Weak Bty:</b> Peds are 2,f-c, subang-subrnd blocky peds. v1,f,pf clay films. Stage I gypsic horizon.	30	188
			Qf3a is 53-72 cm	
<b>Qf2-1</b>	<b>Silty sand:</b> Silty vFL-vcU sand with 15% vf-vc, matrix-supported pebbles. Color of 10-7.5YR 6/4. Much more sand than below. Sharp and planar contact. Debris flow.	<b>Weak Bty:</b> Peds are 2,vc, subrnd to subang blocky and slightly hard. V1,f,pf clay films.	23	158
<b>Qfi</b>	<b>Silty-clayey sand:</b> Silty-clayey vFL-mL sand (mostly very fine sand) and minor (~25%) mU to vcU sand. Internally massive, with 5-7% vf-c pebbles.	<b>Bt:</b> Peds are 2-3,c-vc, subang blocky and hard. 1,f,brpf clay films.	50	135
			Qf2 is 72 cm.	
<b>Qf1-3</b>	<b>Clayey-silty fine sand:</b> Clayey-silty vFL-mL sand with 1% vf-m pebbles. Color of light brown (7.5YR 6/4). Lower contact is planar and gradational over 5 cm.	<b>Btk:</b> Peds are 3,c,subang blocky and very hard. 3,f,pf clay films. Stage I calcic horizon.	22	85
<b>Qf1-2</b>	<b>Clayey-silty fine sand:</b> Clayey-silty vFL-vFU sand with 1% vf-m pebbles. Color of 7.5YR 6/4). Lower contact is planar and gradational over 4 cm.	<b>Strong Btk (argillic horizon?):</b> Peds are 3,c,subang blocky to prismatic and very hard. 3,d,pf clay films. Stage I calcic horizon.	13	63
			Qf1 is >63 cm.	
<b>Qf1-1</b>	<b>Silty-clayey fine sand: Qf1 calcic soil horizon:</b> Silty-clayey fine sand with a color of 7.5YR 8/2-3.	<b>Btk with strong calcic horizon:</b> Peds are 2,m-c, subang blocky and very hard. 3,f,pf clay films overprinted by a stage II+ to III calcic horizon.	>50	50

**La Luz Road west stratigraphic section.** UTM coordinates of: 411,928 E, 3,647,602 N (NAD 27, zone 13)

Unit	Description of sediment	Description of soil	Thickness (cm) (Unit) (Total)	
<b>Qf3-3</b>	<b>Channel-fill of sandy gravel:</b> Channel-fill is inset into underlying units. Very thin to thin, planar to lenticular beds and thin to medium, lenticular beds. Gravel is mostly clast-supported, subrounded to rounded, and consists of limestone_dolomite with 5% sandstone and siltstone. Sand is 2.5YR 5/4 and has 10% clay and 5% vf-f sand; sand is mostly mL-vcU, subrounded to subangular, moderately sorted, and consists of a lithic to arkosic arenite. 1.2 m of scour relief.	<b>No obvious soil.</b>	120	
			Qf3c is 71 cm.	
<b>Qf3-2</b>	<b>Silty fine sand:</b> Silty vL-fL sand. Color of 5YR 5/4.	<b>Bw:</b> Peds are 1,vf-m, subrnd-subang blocky and soft to slightly hard. No clay films.	30	343
<b>Qf3-1</b>	<b>Clayey vL-mL sand:</b> Clayey vL-mL sand that is internally massive, contains abundant charcoal, and has 5-15% scattered pebbles (possibly bioturbated up from underlying unit); minor clay to clayey sand laminae to very thin beds (reddish brown color). Color of 5-7.5YR 5/4. Sharp lower contact with 2-3 cm of scour relief.	<b>Weak Bty:</b> Peds are 2,vf-c,subang blocky. 1,f,pfbr clay films. Gypsum probably present.	41	313
<b>G bed</b>				
<b>Qf2-3</b>	<b>Sand and 5% pebble lenses:</b> Laminated to very thin to thin, vague beds of vL-fU sand (5-7.5YR 5/6-6/4) and minor clayey-silty vL-fU sand (7.5YR 5/4-6/6), 5% thin to medium lenses of vf-vc pebbles, and 10% thin lenses of fL-vcU (7.5YR 5-6/4; subrounded, poorly sorted, and an arkose to lithic arenite). Sharp, planar, lower contact. Fluvial deposit.	<b>No obvious soil.</b>	45	272
			Qf3a is 105 cm-thick.	
<b>Qf2-2</b>	<b>Silty sand:</b> Silty vL-fU sand. Sharp and planar lower contact.	<b>Bw:</b> Peds are 1,vf-c,subrnd-subang blocky and soft. No clay films.	14	227
<b>Qf2-1</b>	<b>Sand:</b> vL-fU sand that is thin-bedded. Color of 7.5YR 5-6/4. Sharp and wavy lower contact with 3 cm of relief.	<b>Incipient soil development:</b> Peds are 2,f-c,subrnd-subang blocky and soft. No clay films.	46	213
<b>Qfi-2</b>	<b>Silty-clayey fine sand:</b> Silty to clayey vL-fU sand. No pebbles. Color of 7.5YR 5/4-6. Sharp to gradational, planar lower contact (over 1 cm).	<b>Bt:</b> Peds are 2,f-c,subang-subrnd blocky. 1-2,f,pf clay films.	52	167
			Qf2 is 76 cm.	
<b>Qfi-1</b>	<b>Clayey fine sand:</b> Clayey vL-fU sand with 20-25% mL-mU sand and 10% cU-vcU sand and vf pebbles. Color of 7.5YR 6/4. Lower contact is gradational over 1-2 cm.	<b>Bty:</b> Peds are 2,c-vc,subang to subrnd blocky. 2,f,pf clay films. Stage I to I+ gypsum filaments	24	115
<b>Qf1-3</b>	<b>Clayey fine sand:</b> Clayey vL-fU sand with minor (25%) m-vc sand and 3% vf-f pebbles. Color of 7.5YR 5/4. Lower contact is planar and gradational over 4-5 cm.	<b>Bty:</b> Peds are 3,vc,prismatic and slightly hard to hard. 1-2,d-p,pf clay films. Stage I-I+ gypsum filaments.	26	91
			Qf1 is >91 cm.	
<b>Qf1-2</b>	<b>Clay and fine sand:</b> Clay and vL-fU sand. Color of 5YR 5/4. Lower contact is wavy (3-4 cm relief) and gradational over 2 cm.	<b>Btk:</b> Peds are 3,vc,subang blocky to prismatic and hard. 3,p,pf clay films. 5% calcium carbonate nodules 5 mm-wide.	22	65
<b>Qf1-1</b>	<b>Clay and fine sand:</b> Clay and vL-fU sand. Color of 7.5YR 6/4-5/6.	<b>Btk:</b> Peds are 2,f-m,subang blocky and slightly hard. 3,d,pf clay films. Stage II calcic horizon. Locally whitish matrix. Calcium carbonate are in nodules 5 mm-wide that cover 15% of area.	>43 cm	

**La Luz Road east stratigraphic section.** Preliminary description. UTM coordinates of: 412,054 E, 3,647,597 N (NAD 27, zone 13)

Unit	Description of sediment	Description of soil	Thickness (cm) (Unit) (Total)	
<b>Qf2,</b>	<b>Silty sand:</b> Silty vL-mL sand that is internally massive.	<b>By:</b> Peds are 2,c-vc, angular blocky	100-200 cm	

Unit	Description of sediment	Description of soil	Thickness (cm)	
			(Unit)	(Total)
<b>Qfi</b> <b>near</b> <b>base</b>	Color of light yellowish brown (10YR 6/4).	(lower 2/3 of unit). Stage I gypsic horizon.		
<b>Qf1</b>	<b>Silt-clay and very fine sand:</b> Silt and vfL-vfU sand; internally massive. Color of light brown (7.5YR 6/4).	<b>Btk:</b> Stage I+?	60	
<b>Qf1</b>	<b>Silty-clayey fine sand:</b> fining-upwards, silty-clayey vfL-fU sand; very thin to thick, tabular beds. 1% very thin, vf-m pebbly fl_vcU sand in lenticular to broadly lenticular beds. Color of 7.5YR 6-7/4.	<b>Btk:</b> Stage II+ calcic horizon in upper 50 cm with weak clay films.	250	
<b>Qf1</b>	<b>Sandy gravel:</b> Vague, thin to medium, lenticular beds. Sand is 7.5YR 5.4, fL-vcU, poorly sorted, subrounded, and a litharenite.		Not measured	

**Upper middle La Luz Creek.** UTM coordinates: 411,570 N, 3,649,708 E (NAD 27, zone 13)

Unit	Description of sediment	Description of soil	Thickness (cm)	
			(Unit)	(Total)
<b>Qf3-2</b>	<b>Silty sand and subordinate intercalated sandy pebble lenses:</b> Silty vfL-mL sand with 10% mU-cL sand and subordinate intercalated thin to medium, sandy vf-vc pebble lenses and U-shaped beds. Pebbles are subrounded to subangular, clast-supported, and consist of limestone+dolomite and ~5% sandstone clasts. Color of 7.5YR 5/4-6. Relatively soft. On south side of arroyo, there is vfL-mU sand that is light yellowish brown (10YR 6/4) and in very thin to thin beds; minor silt-clay laminae.	<b>Soil not described.</b>	50	360
<b>Qf3-1</b>	<b>Silty fine sand:</b> Silty vfL-mL sand that is internally massive. Color of 5YR 5-6/4. Slightly harder than underlying unit.	<b>Soil not described.</b>	60	310
<b>G bed</b>				
<b>Q2-2</b>	<b>Silty fine sand:</b> Silty vfL-mL sand that is internally massive. Color of 5YR 5/6-6/4.	<b>Soil not described.</b>	60	250
<b>Qf2-1</b>	<b>Sand:</b> Laminated to very thin beds of silty vfL-vcU sand with 1% vf-f pebbles. Color of 5-7.5YR 5/6. Sand is mostly vfL-mL.	<b>Soil not described.</b>	58	190
<b>Qfi</b>	<b>Clay, silt, and fine sand:</b> Clay, silty, and vfU-fU sand. Color of 7.5YR 6/6.	<b>Bt:</b> 2,c,subang blocky peds. 3,f-d,pf clay films.	46	132
<b>Qf1-2</b>	<b>Clay and fine sand:</b> 5YR 5/4-6.	<b>Bt:</b> 3,m-c,subang blocky peds and 3,d,pf clay films.	37	86
<b>Qf1-1</b>	<b>Sandy gravel:</b> Clast-supported, pebbles and cobbles.	<b>Byk:</b> Stage II+ gypsic+calcic horizon.	49	49

**Upper Ritas Draw.** UTM coordinates of: 407,809 E, 3,648,259 N (NAD 27, zone 13)

Unit	Description of sediment	Description of soil	Thickness (cm)	
			(Unit)	(Total)
<b>Qf2 or Qf3</b>	<b>Sandy gravel:</b> Subrounded, vf-vc pebbles and f cobbles; discontinuous, beat-up CaCO <sub>3</sub> coats on the clasts. Matrix is 7.5-5YR 5/6 silty-clayey vFL-mL sand and <20% mU-vcU sand. Sharp lower contact.	<b>By:</b> Stage I to II gypsic horizon.	46	348
<b>Qf2</b>	<b>Clay, silt, and very fine to fine sand:</b> Clay, silt, and vFL-fU sand. Color of 5YR 5/4-6/6. Lower contact is gradational over 5 cm and planar. Locally, there are minor lenticular, 10-30 cm-thick sandy gravel channel-fills	<b>Cumulic Bty:</b> Peds are 2,m-c,subang blocky and hard. 3,d,pf clay films. Stage I to I+ gypsum filaments.	128	302
<b>Qfi</b>	<b>Silt, clay, and fine very fine to fine sand:</b> Silt, clay, and vFL-fL sand and minor fU-mU sand. Color of 7.5YR 8/2-3. Lower contact is smooth and has 12 cm of gradation.	<b>Btyk:</b> Peds are 3,vf-m,subang blocky and very hard. 2,f,pf clay films. Stage II gypsic horizon.	34	174
<b>Qf1-2</b>	<b>Silt, clay, and fine very fine to fine sand:</b> Silt, clay, and vFL-fL sand and minor fU-mU sand. Color of 7.5YR 7/4-7/6. Lower contact is smooth and has 2-3 cm gradation.	<b>Btyk:</b> Peds are 2,vf-c,subang blocky and hard. 3,f,pf clay films.	40	140
<b>Qf1-1</b>	<b>Sandy gravel:</b> Clast-supported, sandy gravel. General clast imbrication direction is S45W. Gravel are subrounded to rounded, and consist of vf-vc pebbles and f cobbles (well-graded). Clast composition is >98% Paleozoic limestone and dolomite. Beds are thin to thick, lenticular, and vague. Sand is light brown (7.5YR 6/4), has 5% clay, vFL-vcU, poorly sorted, subrounded to subangular, and a litharenite. Well consolidated because of clay.	<b>Locally the soil described in the above unit extends into this unit.</b>	>1 m	100

**Lower Ritas Draw.** Preliminary description. UTM coordinates of: 407322 E, 3647561 N (NAD 27, zone 13)

Unit	Description of sediment	Description of soil	Thickness (cm)	
			(Unit)	(Total)
<b>Qf3</b>	<b>Silty vf-f sand.</b>	<b>Not described</b>	55	295
<b>Qf2-3</b>	<b>Sandy pebbles through cobbles</b>	<b>Not described</b>	40	240
<b>Qf2-2</b>	<b>Sand:</b> Planar to cross-laminated (2 cm-thick), vFL-vcU, moderately sorted, subrounded to subangular, litharenite to arkosic arenite. Scoured lower cotact with 8 cm of relief.	<b>Not described</b>	72	200
<b>Qfi</b>	<b>Silt, clay, and fine very fine to fine sand:</b> 1-3% very thin sand lenses. Lag gravel at base.	<b>Weaker Bt than below and lighter colored (3,d,pf).</b>	82	128
<b>Qf1-2</b>	<b>Silt, clay, and fine very fine to fine sand:</b>	<b>Bt: Dark reddish brown; 3,p,pf clay films.</b>	16	46
<b>Qf1-1</b>	<b>Silt, clay, and fine very fine to fine sand overlying gravel.</b>	<b>By: Stage II gypsic horizon.</b>	30	30