



NOT TO SCALE
(all depths are below grade)

Well Completion Diagram for MW-33-90
PG&E Topock

Bat Cave Wash Project
LITHOLOGIC LOG

Well Number MW-33-90

Elevation of concrete pad 484.64 (in feet)

Drilling contractor / method Boart Longyear, Sonic

Completion date 3/7/03

Logger R. Lambert

Location 2,103,287 (northing); 7,615,915 (easting)

Borehole diameter 8 in., 4-inch PVC, Sch. 80

COMPLETION DIAGRAM	DEPTH BELOW SURFACE (in feet)	SOIL DESCRIPTION (name, color, particle size, distribution, consistency (hard, soft, etc.), moisture content; structure, etc.)	USCS	SAMPLE NUMBERS and COMMENTS
		Sand, light brown, loose, fine- to medium-grained, dry (dredged sands).	SP	Spud 13:25 MW-33-03 (Dredged sands)
	10	Sand, tan, fine-grained, loose.		MW-33-10
		Sand, tan, fine-grained, loose.		13:28
	20	Sand, light brown, fine- to medium-grained.		MW-33-20 (Adding water while drilling)
		Sand, dark yellowish brown, medium-grained (10YR 4/2), loose.		14:00
	30	Silty sand lens.	SM	14:30 (Down for mechanical problems)
		Sand, medium yellowish brown. Clayey silt with cobbles (<4-inch diameter). Clayey silt with gravel (rounded), medium yellowish brown.	SP ML CL	MW-33-40 (Archive sample)
	40	Silty clay with pebbles (<1/3" dia.), moderate yellow brown (10YR 4/2), moderately plastic, cohesive. Silty sand with gravel. Gravelly sand with some silt, moderate brown, coarse-grained, rounded gravel to 2-inch diameter.	SM SW	7:50 (5YR 4/4)
	50	Silt grading downward to medium subrounded sand, moderate brown, to gravelly, coarse-grained sand. Gravelly, sandy silt, coarse-grained sand, dark, yellowish brown, very stiff.	ML SP ML SM	(10YR 4/2) 8:18 (Down for more pipe, 25 min.)
	60	Less silt. Gravelly, coarse-grained sand, dark, yellowish brown (10YR 4/2), rare cobbles.	SW	9:08 MW-33-60
		As above, with coarse- to very coarse-grained sand, subangular gravel (<1/2-inch diameter); a few thin zones (≤ 6") of silt, approx. 10% gravel.		(Archive sample; when washed, the sand has a salt and pepper appearance) 9:45 (Casing is tight driving in)
	70	As above.	SW	
80	Thin gravel, sand and silt, dark, yellowish brown. Gravelly sand, minor silt, medium- to very coarse-grained sand, occasionally more silt.	SM SW	10:30 11:19 MW-33-80	



Bar Cave Wash Project LITHOLOGIC LOG

Well Number MW-33-90

Elevation of concrete pad 484.64 (in feet)

Drilling contractor / method Boart Longyear, Sonic

Completion date 3/7/03

Logger R. Lambert

Location 2,103,287 (northing); 7,615,915 (easting)

Borehole diameter 8 in., 4-inch PVC, to 89'

COMPLETION DIAGRAM	DEPTH BELOW SURFACE (in feet)	SOIL DESCRIPTION (name, color, particle size, distribution, consistency (hard, soft, etc), moisture content; structure, etc.)	USCS	SAMPLE NUMBERS and COMMENTS
	80	Gravelly sand, medium- to very coarse-grained, dark, yellowish brown (grayer than sand above). Est. 30% angular gravel, 50% very coarse sand, 10% coarse sand, 10% finer sand.	SW	(Archive sample) (Down for alternator / lunch)
	90	Gravelly silt with sand, dark yellowish brown (10YR 4/2), very stiff.	ML	14:05
	100	Gravelly sand, moderate brown (5YR 3/4)	SW	(Archive sample) MW-33-100
	110	Sandy silt with gravel, dark greenish gray (5GY 4/1), in part, hard.	ML	Very stiff at 102' 14:40 Drive 8-in. casing to 105', then 6-inch diameter core.
	110	Some cobbles to 3-inch diameter, subangular, gabbro.	SM	15:30 Very stiff.
	120	Silty sand with cobbles, pale yellowish brown (10YR 6/2), very stiff.	SM	16:00 Core is hot. (using 4-in. core barrel at 115')
	120	Sandy silt with rare gravel. Cemented conglomerate, silty, dry appearance, mottled colors (green, gray, brown).	ML	(Archive sample) MW-33-120 16:35
	130	Silty sand with occasional cobbles, fine- to coarse-grained. Sand with low permeability, occasional sandy lens, wet. Conglomerate, silty matrix, with subangular pebbles, mottled, some olive gray (5Y 3/2), tight, can crumble (Red Fanglomerate?).	SM	(Archive sample)
	130		GM	TD 130' 17:20 (Archive sample)
	140			
150				
160				

SOIL BORING LOG

PROJECT NAME: PG&E Topock, Interim Measures, Phase 2 (2005)		HOLE DEPTH (ft): 237.0	DRILLING CONTRACTOR: Prosonic Corp. Phoenix, AZ	
SURFACE ELEVATION: 484.6 ft. MSL	NORTHING (CCS NAD 27 Z 5): 2,103,295.06	EASTING (CCS NAD 27 Z 5): 7,615,909.82	DATE STARTED: 02/12/2005	DATE COMPLETED: 02/15/2005
DRILLING METHOD: Rotosonic		WATER LEVEL (ft):	DRILLING EQUIPMENT: Track Mounted Sonic	
LOCATION: 600 ft NE of TW-2D, Colorado River floodplain.			LOGGED BY: B. Moayyad, B. Trebble	

DEPTH BGS (feet)	SAMPLE			USCS CODE	SOIL DESCRIPTION SOIL NAME, USCS SYMBOL, COLOR, PERCENT COMPOSITION, GRADING, GRAIN SHAPE, MINERALOGY, DENSITY/CONSISTENCY, STRUCTURE, MOISTURE.	COMMENTS DRILLING OBSERVATIONS AND OPERATIONS, DAILY START AND END TIMES, DRILL RATE, REFUSALS, SAMPLING AND TESTING NOTES.
	INTERVAL	TYPE/NUMBER	RECOVERY (ft)			
5		Box 1	5.6	SP	POORLY GRADED SAND (SP) - brn 7.5YR5/4, 99% subrnd to subang f sand, 97% qtz, ~3% mafics, <1% fines, loose, moist	collect bag samples for archive description and potential grain-size testing. moisture from rain on 02/11/05
10		Box 2 Box 3	8		- as above, 98% sand, <2% fines, becomes dry	no bag sample collected above water soft drilling
15					- 90% qtz, 10% mafics, dry, some feldspar	poor recovery as loose dry sands are pushed aside by core barrel, 10ft soil sample @ 13:30
20		Box 4 Box 5	8.5		- vf-f sand, no gravel, massive, loose, dry	soil samples at 20ft @ 13:45
25						
30		Box 6 Box 7	9	SP	POORLY GRADED FINE SAND (SP) - brn 7.5YR5/3, 99% qtz rich fine sand, 1% fines, no gravel, loose, moist	becomes moist at 27 ft
35						30ft soil sample @14:00

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	INTERVAL	TYPE/NUMBER	RECOVERY (ft)			
				SP	POORLY GRADED FINE SAND (SP) - brn 7.5YR5/3, 96% qtz rich fine sand, 2% fines, 2% m subrnd gravel, loose, dry	bag sample at 35ft: MW33D-GS-35 @ 14:10
40				ML	SILT (ML) - brn 7.5YR4/3, 65% silty fines, 35% vf sand, non-sticky, very plastic, soft, wet - yellow mottled with roots	bag sample at 39ft: MW33D-GS-39 @ 14:10 40ft soil sample @14:10
45		Box 8 Box 9	9	ML	CLAYEY SILT (ML) - lt brn, 85% clayey fines, 15% vf sand, non sticky, very plastic, soft, wet	
				GW	WELL GRADED GRAVEL WITH SAND AND CLAY (GW) - brn, 60% gravel up to 2" long, 27% subrnd well graded sand, 13% clayey fines, subrnd igneous & metamorphic, medium density	
50				SM	SILTY SAND (SM) - lt brn 7.5YR5/4 with iron oxide staining, 80% vf sand, 20% silty fines, loose to medium, wet	
55		Box 10 Box 11	9	SW	WELL GRADED SAND WITH SILT AND GRAVEL (SW) - dk brn 7.5YR3/2, 80% subrnd lithic sand, predominantly medium coarse, 15% silty fines, 5% gravel, hard to medium density, wet, very little pore space - becomes moist below 54ft, clay rich zone 54-55ft - 17% clayey fines - 62% sand, 30% gravel, 8% fines, overall subang with 2% rounded, metamorphic	bag MW33D-GS-53 in cleaner SW collect isoflow groundwater sample between 52 & 57 ft, MW-33D-GS-54.5 @15:45
60				SW	WELL GRADED SAND WITH GRAVEL (SW) - brn 7.5YR4/2, 70% subrnd lithic sand with red sand stone, 25% rnd gravel up to 2.6" long, 5% fines, gray metamorphic and brn chert, medium to hard, wet - as above, less gravel, 87% sand, 10% gravel, 3% fines - 65% sand, 20% gravel up to 1 1/2", 15% fines	60ft soil samples @16:00
65		Box 12 Box 13	9	SM	SILTY SAND (SM) - brn 7.5YR5/3, 77% rnd well graded lithic sand, 20% silty fines, 3% f gravel, soft, wet	bag sample at 63ft: MW33D-GS-63 @16:00
70				SW	WELL GRADED SAND WITH SILT AND GRAVEL (SW) - brn 7.5YR5/3 fine, and gray 7.5YR5/1 sand, 80% subrnd lithic sand, 10% silty fines, 7% gravels, 3% cobbles	hard drilling

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	INTERVAL	TYPE/NUMBER	RECOVERY (ft)			
75		Box 14 Box 15	9	SW	WELL GRADED SAND WITH GRAVEL (SW) - brn 7.5YR5/3 fine, and gray 7.5YR5/1 sand, 77% subrnd lithic sand, 30% gravel, 3% silty fines - sand becomes greenish gray and subang, very poorly sorted vf-vc - one 3.5 inch MM cobble - brn 7.5YR4/3, 58% sand, 40% gravel, 2% silty fines, subang, hard, wet - subang to subrnd - one metamorphic subang cobble at 78ft, and one at 83ft	70ft soil sample @16:30 collect isoflow groundwater sample between 72 & 77 ft, MW-33D-GS-74.5 @16:45
80		Box 16 Box 17	8.5			
85				SM	SILTY SAND WITH GRAVEL (SM) - brn 7.5YR4/4, 80% well packed sand, 15% fines, 5% gravel, subang to well sorted, hard, moist, color due to fines - some clay in fines from 86-87ft	igneous and metamorphic: source for greenish gray sand
90				SC	CLAYEY SAND (SC) - greenish gray sand/ brn fines/ brn overall, 80% subrnd sand, 20% clayey fines, hard, well sorted and well packed, moist	collect bag sample MW33D-88.5 @8:45
95		Box 18 Box 19	0	SM	SILTY SAND WITH GRAVEL (SM) - brn overall (greenish gray sand) as above, 73% subang sand, 20% fines, 7% f MM gravels, hard, well sorted and well packed, moist	no water for isoflow sample 92-97ft
100				SW	WELL GRADED SAND WITH SILT AND GRAVEL (SW) - brn, 80% sand, 10% gravel, 10% fines, subrnd, hard, moist to wet - clayey fines - brn overall 7.5YR5/3, greenish gray MM sand and gravel, 78% subang sand, 15% f gravel, 7% silty fines, wet	bag sample collected at 98ft:MW33DGS-98@ 9:10 100ft soil sample @9:10
105		Box 20 Box 21	9			

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	INTERVAL	TYPE/NUMBER	RECOVERY (ft)			
110				SM	SILTY SAND WITH GRAVEL (SM) - brn overall, 75% sand, 15% silty fines, 10% gravel, subang MM sands and gravels, hard, moist	partially cemented, hard drilling reworked older alluvium?
				SW	WELL GRADED SAND WITH SILT AND GRAVEL (SW) - brn 7.5YR5/3, 85% sand, 10% gravels, 5% fines, subrnd, medium density, wet	
				SM	SILTY SAND WITH GRAVEL (SM) - brn 7.5YR5/3, subang greenish gray sand and gravel, 75% sand, 20% silty fines, 5% gravel, hard, moist	110ft soil sample @9:55
115		Box 22 Box 23	9	SC	CLAYEY SAND WITH GRAVEL (SC) - brn 7.5YR4/2, 60% sand, 22% clay and silt, 18% gravel up to 2.7" long, subang to ang, metamorphic sands and gravels, hard, well sorted, well packed, moist (near dry)	
				SW	WELL GRADED SAND WITH SILT (SW) - brn overall 5YR5/3, 85% sand, 10% fines, 5% f gravel, subrnd MM sands and gravels, medium to hard, wet	groundwater isoflow sample 115-122 ft:MW33D-GS-113.5 @12:25
120				SM	SILTY SAND (SM) - brn 5YR5/3, 75% well packed sand, 20% silty fines, 5% f gravel, subang, hard, well graded, well packed, moist	partially cemented, hard drilling
		Box 24 Box 25	8.5	SC	CLAYEY SAND WITH GRAVEL (SC) - brn, 60% subang well graded sand, 30% clayey fines, 10% gravel, hard, moist	
125				SM	SILTY SAND WITH GRAVEL (SM) - brn, 70% sand, 18% silty fines, 12% gravel and cobbles, subang, hard, moist	
130				SW	WELL GRADED SAND WITH SILT AND GRAVEL (SW) - brn 5YR4/3, 80% sand, 13% f gravel, 7% silty fines, subrnd metamorphic sand and gravel, medium density, wet	
		Box 26 Box 27	9	SW	WELL GRADED SAND WITH GRAVEL (SW) - brn 5YR5/3, 80% sand, ~60% qtz, ~30% mafics, 15% f gravel, ~10% feldspar, 5% fines, subrnd metamorphic sand and fine gravel, medium to hard, wet - larger gravel up to 1 inch below 135ft, 75% sand, 20% gravel, 5% silty fines	bag sample @130ft: MW33D-GS-130 @14:45 collect groundwater isoflow sample between 132-137ft: MW33D-134.5 @ 15:35
135				SW		
140					- well graded sand as above, 75% sand, 18% f subang gravel up to 1 inch long, 7% silty fines	

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145		Box 28 Box 29	9	SW	WELL GRADED SAND WITH GRAVEL (SW) - brn 5YR5/3, 80% sand, ~60% qtz, ~30% mafics, 15% f gravel, ~10% feldspar, 5% fines, subang to ang sharp metamorphic sand and fine gravel, medium to hard, wet - 73% sand, 25% gravel up to 2.5 inch, 2%fines	collect 140ft soil sample @15:55
150					- as above with smaller gravels up to 1.5 inch long, becomes reddish brn 2.5YR5/3	collect 150ft soil sample @16:30
155		Box 30 Box 31	9	SM	SILTY SAND WITH GRAVEL (SM) - reddish brn 2.5YR5/3, 72% sand, 18% silty fines, 10% f gravel, subang metamorphic gravel and sand, hard, wet	hard, cemented, possibly reworked fanglomerate collect groundwater 152-157: MW33D-154.5 @17:15 collect bag sample at 155ft: MW33D-GS-155 @16:30
160				SW	WELL GRADED SAND WITH SILT AND GRAVEL (SW) - reddish brn 2.5YR5/3, 70% sand, 18% gravel, 12% fines, subang metamorphic sand and gravel, medium density, wet	collect bag sample at 160 ft: MW33D-GS-160 @07:30
165		Box 32 Box 33	9		- less gravel below 161.5ft, 78% sand, 12% fines, 10% gravel,	
170				SM	- 72% sand, 15% gravel, 13% red fines, subang metamorphic sand and gravel, medium to hard	collect 170ft soil sample @8:10, reworked fanglomerate ?
175		Box 34 Box 35	9.5		- fractured metamorphic cobbles at 171.5ft - 70% sand, 20% gravel, 10% silty fines	collect groundwater isoflow sample

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180			9.5	SW	gravel, subang, hard WELL GRADED SAND WITH SILT AND GRAVEL (SW) - 75% sand, 15% gravel, 10% fines	between 172-177ft: MW33D-174.5 @ 09:00
				GM	SILTY GRAVEL WITH SAND (GM) - reddish brn, subang to ang, moist	
				SW	WELL GRADED SAND WITH SILT AND GRAVEL (SW) - 77% sand, 15% gravel, 8% fines	
				SM	SILTY SAND WITH GRAVEL (SM) - 60% sand, 20% fines, 20% gravel and cobbles	
				SW	WELL GRADED SAND WITH SILT AND GRAVEL (SW) - reddish brn 2.5YR5/3, 72% sand, 20% gravel, 8% silty fines, subang metamorphic sand and gravel up to 2" long, medium density, wet	
185				SC	CLAYEY SAND WITH GRAVEL (SC) - reddish brn, 60% sand, 20% gravel, 20% clay and silt, subang, hard	collect 180ft soil sample at 9:50 reworked fanglomerate ?
190			9.5	SW	WELL GRADED SAND WITH SILT AND GRAVEL (SW) - reddish brn 2.5YR5/3, subang metamorphic sand and gravel, loose to medium, wet - 70% sand, 20% gravel, 10% fines - cobbles	collect 190ft soil samples @10:50, easier drilling
195					- more gravel below 194.5 ft, 65% sand, 25% gravel, 10% fines	
200				SM	SILTY SAND WITH GRAVEL (SM) - 65% sand, 20% silty fines, 15% gravel	bag sample collected in gravel rich zone at 196ft: MW33D-GS-196 @10:50
205			9.5	SW	WELL GRADED SAND WITH SILT AND GRAVEL (SW) - reddish brn 2.5YR5/3, 68% sand, 20% gravel, 12% silty fines, subang metamorphic sand and gravel up to 1.5" long, loose to medium, wet	collect 200ft soil sample @12:00 reworked fanglomerate
210				SM	SILTY SAND WITH GRAVEL (SM) - reddish brn, 65% sand, 20% fines, 15% gravel, subang, hard, moist WELL GRADED SAND WITH SILT AND GRAVEL (SW) - reddish brn 2.5YR5/3, 73% sand, 15% gravel, 12% silty fines, subang metamorphic sand and gravel up to 1.2" long, medium density, wet	

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215		Box 42 Box 43	9.5	SW	WELL GRADED SAND WITH SILT AND GRAVEL (SW) - reddish brn 2.5YR5/3, 73% sand, 15% gravel, 12% silty fines, subang metamorphic sand and gravel up to 1.2" long, medium density, wet	collect 210ft sample @12:20
					CONGLOMERATE (BR) - reddish brn 2.5YR5/3, 60% sand, 22% silty fines, 18% gravel, subang metamorphic, hard, moist, partially cemented	collect isoflow water sample Top Miocene Conglomerate 213 ft bgs
220					- as above, cobbles at 218.5 ft, 58% sand, 22% gravel and cobbles, 20% fines	harder drilling, weathered fanglomerate, not wet below 213.5ft (moist)
225		Box 44 Box 45	9.5		- more clay and stronger cementation observed below 222 ft, 55% sand, 25% silt and clay, 20% gravel	less weathering in fanglomerate
230				BR	- as above	relatively intact red fanglomerate
235		Box 46 Box 47	9.5		- as above - sandy (SM) zone at 232 ft	
					Boring Terminated at 237 ft	
					ABBREVIATIONS cc = continuous core run brn = brown lt = light dk = dark vf = very fine-grained f = fine-grained m = medium-grained c = coarse-grained	

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					vc = very coarse-grained ang = angular subang = subangular subrnd = subrounded rnd = rounded br = bedrock formation ss = sandstone conglom = conglomerate comptd = compacted qtz = quartz	