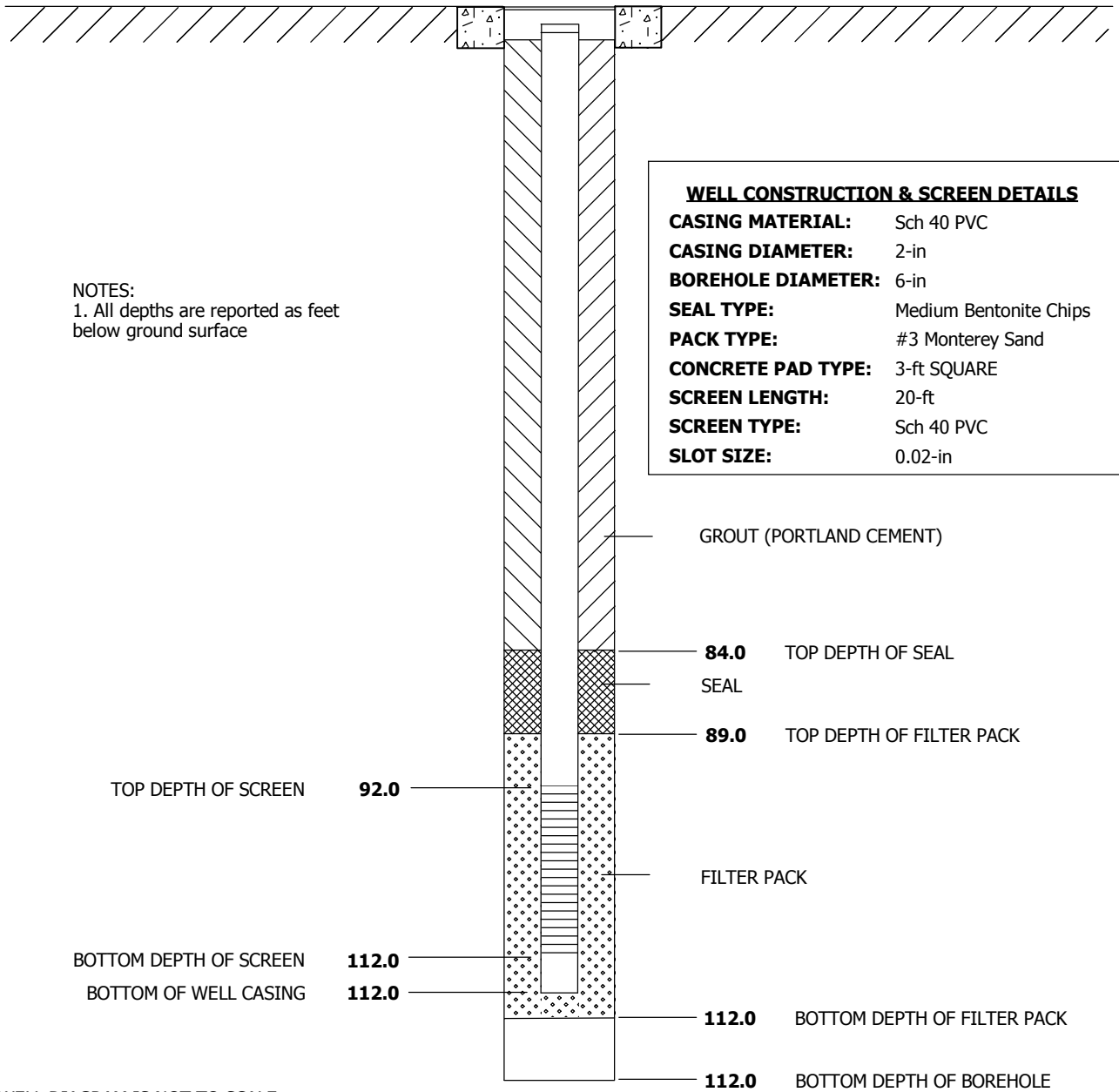
WELL COMPLETION DIAGRAM

PROJECT NO: 382653.FP.04.FW	**PROJECT:** PG&E Topock - ERGI	**WELL NO:** ***MW-61-110***
LOCATION: Site C		

DRILLING CONTRACTOR: Boart Longyear (D. Roberts)	**DRILLING START:** 3/4/2009
DRILLING METHOD: Rotary Core (HQ) - Rotosonic overdrill	**DRILLING END:** 3/13/2009
LOGGER: A. Brewster (Northstar)	**WELL COMPLETION DATE:** 3/13/2009
GROUND SURFACE ELEVATION (NAVD 88): 544.12 ft AMSL	**GENERAL REMARKS:** Alias during field work: MW-61
NORTHING (CCS NAD 83 Z 5): 2100713.02 / **EASTING (CCS NAD 83 Z 5):** 7616591.04	

12-IN DIAMETER WELL VAULT (FLUSH WITH GRADE)



NOTES:
1. All depths are reported as feet below ground surface

WELL CONSTRUCTION & SCREEN DETAILS

CASING MATERIAL:	Sch 40 PVC
CASING DIAMETER:	2-in
BOREHOLE DIAMETER:	6-in
SEAL TYPE:	Medium Bentonite Chips
PACK TYPE:	#3 Monterey Sand
CONCRETE PAD TYPE:	3-ft SQUARE
SCREEN LENGTH:	20-ft
SCREEN TYPE:	Sch 40 PVC
SLOT SIZE:	0.02-in

WELL DIAGRAM IS NOT TO SCALE

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
382653.FP.04.FW	MW-61 SHEET 1 OF 7

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI
LOCATION : Site C (2100713.0 N, 7616591.0 E)
ELEVATION : 544.1 ft
DRILLING CONTRACTOR : Boart Longyear (D. Roberts)
DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools
ORIENTATION : Vertical
WATER LEVELS : Approx. 87 ft BGS
START : 3/4/2009
END : 3/12/2009
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
5, 10		COMPLETE		SM	**Silty Sand With Gravel (SM)** 0.0-14.0' - dark brown, (7.5YR 3/3), dry, loose, 30% gravel, 50% sand, 20% fines, sand is angular to subangular, poorly graded, no dominant mineralogy, matrix supported, max clast size = 40 mm		Boring initially drilled to 68.0' bgs using Rotosonic tools up to 6-in in diameter. 6-in Rotosonic casing then used as a temporary conductor casing to facilitate the rotary core drilling. Boring drilled from 68.0' bgs to a total depth of 112.4' bgs using diamond bit rotary core tools (HQ-size, 3.8-in diameter) and then overdrilled to total depth using 6-in Rotosonic tools.
15, 20				SP-SM	**Poorly Graded Sand With Silt And Gravel (SP-SM)** 14.0-63.0' - dark brown, (7.5YR 3/3), dry, loose, 20% gravel, 70% sand, 10% fines, sand is angular to subangular, poorly graded, no dominant mineralogy, matrix supported, max clast size = 50 mm		

PROJECT NUMBER: 382653.FP.04.FW	BORING NUMBER: MW-61	SHEET 2 OF 7

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI
LOCATION : Site C (2100713.0 N, 7616591.0 E)
ELEVATION : 544.1 ft
DRILLING CONTRACTOR : Boart Longyear (D. Roberts)
DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools
ORIENTATION : Vertical
WATER LEVELS : Approx. 87 ft BGS
START : 3/4/2009
END : 3/12/2009
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
25		COMPLETE			**Poorly Graded Sand With Silt And Gravel (SP-SM)** 14.0-63.0' - dark brown, (7.5YR 3/3), dry, loose, 20% gravel, 70% sand, 10% fines, sand is angular to subangular, poorly graded, no dominant mineralogy, matrix supported, max clast size = 50 mm		
30				SP-SM			
35							
40							

PROJECT NUMBER: 382653.FP.04.FW	BORING NUMBER: MW-61	SHEET 3 OF 7

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI
LOCATION : Site C (2100713.0 N, 7616591.0 E)
ELEVATION : 544.1 ft
DRILLING CONTRACTOR : Boart Longyear (D. Roberts)
DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools
ORIENTATION : Vertical
WATER LEVELS : Approx. 87 ft BGS
START : 3/4/2009
END : 3/12/2009
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE			**Poorly Graded Sand With Silt And Gravel (SP-SM)** 14.0-63.0' - dark brown, (7.5YR 3/3), dry, loose, 20% gravel, 70% sand, 10% fines, sand is angular to subangular, poorly graded, no dominant mineralogy, matrix supported, max clast size = 50 mm		
45							
50				SP-SM			
55							
60							

PROJECT NUMBER: 382653.FP.04.FW	BORING NUMBER: MW-61	SHEET 4 OF 7

SOIL BORING LOG

PROJECT : PG&E Topock - ERGI
LOCATION : Site C (2100713.0 N, 7616591.0 E)
ELEVATION : 544.1 ft
DRILLING CONTRACTOR : Boart Longyear (D. Roberts)
DRILLING EQUIPMENT AND METHOD : Track-mounted Rig, Rotosonic drill head and tools
ORIENTATION : Vertical
WATER LEVELS : Approx. 87 ft BGS
START : 3/4/2009
END : 3/12/2009
LOGGER : A. Brewster (Northstar)

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (in)	LAB SAMPLE	USCS CODE/ LITHOLOGY	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
		COMPLETE		SP-SM	**Poorly Graded Sand With Silt And Gravel (SP-SM)** 14.0-63.0' - dark brown, (7.5YR 3/3), dry, loose, 20% gravel, 70% sand, 10% fines, sand is angular to subangular, poorly graded, no dominant mineralogy, matrix supported, max clast size = 50 mm		
65				pTbr	**Metadiorite (pTbr)** 63.0-112.4' - bedrock is consolidated. Drilling method pulverizes most of the core.		Total depth of initial Rotosonic boring is 68.0 ft bgs. Begin rotary core drilling.
	68.0				Begin rock coring from 68.0 ft bgs See the next page for the rock core log.		
70							
75							
80							

PROJECT NUMBER: 382653.FP.04.FW	BORING NUMBER: MW-61	SHEET 5 OF 7

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI
LOCATION : Site C (2100713.0 N, 7616591.0 E)
ELEVATION : 544.1 ft
DRILLING CONTRACTOR : Boart Longyear (D. Roberts)
CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)
ORIENTATION : Vertical
WATER LEVELS : Approx. 87 ft BTOC
START : 3/4/2009
END : 3/12/2009
LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	68.0		0			**Metadiorite (pTbr)** 63.0-112.4' - dusky yellowish green, (10GY 3/2), intermediate (dioritic) mineralogy, fine grained, hard to very hard, unweathered, massive to foliated, pale greenish yellow (10YR 8/2) banding throughout	General Note: The metadiorite bedrock exhibits many small healed fractures (1-3 mm) of somewhat random orientation. These healed fractures create weaknesses in the rock. It can be difficult to determine if the metadiorite is jointed in-situ, or if the discontinuities are caused by the drilling method. Intervals with fracture per foot counts >10 are likely caused by drilling.
70			>10	69.3-69.6' and 70.4-70.6' - Fracture zone, rough, undulating, < 1 mm calcite infilling, reddish staining, tight, no dominant orientation (two at 60 deg)			
	R1 7 ft 100%	53	>10				
			0				
			1	72.5' - Joint, 30 deg, rough, undulating, < 5 mm calcite infilling, some reddish staining, tight			
			>10	73.6-74.0' - Fracture zone, rough, undulating, < 1 mm calcite infilling, no staining, moderately tight, no dominant orientation			R1 = 17.0 min
75	75.0		1	74.4, 75.3' - Joint, 60 deg, rough, undulating, < 3 mm calcite infilling, reddish staining, tight			
			1				
			0			76.0' - yellow-orange staining	
			1				
			1	77.9, 78.4, 79.5, 80.9' - Joint, 60 deg, rough, undulating, < 3 mm calcite infilling, some reddish staining, tight			
	R2 9.3 ft 100%	86	1				
80			1				
			>10			81.0-94.5' - dusky yellow green, (5GY 5/2)	
			1	81.8-82.0' - Fracture zone, rough, undulating, no staining, infill by calcite (primary) and dark greyish black material (< 3 mm), moderately tight, no dominant orientation			
			>10	82.5' - Joint, 80 deg, rough, undulating, calcite (< 1 mm) and dark greyish black material (< 2 mm), no staining, moderately tight			R2 = 33.0 min
	84.3		>10	83.5-84.6' - Fracture zone, < 1 mm calcite infilling, no staining, tight, no dominant orientation			
85			1				
	R3 6 ft 100%	57	2	85.5, 86.4, 86.5, 87.4' - Joint, rough, undulating, < 5 mm calcite infilling, prominent reddish staining, 45, 80, 80, and 10 deg respectively, tight			
			1			87.0' - yellow-orange staining	

PROJECT NUMBER: 382653.FP.04.FW	BORING NUMBER: MW-61	SHEET 6 OF 7

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI
LOCATION : Site C (2100713.0 N, 7616591.0 E)
ELEVATION : 544.1 ft
DRILLING CONTRACTOR : Boart Longyear (D. Roberts)
CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)
ORIENTATION : Vertical
WATER LEVELS : Approx. 87 ft BTOC
START : 3/4/2009
END : 3/12/2009
LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			0			**Metadiorite (pTbr)** 63.0-112.4' - dusky yellow green, (5GY 5/2), intermediate (dioritic) mineralogy, fine grained, hard to very hard, unweathered, massive to foliated, pale greenish yellow (10YR 8/2) banding throughout 89.0-94.5' - medium grained	
			0				
90							
	90.3						
			1				R3 = 12.5 min
	R4 4.2 ft 100%	71	1	90.9' - Joint, 20 deg, rough, undulating, < 1 mm calcite infilling, prominent reddish staining, tight			
			>10	91.9' - Joint, 80 deg, rough, undulating, calcite (< 3 mm) and dark greyish black material (< 1 mm), no staining, tight			
			>10	92.2-93.4' - Fracture zone, rough, undulating, primary calcite infill, secondary reddish staining, tertiary dark greyish-black infill, tight, no dominant orientation			
	94.5		2	94.2, 94.5, 95.6, 96.4' - Joint, rough, undulating, < 1 mm calcite infilling, reddish staining, 60, 30, 60, and 30 deg (respectively), tight			R4 = 11.8 min
95						94.5-109.2' - dusky yellowish green, (10GY 3/2), fine grained	
			1				
			1				
			>10	97.0-97.7' - Fracture zone, no staining, < 1 mm dark greyish-black infill, tight, no dominant orientation			
			0				
	R5 10 ft 100%	90	1	99.4, 101.2, 101.8, 102.5, 103.3' - Joint, rough, undulating, < 1 mm calcite infilling, some reddish staining, 40, 40, 10, 40, and 60 deg (respectively), tight			
100							
			0				
			2				
			1				
			1				
	104.5		0				R5 = 30.0 min
105							
			1	105.4, 106.2, 106.7' - Joint, 10 deg, rough, undulating, < 5 mm calcite infilling, some reddish staining, tight			
	R6 4.7 ft 100%	94	2				
			0				

PROJECT NUMBER: 382653.FP.04.FW	BORING NUMBER: MW-61	SHEET 7 OF 7

ROCK CORE LOG

PROJECT : PG&E Topock - ERGI

LOCATION : Site C (2100713.0 N, 7616591.0 E)

ELEVATION : 544.1 ft

DRILLING CONTRACTOR : Boart Longyear (D. Roberts)

CORING EQUIPMENT AND METHOD : Track-mounted Rig, LF-70 Drill Head and HQ-sized tools (diamond bit)

ORIENTATION : Vertical

WATER LEVELS : Approx. 87 ft BTOC

START : 3/4/2009

END : 3/12/2009

LOGGER : A. Brewster (Northstar)

DEPTH AND ELEVATION BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, HARDNESS, WEATHERING, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
			1	108.1, 109.2, 109.9, 110.3, 111.8' - Joint, 60, 40, 10, 20, and 30 deg (respectively), rough, undulating to stepped, calcite growth (< 1 mm), reddish to dark reddish staining, tight.		**Metadiorite (pTbr)** 63.0-112.4' - dusky yellowish green, (10GY 3/2), intermediate (dioritic) mineralogy, fine grained, hard to very hard, unweathered, massive to foliated, pale greenish yellow (10YR 8/2) banding throughout 109.2-112.4' - greyish pink, (5R 8/2), coarse grained, greyish pink, (5R 8/2), coarse grained	
109.2			2				R6 = 24.0 min
110	R7 3.2 ft 100%	100	1				
			1				
112.4			0				R7 = 22.0 min
						End Drilling on 3/12/2009 Total Borehole Depth: 112.4 ft bgs	
115							
120							
125							