GEOLOGIC LOG OF DRILL HOLE NO. MW-09-36

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Right, Madera County
BEGUN: 9/23/09 FINISHED: 9/23/09
DEPTH AND ELEVATION OF WATER LEVEL AND DATE MEASURED: NA

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,169,946.8 E 6,210,378.5 (NAGD83)
TOTAL DEPTH: 47.5 ft.

STATE: California
GROUND SURFACE ELEVATION: 191.0 ft. (NAVD88)
T.O.C ELEVATION: 190.79 ft. (NAVD88)
HOLE LOGGED BY: J. Vauk
REVIEWED BY: A. Warren

ALL MEASUREMENTS ARE IN FEET FROM THE GROUND SURFACE.

PURPOSE OF HOLE:
To recover core, collect data to determine geologic and hydrologic site conditions, and install a groundwater monitoring well.

DRILLED BY:
USGS Drill Crew
James Huckaby, Driller
Jim Rauman, Helper

DRILL RIG:
CME-550

DRILLING & SAMPLING METHODS:
Drill hole MW-09-36 was advanced using hollow stem flight augers with continuous dry core sampling system (FADC) from the ground surface to a total depth of 47.5 feet. FADC uses 7-5/8-inch O.D., 4-1/4-inch I.D. hollow stem augers, with a 5-foot-long, 3-inch I.D. split sample barrel.

Interval Method
0.0 to 47.5 ft. - FADC

DRILLING CONDITIONS AND DRILLER'S COMMENTS:
0.0 to 32.0 ft. - smooth drilling
32.0 to 37.0 ft. - encountered hard sand layer
37.0 to 47.0 ft. - smooth drilling

DRILL FLUID, RETURN AND COLOR:
0.0 to 27.0 ft. - None
27.0 to 47.0 ft. - Water, no return

WATER LEVEL:
Not Recorded

REASON FOR HOLE TERMINATION:
The hole was terminated upon successful completion to the target depth.

HOLE COMPLETION:
Well Casing - 0.2 to 17.0 ft. (T.O.C. El. 190.79 ft.)
Dual Pre-pack Screen - 17.0 to 37.0 ft. (Slotted 0.020-inch)
Well Screen Filter Pack - #3 Sand
Filter Pack - 14.0 to 37.0 ft. (#3 Sand)
Bottom Bentonite Seal - 37.0 to 47.5 ft.
Bentonite Seal - 1.0 to 14.0 ft.
Well Protection - flush-mounted 18-inch manhole (15/16-inch hexbolts)

DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL
5	64										s(ML) 188.3	
											SM 186.7	
	80										SP/SM 185.4	
		36.9	8.0	44.9	55.1	0.0	NP	NP	13.2	SM 184.7	SM 184.7	
10	94	5.5	0.0	5.5	94.1	0.4	NP	NP	2.6	SP-SM 176.1	SP/SM 174.6	Qal
15	70										(GP/GM)s 174.0	
											SM 173.3	
		3.9	0.0	3.9	50.7	45.4	NP	NP	2.1	(SP)g 172.0	(SP/SM)g 172.0	
20	66											
		5.2	0.0	5.2	94.2	0.6	NP	NP	2.2	SP-SM 163.3	SP/SM 163.3	
25	80											

0.0 to 47.5 feet
QUATERNARY ALLUVIUM (Qal)

0.0 to 2.5 ft. SANDY SILT, s(ML): About 65% fines with low plasticity, toughness, and medium dry strength, and rapid dilatancy; about 35% fine to coarse sand; trace of fine, hard, subrounded gravel; maximum size: 1/2 inches; dry, light brown, slow reaction with HCl; very firm consistency; organics in top 0.5 feet.

2.5 to 4.1 ft. SILTY SAND, SM: About 80% fine sand; about 20% non-plastic fines with rapid dilatancy; maximum size: fine sand; dry, light brown, no reaction with HCl; soft consistency.

4.1 to 5.4 ft. POORLY GRADED SAND WITH SILT, SP/SM: About 90% fine sand; about 10% non-plastic fines with rapid dilatancy; maximum size: fine sand; dry, light brown to light gray, no reaction with HCl; very soft consistency.

5.4 to 6.1 ft. SILTY SAND, SM: About 55% fine sand; about 45% fines low plasticity, toughness and dry strength, with rapid dilatancy; maximum size: fine sand; dry, dark brown, no reaction with HCl; soft consistency.

Laboratory Data Interval
5.4 to 6.1 ft.

6.1 to 16.2 ft. POORLY GRADED SAND WITH SILT, SP/SM: About 90% fine to medium sand; about 10% non-plastic fines with rapid dilatancy; maximum size: medium sand; dry, light brown to light gray, no reaction with HCl; soft consistency.

Laboratory Data Interval
7.5 to 14.7 ft.

16.2 to 16.8 ft. POORLY GRADED GRAVEL WITH SILT AND SAND, (GP/GM)S: About 50% fine, hard, subrounded gravel; about 40% fine to coarse sand; about 10% non-plastic fines; maximum size: 5/8 inches; dry, light brown to light gray, weak reaction with HCl; soft consistency.

16.8 to 17.5 ft. SILTY SAND, SM: About 85% fine to medium sand (mostly fine); about 15% non-plastic fines with rapid dilatancy; maximum size: medium sand; dry, light brown and light gray, no reaction with HCl; soft consistency.

17.5 to 18.8 ft. POORLY GRADED SAND WITH SILT AND GRAVEL, (SP/SM)g: About 55% fine to coarse sand; about 35% fine, subrounded gravel; 10% non-plastic fines with rapid dilatancy; maximum size: 3/4 inches; moist, medium brown, no reaction with HCl; soft consistency.

Laboratory Data Interval
17.5 to 18.8 ft.

18.8 to 27.5 ft. POORLY GRADED SAND WITH SILT, SP/SM: About 90% fine to coarse sand (trace of coarse); about 10% non-plastic fines with rapid dilatancy; maximum size: coarse sand; dry, off-white, light brown, and light gray, no reaction with HCl; soft consistency.

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram.

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TOTAL DEPTH: 47.5 ft.

STATE: California
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T.O.C ELEVATION: 190.79 ft. (NAVD88)
HOLE LOGGED BY: J. Vauk
REVIEWED BY: A. Warren

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL
												(SM)g 162.9	
			59.5	12.1	71.6	28.4	0.0	NP	NP	32.6	(ML)s 161.6	(ML)s 161.6	
	30	78	6.9	0.0	6.9	93.1	0.0	NP	NP	6.6	SP-SM 158.8	SP/SM 158.8	
	35	74	3.6	0.8	4.4	29.5	66.1	NP	NP	2.6	(GW)s 153.3	(GP/GM)s 152.9	Qal
	40	100	31.3	47.7	79.0	21.0	0.0	43.3	21.8	25.8	(CL)s 148.3	(CL/ML)s 147.6	
	45	100										SM 144.2	
												s(ML) 144.0	
												SM 143.3	

BOTTOM OF HOLE

CLASSIFICATION AND PHYSICAL CONDITION

Laboratory Data Interval
18.8 to 27.5 ft.

27.5 to 27.9 ft. SILTY SAND WITH GRAVEL, (SM)g: About 70% fine to coarse sand; 15% non-plastic fines with rapid dilatancy; about 15% fine, hard, subrounded gravel; maximum size: 1 inch; dry, light brown, no reaction with HCl; soft consistency; material recovered disturbed.

27.9 to 29.2 ft. SILT WITH SAND, (ML)s: About 80% fines with rapid dilatancy; about 20% fine sand; maximum size: fine sand; moist, medium brown, no reaction with HCl; firm consistency.

Laboratory Data Interval
27.9 to 29.2 ft.

29.2 to 32.0 ft. POORLY GRADED SAND WITH SILT, SP/SM: About 90% fine to medium sand (mostly medium); about 10% non-plastic fines with rapid dilatancy; maximum size: medium sand; dry, banded light brown and orange, no reaction with HCl; soft consistency.

Laboratory Data Interval
29.2 to 32.0 ft.

32.0 to 37.9 ft. POORLY GRADED GRAVEL WITH SILT AND SAND, (GP/GM)s: About 55% fine, hard, subrounded gravel; about 35% fine to coarse sand; about 10% non-plastic fines with rapid dilatancy; maximum size: 1.5 inches; dry, light gray from 32.0 32.5 feet and banded light brown, medium brown, light gray and orange from 32.5 to 37.9 feet, no reaction with HCl; firm consistency.

Laboratory Data Interval
32.5 to 37.5 ft.

37.9 to 43.2 ft. SILTY CLAY WITH SAND, (CL/ML)s: About 85% fines with medium plasticity, toughness, and dry strength, and no dilatancy; about 15% fine sand; maximum size: fine sand; moist, light brown from 37.9 to 39.2 feet and light greenish-gray 39.2 to 42.5 feet, no reaction with HCl.

Laboratory Data Interval
37.9 to 42.5 ft.

43.2 to 46.6 ft. SILTY SAND, SM: About 80 to 85% fine to medium sand (mostly fine); about 15 to 20% non-plastic fines with rapid dilatancy; maximum size: medium sand; dry, light brown, light gray greenish-brown; no reaction with HCl; soft consistency.

46.6 to 46.8 ft. SANDY SILT, s(ML): About 65% non-plastic fines with rapid dilatancy; about 35% fine sand; maximum size: fine sand; dry, light gray, no reaction with HCl; soft consistency.

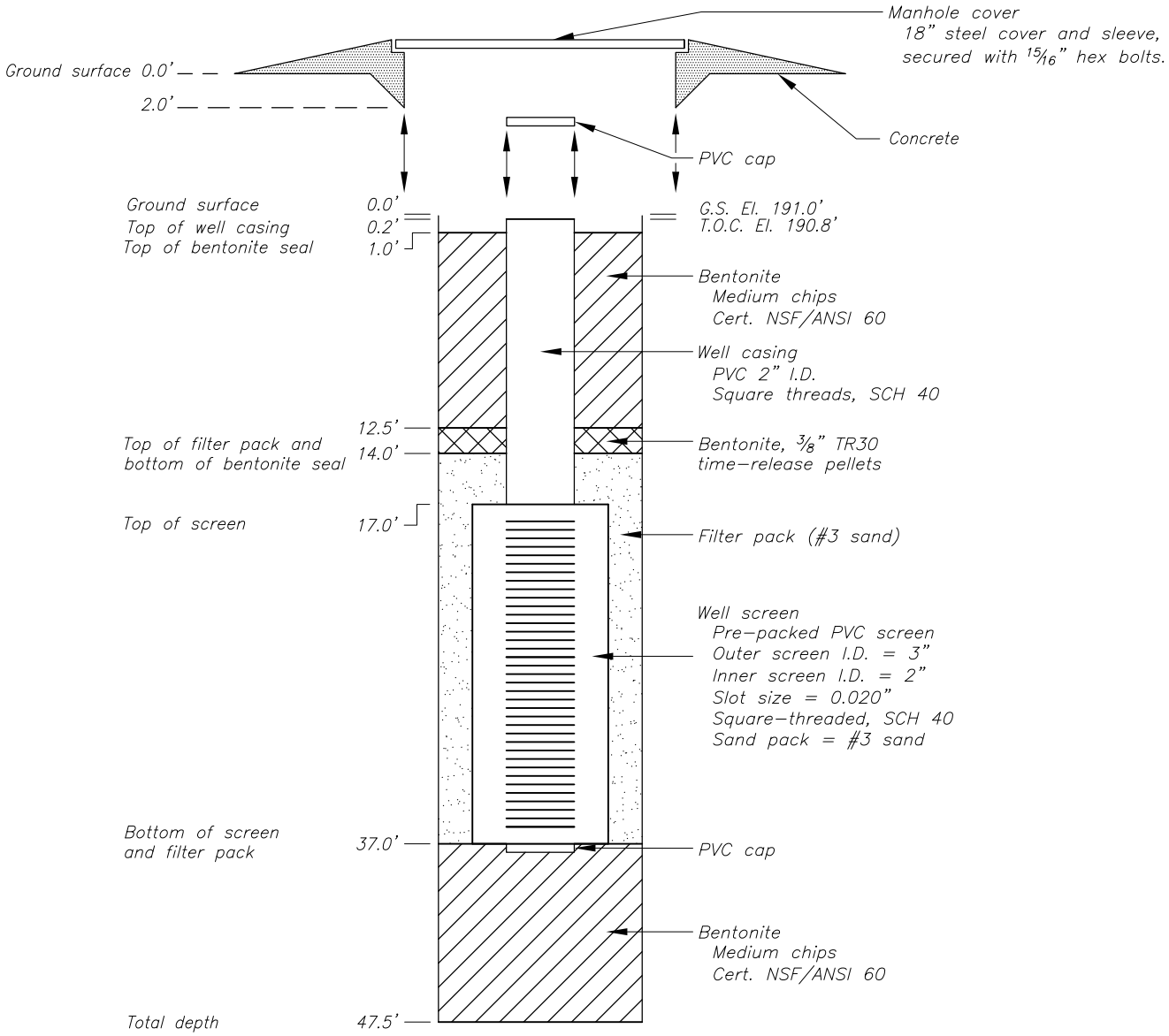
46.8 to 47.5 ft. SILTY SAND, SM: About 80 to 85% fine to medium sand; about 15 to 20% non-plastic fines with rapid dilatancy; maximum size: medium sand; dry, light gray; no reaction with HCl; soft consistency.

T.D. = 47.5 ft.

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram.

MW–09–36	GEOLOGIST: J. VAUK
WELL COMPLETION DIAGRAM	DRILLER: J. HUCKABY
DATE COMPLETED: 9/23/2009	HELPER: J. RAUMAN
TOP OF WELL CASING COORDINATES: N2169946.8 E6210378.5 (NAD83) ELEVATION 190.8' (NAVD88) GROUND SURFACE ELEVATION 191.0' (NAVD88)	



*NOT TO SCALE

NOTES:
T.O.C. = Top of well casing, I.D. = Inner Diameter, G.S. = Ground Surface, El. = Elevation
Sand backfills the well above the top of bentonite seal, inside the manhole.

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-37

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Left, Fresno County
BEGUN: 9/12/09 FINISHED: 9/14/09
DEPTH AND ELEVATION OF WATER LEVEL
AND DATE MEASURED: 76.7 ft. (El. 114.97 ft.) 9/14/2009

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,169,060.3 E 6,210,550.8 (NAGD83)
TOTAL DEPTH: 87.5 ft.

STATE: California
GROUND SURFACE ELEVATION: 191.8 ft. (NAVD88)
T.O.C ELEVATION: 191.67 ft. (NAVD88)
HOLE LOGGED BY: G. Russell
REVIEWED BY: J. Vauk

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL	CLASSIFICATION AND PHYSICAL CONDITION
ALL MEASUREMENTS ARE IN FEET FROM THE GROUND SURFACE. **PURPOSE OF HOLE:** To recover core, collect data to determine geologic and hydrologic site conditions, and install a groundwater monitoring well. **DRILLED BY:** USGS Drill Crew James Huckaby, Driller Jim Rauman, Helper **DRILL RIG:** CME-550 **DRILLING & SAMPLING METHODS:** Drill hole MW-09-37 was advanced using hollow stem flight augers with continuous dry core sampling system (FADC) from the ground surface to a total depth of 87.5 feet. FADC uses 7-5/8-inch O.D., 4-1/4-inch I.D. hollow stem augers, with a 5-foot-long, 3-inch I.D. split sample barrel. Interval Method 0.0 to 87.5 ft. - FADC Drill hole DH-09-37B was advanced using hollow stem flight augers (FADC) and a pilot bit from the ground surface to a total depth of 25.5 feet. FADC uses 7-5/8-inch O.D., 4-1/4-inch I.D. hollow stem augers and a tri-cone pilot bit. Interval Method 0.0 to 25.5 ft. - FADC with pilot bit **DRILLING CONDITIONS AND DRILLER'S COMMENTS:** MW-09-37 0.0 to 57.0 ft. - smooth drilling 57.0 to 62.0 ft. - encountered firm sand layer 62.0 to 72.0 ft. - firm clay 72.0 to 77.0 ft. - very firm clay stalled drill rig, adjust sampler 77.0 to 87.5 ft. - clay bottom hole was terminated **DRILLING CONDITIONS AND DRILLER'S COMMENTS:** MW-09-37B 0.0 to 25.5 ft. - blind drilled **DRILL FLUID, RETURN AND COLOR:** MW-09-37 0.0 to 87.5 ft. - None MW-09-37B 0.0 to 25.5 ft. - None **WATER LEVEL:** 76.7 feet b.g.s. on 9/14/2009 in MW-09-37 **REASON FOR HOLE TERMINATION:** The drill holes were terminated upon successful completion to the target depth.	5 10 15 20 25	100 100 100 100 92 100 100	69.2 56.9 4.2 69.7	14.0 4.2 0.7 16.4	83.2 61.1 4.9 86.1	16.8 38.9 95.1 13.9	0.0 0.0 0.0 0.0	19.5 NP NP NP	2.7 NP NP NP	3.2 5.7 2.3 19.4	(ML)s 186.2 s(ML) 179.2 SP 173.7 ML 164.3	s(ML) 187.7 (ML)s 184.7 s(ML) 180.4 s(ML) 177.3 SM 175.1 SP/SM 172.1 SM & SP/SM 165.1 (ML)s 164.0 SM 162.2	Qal	**SOIL DESCRIPTIONS CHARACTERIZE SAMPLES FROM DRILL HOLE MW-09-37.** ***0.0 to 87.5 feet*** ***QUATERNARY ALLUVIUM (Qal)*** **0.0 to 4.0 ft. SANDY SILT, s(ML):** About 65% fines with no to low plasticity, low toughness and dry strength, and rapid dilatancy; about 35% fine sand; maximum size: fine sand; dry, brown, weak to moderate reaction with HCl; firm to hard consistency; contains abundant organic debris (roots). **4.0 to 7.0 ft. SILT WITH SAND, (ML)s:** About 80% fines with low to medium plasticity, medium toughness and dry strength, and slow dilatancy; about 20% fine sand; maximum size: fine sand; dry, light brown (with minor rust-red iron-oxide staining), occasional zones have moderate reaction with HCl; moderately soft to hard consistency; contains minor organic debris (roots). Lab Data Interval 5.0 to 5.5 ft. **7.0 to 11.3 ft. SANDY SILT, s(ML):** About 65% fines with no to low plasticity, low toughness and dry strength, and rapid dilatancy; about 35% fine sand; maximum size: fine sand; dry, light gray with gray lenses, no reaction with HCl; soft to firm consistency; contains dark rust-red stringers of iron-oxide staining. Zone of higher sand content from 7.5 to 9.8 feet; zone of higher fines content from 9.8 to 11.3 feet. **11.3 to 14.4 ft. SANDY SILT, s(ML):** About 60% fines; about 40% fine sand (grains consist of quartz, dark mica, various other minerals); maximum size: fine sand; dry, light orange-brown: slightly stained with rust-colored iron oxide; no reaction with HCl; soft consistency. Lab Data Interval 12.0 to 12.5 ft. **14.4 to 16.6 ft. SILTY SAND, SM:** About 80 to 85% fine to medium sand (grains consist of quartz, mica, various other minerals)(predominantly fine); about 15 to 20% fines; maximum size: medium sand; slightly moist; light to medium brown with dark brown and black streaks (higher fines): slightly stained with rust-colored iron oxide; no reaction with HCl; very soft (loose) consistency. **16.6 to 19.6 ft. POORLY GRADED SAND WITH SILT: SP/SM:** About 90% fine to medium sand; about 10% fines; maximum size: medium sand; moist, light brown, no reaction with HCl; very soft (loose) consistency. Lab Data Interval 17.5 to 18.0 ft. **19.6 to 26.6 ft. INTERBEDDED SILTY SAND, SM, AND POORLY GRADED SAND WITH SILT, SP/SM:** Grain-size distribution of interbedded soils layers is listed below. Most soils sampled have the following description: maximum size: medium sand; slightly moist, light brown; no reaction with HCl; very soft (loose) consistency.

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram.
Well development information is provided in attached Monitoring Well Development form.

MW-09-37B
TOC Coordinates= N 2169064.9 E 6210552.2 (NAGD83) El. 191.96 (NAVD88)
Ground surface El.= 192.1 (NAVD88)

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-37

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Left, Fresno County
BEGUN: 9/12/09 FINISHED: 9/14/09
DEPTH AND ELEVATION OF WATER LEVEL
AND DATE MEASURED: 76.7 ft. (El. 114.97 ft.) 9/14/2009

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,169,060.3 E 6,210,550.8 (NAGD83)
TOTAL DEPTH: 87.5 ft.

STATE: California
GROUND SURFACE ELEVATION: 191.8 ft. (NAVD88)
T.O.C ELEVATION: 191.67 ft. (NAVD88)
HOLE LOGGED BY: G. Russell
REVIEWED BY: J. Vauk

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL	CLASSIFICATION AND PHYSICAL CONDITION
HOLE COMPLETION: MW-09-37 Well Casing - 0.1 to 67.0 ft. (T.O.C. El. 191.67 ft.) Dual Pre-pack Screen - 67.0 to 87.0 ft. (Slotted 0.020-inch) Well Screen Filter Pack - #3 Sand Filter Pack - 59.0 to 87.5 ft. (#3 Sand) Bentonite Seal - 2.0 to 59.0 ft. Well Protection - flush-mounted 18-inch manhole (15/16-inch hexbolts) MW-09-37B Well Casing - 0.1 to 15.0 ft. (T.O.C. El. 191.69 ft.) Dual Pre-pack Screen - 15.0 to 25.0 ft. (Slotted 0.020-inch) Well Screen Filter Pack - #3 Sand Filter Pack - 12.0 to 25.5 ft. (#3 Sand) Bentonite Seal - 2.0 to 12.0 ft. Well Protection - flush-mounted 18-inch manhole (15/16-inch hexbolts)	35	100	57.4	26.2	83.6	16.4	0.0	21.8	2.9	19.8	(ML)s 157.4	SM 160.7 (ML)s 154.8		19.6 to 20.0 ft. - SM: 80% sand; 20% fines. 20.0 to 22.3 ft. - SP/SM: 90% sand; 10% fines. 22.3 to 22.5 ft. - SM: 80% sand; 20% fines. 22.5 to 22.9 ft. - SP/SM: 90% sand; 10% fines. 22.9 to 23.0 ft. - SM: 70% sand; 30% fines. 23.0 to 23.5 ft. - SP/SM: 90% sand; 10% fines. 23.5 to 23.8 ft. - SM: 70% sand; 30% fines. 23.8 to 26.3 ft. - SP/SM: 90% sand; 10% fines. 26.3 to 26.6 ft. - SM: 70% sand; 30% fines. **26.6 to 27.7 ft. SILT WITH SAND, (ML)s:** About 85% fines with low plasticity, toughness and dry strength; about 15% fine sand; trace gravel; maximum size: fine sand; slightly moist, gray-brown, no reaction with HCl; soft to firm consistency. Lab Data Interval 27.2 to 27.4 ft. **27.7 to 29.5 ft. SILTY SAND, SM:** About 85% sand (grains consist of quartz, mica, various other minerals); about 15% fines; maximum size: fine sand; dry, light brown; no reaction with HCl; very soft (loose) consistency.
	40	100	52.2	27.4	79.6	20.4	0.0	34.8	13.4	21.9	(CL)s 147.7	CL 148.0		**29.5 to 31.0 ft. SILTY SAND, SM:** About 60% sand (grains consist of quartz, dark mica, various other minerals); about 40% fines; maximum size: fine sand; dry, light to medium gray, no reaction with HCl; soft consistency; occasional lenses with higher fines content.
	45	100										(CL)s 144.2	Qal	**31.0 to 36.9 ft. SILT WITH SAND, (ML)s:** About 85% fines with low to medium plasticity, medium toughness, low dry strength, and slow dilatancy; about 15% fine sand; maximum size: fine sand; moist, dark olive-gray, slightly stained with rust-colored iron oxide, no reaction with HCl; firm to hard consistency. Sandy lenses from 33.3 to 33.4, and 35.6 to 36.0 feet. Lab Data Interval 34.0 to 34.3 ft.
	50	100										SM 138.8		**36.9 to 43.7 ft. LEAN CLAY, CL:** About 90% fines with medium plasticity, toughness, and no to slow dilatancy; about 10% sand; maximum size: fine sand; moist, blue-green-gray, slightly stained with rust-colored iron oxide, occasional zones have weak to strong reaction with HCl; very firm to hard consistency. **43.7 to 47.5 ft. LEAN CLAY WITH SAND, (CL)s:** About 80% fines with medium plasticity and toughness, and no to slow dilatancy; about 20% sand; maximum size: fine sand; moist, blue-green-gray, slightly stained with rust-colored iron oxide, occasional zones have weak to strong reaction with HCl; very firm to hard consistency.
	55	100										(CL)s 132.2		Lab Data Interval 43.7 to 44.0 ft. **47.5 to 52.9 ft.SILTY SAND, SM:** About 65% fine to medium sand; about 35% non-plastic fines with rapid dilatancy; maximum size: medium sand; moist, gray, no reaction with HCl; soft to firm consistency. **52.9 to 59.5 ft. LEAN CLAY WITH SAND, (CL)s:** About 75% fines with medium plasticity and toughness, and no to slow dilatancy; about 25% sand; maximum size:
		100												

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Ground surface El.= 192.1 (NAVD88)

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REVIEWED BY: J. Vauk

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			42.8	6.9	49.7	50.3	0.0	NP	NP	24.7	SM 128.3	(CL/ML)s	Qal	fine sand; moist, blue-green-gray, slightly stained with rust-colored iron oxide, occasional zones have weak to strong reaction with HCl; very firm to hard consistency.
	65	90												**59.5 to 74.2 ft. SILTY LEAN CLAY WITH SAND, (CL/ML)s:** About 80% fines with low plasticity, toughness and dry strength, and slow dilatancy; about 20% fine sand; maximum size: fine sand; very moist, dark blue-green-gray, no reaction with HCl; firm to hard consistency (sandy zones are soft to firm). Occasional layers with 40% to 60% fine sand from 63.0 to 63.2, 64.8 to 64.9, 63.0 to 66.3, and 72.0 to 73.0 feet.
														Lab Data Interval 63.0 to 63.4 ft.
	70	100												**74.2 to 78.2 ft. Claystone/Siltstone:** Material has properties intermediate between soil and rock. Material breaks into gravel-size to sand-size angular fragments of cemented claystone or siltstone. Very slow and difficult to auger; driller reported that the zone augered like a gravel material. Fragments are very difficult to break with finger pressure; but will break readily with hammer blow. Crushed material appears as sand, but consists of claystone/siltstone grains, with minor quartz grains. Very moist, dark blue-green-gray; no reaction with HCl; hard to very hard.
		100										117.5		**78.2 to 79.7 ft.SILTY SAND, SM:** About 55% fine sand, about 45% fines; maximum size: fine sand; wet, dark blue-green-gray, no reaction with HCl; soft to firm consistency. One-inch-thick lens of SILT WITH SAND, (ML)s, encountered in middle of depth interval.
	75										▼ 76.7 ft. (El. 114.97 ft.)	Rock 113.5		**79.7 to 86.7 ft. POORLY GRADED SAND WITH SILT: SP/SM:** About 90% fine to medium sand (predominantly fine)(grains consist of quartz and various other minerals); about 10% fines; maximum size: medium sand; wet, gray, no reaction with HCl; very soft (loose) consistency.
		70										SM 112.0		
	80													**86.7 to 87.5 ft: SILT, ML:** About 90% fines with low plasticity, low toughness, no to low dry strength, and rapid dilatancy; about 10% fine sand; maximum size: fine sand; wet, dark green-gray, no reaction with HCl; hard consistency.
		0										SP/SM		Lab Data Interval 85.5 to 85.7 ft. 87.0 to 87.2 ft.
	85		6.5	1.6	8.1	91.7	0.2	NP	NP	14.2	SP-SM 106.0	105.0		***T.D. = 87.5 ft.***
		100	73.8	20.9	94.7	5.3	0.0	29.0	3.1	23.6	ML 104.5	ML 104.2		

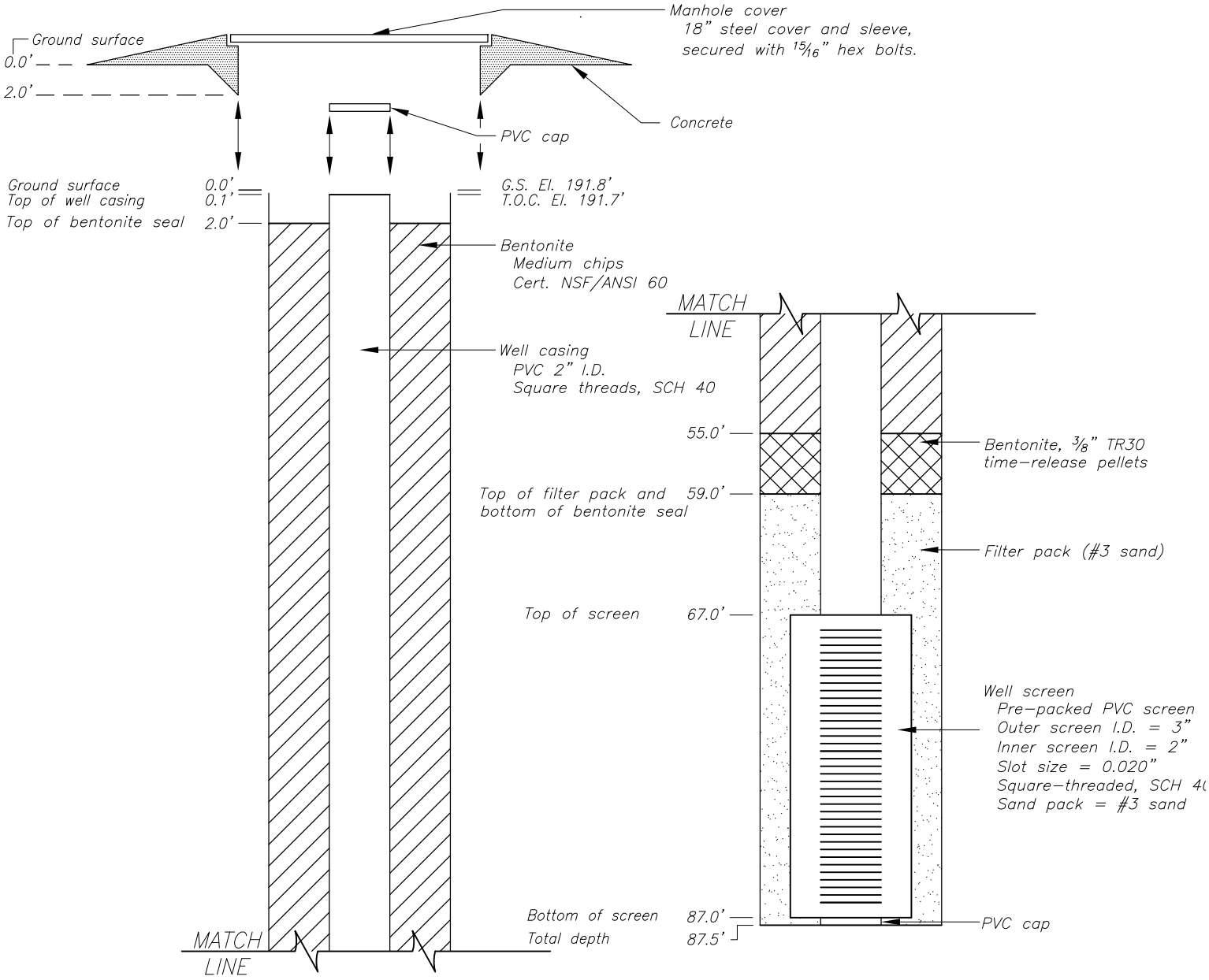
BOTTOM OF HOLE

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram.
Well development information is provided in attached Monitoring Well Development form.

MW-09-37B
TOC Coordinates= N 2169064.9 E 6210552.2 (NAGD83) El. 191.96 (NAVD88)
Ground surface El.= 192.1 (NAVD88)

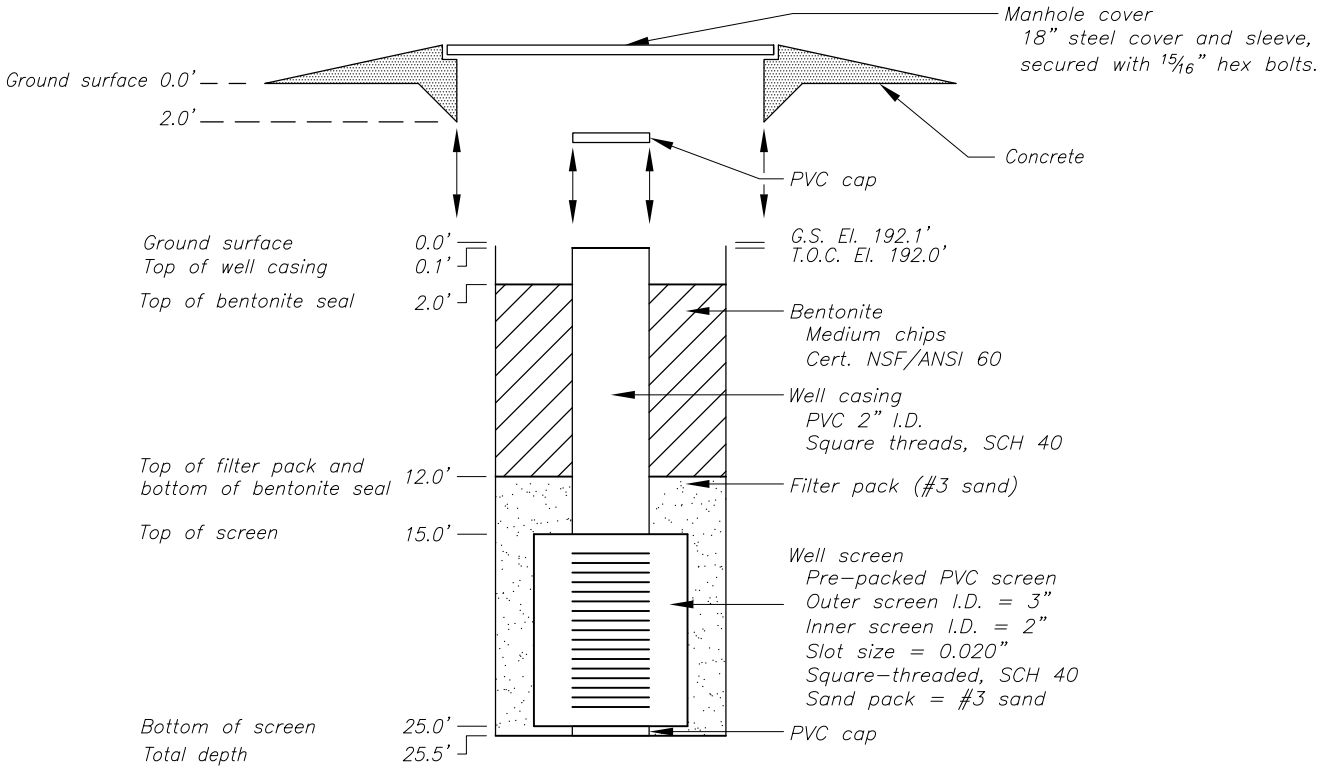
MW–09–37	GEOLOGIST: G. RUSSELL
WELL COMPLETION DIAGRAM	DRILLER: J. HUCKABY
DATE COMPLETED: 9/14/2009	HELPER: J. RAUMAN
TOP OF WELL CASING COORDINATES: N2169060.3 E6210550.8 (NAD83) ELEVATION 191.7' (NAVD88) GROUND SURFACE ELEVATION 191.8' (NAVD88)	



*NOT TO SCALE

NOTES:
T.O.C. = Top of well casing, I.D. = Inner Diameter, G.S. = Ground Surface, El. = Elevation
Sand backfills the well above the top of bentonite seal, inside the manhole.

MW-09-37B	GEOLOGIST: G. RUSSELL
WELL COMPLETION DIAGRAM	DRILLER: J. HUCKABY
DATE COMPLETED: 9/14/2009	HELPER: J. RAUMAN
TOP OF WELL CASING COORDINATES: N2169064.9 E6210552.2 (NAD83) ELEVATION 192.0' (NAVD88) GROUND SURFACE ELEVATION 192.1' (NAVD88)	



*NOT TO SCALE

NOTES:
T.O.C. = Top of well casing, I.D. = Inner Diameter, G.S. = Ground Surface, El. = Elevation
Sand backfills the well above the top of bentonite seal, inside the manhole.

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-39

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Left, Fresno County
BEGUN: 9/8/09 FINISHED: 9/11/09
DEPTH AND ELEVATION OF WATER LEVEL
AND DATE MEASURED: 79.0 ft. (El. 105.89 ft.) 9/11/2009

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,171,130.1 E 6,204,815.3 (NAGD83)
TOTAL DEPTH: 92.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 184.9 ft. (NAVD88)
T.O.C ELEVATION: 184.89 ft. (NAVD88)
HOLE LOGGED BY: G. Russell
REVIEWED BY: J. Vauk

ALL MEASUREMENTS ARE IN FEET FROM THE GROUND SURFACE.

PURPOSE OF HOLE:
To recover core, collect data to determine geologic and hydrologic site conditions, and install a groundwater monitoring well.

DRILLED BY:
USGS Drill Crew
James Huckaby, Driller
Jim Rauman, Helper

DRILL RIG:
CME-550

DRILLING & SAMPLING METHODS:
Drill hole MW-09-39 was advanced using hollow stem flight augers with continuous dry core sampling system (FADC) from the ground surface to a total depth of 92.0 feet. FADC uses 7-5/8-inch O.D., 4-1/4-inch I.D. hollow stem augers, with a 5-foot-long, 3-inch I.D. split sample barrel.

Interval Method
0.0 to 92.0 ft. - FADC

Drill hole DH-09-39B was advanced using hollow stem flight augers (FADC) and a pilot bit from the ground surface to a total depth of 25.0 feet. The system uses 7-5/8-inch O.D., 4-1/4-inch I.D. hollow stem augers and a tri-cone pilot bit.

Interval Method
0.0 to 25.0 ft. - FADC with pilot bit

DRILLING CONDITIONS AND DRILLER'S COMMENTS:
MW-09-39
0.0 to 22.0 ft. - smooth drilling
22.0 to 27.0 ft. - encountered firm interbedded sand and clay
27.0 to 92.0 ft. - smooth drilling, difficult to pull augers during hole completion

DRILLING CONDITIONS AND DRILLER'S COMMENTS:
MW-09-39B
0.0 to 25.0 ft. - blind drilled

DRILL FLUID, RETURN AND COLOR:
MW-09-39
0.0 to 92.0 ft. - None

MW-09-39B
0.0 to 25.0 ft. - None

WATER LEVEL:
79.0 feet b.g.s. on 9/11/2009 in MW-09-39

REASON FOR HOLE TERMINATION:
The drill holes were terminated upon successful completion to the target depth.

DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL
	55										s(ML) 182.9	
5	78											
		5.9	0.7	6.6	93.4	0.0	NP	NP	0.4	SP-SM 177.4	SM	
10	86											Qal
		4.1	0.0	4.1	95.9	0.0	NP	NP	0.9	SP 167.9	SP/SM 165.6	
15	84											
20	90	63.6	20.4	84.0	15.6	0.4	23.2	4.5	12.3	(CL-ML)s 164.8	(ML)s 164.3	
											SM 161.1	
	100										SM 160.3	

SOIL DESCRIPTIONS CHARACTERIZE SAMPLES FROM DRILL HOLE MW-09-39.

0.0 to 92.0 feet
QUATERNARY ALLUVIUM (Qal)

0.0 to 2.0 ft. SANDY SILT, s(ML): About 55% fines with low plasticity and dry strength, and rapid dilatancy; about 45% fine sand; maximum size: fine sand; dry, brown, no reaction HCl, consistency very soft (loose); contains abundant organic debris; material is road base.

2.0 to 14.0 ft. SILTY SAND, SM: About 85% fine sand; about 15% fines; maximum size: fine sand; dry to moist, light grayish brown, no reaction with HCl; very soft (loose) consistency; fines percentage varies from about 5% to 20% in layers. A layer of high fines of 20% occurs from 8.0 to 10.0 feet depth.

Lab Data Interval
7.0 to 7.5 ft.

14.0 to 19.3 ft. POORLY GRADED SAND WITH SILT, SP/SM: About 90% fine to coarse sand with grains consisting of quartz, mica, various other minerals (predominately fine to medium)(coarse sand is sub-angular to angular and hard); about 10% fines; trace of fine to coarse, hard, subrounded gravel (gravel occurs only at the bottom 0.3 feet of interval); maximum size: 1 inch; moist, light orange-gray: slightly stained with rust-colored iron oxide, no reaction with HCl; very soft (loose) consistency.

Lab Data Interval
16.5 to 17.0 ft.

19.3 to 20.6 ft. SILT WITH SAND, (ML)s: About 80% fines with low plasticity and toughness, and slow dilatancy; about 20% fine sand; maximum size: fine sand; moist, dark olive-gray with dark rust-colored stringers and blebs (iron-oxide); no reaction with HCl; firm consistency.

20.6 to 23.8 ft. SILTY SAND, SM: About 85% fine sand; about 15% fines; maximum size: fine sand; dry to moist; light orange-gray, slightly stained with rust-colored iron oxide; no reaction with HCl; very soft (loose) consistency.

23.8 to 24.6 ft. SILTY SAND, SM: About 65% fine to medium sand (predominately fine); about 35% fines; maximum size: medium sand; moist, dark olive-gray, with streaks of rust-colored iron oxide; no reaction with HCl; very firm consistency.

24.6 to 26.5 ft. SANDY SILT, s(ML): About 60% fines with low to medium plasticity, medium toughness, and slow dilatancy; about 40% fine sand; maximum size: fine sand; moist, dark olive-gray, no reaction HCl; very firm consistency.

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram.

MW-09-39B
TOC Coordinates= N 2171125.4 E 6204815.1 (NAGD83) El. 184.80 (NAVD88)
Ground surface El.= 184.9 (NAVD88)

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-39

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Left, Fresno County
BEGUN: 9/8/09 FINISHED: 9/11/09
DEPTH AND ELEVATION OF WATER LEVEL
AND DATE MEASURED: 79.0 ft. (El. 105.89 ft.) 9/11/2009

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,171,130.1 E 6,204,815.3 (NAGD83)
TOTAL DEPTH: 92.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 184.9 ft. (NAVD88)
T.O.C ELEVATION: 184.89 ft. (NAVD88)
HOLE LOGGED BY: G. Russell
REVIEWED BY: J. Vauk

HOLE COMPLETION:

MW-09-39
Well Casing - 0.0 to 72.0 ft. (T.O.C. El. 184.89 ft.)
Dual Pre-pack Screen - 72.0 to 92.0 ft. (Slotted 0.020-inch)
Well Screen Filter Pack - #3 Sand Filter Pack - 64.0 to 92.0 ft. (#3 Sand)
Bentonite Seal - 2.0 to 64.0 ft.
Well Protection - flush-mounted 18-inch manhole (15/16-inch hexbolts)

MW-09-39B
Well Casing - 0.1 to 14.5 ft. (T.O.C. El. 184.80 ft.)
Dual Pre-pack Screen - 14.5 to 24.5 ft. (Slotted 0.020-inch)
Well Screen Filter Pack - #3 Sand Filter Pack - 10.5 to 25.0 ft. (#3 Sand)
Bentonite Seal - 2.0 to 10.5 ft.
Well Protection - flush-mounted 18-inch manhole (15/16-inch hexbolts)

DEPTH	% CORE RECOVERY	% SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION	ELEVATION	VISUAL CLASSIFICATION	ELEVATION	GEOLOGIC UNIT SYMBOL
												s(ML)		
													158.4	
	94											SM SP/SM (CL/ML)s		
30		35.4	4.1	39.5	60.5	0.0	NP	NP	3.5	SM	156.4			
													151.9	
35	100											(CL/ML)s		
		58.2	27.6	85.8	14.2	0.0	25.7	8.4	8.7	CL	147.5			Qal
													145.7	
40	100											SM		
													144.2	
												s(ML)		
													142.8	
	100	28.1	44.2	72.3	27.7	0.0	45.0	10.7	20.4	(ML)s	140.4	s(CL)		
45													137.8	
												SM		
													136.3	
	100											s(CL/ML)		

26.5 to 33.0 ft. INTERBEDDED SILTY SAND, SM; CLAYEY SILT WITH SAND, (ML/CL)s; and POORLY GRADED SAND WITH SILT, SP/SM: Predominately SILTY SAND, SM, with about 75% fine sand (grains consist of quartz, mica, various other minerals); about 25% fines; maximum size: fine sand; slightly moist, dark olive-gray to light gray (more sandy intervals), no reaction with HCl. Bottom of unit (33.0 feet) has thin layer of dark rust-colored iron-oxide staining. Very soft (high sand intervals) to very firm (high fines intervals). An interval of higher fines content occurs from 31.0 to 31.8 feet; with about 20% fine sand, about 80% fines. Fines have slow dilatancy, medium toughness, low to medium plasticity.

Lab Data Interval
28.2 to 28.5 ft.

33.0 to 39.2 ft. SILTY CLAY WITH SAND, (CL/ML)s: About 75% fines with medium plasticity, low to medium toughness, medium to high dry strength, slow dilatancy; about 25% fine sand; maximum size: fine sand; moist, dark olive-gray with occasional rust-colored stringers (Fe oxide), no reaction with HCl; firm to hard consistency. Percentage of sand increases with depth and a zone of SILTY SAND, SM, is encountered from 36.0 to 36.6 feet.

Lab Data Interval
37.2 to 37.4 ft.

39.2 to 40.7 ft. SILTY SAND, SM: About 60% fine sand (grains consist of quartz, mica, various other minerals); about 40% fines; maximum size: fine sand; moist, olive-gray; no reaction with HCl; firm consistency.

40.7 to 42.1 ft. SANDY SILT, s(ML): About 60% fines with low plasticity and toughness, and slow dilatancy; about 40% sand (predominately fine); trace of fine gravel; maximum size: fine gravel; moist, dark olive-gray; no reaction with HCl; firm to hard consistency.

42.1 to 47.1 ft. SANDY LEAN CLAY, s(CL): About 70% fines with medium plasticity, toughness and dry strength, and slow dilatancy; about 30% fine to coarse sand (most grains consist of fragments of medium to hard siltstone/claystone and minor amounts of quartz); maximum size: coarse sand; dry to moist, olive-gray with occasional rust-colored blebs (iron-oxide); strong reaction with HCl in calcareous lenses; very firm to hard consistency.

Lab Data Interval
44.2 to 44.5 ft.

47.1 to 48.6 ft. SILTY SAND, SM: About 65% fine sand (grains consist of quartz, mica, various other minerals); about 35% fines; maximum size: fine sand; moist, olive-gray, slightly rust-colored; no reaction with HCl; firm to hard consistency.

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram.

MW-09-39B
TOC Coordinates= N 2171125.4 E 6204815.1 (NAGD83) El. 184.80 (NAVD88)
Ground surface El.= 184.9 (NAVD88)

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-39

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Left, Fresno County
BEGUN: 9/8/09 FINISHED: 9/11/09
DEPTH AND ELEVATION OF WATER LEVEL
AND DATE MEASURED: 79.0 ft. (El. 105.89 ft.) 9/11/2009

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,171,130.1 E 6,204,815.3 (NAGD83)
TOTAL DEPTH: 92.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 184.9 ft. (NAVD88)
T.O.C ELEVATION: 184.89 ft. (NAVD88)
HOLE LOGGED BY: G. Russell
REVIEWED BY: J. Vauk

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL	CLASSIFICATION AND PHYSICAL CONDITION
												134.2		**48.6 to 50.7 ft. SANDY SILTY CLAY, s(CL/ML):** About 60% fines with medium plasticity, low to medium toughness, medium to high dry strength, and slow dilatancy; about 40% fine sand; maximum size: fine sand; moist, gray; no reaction with HCl; firm to hard consistency.
												(ML)s 133.4		
												SM 132.9		
												(CL/ML)s 131.5		**50.7 to 51.5 ft. SILT WITH SAND, (ML)s:** About 85% fines with no to low plasticity, low toughness and dry strength, and rapid dilatancy; about 15% fine sand; maximum size: fine sand; moist, gray with dark gray streaks; no reaction with HCl; very firm consistency.
			36.6	0.0	36.6	63.4	0.0	NP	NP	4.9	SM 130.5			
	55	100										SP/SM 128.9		**51.5 to 52.0 ft. SILTY SAND, SM:** About 55% fine sand (grains consist of quartz, mica, various other minerals); about 45% fines; maximum size: fine sand; moist, gray, no reaction with HCl; firm consistency.
														52.0 to 53.4 ft. SILTY CLAY WITH SAND, (CL/ML)s: About 80% fines with low to medium plasticity, low toughness, medium dry strength, and slow dilatancy; about 20% fine sand; maximum size: fine sand (but sample is difficult to break down due to hard fragments of siltstone/claystone), moist, gray with dark gray streaks; no reaction with HCl; hard consistency.
												SM 123.5		**53.4 to 56.0 ft. POORLY GRADED SAND WITH SILT, SP/SM:** About 90% fine sand, about 10% fines; maximum size: fine sand; dry, light gray; no reaction with HCl; very soft (loose) consistency.
	60	100												Lab Data Interval 54.0 to 54.4 ft.
												SM 121.4	Qal	**56.0 to 61.4 ft. SILTY SAND, SM:** About 60% fine to coarse sand (predominately fine to medium); about 40% fines; maximum size: coarse sand; moist, light olive-gray; strong reaction with HCl in calcareous zones; firm consistency.
												s(CL/ML) 119.4		
	65	100												
			54.7	36.5	91.2	8.8	0.0	29.2	7.8	17.8	CL 119.1	CL 119.1		**61.4 to 63.5 ft. SILTY SAND, SM:** About 75% fine to medium sand (grains consist of quartz and various rock types); about 25% fines; maximum size: medium sand; moist, light olive-gray; no reaction with HCl; very soft consistency.
												s(CL/ML) 116.7		**63.5 to 65.5 ft. SANDY SILTY CLAY, s(CL/ML):** About 70% fines with low plasticity, low to medium dry strength, and slow to rapid dilatancy; about 30% fine sand; maximum size: fine sand (but sample is difficult to break down due to hard fragments of siltstone/claystone); moist, olive-gray; no reaction with HCl; hard consistency.
												SM 115.3		
	70	100										s(CL/ML) 114.7		**65.5 to 65.8 ft. LEAN CLAY, CL:** About 90% fines with low plasticity, low to medium dry strength, and slow to rapid dilatancy; about 10% fine sand; maximum size: fine sand; moist, olive-gray; no reaction with HCl; hard consistency.
												SM 112.4		
														Lab Data Interval 65.5 to 65.8 ft.
												s(CL/ML) 110.0		
		100												

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram.

MW-09-39B
TOC Coordinates= N 2171125.4 E 6204815.1 (NAGD83) El. 184.80 (NAVD88)
Ground surface El.= 184.9 (NAVD88)

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-39

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Left, Fresno County
BEGUN: 9/8/09 FINISHED: 9/11/09
DEPTH AND ELEVATION OF WATER LEVEL
AND DATE MEASURED: 79.0 ft. (El. 105.89 ft.) 9/11/2009

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,171,130.1 E 6,204,815.3 (NAGD83)
TOTAL DEPTH: 92.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 184.9 ft. (NAVD88)
T.O.C ELEVATION: 184.89 ft. (NAVD88)
HOLE LOGGED BY: G. Russell
REVIEWED BY: J. Vauk

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL	CLASSIFICATION AND PHYSICAL CONDITION
												SM & s(CL/ML)		**65.8 to 68.2 ft. SANDY SILTY CLAY, s(CL/ML):** About 70% fines with low plasticity, low to medium dry strength, and slow to rapid dilatancy; about 30% fine sand; maximum size: fine sand (but sample is difficult to break down due to hard fragments of siltstone/claystone); moist, olive-gray; no reaction with HCl, hard consistency, becoming more sandy toward bottom of interval.
												107.9		
		67									▼ 79.0 ft. (El. 105.89 ft.)			**68.2 to 69.6 ft. SILTY SAND, SM:** About 65% fine sand (grains consist of quartz, some mica and various other minerals); about 35% fines; maximum size: fine sand; moist, olive-gray; no reaction with HCl; very soft consistency.
80														**69.6 to 70.2 ft. SANDY SILTY CLAY, s(CL/ML):** About 70% fines with, low plasticity, low to medium dry strength, and slow to rapid dilatancy; about 30% fines; maximum size: fine sand; moist, olive-gray; no reaction with HCl; hard consistency.
		100												
												SP/SM		**70.2 to 72.5 ft. SILTY SAND, SM:** About 65% fine sand (grains consist of quartz, some mica and various other minerals); about 35% fines; maximum size: fine sand; moist, gray; no reaction with HCl; soft consistency.
													Qal	
		67	12.3	3.6	15.9	84.1	0.0	NP	NP	16.2	SM 99.9			**72.5 to 74.9 ft. SANDY SILTY CLAY, s(CL/ML):** About 70% fines with low plasticity, low to medium dry strength, and slow to rapid dilatancy; about 30% fine sand; maximum size: fine sand; moist, gray; no reaction with HCl; hard consistency.
85														**74.9 to 77.0 ft. INTERBEDDED SILTY SAND, SM; AND SANDY SILTY CLAY, s(CL/ML):** Descriptions are the same as two previous depth intervals.
												95.9		**77.0 to 89.0 ft. POORLY GRADED SAND WITH SILT, SP/SM:** About 90% fine sand (grains consist of quartz and other minerals); about 10% fines; maximum size: fine sand; wet, gray; no reaction with HCl; very soft consistency.
		76												
90			53.0	5.2	58.2	41.8	0.0	NP	NP	18.2	s(ML) 94.5			Lab Data Interval 84.5 to 85.0 ft.
												s(ML)		**89.0 to 92.0 ft. SANDY SILT, s(ML):** About 65% fines with low plasticity and dry strength, and rapid dilatancy; about 35% fine sand; maximum size: fine sand; moist, olive-gray; no reaction with HCl; firm to hard consistency . Fines percentage increases with depth.
												92.9		Lab Data Interval 90.0 to 90.4 ft.
														T.D. = 92.0 ft.

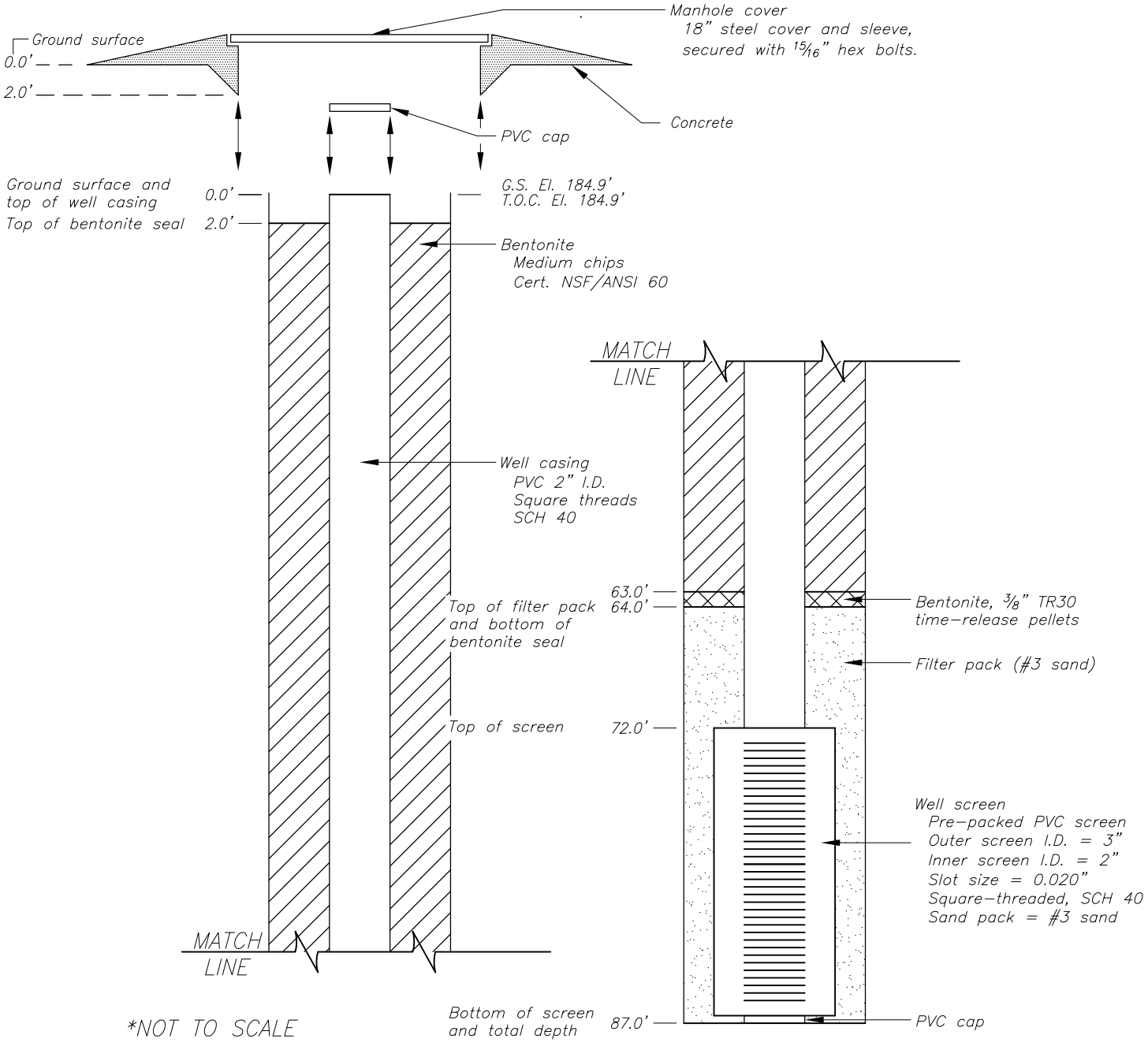
BOTTOM OF HOLE

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram.

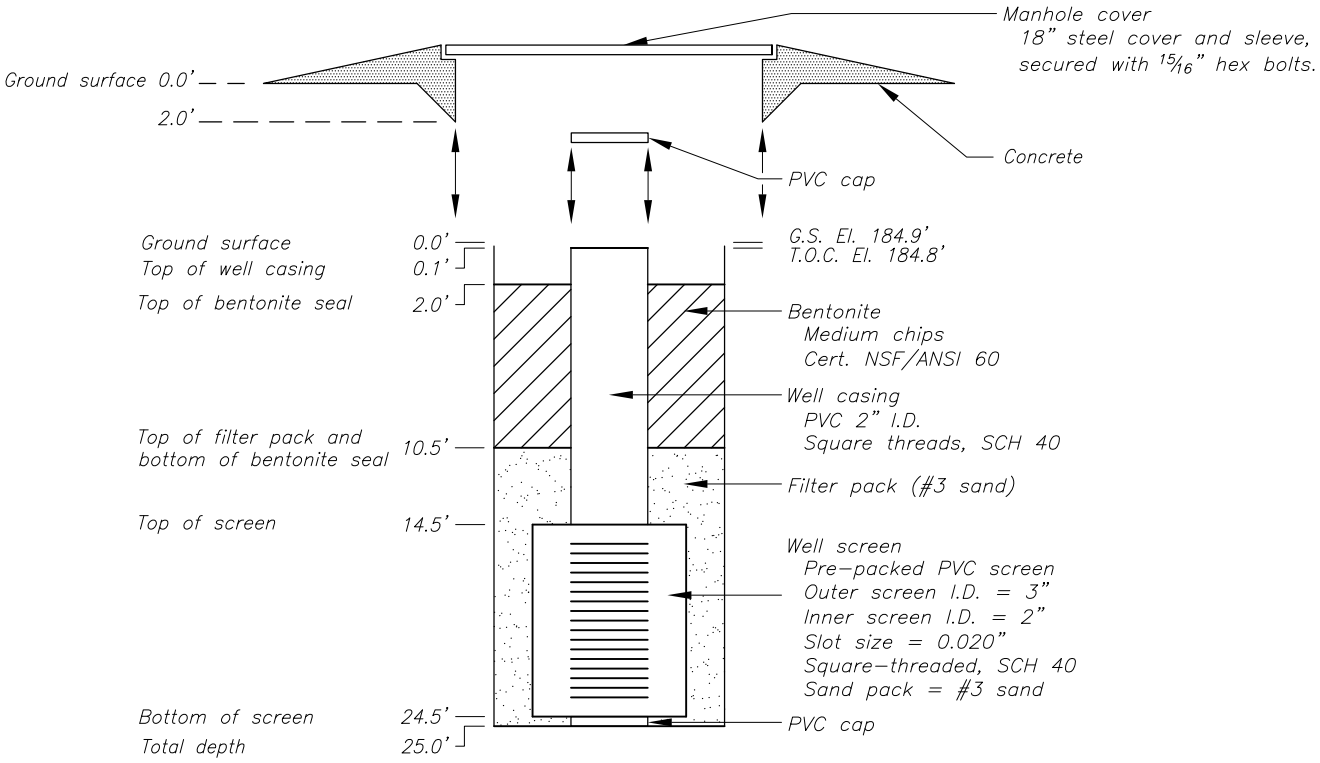
MW-09-39B
TOC Coordinates= N 2171125.4 E 6204815.1 (NAGD83) El. 184.80 (NAVD88)
Ground surface El.= 184.9 (NAVD88)

MW–09–39	GEOLOGIST: G. RUSSELL
WELL COMPLETION DIAGRAM	DRILLER: J. HUCKABY
DATE COMPLETED: 9/11/2009	HELPER: J. RAUMAN
TOP OF WELL CASING COORDINATES: N2171130.1 E6204815.3 (NAD83) ELEVATION 184.9' (NAVD88) GROUND SURFACE ELEVATION 184.9' (NAVD88)	



NOTES:
T.O.C. = Top of well casing, I.D. = Inner Diameter, G.S. = Ground Surface, El. = Elevation
Sand backfills the well above the top of bentonite seal, inside the manhole.

MW–09–39B	GEOLOGIST: G. RUSSELL
WELL COMPLETION DIAGRAM	DRILLER: J. HUCKABY
DATE COMPLETED: 9/11/2009	HELPER: J. RAUMAN
TOP OF WELL CASING COORDINATES: N2171125.4 E6204815.1 (NAD83) ELEVATION 184.8' (NAVD88) GROUND SURFACE ELEVATION 184.9' (NAVD88)	



*NOT TO SCALE

NOTES:
T.O.C. = Top of well casing, I.D. = Inner Diameter, G.S. = Ground Surface, El. = Elevation
Sand backfills the well above the top of bentonite seal, inside the manhole.

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-41

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Left, Fresno County
BEGUN: 12/10/08 FINISHED: 12/10/08
DEPTH AND ELEVATION OF WATER LEVEL
AND DATE MEASURED: 73.3 ft. (El. 107.23 ft.) 8/27/2009

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,171,186.2 E 6,204,387.3 (NAGD83)
TOTAL DEPTH: 82.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 180.7 ft. (NAVD88)
T.O.C ELEVATION: 180.53 ft. (NAVD88)
HOLE LOGGED BY: B. Simpson
REVIEWED BY: J. Vauk

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL	CLASSIFICATION AND PHYSICAL CONDITION
ALL MEASUREMENTS ARE IN FEET FROM GROUND SURFACE. **PURPOSE OF HOLE:** To recover core, collect data to determine geologic and hydrologic site conditions, and install a groundwater monitoring well. **LOCATION:** MW-09-41, Reach 2, River Bank Left, Fresno County, California **DRILLED BY:** USGS-Regional Drill Crew J. Huckaby, Driller; K. Coy, Helper **DRILL RIG:** CME 550 **DRILLING & SAMPLING METHODS:** The hole was completed with hollow stem flight augers (FDAC) drilling methods. Advancement of the hole would proceed in this manner until the target depth of the borehole as defined by the scope of work and communication with the project hydrologist. FADC utilizes 7-5/8-inch O.D. by 4-1/4-inch I.D. hollow stem flight augers, advancing a 5-foot-long, 3-1/2-inch I.D. Split Barrel dry core system (FDAC) using NWF rods, typically advanced on 2-, 3- or 5-foot intervals. **INTERVAL AND METHOD:** 0.0 to 82.0 ft.: FADC **DRILLING CONDITIONS AND DRILLER'S COMMENTS:** 0.0 to 82.0 ft.: smooth, soft to firm **DRILLNG FLUID:** 0.0 to 82.0 ft.: Drilled without water **DRILL FLUID RETURN AND COLOR:** NA **CAVING CONDITIONS:** Upper 23 feet of boring had loose sands. **WATER LEVEL:** 73.3 feet b.g.s. on 8-28-2009. **REASON FOR HOLE TERMINATION:** The hole terminated upon successful completion to the depth requested in the FER. **HOLE COMPLETION:** Well Casing - 0.2 to 62.0 ft. (T.O.C. El. 180.53 ft.) Dual Pre-pack Screen - 62.0 to 82.0 ft. (Slotted 0.020-inch) Well Screen Filter Pack - #3 Sand Filter Pack - 55.0 to 82.0 ft. (#3 Sand) Bentonite Seal - 2.0 to 55.0 ft. Well Protection - flush-mounted 18-inch manhole (15/16-inch hexbolts)	5	50	6.0	1.6	7.6	91.7	0.7	NP	NP	1.0	SP-SM 175.5			***0.0 to 82.0 feet*** ***QUATERNARY ALLUVIUM (Qa)*** **0.0 to 23.0 ft.: POORLY GRADED SAND WITH SILT, SP/SM:** About 90% fine to coarse sand (coarse sand is subrounded); about 10% non-plastic fines with rapid dilatancy; maximum size: coarse sand; light brown in color (7.5 YR 6/4), no reaction with HCl; organics encountered in top two inches of sample, extremely micaceous; dark brown (7.5 YR 3/2) from 9.6 to 10.0 feet; very loose to loose consistency. Laboratory Data Interval 0.0 to 5.0 ft. 15.0 to 17.0 ft.
		100												
		84												**23.0 to 23.4 ft.: LEAN CLAY, (CL):** About 90% fines with low to medium plasticity, low toughness, low dry strength, and no dilatancy; about 10% fine sand; maximum size: fine sand; light brown (7.5 YR 6/4) to dark brown (7.5 YR 3/2), moist, no reaction with HCl; firm consistency.
10														**23.4 to 25.6 ft.: SILTY SAND, (SM):** About 65% fine sand; about 35% non-plastic fines with slow dilatancy; maximum size: fine sand; olive brown (2.5Y 4/4), moist, no reaction with HCl; loose consistency.
		100										(SP/SM)		
		87												Laboratory Data Interval 24.5 to 25.0 ft. **25.6 to 34.8 ft.: SANDY SILT, s(ML):** About 65% non-plastic fines with no dilatancy; about 35% fine sand; maximum size: fine sand; moist, olive brown (2.5Y 4/4 to gray brown (2.5Y 4/2); no reaction with HCl.
15													Qal	
		100	3.4	1.7	5.1	94.9	0.0	NP	NP	4.1	SP-SM 163.5			Laboratory Data Interval 26.5 to 27.0 ft.
		100												**34.8 to 38.8 ft.: LEAN CLAY, (CL):** About 90% fines with low plastic and toughness, low to medium dry strength, and no dilatancy; about 10% fine sand; maximum size: fine sand; olive brown (2.5 YR 4/4), moist, no reaction with HCl, firm consistency.
20														**38.8 to 39.6. ft.: SILT WITH SAND, (ML)s:** About 80% fines with low plasticity and toughness, no dry strength, and no dilatancy; about 20% fine sand; maximum size: fine sand; moist, gray brown (2.5Y 4/2), no reaction with HCl; firm consistency.
		100												Laboratory Data Interval 38.8 to 39.6 ft.
												157.5 CL 157.1		
		100										SM		**39.6 to 40.8 ft.: SILTY SAND, (SM):** About 80% fine to medium sand; about 20% non-plastic fines with slow dilatancy; maximum size: medium sand; moist, light brown (7.5Y 6/4) moist, no reaction with HCl; loose consistency.
			32.8	12.9	45.7	54.3	0.0	20.6	4.5	12.1	SC-SM 155.5	154.9		
25		100												Laboratory Data Interval 39.6 to 40.8 ft.
			42.7	3.3	46.0	54.0	0.0	NP	NP	8.2	SM 153.5			**40.8 to 41.5 ft.: SILT WITH SAND, (ML)s:** About 80% non-plastic fines with slow dilatancy; about 20% fine sand; maximum size: fine sand; moist, gray brown (2.5Y 4/2), no reaction with HCl.
		100												**41.5 to 43.2 ft.: SILTY SAND, (SM):** About

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram. Well development information is provided in attached Monitoring Well Development form.

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-41

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Left, Fresno County
BEGUN: 12/10/08 FINISHED: 12/10/08
DEPTH AND ELEVATION OF WATER LEVEL
AND DATE MEASURED: 73.3 ft. (El. 107.23 ft.) 8/27/2009

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,171,186.2 E 6,204,387.3 (NAGD83)
TOTAL DEPTH: 82.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 180.7 ft. (NAVD88)
T.O.C ELEVATION: 180.53 ft. (NAVD88)
HOLE LOGGED BY: B. Simpson
REVIEWED BY: J. Vauk

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL	CLASSIFICATION AND PHYSICAL CONDITION
	35	100										s(ML) 145.7		60% fine to medium sand; about 40% non-plastic fines with slow dilatancy; maximum size: medium sand; gray (2.5Y N5), moist, no reaction with HCl; loose consistency. **43.2 to 43.9 ft.: LEAN CLAY, (CL):** About 90% fines, low plasticity and toughness, low to medium dry strength, no dilatancy; about 10% fine sand; maximum sand: fine sand; gray brown (2.5 YR 4/2), moist, no reaction HCL; firm consistency. Laboratory Data Interval 43.2 to 43.9 ft. **43.9 to 45.3 ft.: SANDY SILT, s(ML):** About 65% non-plastic fines with slow dilatancy; about 35% fine sand; maximum size: fine sand; moist, olive brown (2.5Y 4/4), no reaction with HCl; firm consistency.
												CL 141.7		
			71.3	5.7	77.0	23.0	0.0	27.0	2.4	25.0	(ML)s 140.9	(ML)s 140.9		
	40	100	12.2	1.2	13.4	86.6	0.0	NP	NP	5.5	SM 139.7	SM 139.7		**45.3 to 47.3 ft.: SILTY SAND, (SM):** About 65% fine to medium sand; about 35% non-plastic fines with slow dilatancy; maximum size: medium sand; olive brown (5Y 4/2) to light brown (7.5YR 6/4), moist, no reaction with HCl; loose consistency. Laboratory Data Interval 45.3 to 47.3 ft.
												(ML)s 139.0		
												SM 137.3		
			30.8	52.9	83.7	16.3	0.0	35.8	16.4	22.8	(CL)s 136.6	CL 136.6		**47.3 to 49.3 ft.: SILT, (ML):** About 90% non-plastic fines with slow dilatancy; about 10% fine sand; maximum size: fine sand; moist, gray brown (2.5Y 4/2), moist, no reaction with HCl.
	45	100										s(ML) 135.2	Qal	**49.3 to 51.7 ft.: SILTY SAND, SM:** About 60% fine to medium sand; about 40% non-plastic fines with slow dilatancy; maximum size: medium sand; gray (2.5Y N5), moist, no reaction with HCl; ½ to ¼ inch laminations observed with black banding; soft (loose) consistency.
			24.5	3.6	28.1	71.9	0.0	NP	NP	8.4	SM 133.5	SM 133.2		
												ML 131.2		Laboratory Data Interval 49.5 to 49.6 ft. **51.7 to 60.3 ft.: SILT, (ML):** About 90% non-plastic fines with slow dilatancy; about 10% fine sand; maximum size: fine sand; moist, gray brown (2.5Y 4/2), strong reaction with HCl (calcareous); firm consistency.
	50	97	12.0	0.0	12.0	88.0	0.0	NP	NP	13.0	130.9 SP-SM	SM 128.8		**60.3 to 61.5 ft.: SILTY SAND, SM:** About 80% fine to medium sand; about 20% non-plastic fines with slow dilatancy; maximum size: medium sand; moist, light brown (7.5Y 6/4), no reaction with HCl; soft (loose) consistency.
	55	100	32.2	20.5	52.7	47.3	0.0	40.3	7.3	35.7	125.4 s(ML)	ML		**61.5 to 64.9 ft.: SILT, (ML):** About 90% non-plastic fines with slow dilatancy; about 10% fine sand; maximum size: fine sand; moist, gray brown (2.5Y 4/2), no reaction with HCl; loose consistency. **64.9 to 65.6 ft.: SILTY SAND, (SM):** About 80% fine to medium sand; about 20% non-plastic fines with rapid dilatancy; maximum size: medium sand; light brown (7.5Y 6/4), moist, no reaction with HCl; loose consistency.
		100												

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram. Well development information is provided in attached Monitoring Well Development form.

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-41

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Left, Fresno County
BEGUN: 12/10/08 FINISHED: 12/10/08
DEPTH AND ELEVATION OF WATER LEVEL
AND DATE MEASURED: 73.3 ft. (El. 107.23 ft.) 8/27/2009

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,171,186.2 E 6,204,387.3 (NAGD83)
TOTAL DEPTH: 82.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 180.7 ft. (NAVD88)
T.O.C ELEVATION: 180.53 ft. (NAVD88)
HOLE LOGGED BY: B. Simpson
REVIEWED BY: J. Vauk

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL	CLASSIFICATION AND PHYSICAL CONDITION
												120.2		
												SM		
												119.0		
											117.4	ML		
			58.4	6.8	65.2	34.8	0.0	20.7	1.6	19.3	s(ML)			
	65	100										115.6		
												SM		
												114.9		
												ML		
												113.5		
	70	100										SM		
												109.0	Qal	
											73.3 ft. (El. 107.23 ft.)			
	75	80										SP		
	80	80										98.5		

BOTTOM OF HOLE

65.6 to 67.0 ft.: SILT, (ML): About 90% non-plastic fines with slow dilatancy; about 10% fine sand; maximum size: fine sand; moist, gray brown (2.5Y 4/2), no reaction with HCl; increase in the percentage of sand with depth.

Laboratory Data Interval
65.0 to 65.1 ft.

67.0 to 71.5 ft.: SILTY SAND, (SM): About 60% fine to medium sand; about 40% non-plastic fines with slow dilatancy; maximum size: medium sand; olive brown (2.5Y 4/4), moist, no reaction with HCl; soft (loose) consistency.

71.5 to 82.0 ft.: POORLY GRADED SAND, (SP): About 95% medium sand; about non-plastic 5% fines with rapid dilatancy; maximum size: medium sand; gray (2.5Y N5), moist from 71.5 to 73.0 ft. and wet from 73.0 to 82.0 ft., no reaction with HCl; soft (loose) consistency.

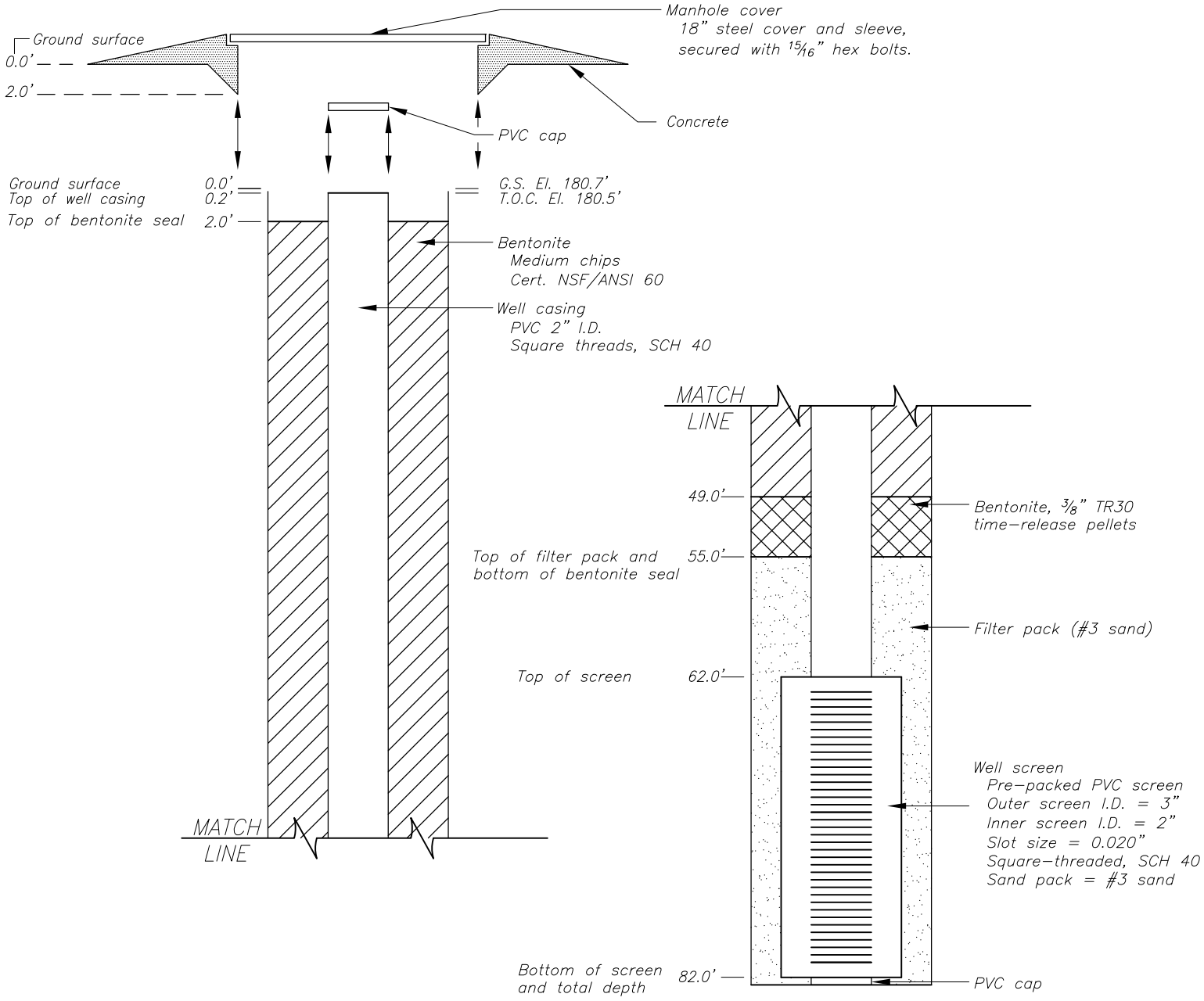
Laboratory Data Interval
80.0 to 80.1 ft.

T.D. = 82.0 ft.

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram. Well development information is provided in attached Monitoring Well Development form.

MW–09–41	GEOLOGIST: J. VAUK
WELL COMPLETION DIAGRAM	DRILLER: J. HUCKABY
DATE COMPLETED: 8/27/2009	HELPER: K. COY
TOP OF WELL CASING COORDINATES: N2171186.2 E6204387.3 (NAD83) ELEVATION 180.5' (NAVD88) GROUND SURFACE ELEVATION 180.7' (NAVD88)	



*NOT TO SCALE

NOTES:
T.O.C. = Top of well casing, I.D. = Inner Diameter, G.S. = Ground Surface, El. = Elevation
Sand backfills the well above the top of bentonite seal, inside the manhole.

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-44

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Left, Fresno County
BEGUN: 8/19/09 FINISHED: 8/20/09
DEPTH AND ELEVATION OF WATER LEVEL
AND DATE MEASURED: 45.7 ft. (El. 133.46 ft.) 8/20/2009

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,165,488.3 E 6,199,215.8 (NAGD83)
TOTAL DEPTH: 67.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 179.2 ft. (NAVD88)
T.O.C ELEVATION: 179.16 ft. (NAVD88)
HOLE LOGGED BY: J. Vauk
REVIEWED BY: A. Warren

ALL MEASUREMENTS ARE IN FEET FROM THE GROUND SURFACE.

PURPOSE OF HOLE:
To recover core, collect data to determine geologic and hydrologic site conditions, and install a groundwater monitoring well.

DRILLED BY:
USGS Drill Crew
James Huckaby, Driller
Kevin Coy, Helper

DRILL RIG:
CME-550

DRILLING & SAMPLING METHODS:
Drill hole MW-09-44 was advanced using hollow stem flight augers with continuous dry core sampling system (FADC) from the ground surface to a total depth of 67.0 feet. FADC uses 7-5/8-inch O.D., 4-1/4-inch I.D. hollow stem augers, with a 5-foot-long, 3-inch I.D. split sample barrel.

Interval Method
0.0 to 67.0 ft. - FADC

DRILLING CONDITIONS AND DRILLER'S COMMENTS:
0.0 to 7.0 ft. - slow and smooth drilling
7.0 to 10.0 ft. - no recovery
10.0 to 67.0 ft. - slow and smooth drilling

DRILL FLUID, RETURN AND COLOR:
0.0 to 42.0 ft. - None,
42.0 to 67.0 ft. - Water, no return

WATER LEVEL:
41.8 feet b.g.s. on 8/19/2009

REASON FOR HOLE TERMINATION:
The hole was terminated upon successful completion to the target depth.

HOLE COMPLETION:
Well Casing - 0.0 to 41.5 ft. (T.O.C. El. 179.16 ft.)
Dual Pre-pack Screen - 41.5 to 61.5 ft. (Slotted 0.020-inch)
Well Screen Filter Pack - #3 Sand Filter Pack - 36.0 to 62.0 ft. (#3 Sand)
Bottom Bentonite Seal - 62.0 to 67.0 ft.
Bentonite Seal - 2.0 to 36.0 ft.
Well Protection - flush-mounted 18-inch manhole (15/16-inch hexbolts)

DEPTH	% CORE RECOVERY	% SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION	ELEVATION	VISUAL CLASSIFICATION	ELEVATION	GEOLOGIC UNIT SYMBOL
	15											SM	177.2	
	117	65.8	18.7	84.5	15.5	0.0	NP	NP	7.7	(ML)s	174.2	(ML)s	172.2	
5	100													
	NR											NR	169.2	
10	100											SW	164.2	
	93	3.6	1.2	4.8	81.0	14.2	NP	NP	1.0	GW				Qal
15	100												162.6	
												(ML)s	162.1	
	107	59.8	37.4	97.2	2.8	0.0	39.0	14.4	37.2	CL	161.6	ML	161.6	
										(ML)s			161.5	
20	100											ML & (ML)s		
	100	64.3	28.0	92.3	7.7	0.0	35.1	11.6	34.8	CL	155.7			

0.0 to 67.0 feet
QUATERNARY ALLUVIUM (Qal)

0.0 to 2.0 ft. SILTY SAND, SM: About 70% fine to medium sand; about 30% non-plastic fines with rapid dilatancy; maximum size: medium sand; dry, light brown, no reaction with HCl; contains organics roots and grass; soft consistency.

2.0 to 7.0 ft. SILT WITH SAND, (ML)s: About 85% fines with low plasticity, toughness, and dry strength, and rapid dilatancy; about 15% fine sand; maximum size: fine sand; dry, light brown (dark brown when wet), no reaction with HCl; firm consistency.

Laboratory Data Interval
2.0 to 5.0 ft.

7.0 to 10.0 ft. No Recovery

10.0 to 16.6 ft. WELL GRADED SAND, SW: About 85 to 90% fine to coarse sand; about 5 to 10% fine, hard, subrounded gravel; about 5% non-plastic fines with rapid dilatancy; maximum size: 3/8 inches; dry, light brown and off-white, no reaction with HCl; soft (loose) consistency.

Laboratory Data Interval
10.0 to 15.0 ft.

16.6 to 17.1 ft. SILT WITH SAND, (ML)s: About 80% fines with low to medium plasticity, low toughness, low to medium dry strength, and rapid dilatancy; about 20% fine to medium sand (mostly fine); maximum size: medium sand; moist, medium brown, no reaction with HCl; soft consistency.

17.1 to 17.6 ft. SILT, ML: About 95% fines with low to medium plasticity, low toughness, low to medium dry strength, and rapid dilatancy; about 5% fine sand; maximum size: fine sand; moist, medium brown, no reaction with HCl; soft consistency.

Laboratory Data Interval
17.1 to 17.6 ft.

17.6 to 17.7 ft. SILT WITH SAND, (ML)s: About 85% fines with low to medium plasticity, low toughness, low to medium dry strength, rapid dilatancy; about 15% fine sand; maximum size: fine sand; moist, medium brown, no reaction with HCl; soft consistency.

17.7 to 29.2 ft. INTERBEDDED SILT, ML; AND SILT WITH SAND, (ML)s: Grain-size distribution of interbedded soils layers is listed below. Soil descriptions for SILT, ML, is the same as described in depth interval 17.1 to 17.6 feet. Soil description for SILT WITH SAND, (ML)s, is the same as described in depth interval 17.6 to 17.7 feet.
17.7 to 17.9 ft. - ML: 95% fines; 5% sand.
17.9 to 18.1 ft. - (ML)s: 85% fines; 15% sand.
18.1 to 19.2 ft. - ML: 95% fines; 5% sand.
19.2 to 20.2 ft. - (ML)s: 85% fines; 15% sand.
20.2 to 20.3 ft. - ML: 95% fines; 5% sand.
20.3 to 20.7 ft. - (ML)s: 85% fines; 15% sand.
20.7 to 20.8 ft. - ML: 95% fines; 5% sand.
20.8 to 21.8 ft. - (ML)s: 85% fines; 15% sand.
21.8 to 23.5 ft. - ML: 95% fines; 5% sand.
23.5 to 24.4 ft. - (ML)s: 80% fines; 20% sand.
24.4 to 25.3 ft. - ML: 90% fines; 10% sand.

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram. Well development information is provided in attached Monitoring Well Development form.

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-44

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Left, Fresno County
BEGUN: 8/19/09 FINISHED: 8/20/09
DEPTH AND ELEVATION OF WATER LEVEL
AND DATE MEASURED: 45.7 ft. (El. 133.46 ft.) 8/20/2009

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,165,488.3 E 6,199,215.8 (NAGD83)
TOTAL DEPTH: 67.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 179.2 ft. (NAVD88)
T.O.C ELEVATION: 179.16 ft. (NAVD88)
HOLE LOGGED BY: J. Vauk
REVIEWED BY: A. Warren

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL	CLASSIFICATION AND PHYSICAL CONDITION
														25.3 to 25.5 ft. - (ML)s: 85% fines; 15% sand. 25.5 to 27.8 ft. - ML: 90% fines; 10% sand. 27.8 to 29.2 ft. - (ML)s: 85% fines; 15% sand. Laboratory Data Interval 21.8 to 23.5 ft. 25.5 to 27.8 ft.
		100	62.1	20.3	82.4	17.6	0.0	NP	NP	31.5	(ML)s 151.4			
		100										150.0		**29.2 to 30.5 ft. SILTY SAND, SM:** About 80% fine sand; about 20% non-plastic fines with rapid dilatancy; maximum size: fine sand; dry, light brown, no reaction with HCl; soft consistency.
	30		15.7	4.4	20.1	79.9	0.0	NP	NP	12.9	SM 148.7	SM 148.7		Laboratory Data Interval 29.2 to 30.5 ft.
		80										ML 148.4 s(ML) 148.0 SP 147.6		**30.5 to 30.8 ft. SILT, ML:** About 95% non-plastic fines with rapid dilatancy; about 5% fine sand; maximum size: fine sand; moist, dark gray, no reaction with HCl; soft consistency.
											s(ML) →	(SP)g 147.5 147.2		
		57	2.4	1.0	3.4	36.6	60.0	NP	NP	2.3	(GP)s 142.2			**30.8 to 31.2 ft. SANDY SILT, s(ML):** About 55% non-plastic fines with rapid dilatancy; about 45% fine sand; maximum size: fine sand; moist, light brown and orange, no reaction with HCl; soft consistency.
	35											(GP)s		**31.2 to 31.6 ft. POORLY GRADED SAND, SP:** About 95% fine to medium sand (mostly fine); about 5% non-plastic fines with rapid dilatancy; maximum size: medium sand; dry, light brown; soft consistency.
		50												**31.6 to 31.7 ft. SANDY SILT, s(ML):** About 60% non-plastic fines with rapid dilatancy; about 40% fine sand; maximum size: fine sand; moist, medium brown, no reaction with HCl; soft consistency.
												141.4	Qal	
		83										(ML)s		**31.7 to 32.0 ft. POORLY GRADED SAND WITH GRAVEL, (SP)g:** About 65% fine to coarse sand; about 30% fine, hard, subrounded gravel; about 5% non-plastic fines with rapid dilatancy; maximum size: 1 inch; dry, light brown, no reaction with HCl; soft consistency.
	40											139.2		
		115										s(ML)		**32.0 to 37.8 ft. POORLY GRADED GRAVEL WITH SAND, (GP)s:** About 55% fine to coarse (mostly fine), hard, subrounded gravel; about 40% fine to coarse sand; about 5% non-plastic fines; maximum size: 1.25 inches; moist; light brown, no reaction with HCl, soft consistency.
												136.4		Laboratory Data Interval 32.0 to 37.0 ft.
		97	10.5	5.2	15.7	84.3	0.0	NP	NP	21.9	SM			**37.8 to 40.0 ft. SILT WITH SAND, (ML)s:** About 80% non-plastic fines with rapid dilatancy; about 20% fine sand; maximum size: fine sand; moist, gray, no reaction with HCl; soft consistency.
	45										45.7 ft. (El. 133.46 ft.)			
		40									132.2	SM		**40.0 to 42.8 ft. SANDY SILT, s(ML):** About 60% non-plastic fines with rapid dilatancy; about 40% fine sand; maximum size: fine sand; moist from 40.0 to 41.8 ft., wet from 41.8 to 42.8 ft.; strong reaction with HCl, calcite veins.
		50												**42.8 to 49.3 ft. SILTY SAND, SM:** About 70% fine sand; about 30% non-plastic fines; maximum size: fine sand; moist to wet, gray, no reaction with HCl; soft consistency.
												129.9		
												SM 129.2		

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram. Well development information is provided in attached Monitoring Well Development form.

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-44

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Left, Fresno County
BEGUN: 8/19/09 FINISHED: 8/20/09
DEPTH AND ELEVATION OF WATER LEVEL
AND DATE MEASURED: 45.7 ft. (El. 133.46 ft.) 8/20/2009

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,165,488.3 E 6,199,215.8 (NAGD83)
TOTAL DEPTH: 67.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 179.2 ft. (NAVD88)
T.O.C ELEVATION: 179.16 ft. (NAVD88)
HOLE LOGGED BY: J. Vauk
REVIEWED BY: A. Warren

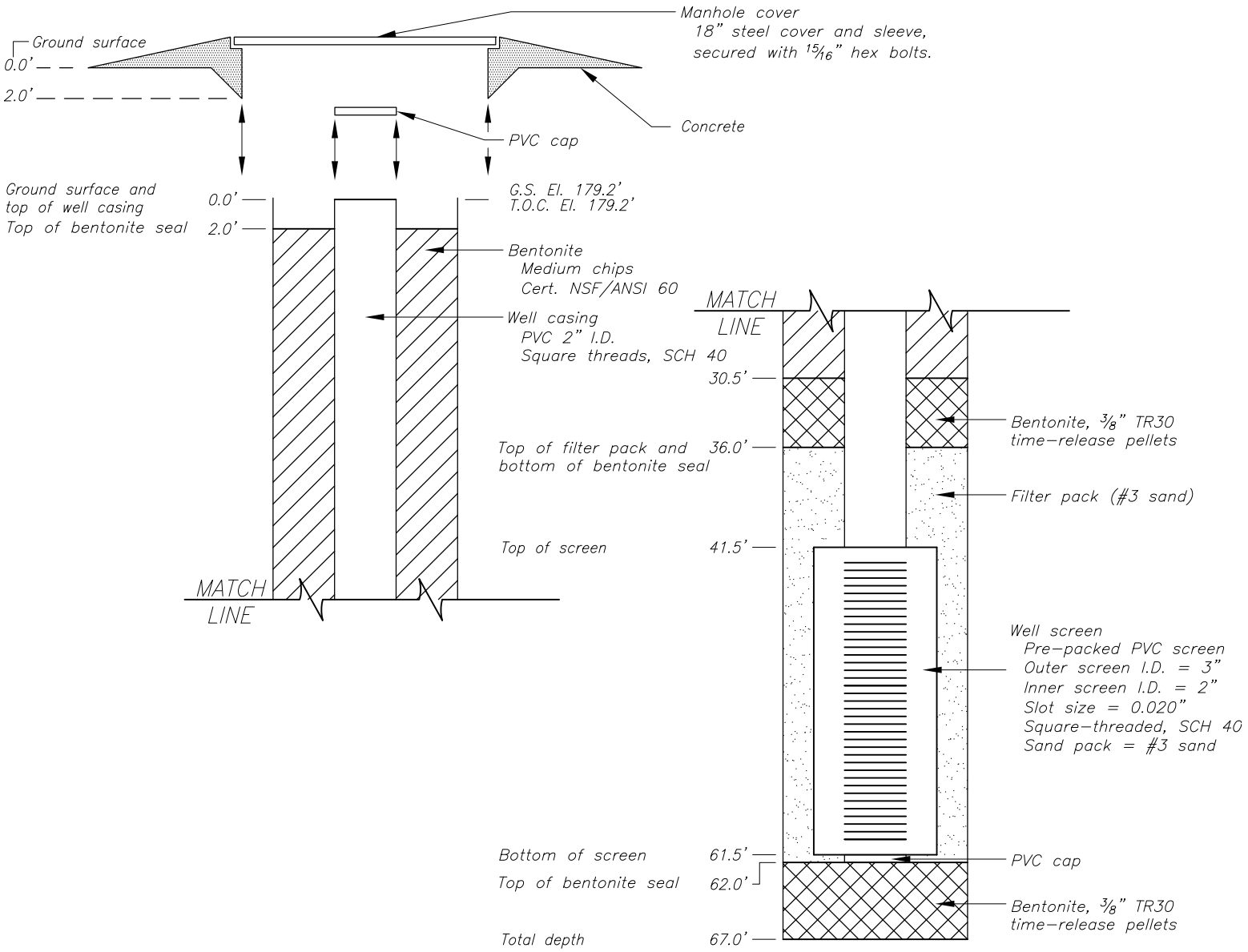
NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL	CLASSIFICATION AND PHYSICAL CONDITION
		10												Laboratory Data Interval 42.8 to 47.0 ft.
														49.3 to 50.0 ft. SILTY SAND, SM: About 60% fine sand; about 40% non-plastic fines with rapid dilatancy; maximum size: fine sand; moist, gray, no reaction with HCl; firm consistency.
		NR												**50.0 to 59.9 ft. SILTY SAND, SM:** About 80 to 85% fine sand; about 15 to 20% non-plastic fines with rapid dilatancy; maximum size: fine sand; moist to wet, gray, no reaction with HCl; soft consistency.
	55											SM		
		55	6.2	2.4	8.6	91.4	0.0	NP	NP	25.1	SP-SM 122.2			Laboratory Data Interval 55.0 to 57.0 ft.
														59.9 to 60.1 ft. SILT WITH SAND, (ML)s: About 80% fines with medium plasticity, toughness, and dry strength, and no dilatancy; about 20% fine sand; maximum size: fine sand; gray, no reaction with HCl; firm consistency.
		76											Qal	**60.1 to 63.9 ft. SILTY SAND, SM:** About 80% fine sand; about 20% non-plastic fines with rapid dilatancy; maximum size: fine sand; wet, gray, no reaction with HCl; soft consistency.
	60											(ML)s 119.3 / 119.1		
			8.6	5.9	14.5	85.5	0.0	NP	NP	24.1	SM 117.2			Laboratory Data Interval 60.1 to 62.0 ft.
												SM		**63.9 to 67.0 ft. LEAN CLAY WITH SAND, (CL)s:** About 80% fines with low plasticity, toughness, and dry strength, and rapid dilatancy; about 20% fine sand; maximum size: fine sand; moist, greenish-gray, no reaction with HCl; firm consistency.
												115.3		Laboratory Data Interval 63.9 to 67.0 ft.
		62												
	65		45.6	39.8	85.4	14.6	0.0	28.9	12	24.9	CL 112.2	(CL)s 112.2		***T.D. = 67.0 ft.***

BOTTOM OF HOLE

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram. Well development information is provided in attached Monitoring Well Development form.

MW–09–44	GEOLOGIST: J. VAUK
WELL COMPLETION DIAGRAM	DRILLER: J. HUCKABY
DATE COMPLETED: 8/20/2009	HELPER: K. COY
TOP OF WELL CASING COORDINATES: N2165488.3 E6199215.8 (NAD83) ELEVATION 179.2' (NAVD88) GROUND SURFACE ELEVATION 179.2' (NAVD88)	



*NOT TO SCALE

NOTES:
T.O.C. = Top of well casing, I.D. = Inner Diameter, G.S. = Ground Surface, El. = Elevation
Sand backfills the well above the top of bentonite seal, inside the manhole.

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-46

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Left, Fresno County
BEGUN: 8/16/09 FINISHED: 8/17/09
DEPTH AND ELEVATION OF WATER LEVEL
AND DATE MEASURED: 19.3 ft. (El. 154.08 ft.) 8/16/2009

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,166,236.8 E 6,192,397.8 (NAGD83)
TOTAL DEPTH: 67.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 173.5 ft. (NAVD88)
T.O.C ELEVATION: 173.38 ft. (NAVD88)
HOLE LOGGED BY: J. Vauk
REVIEWED BY: A. Warren

ALL MEASUREMENTS ARE IN FEET FROM THE GROUND SURFACE.

PURPOSE OF HOLE:
To recover core, collect data to determine geologic and hydrologic site conditions, and install a groundwater monitoring well.

DRILLED BY:
USGS Drill Crew
James Huckaby, Driller
Kevin Coy, Helper

DRILL RIG:
CME-550

DRILLING & SAMPLING METHODS:
Drill hole MW-09-46 was advanced using hollow stem flight augers with continuous dry core sampling system (FADC) from the ground surface to a total depth of 67.0 feet. FADC uses 7-5/8-inch O.D., 4-1/4-inch I.D. hollow stem augers, with a 5-foot-long 3-inch I.D. split sample barrel.

Interval Method
0.0 to 67.0 ft. - FADC

DRILLING CONDITIONS AND DRILLER'S COMMENTS:
0.0 To 27.0 ft. - slow and smooth drilling
27.0 to 37.0 ft. - extend sampler out in-front of shoe, smooth drilling
37.0 to 67.0 ft. - shorten run length to 2 to 3 feet, smooth drilling

DRILL FLUID, RETURN AND COLOR:
0.0 to 27.0 ft. - None
27.0 to 67.0 ft. - Water, no return

WATER LEVEL:
19.3 feet b.g.s. on 8/16/2009

REASON FOR HOLE TERMINATION:
The hole was terminated upon successful completion to the target depth.

HOLE COMPLETION:
Well Casing - 0.1 to 42.0 ft. (T.O.C. El. 173.38 ft.)
Dual Pre-pack Screen - 42.0 to 62.0 ft. (Slotted 0.020-inch)
Well Screen Filter Pack - #3 Sand Filter Pack - 37.0 to 62.5 ft. (#3 Sand)
Bottom Bentonite Seal - 62.5 to 67.0 ft.
Bentonite Seal - 2.0 to 37.0 ft.
Well Protection - flush-mounted 18-inch manhole (15/16-inch hexbolts)

DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL
											SM 171.6	
											SP/SM 171.3	
	62											
5												
	40	8.3	2.4	10.7	89.3	0.0	NP	NP	2.2	SW-SM 163.4	SM 163.4	
10												
	30										(GM)s 161.4	
	60	1.7	2.2	3.9	94.5	1.6	NP	NP	1.6	SP 158.5	SP/SM 157.6	
15											(GP)s 156.6	Qal
											SM 155.3	
		1.6	1.3	2.9	57.4	39.7	NP	NP	3.6	(SP)g 154.8		
	32									19.3 ft. (El. 154.08 ft.)	(SP/SM)g 151.4	
20												
	26										(SM)g 146.4	
25												
		2.7	0.6	3.3	96.3	0.4	NP	NP	13.5	SP 143.9	SP/SM 143.9	
	36										(SM)g 143.4	

0.0 to 67.0 feet
QUATERNARY ALLUVIUM (Qal)

0.0 to 1.8 ft.: SILTY SAND, SM: About 75% fine sand; about 25% non-plastic fines with rapid dilatancy; maximum size: medium sand; dry, light brown, no reaction with HCl; soft consistency.

1.8 to 2.1 ft.: POORLY GRADED SAND WITH SILT, SP/SM: About 90% fine to coarse sand; about 10% non-plastic fines with rapid dilatancy; maximum size: coarse sand; dry, light brown, no reaction with HCl; soft consistency.

2.1 to 10.0 ft.: SILTY SAND, SM: About 85% fine to medium sand; about 15% non-plastic fines with rapid dilatancy; maximum size: medium sand; dry, light brown, no reaction with HCl; soft consistency.

Laboratory Data Interval
5.0 to 10.0 ft.

10.0 to 12.0 ft.: SILTY GRAVEL WITH SAND, (GM)s: About 50% fine to coarse, hard, sub-rounded gravel; about 35% fine sand; about 15% non-plastic fines with rapid dilatancy; maximum size: 3/4 inches; dark and light brown, no reaction with HCl; soft consistency.

Laboratory Data Interval
12.0 to 14.9 ft.

12.0 to 15.8 ft.: POORLY GRADED SAND WITH SILT, SP/SM: About 90% fine to coarse sand (coarse subrounded sand encountered from 12.0 to 14.9 ft.); about 10% non-plastic fines with rapid dilatancy; maximum size: 1/8 inches; light gray and light brown, no reaction with HCl; soft consistency.

15.8 to 16.8 ft.: POORLY GRADED GRAVEL WITH SAND, (GP)s: About 50% fine to coarse, hard, rounded to sub-rounded gravel; about 45% fine to coarse sand; about 5% non-plastic fines with rapid dilatancy; maximum size: 1 inch; dry, light brown, no reaction with HCl.

16.8 to 18.1 ft.: SILTY SAND, SM: About 80% fine to coarse sand; about 20% non-plastic fines with rapid dilatancy; maximum size: coarse sand; dry, light brown to off white, no reaction with HCl; soft consistency.

18.1 to 22.0 ft.: POORLY GRADED SAND WITH SILT AND GRAVEL, (SP/SM)g: About 50% fine to coarse sand; about 40% fine, hard, rounded to sub-rounded gravel; about 10% non-plastic fines with rapid dilatancy; maximum size: 3/4 inches; wet, light brown, no reaction with HCl; soft consistency.

Laboratory Data Interval
18.1 to 18.6 ft.

22.0 to 27.0 ft.: SILTY SAND WITH GRAVEL, (SM)g: About 65% fine to coarse sand; about 20% fine, hard, rounded to sub-rounded gravel; about 15% non-plastic fines with rapid dilatancy; maximum size: 3/4 inches; wet, light brown, no reaction with HCl; soft consistency; poor recovery due to loose wet sand.

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram. Well development information is provided in attached Monitoring Well Development form.

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-46

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Left, Fresno County
BEGUN: 8/16/09 FINISHED: 8/17/09
DEPTH AND ELEVATION OF WATER LEVEL
AND DATE MEASURED: 19.3 ft. (El. 154.08 ft.) 8/16/2009

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,166,236.8 E 6,192,397.8 (NAGD83)
TOTAL DEPTH: 67.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 173.5 ft. (NAVD88)
T.O.C ELEVATION: 173.38 ft. (NAVD88)
HOLE LOGGED BY: J. Vauk
REVIEWED BY: A. Warren

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL	CLASSIFICATION AND PHYSICAL CONDITION
												SM 139.1		**27.0 to 29.5 ft.: POORLY GRADED SAND WITH SILT, SP/SM:** About 85% fine to coarse sand; about 10% non-plastic fines with rapid dilatancy; about 5% hard, sub-rounded gravel; maximum size: 1/2 inches; wet, light brown, no reaction with HCl; soft consistency.
		87												Laboratory Data Interval 27.0 to 29.5 ft.
												SM 138.4		**29.5 to 30.0 ft.: SILTY SAND WITH GRAVEL, (SM)g:** About 45% fine to coarse sand; about 35% fine to coarse, hard, rounded to sub-rounded gravel; about 20% non-plastic fines with rapid dilatancy; maximum size: coarse gravel; light brown, no reaction with HCl; soft consistency.
	35		59.7	18.9	78.6	21.4	0.0	24.4	5.6	22.3	(CL-ML)s 137.8			
		30										(ML)s 134.9		**30.0 to 34.3 ft.: SILTY SAND, SM:** About 75% fine sand; about 25% non-plastic fines with rapid dilatancy; maximum size: fine sand; wet, light brown, no reaction with HCl.
		87	9.6	2.3	11.9	88.1	0.0	NP	NP	21.2	SP-SM 133.4			**34.3 to 35.0 ft.: SILTY SAND, SM:** About 55% fine sand; about 45% non-plastic to low plasticity fines; maximum size: fine sand; wet, light brown, no reaction with HCl.
	40											SP/SM 131.4		**35.0 to 38.5 ft.: SILT WITH SAND, (ML)s:** About 75% fines with low plasticity, toughness, and dry strength, and rapid dilatancy; about 25% fine sand; maximum size: fine sand; medium brown, no reaction with HCl; soft consistency.
		85										s(ML) 131.2		
		60										NR 128.4		Laboratory Data Interval 35.0 to 35.6 ft.
	45		24.6	14.6	39.2	60.8	0.0	NP	NP	16.2	SM 127.7	SM 127.7	Qal	**38.5 to 42.0 ft.: POORLY GRADED SAND WITH SILT, SP/SM:** About 90% fine sand; about 10% non-plastic fines; maximum size: fine sand; light brown and light gray, no reaction with HCl; soft consistency.
		95										SM 126.4		Laboratory Data Interval 38.5 to 40.0 ft.
		100	5.7	4.9	10.6	89.4	0.0	NP	NP	22.8	SP-SM 123.4	SM 123.0		**42.0 to 42.2 ft.: SANDY SILT, s(ML):** About 55% non-plastic fines; about 45% fine sand; maximum size: fine sand; wet, light brown, no reaction with HCl; soft consistency.
	50											SP 122.6		**42.2 to 45.0 ft.: No Recovery**
		60												**45.0 to 45.7 ft.: SILTY SAND, SM:** About 55% fine sand; about 45% non-plastic fines; maximum size: fine sand; wet, light brown, no reaction with HCl; soft consistency.
		47										SM 119.0		Laboratory Data Interval 45.0 to 45.7 ft.
	55											(ML)s 118.4		**45.7 to 47.0 ft.: SILTY SAND, SM:** About 80% fine to medium sand; about 20% non-plastic fines; maximum size: medium sand; wet, light brown to light gray; soft consistency.
		30										s(ML) 116.4		**47.0 to 50.4 ft.: SILTY SAND, SM:** About 70% fine to medium sand; about 30% non-plastic fines; maximum size: medium sand; wet, greenish-gray, no reaction with HCl; firm consistency.
		50										s(ML) 113.4		Laboratory Data Interval 47.0 to 50.0 ft.
			18.5	6.8	25.3	74.7	0.0	NP	NP	17.2	SM 113.4			

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram. Well development information is provided in attached Monitoring Well Development form.

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-46

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Left, Fresno County
BEGUN: 8/16/09 FINISHED: 8/17/09
DEPTH AND ELEVATION OF WATER LEVEL
AND DATE MEASURED: 19.3 ft. (El. 154.08 ft.) 8/16/2009

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,166,236.8 E 6,192,397.8 (NAGD83)
TOTAL DEPTH: 67.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 173.5 ft. (NAVD88)
T.O.C ELEVATION: 173.38 ft. (NAVD88)
HOLE LOGGED BY: J. Vauk
REVIEWED BY: A. Warren

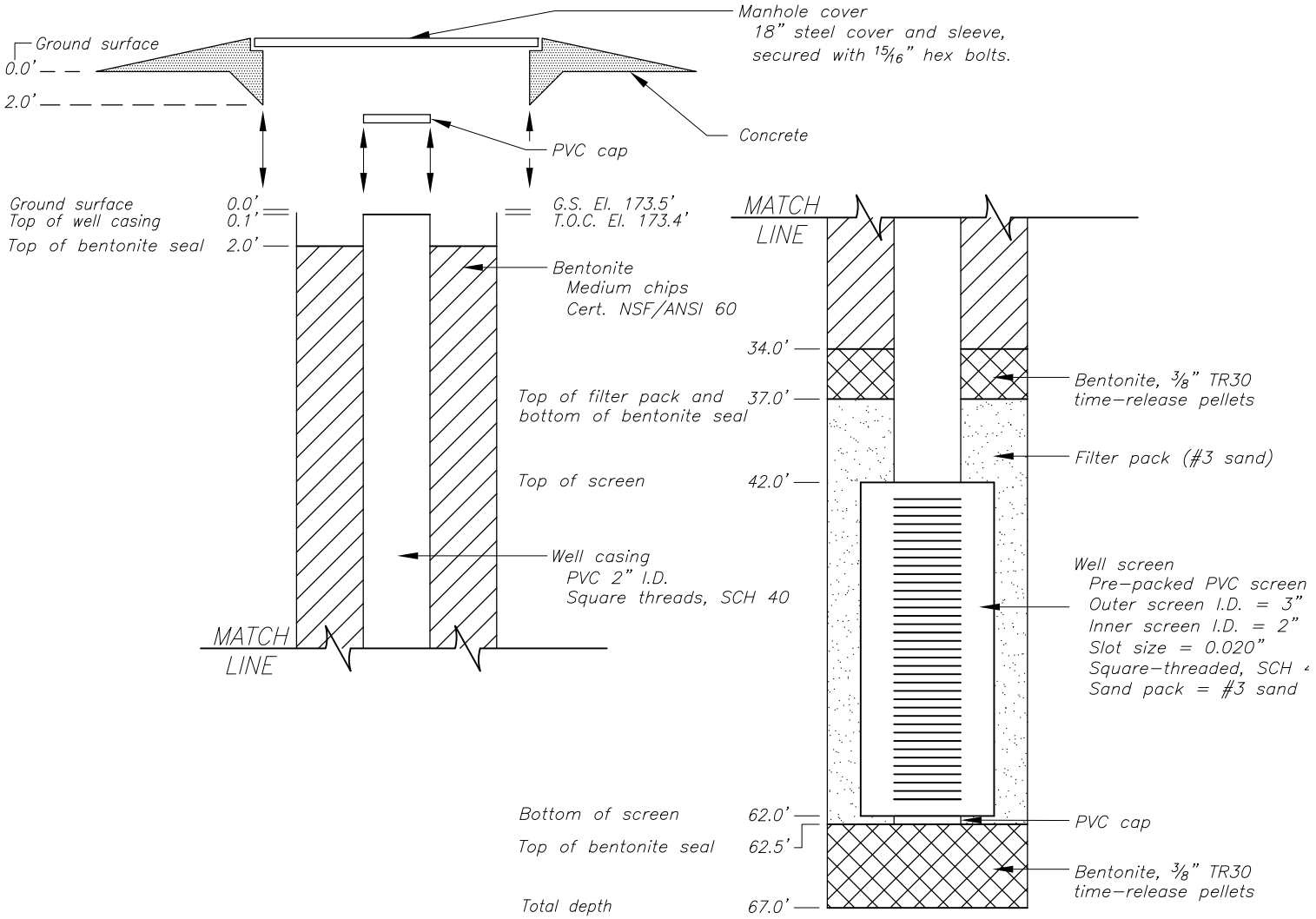
NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL	CLASSIFICATION AND PHYSICAL CONDITION
		NR										NR 111.4		**50.4 to 50.8 ft.: POORLY GRADED SAND, SP:** About 95% fine to medium sand; about 5% non-plastic fines; maximum size: medium sand; wet, light brown to off white, no reaction with HCl; soft consistency.
		100	47.8	16.8	64.6	35.4	0.0	27.1	8.5	25.0	s(CL)	s(CL)	Qal	**50.8 to 54.4 ft.: SILTY SAND, SM:** About 85% fine sand; about 15% non-plastic fines with rapid dilatancy; maximum size: fine sand; wet, light brown, no reaction with HCl; soft consistency.
	65													**54.4 to 55.0 ft.: SILT WITH SAND, (ML)s:** About 80% fines with low plasticity, toughness and dry strength, and rapid dilatancy; about 20% fine sand; maximum size: fine sand; moist, greenish-gray, no reaction with HCl; firm consistency.
		80									106.4	106.4		**55.0 to 57.0 ft.: SANDY SILT, s(ML):** About 70% non-plastic fines with rapid dilatancy; about 30% fine sand; maximum size: fine sand; moist, greenish-gray, no reaction with HCl; soft consistency.
														57.0 to 60.0 ft.: SANDY SILT, s(ML): About 55% non-plastic fines with rapid dilatancy; about 45% fine sand; maximum size: fine sand; moist, greenish-gray with tan sand bands 2mm in length, no reaction with HCl; soft consistency.
														Laboratory Data Interval 59.4 to 60.0 ft.
														60.0 to 62.0 ft.: No Recovery
														62.0 to 67.0 ft.: SANDY LEAN CLAY, s(CL): About 70% fines with low plasticity, toughness and dry strength, and rapid dilatancy; about 30% fine sand; maximum size: fine sand; moist, greenish-gray, strong reaction with HCl; firm consistency; streaked with calcium carbonate.
														Laboratory Data Interval 62.0 to 67.0 ft.
														T.D. = 67.0 ft.

BOTTOM OF HOLE

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram. Well development information is provided in attached Monitoring Well Development form.

MW-09-46	GEOLOGIST: J. VAUK
WELL COMPLETION DIAGRAM	DRILLER: J. HUCKABY
DATE COMPLETED: 8/17/2009	HELPER: K. COY
TOP OF WELL CASING COORDINATES: N2166236.8 E6192397.8 (NAD83) ELEVATION 173.4' (NAVD88) GROUND SURFACE ELEVATION 173.5' (NAVD88)	



*NOT TO SCALE

NOTES:
T.O.C. = Top of well casing, I.D. = Inner Diameter, G.S. = Ground Surface, El. = Elevation
Sand backfills the well above the top of bentonite seal, inside the manhole.

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-47

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Right, Madera County
BEGUN: 9/15/09 FINISHED: 9/17/09
DEPTH AND ELEVATION OF WATER LEVEL
AND DATE MEASURED: 27.4 ft. (El. 147.24 ft.) 9/17/2009

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,166,619.1 E 6,192,701.7 (NAGD83)
TOTAL DEPTH: 50.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 174.7 ft. (NAVD88)
T.O.C ELEVATION: 174.64 ft. (NAVD88)
HOLE LOGGED BY: G. Russell
REVIEWED BY: J. Vauk

ALL MEASUREMENTS ARE IN FEET FROM THE GROUND SURFACE.

PURPOSE OF HOLE:
To recover core, collect data to determine geologic and hydrologic site conditions, and install a groundwater monitoring well.

DRILLED BY:
USGS Drill Crew
James Huckaby, Driller
Kevin Coy, Helper

DRILL RIG:
CME-550

DRILLING & SAMPLING METHODS:
Drill hole MW-09-47 was advanced using hollow stem flight augers with continuous dry core sampling system (FADC) from the ground surface to a total depth of 50.0 feet. FADC uses 7-5/8-inch O.D., 4-1/4-inch I.D. hollow stem augers, with a 5-foot-long, 3-inch I.D. split sample barrel.

Interval Method
0.0 to 50.0 ft. - FADC

DRILLING CONDITIONS AND DRILLER'S COMMENTS:
0.0 to 22.0 ft. - smooth drilling
22.0 to 27.0 ft. - encountered gravel layer, rough drilling
27.0 to 42.0 ft. - difficult drilling heaving sands
42.0 ft. - ream hole with pilot-bit
42.0 to 50.0 ft. - smooth drilling.

DRILL FLUID, RETURN AND COLOR:
0.0 to 32.0 ft. - None
32.0 to 50.0 ft. - Water, no return

WATER LEVEL:
27.4 feet b.g.s. on 9/15/2009

REASON FOR HOLE TERMINATION:
The hole was terminated upon successful completion to the target depth.

HOLE COMPLETION:
Well Casing - 0.1 to 20.0 ft. (T.O.C. El. 174.64 ft.)
Dual Pre-pack Screen - 20.0 to 40.0 ft. (Slotted 0.020-inch)
Well Screen Filter Pack - #3 Sand Filter Pack - 17.0 to 41.5 ft. (#3 Sand)
Bottom Bentonite Seal - 41.5 to 50.0 ft.
Bentonite Seal - 2.0 to 17.0 ft.
Well Protection - flush-mounted 18-inch manhole (15/16-inch hexbolts)

DEPTH	% CORE RECOVERY	% SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL
	100										s(ML)	
		50.0	15.5	65.5	34.5	0.0	29.8	6.8	5.5	s(ML) 170.8	169.9	
5	86	15.2	0.7	15.9	83.8	0.3	NP	NP	2.0	SM 169.3	SM 167.6	
											SP/SM 164.8	
10	70										(SM)g 164.1	Qal
		6.5	0.0	6.5	93.5	0.0	NP	NP	0.5	SP-SM 162.4	SP/SM 161.1	
											(SP)g 160.5	
15	74										SP 158.6	
											(SM)g 157.7	
	76										SP 155.6	

0.0 to 50.0 feet
QUATERNARY ALLUVIUM (Qal)

0.0 to 4.7 ft.: SANDY SILT, s(ML): About 65% fines with low plasticity, toughness and dry strength, and rapid dilatancy; about 35% fine sand; maximum size: very fine sand; dry, brown, no reaction with HCl; firm to hard consistency; contains some organics (roots).

Laboratory Data Interval
3.5 to 3.8 ft.

4.7 to 7.0 ft.: SILTY SAND, SM About 65% fine sand; about 35% fines; maximum size: fine sand; dry, brown, no reaction with HCl; soft consistency; contains layers with a higher percentage of fines.

Laboratory Data Interval
5.0 to 5.3 ft.

7.0 to 9.8 ft.: POORLY GRADED SAND WITH SILT, SP/SM: About 90% fine to medium sand; about 10% fines; maximum size: medium sand; moist, orange-brown with darker lenses, no reaction with HCl; very soft consistency.

9.8 to 10.5 ft.: SILTY SAND WITH GRAVEL, (SM)g: About 55% fine sand; about 30% fine to coarse, very hard, sub-rounded, gravel; about 15% fines; maximum size: 2-inches; moist, brown, no reaction with HCl; very soft consistency.

10.5 to 13.5 ft.: POORLY GRADED SAND WITH SILT, SP/SM: About 90% fine to coarse sand (coarse sand is hard and sub-angular, grains consist of quartz, mica, various other minerals); about 10% fines; maximum size: coarse sand; moist, light brown-gray, no reaction with HCl; very soft consistency; minor iron-oxide staining.

Laboratory Data Interval
11.8 to 12.2 ft.

13.5 to 14.1 ft.: POORLY GRADED SAND WITH GRAVEL, (SP)g: About 75% fine to coarse sand (coarse sand is hard and sub-angular, with grains consisting of quartz, mica, various other minerals); about 20% fine to coarse, hard, sub-rounded gravel; about 5% fines; maximum size: 1 inch; moist, light brown-gray, no reaction with HCl; very soft consistency.

14.1 to 16.0 ft.: POORLY GRADED SAND, SP: About 95% fine to coarse sand; about 5% fines; trace of fine, hard, sub-rounded gravel; maximum size: 1/2 inches; moist, light gray, no reaction with HCl; very soft consistency; minor iron-oxide staining.

16.0 to 16.9 ft.: SILTY SAND WITH GRAVEL, (SM)g: About 70% fine to coarse sand with grains consisting of quartz, mica, and various other minerals; about 15% fine to coarse, hard, sub-rounded gravel; about 15% fines; maximum size: 1 inch; moist, gray-brown, no reaction with HCl; very soft consistency.

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram. Well development information is provided in attached Monitoring Well Development form.

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-47

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Right, Madera County
BEGUN: 9/15/09 FINISHED: 9/17/09
DEPTH AND ELEVATION OF WATER LEVEL
AND DATE MEASURED: 27.4 ft. (El. 147.24 ft.) 9/17/2009

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,166,619.1 E 6,192,701.7 (NAGD83)
TOTAL DEPTH: 50.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 174.7 ft. (NAVD88)
T.O.C ELEVATION: 174.64 ft. (NAVD88)
HOLE LOGGED BY: G. Russell
REVIEWED BY: J. Vauk

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL	CLASSIFICATION AND PHYSICAL CONDITION
												(SP/SM)g 153.6		**16.9 to 19.0 ft.: POORLY GRADED SAND, SP:** About 95% fine to coarse sand (coarse sand is hard and sub-angular, with grains consisting of quartz, mica, and various other minerals); about 5% fines; maximum size: coarse sand; moist, gray-brown, no reaction with HCl; very soft consistency.
			4.6	0.0	4.6	90.2	5.2	NP	NP	6.4	SP 152.2			**19.0 to 21.0 ft.: POORLY GRADED SAND WITH SILT AND GRAVEL, (SP/SM)g:** About 60% fine to coarse sand; about 30% fine to coarse, hard, sub-rounded gravel; about 10% fines; maximum size: 2 inches; moist, light gray-brown, no reaction with HCl; very soft consistency.
												SP/SM		
	25	40												**21.0 to 25.5 ft.: POORLY GRADED SAND WITH SILT, (SP/SM):** About 85% fine to coarse sand; about 10% fines; about 5% fine, hard, sub-rounded gravel; maximum size: 1/2 inches; moist, orange-brown, no reaction with HCl; very soft consistency; minor iron-oxide staining.
												149.1		
												(GP/GM)s 148.6		
			6.4	1.9	8.3	48.8	42.9	NP	NP	5.8	(SP-SM)g 148.3			Laboratory Data Interval 22.0 to 22.4 ft.
											▼ 27.4 ft. (El. 147.24 ft.)			**25.5 to 26.0 ft.: POORLY GRADED GRAVEL WITH SILT AND SAND, (GP/GM)s:** About 55% fine to coarse, hard, sub-rounded gravel; about 35% fine to coarse sand; about 10% fines; maximum size: 2 inches; wet, brown, no reaction with HCl; very soft consistency.
												(SP/SM)g 144.8		
	30	56											Qal	**26.0 to 29.8 ft.: POORLY GRADED SAND WITH SILT AND GRAVEL, (SP/SM)g:** About 50 to 60% fine to coarse sand; about 30 to 40% fine to coarse, hard, sub-rounded gravel; about 10% fines; maximum size: 2 inches; moist, light gray-brown, no reaction with HCl; very soft consistency; increases in percentage of sand with depth.
												SP/SM 142.6		Laboratory Data Interval 26.0 to 26.3 ft.
			3.9	0.0	3.9	96.1	0.0	NP	NP	13.7	SP 142.3			**29.8 to 32.0 ft.: POORLY GRADED SAND WITH SILT, (SP/SM):** About 85% fine to medium sand; about 10% fines; about 5% fine, hard, sub-rounded gravel; maximum size: 1/2 inches; moist, orange-brown, no reaction with HCl; very soft consistency.
														32.0 to 38.0 ft.: POORLY GRADED SAND, SP: About 95% fine to medium sand; about 5% fines; maximum size: medium sand; moist, orange-brown, no reaction with HCl; very soft consistency.
	35	32										SP		Laboratory Data Interval 32.0 to 32.3 ft.
												136.6		**38.0 to 41.0 ft.: SILTY SAND, SM:** About 85% fine sand; about 15% fines; maximum size: fine sand; wet, brown-gray, no reaction with HCl; very soft consistency.
		40										SM		

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram. Well development information is provided in attached Monitoring Well Development form.

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-47

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Right, Madera County
BEGUN: 9/15/09 FINISHED: 9/17/09
DEPTH AND ELEVATION OF WATER LEVEL
AND DATE MEASURED: 27.4 ft. (El. 147.24 ft.) 9/17/2009

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,166,619.1 E 6,192,701.7 (NAGD83)
TOTAL DEPTH: 50.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 174.7 ft. (NAVD88)
T.O.C ELEVATION: 174.64 ft. (NAVD88)
HOLE LOGGED BY: G. Russell
REVIEWED BY: J. Vauk

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION	ELEVATION	VISUAL CLASSIFICATION	ELEVATION	GEOLOGIC UNIT SYMBOL	CLASSIFICATION AND PHYSICAL CONDITION
		60												133.6		
			43.6	18.9	62.5	37.5	0.0	23.5	6.7	10.8	s(CL-ML)	132.7	s(CL)	132.6		
													NR			
	45	0												129.6	Qal	
		60											(ML)s			
			64.8	9.8	74.6	25.4	0.0	NP	NP	25.6	(ML)s	126.4		126.3		
			28.4	3.3	31.7	68.3	0.0	NP	NP	23.4	SM	125.4	SM			
	50													124.6		

BOTTOM OF HOLE

41.0 to 42.0 ft.: <u>SANDY LEAN CLAY, s(CL)</u>: About 65% fines with medium plasticity, low to medium toughness, medium to high dry strength, and slow dilatancy; about 35% fine sand; maximum size: fine sand; wet, blue-gray, no reaction with HCl; firm consistency; unable to determine exact depth of the bottom of this soil because no sample was obtained from 42.0 to 45.0 ft.

<u>Laboratory Data Interval</u>
41.7 to 41.9 ft.

42.0 to 45.0 ft.: <u>No Recovery</u>

45.0 to 48.3 ft.: <u>SILT WITH SAND, (ML)s</u>: About 75% fines with low plasticity and toughness, no to low dry strength, and rapid dilatancy; about 25% fine sand; maximum size: fine sand; wet, dark gray, no reaction with HCl; soft consistency.

<u>Laboratory Data Interval</u>
48.0 to 48.2 ft.

48.3 to 50.0 ft.: <u>SILTY SAND, SM</u>: About 60% fine sand; about 40% fines; maximum size: fine sand; wet, brown with dark gray streaks, no reaction with HCl; soft consistency.

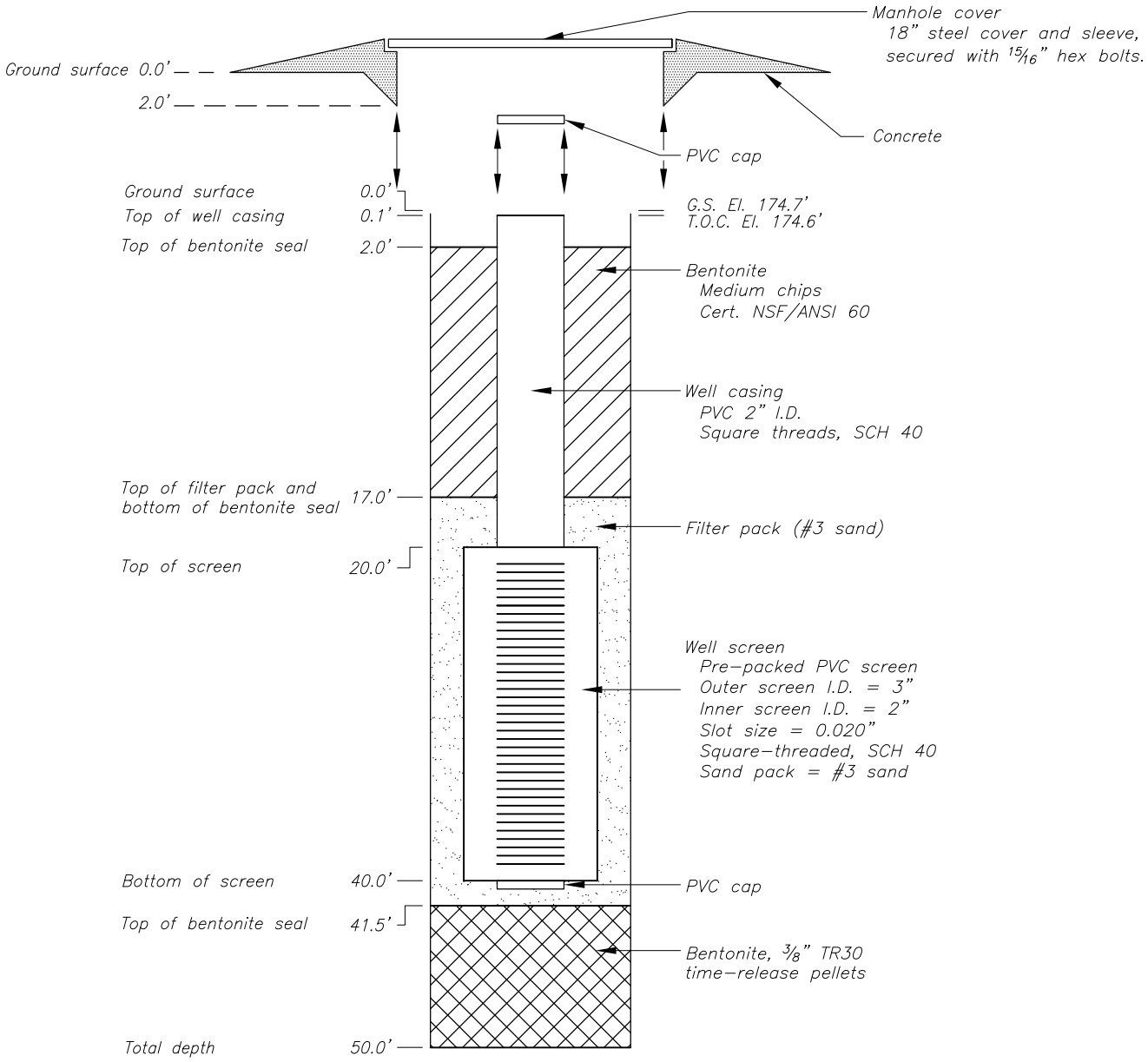
<u>Laboratory Data Interval</u>
49.0 to 49.2 ft.

T.D. = 50.0 ft.

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram. Well development information is provided in attached Monitoring Well Development form.

MW–09–47	GEOLOGIST: G. RUSSELL
WELL COMPLETION DIAGRAM	DRILLER: J. HUCKABY
DATE COMPLETED: 9/17/2009	HELPER: J. RAUMAN
TOP OF WELL CASING COORDINATES: N2166619.1 E6192701.7 (NAD83) ELEVATION 174.6' (NAVD88) GROUND SURFACE ELEVATION 174.7' (NAVD88)	



*NOT TO SCALE

NOTES:
T.O.C. = Top of well casing, I.D. = Inner Diameter, G.S. = Ground Surface, El. = Elevation
Sand backfills the well above the top of bentonite seal, inside the manhole.

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-49

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Left, Fresno County
BEGUN: 8/3/09 FINISHED: 8/4/09
DEPTH AND ELEVATION OF WATER LEVEL AND DATE MEASURED: NA

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,166,341.5 E 6,189,657.4 (NAGD83)
TOTAL DEPTH: 65.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 171.0 ft. (NAVD88)
T.O.C ELEVATION: 170.83 ft. (NAVD88)
HOLE LOGGED BY: J. Vauk
REVIEWED BY: A. Warren

ALL MEASUREMENTS ARE IN FEET FROM THE GROUND SURFACE.

PURPOSE OF HOLE:
To recover core, collect data to determine geologic and hydrologic site conditions, and install a groundwater monitoring well.

DRILLED BY:
USGS Drill Crew
James Huckaby, Driller
Jim Rauman, Helper

DRILL RIG:
CME-550

DRILLING & SAMPLING METHODS:
Drill hole MW-09-49 was advanced using hollow stem flight augers with continuous dry core sampling system (FADC) from the ground surface to a total depth of 65.0 feet. FADC uses 7-5/8-inch O.D., 4-1/4-inch I.D. hollow stem augers, with a 5-foot-long, 3-inch I.D. and a split sample barrel sampler.

Interval Method
0.0 to 65.0 ft. - FADC

Drill hole DH-09-49B was advanced using hollow stem flight augers (FADC) and a pilot bit from the ground surface to a total depth of 22.0 feet. FADC uses 7-5/8-inch O.D., 4-1/4-inch I.D. hollow stem augers and a tri-cone pilot bit.

Interval Method
0.0 to 22.0 ft. - FADC with pilot bit

DRILLING CONDITIONS AND DRILLER'S COMMENTS:
MW-09-49
0.0 to 30.0 ft. - smooth drilling
30.0 to 35.0 ft. - flowing sands, add water
35.0 to 40.0 ft. - poor recovery
40.0 to 60.0 ft. - flowing sands, difficult drilling
60.0 to 65.0 ft. - encountered clay, firm drilling

DRILLING CONDITIONS AND DRILLER'S COMMENTS:
MW-09-49B
0.0 to 22.0 ft. - blind drilled

DRILL FLUID, RETURN AND COLOR:
MW-09-49
0.0 to 30.0 ft. - None
30.0 to 65.0 ft. - Water, no return

MW-09-49B
0.0 to 22.0 ft. - None

WATER LEVEL:
Not measured

REASON FOR HOLE TERMINATION:
The drill holes were terminated upon successful completion to the target depth.

DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL
	86										s(ML) 166.8	
5											SM 165.3	
	72										SP/SM 159.8	
		3.5	2.2	5.7	94.2	0.1	NP	NP	2.6	SP-SM 161.3		
10												
	60										SP/SM 156.3	Qal
15												
	80										SP/SM 149.6	
		2.9	2.2	5.1	94.6	0.3	NP	NP	2.1	SP-SM 151.8		
20												
	94										(ML)s	
		79.6	11.6	91.2	8.8	0.0	NP	NP	25.2	ML 147.4		

SOIL DESCRIPTIONS CHARACTERIZE SAMPLES FROM DRILL HOLE MW-09-49.

0.0 to 65.0 feet
QUATERNARY ALLUVIUM (Qal)

0.0 to 4.0 ft.: SANDY SILT, s(ML): About 70% fines with no to low plasticity, low toughness and dry strength, and slow to rapid dilatancy; about 30% fine sand; maximum size: fine sand; dry, brown, no reaction with HCl; soft to firm consistency; lower 1-foot of interval increasing in sand content (to about 50%).

4.0 to 5.5 ft.: SILTY SAND, SM: About 65% fine sand; about 35% fines; maximum size: fine sand; dry, brown, no reaction with HCl; very soft consistency.

5.5 to 11.0 ft.: POORLY GRADED SAND WITH SILT, SP/SM: About 90% fine to medium sand; about 10% fines; maximum size: medium sand; dry, light brown-gray, no reaction with HCl; very soft consistency.

Laboratory Data Interval
9.0 to 9.5 ft.

11.0 to 14.5 ft.: POORLY GRADED SAND WITH SILT, SP/SM: About 85% fine to coarse sand (coarse sand is hard and sub-angular, with grains consisting of quartz, mica, and various other minerals); about 10% fines; about 5% fine, hard, sub-rounded, hard gravel; maximum size: 3/4 inches; moist, light gray, no reaction with HCl; very soft consistency.

14.5 to 21.2 ft.: POORLY GRADED SAND WITH SILT, SP/SM: About 90% fine to medium sand; about 10% fines; maximum size: medium sand; moist, light gray with darker streaks in lower 2.5 feet, no reaction with HCl; very soft consistency; sampling procedure may consolidate the sand in the sample barrel and result in less-than-full recovery.

Laboratory Data Interval
18.5 to 19.0 ft.

21.2 to 28.0 ft.: SILT WITH SAND, (ML)s: About 85% fines with low to no plasticity, low toughness, no to low dry strength, and rapid dilatancy; about 15% fine sand; maximum size: fine sand; moist, greenish gray, no reaction with HCl; firm consistency.

Laboratory Data Interval
23.1 to 23.4 ft.

28.0 to 29.0 ft.: SILTY SAND, SM: About 65% fine sand with abundant mica; about 35% fines; maximum size: fine sand; moist to wet, greenish gray, no reaction with HCl; very soft consistency.

29.0 to 31.7.: SILTY SAND, SM: About 85% fine to medium sand; about 15% fines; maximum size: medium sand; wet, greenish brown, no reaction with HCl; very soft consistency; layer of higher fines content from 29.5 to 29.7 ft. depth.

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram.
Well development information is provided in attached Monitoring Well Development form.

MW-09-49B
TOC Coordinates= N 2166345.1 E 6189660.9 (NAGD83) El. 170.85 (NAVD88)
Groundsurface El.= 170.9 (NAVD88)

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-49

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Left, Fresno County
BEGUN: 8/3/09 FINISHED: 8/4/09
DEPTH AND ELEVATION OF WATER LEVEL AND DATE MEASURED: NA

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,166,341.5 E 6,189,657.4 (NAGD83)
TOTAL DEPTH: 65.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 171.0 ft. (NAVD88)
T.O.C ELEVATION: 170.83 ft. (NAVD88)
HOLE LOGGED BY: J. Vauk
REVIEWED BY: A. Warren

HOLE COMPLETION:

MW-09-49
Well Casing - 0.2 to 50.0 ft. (T.O.C. El. 170.83 ft.)
Dual Pre-pack Screen - 50.0 to 60.0 ft. (Slotted 0.020-inch)
Well Screen Filter Pack - #3 Sand Filter Pack - 49.0 to 65.0 ft. (#3 Sand)
Bentonite Seal - 36.0 to 43.0 ft.
Backfill - 33.0 to 36.0 ft. and 43.0 to 49.0 ft. (Native material caved)
Backfill - 2.0 to 33.0 ft. (Bentonite)
Well Protection - flush-mounted 18-inch manhole (15/16-inch hexbolts)

MW-09-49B
Well Casing - 0.1 to 10.0 ft. (T.O.C. El. 170.85 ft.)
Dual Pre-pack Screen - 10.0 to 20.0 ft. (Slotted 0.020-inch)
Well Screen Filter Pack - #3 Sand Filter Pack - 7.5 to 22.0 ft. (#3 Sand)
Bentonite Seal - 2.0 to 7.5 ft.
Well Protection - flush-mounted 18-inch manhole (15/16-inch hexbolts)

DEPTH	% CORE RECOVERY	% SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL
30	98										142.8	Qal
											SM 141.8	
											SM 139.1	
											SM 138.0	
	80										s(ML) 137.2	
35											SM 130.8	
	20											
40		5.8	2.2	8.0	92.0	0.0	NP	NP	13.9	SP-SM 130.2		
											SP/SM 128.0	
	66										SM 126.8	
											s(ML) 125.8	
45											SM 123.3	
	80										SM 122.1	
											s(CL/ML) 121.3	
		60.5	31.3	91.8	8.2	0.0	22.6	5.7	17.5	CL-ML 120.9	CL/ML 120.8	

31.7 to 32.8 ft.: SILTY SAND, SM: About 60% fine sand; about 40% fines; maximum size: fine sand; wet, greenish gray, no reaction with HCl; very soft consistency.

32.8 to 33.6 ft.: SANDY SILT, s(ML): About 60% fines with no to low plasticity, low toughness and dry strength, rapid dilatancy; about 40% fine sand; maximum size: fine sand; wet, greenish brown, no reaction with HCl; soft consistency.

33.6 to 40.0 ft.: SILTY SAND, SM: About 60% fine sand; about 40% fines; maximum size: fine sand; wet, greenish gray, no reaction with HCl; very soft consistency.

40.0 to 42.8 ft.: POORLY GRADED SAND WITH SILT, SP/SM: About 90% fine sand; about 10% fines; maximum size: fine sand; wet, greenish gray, no reaction with HCl; very soft consistency.

Laboratory Data Interval
40.3 to 40.6 ft.

42.8 to 44.0 ft.: SILTY SAND, SM: About 55% fine sand; about 45% fines; maximum size: fine sand; wet, greenish gray, no reaction with HCl; very soft consistency.

44.0 to 45.0 ft.: SANDY SILT, s(ML): About 65% fines with no to low plasticity fines, low toughness and dry strength, and rapid dilatancy; about 35% fine sand; maximum size: fine sand; wet, greenish gray, no reaction with HCl; firm consistency.

45.0 to 47.5 ft.: SILTY SAND, SM: About 85% fine sand containing mica; about 15% fines; maximum size: fine sand; wet, greenish gray, no reaction with HCl; very soft consistency.

47.5 to 48.7 ft.: SILTY SAND, SM: About 70% fine to coarse sand (predominately fine to medium)(coarse sand is sub-angular); about 30% fines; maximum size: coarse sand; wet, greenish gray, no reaction with HCl; soft to firm consistency.

48.7 to 49.5 ft.: SANDY, SILTY CLAY, s(CL/ML): About 70% fines with low to medium plasticity, medium toughness and low dry strength, and no dilatancy; about 30% fine sand; maximum size: fine sand; moist, dark gray, no reaction with HCl; firm to hard consistency.

49.5 to 50.0 ft.: SILTY CLAY, CL/ML: About 90% fines with low to medium plasticity, medium toughness and low dry strength, and no dilatancy; about 10% fine sand; maximum size: fine sand; moist, dark gray, no reaction with HCl; firm to hard consistency.

Laboratory Data Interval
49.6 to 49.9 ft.

50.0 to 55.0 ft.: SILTY SAND, SM: About 75% fine sand; about 25% fines; maximum size: fine sand; wet, dark gray, no reaction with HCl; very soft consistency.

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram.
Well development information is provided in attached Monitoring Well Development form.

MW-09-49B
TOC Coordinates= N 2166345.1 E 6189660.9 (NAGD83) El. 170.85 (NAVD88)
Groundsurface El.= 170.9 (NAVD88)

GEOLOGIC LOG OF DRILL HOLE NO. MW-09-49

FEATURE: Groundwater Monitoring
LOCATION: Reach 2A, River Bank Left, Fresno County
BEGUN: 8/3/09 FINISHED: 8/4/09
DEPTH AND ELEVATION OF WATER LEVEL AND DATE MEASURED: NA

PROJECT: San Joaquin River Restoration Project
COORDINATES: N 2,166,341.5 E 6,189,657.4 (NAGD83)
TOTAL DEPTH: 65.0 ft.

STATE: California
GROUND SURFACE ELEVATION: 171.0 ft. (NAVD88)
T.O.C ELEVATION: 170.83 ft. (NAVD88)
HOLE LOGGED BY: J. Vauk
REVIEWED BY: A. Warren

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION / ELEVATION	VISUAL CLASSIFICATION / ELEVATION	GEOLOGIC UNIT SYMBOL	CLASSIFICATION AND PHYSICAL CONDITION
	55	30										SM 115.8		**55.0 to 59.3 ft.: POORLY GRADED SAND WITH SILT, SP/SM:** About 90% fine sand; about 10% fines; maximum size: fine sand; wet, dark gray, no reaction with HCl; very soft consistency. Laboratory Data Interval 55.5 to 55.9 ft. **59.3 to 65.0 ft.: SANDY LEAN CLAY, s(CL):** About 65% fines low to medium plasticity, medium toughness and low to medium dry strength, and no dilatancy; about 35% fine to medium sand; maximum size: medium sand; moist, dark bluish gray, no reaction with HCl; hard consistency. Laboratory Data Interval 63.7 to 64.0 ft. ***T.D. = 65.0 ft.***
			3.9	3.0	6.9	93.1	0.0	NP	NP	19.1	SP-SM 114.9			
		50										SP/SM 111.5	Qal	
	60													
		100										s(CL) 105.8		
			42.9	15.4	58.3	41.7	0.0	NP	NP	19.1	s(ML) 106.8			
	65													

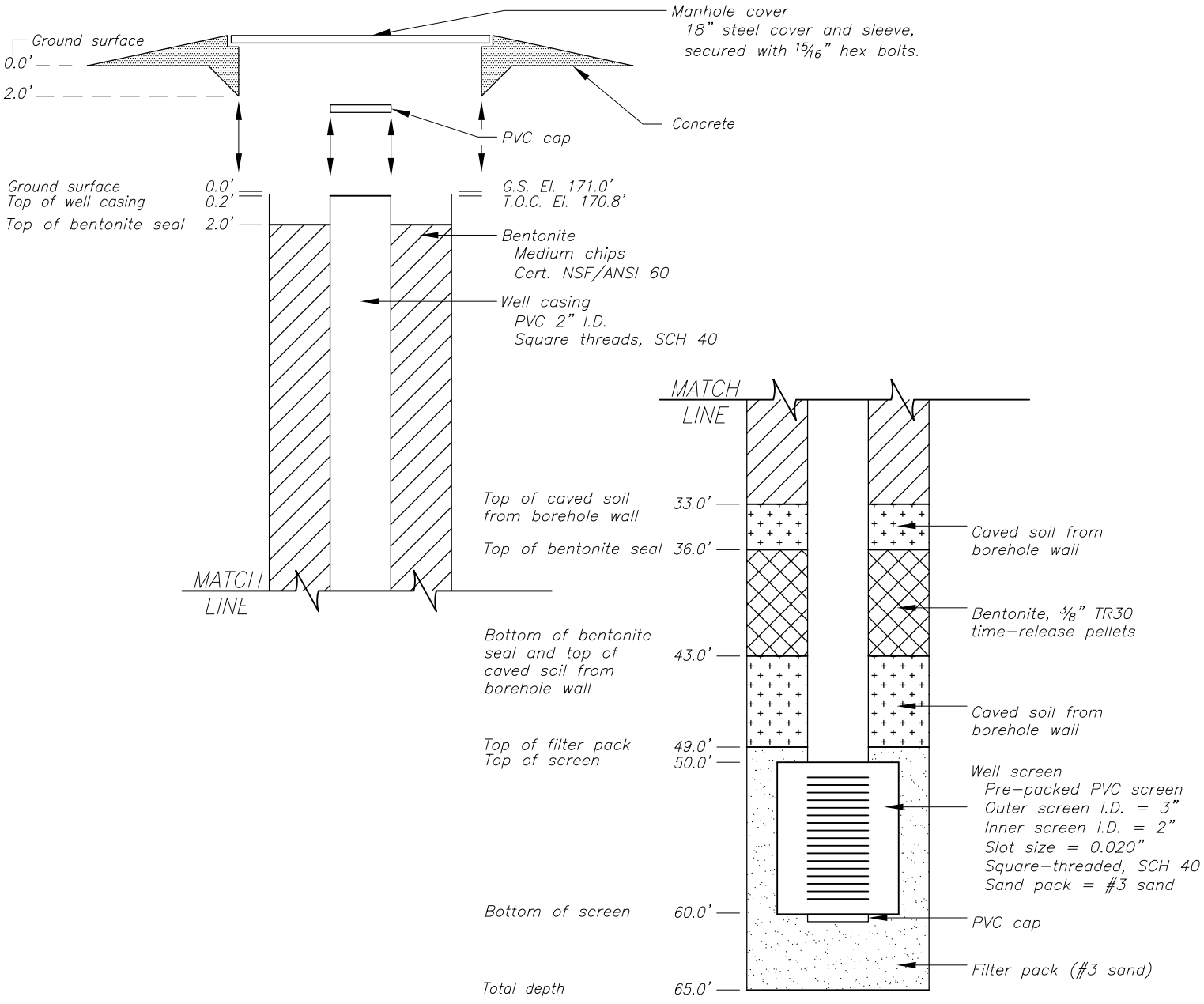
BOTTOM OF HOLE

COMMENTS:
FADC = Flight Auger Dry Core
HSA = Hollow Stem Auger
NP = Non-plastic
NR = No Recovery
NA = Not applicable
G.S. = Ground surface
b.g.s. = Below the ground surface
T.O.C. = Top of well casing

Well completion information is provided in attached Well Completion Diagram.
Well development information is provided in attached Monitoring Well Development form.

MW-09-49B
TOC Coordinates= N 2166345.1 E 6189660.9 (NAGD83) El. 170.85 (NAVD88)
Groundsurface El.= 170.9 (NAVD88)

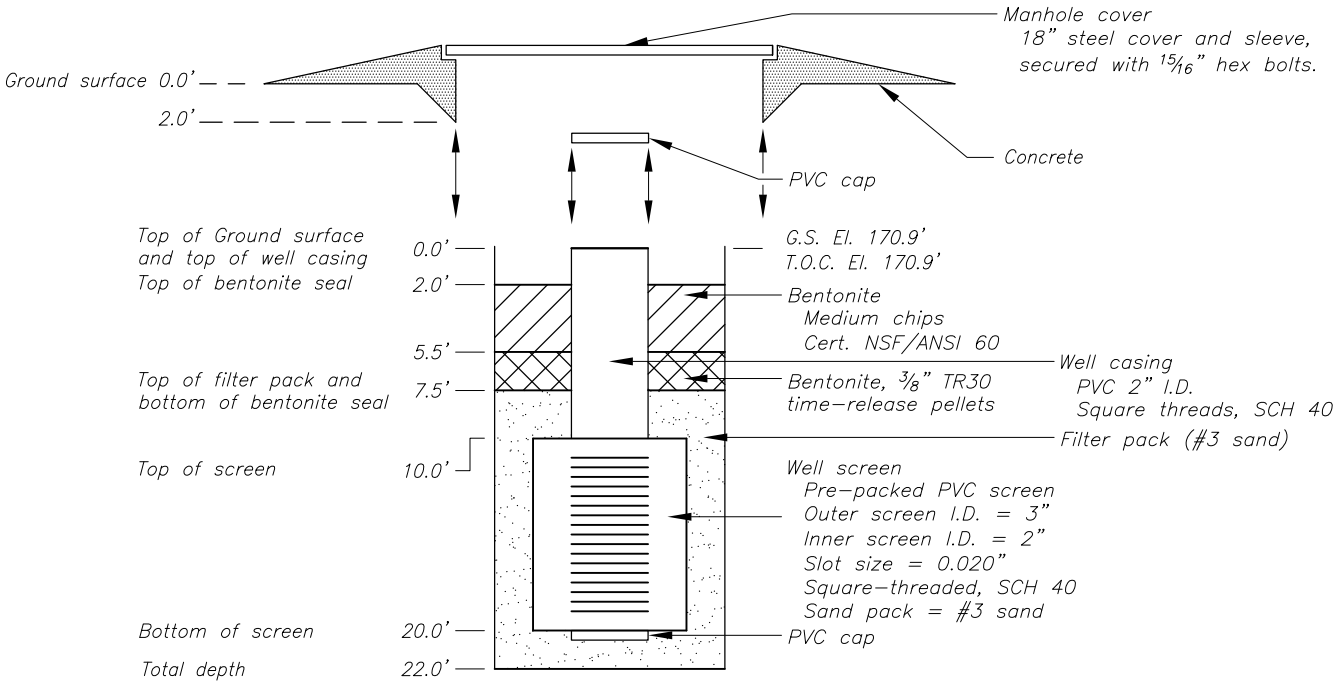
MW–09–49	GEOLOGIST: J. VAUK
WELL COMPLETION DIAGRAM	DRILLER: J. HUCKABY
DATE COMPLETED: 8/4/2009	HELPER: J. RAUMAN
TOP OF WELL CASING COORDINATES: N2166341.5 E6189657.4 (NAD83) ELEVATION 170.8' (NAVD88) GROUND SURFACE ELEVATION 171.0' (NAVD88)	



*NOT TO SCALE

NOTES:
T.O.C. = Top of well casing, I.D. = Inner Diameter, G.S. = Ground Surface, El. = Elevation
Sand backfills the well above the top of bentonite seal, inside the manhole.

MW–09–49B	GEOLOGIST: J. VAUK
WELL COMPLETION DIAGRAM	DRILLER: J. HUCKABY
DATE COMPLETED: 8/5/2009	HELPER: J. RAUMAN
TOP OF WELL CASING COORDINATES: N2166345.1 E6189660.9 (NAD83) ELEVATION 170.9' (NAVD88) GROUND SURFACE ELEVATION 170.9' (NAVD88)	



*NOT TO SCALE

NOTES:
T.O.C. = Top of well casing, I.D. = Inner Diameter, G.S. = Ground Surface, El. = Elevation
Sand backfills the well above the top of bentonite seal, inside the manhole.