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ARIMETCO INC.

MONITOR WELL DESIGN

NAME: _____

PROJECT: _____

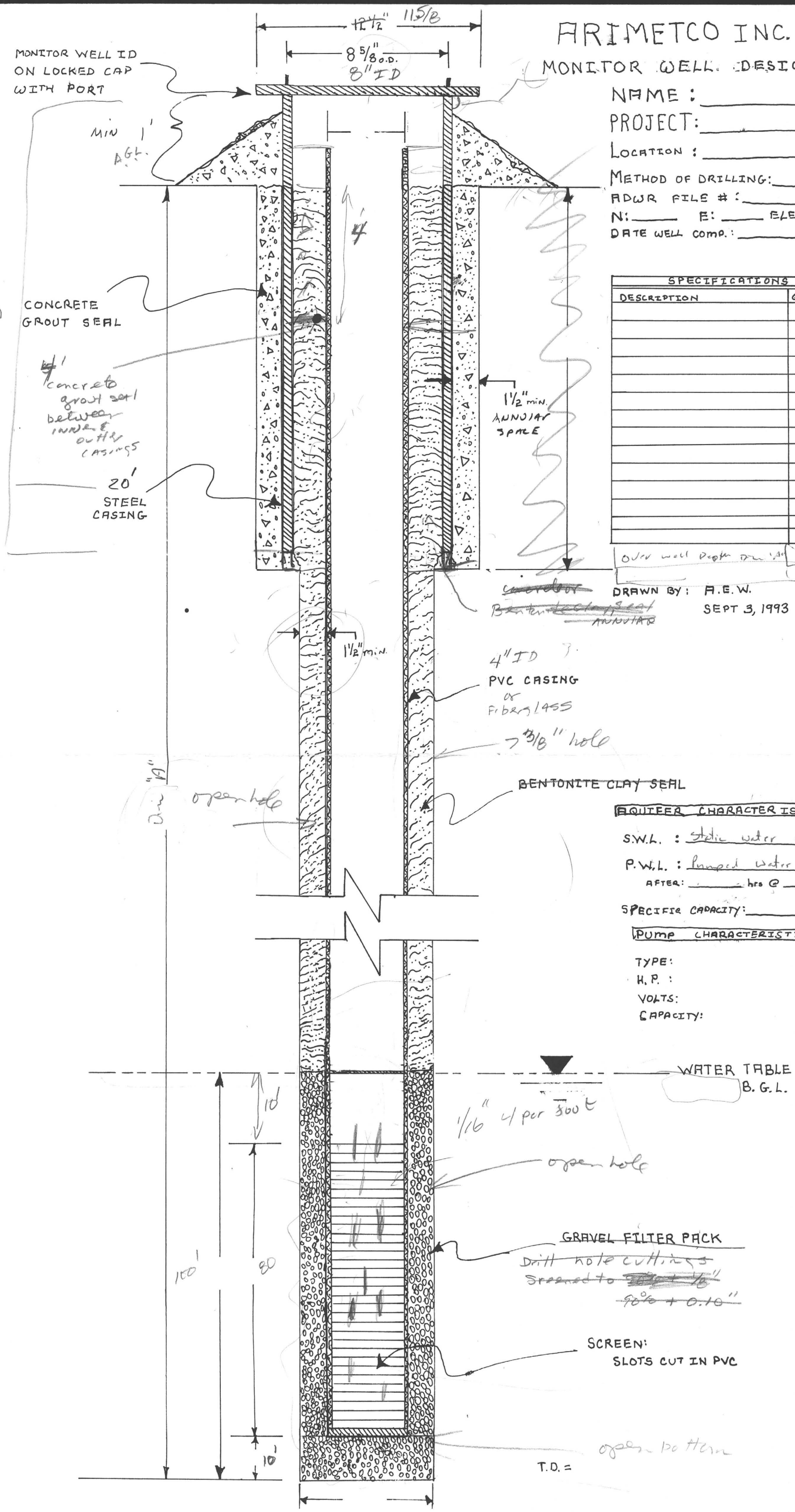
LOCATION: _____

METHOD OF DRILLING: _____

ADWR FILE #: _____

N: _____ E: _____ ELEV: _____

DATE WELL COMP.: _____



SPECIFICATIONS	
DESCRIPTION	QUANTITY
over well depth dia "A"	

DRAWN BY: A.E.W.

SEPT 3, 1993

AQUIFER CHARACTERISTICS

S.W.L.: static water level

P.W.L.: Pumped water level

AFTER: _____ hrs @ _____

SPECIFIC CAPACITY: _____

PUMP CHARACTERISTICS

TYPE:

H.P.:

VOLTS:

CAPACITY:

R12-15-812. SPECIAL AQUIFER CONDITIONS

A. ARTESIAN WELLS

1. WELL CASING - EXTEND INTO OVERLYING CONFINING FORMATION.

   - grout 10' INTO FORMATION AND TO THE LAND SURFACE.

2. LEAKS ADJACENT TO WELL/AROUND WELL

   - within 30 DAYS WELL SHALL BE SEALED, PACKED, OR CASED AND grouted TO ELIMINATE LEAK.
   -or-
   - ABANDONED

3. WELL FLOWS @ LAND SURFACE

   - WELL SHALL BE EQUIPPED with A CONTROL VALVE. OR OTHER MEANS OF CONTROLLING FLOW.

B. MINERALIZED / POLLUTED WATER

BOREHOLE SHALL BE CASED AND grouted SO THAT CONTAMINATION OF THE OVERLYING OR UNDERLYING groundwater ZONES WILL NOT OCCUR:

R12-15-811. MINIMUM WELL CONSTRUCTION REQUIREMENTS

A. WELL CASING

- SUFFICIENT STRENGTH / WALL THICKNESS TO HOLD HOLE OPEN
- STEEL OR THERMOPLASTIC CASING
- EXTEND 1' ABOVE GROUND LEVEL
- JOINTS/OVERLAPS SHALL BE WATER TIGHT.
- ALL OPENINGS IN CASING ABOVE WATER LEVEL SHALL BE PLUGGED.

* - THERMOPLASTIC CASING USED ONLY IN
  - OVERSIZED DRILLHOLE W/O DRIVING.
  - ASTM F480-89 (1989)

- RIVETS OR SCREW SHALL NOT PENETRATE INSIDE CASING.

* - STEEL CASING
  - NEW / LIKE NEW CONDITION
  - ASTM A 53-89a (1989)
    A 139-89b (1989)
    A312/A312M-89 a (1989)

B. SURFACE SEAL

- ALL WELLS SHALL HAVE SEALS.
- STEEL CASING 1' ABOVE SURFACE
  CEMENT GROUT FROM BOTTOM ZONE TO LAND SURFACE
  minimum length 20'
  minimum ANNULAR SPACE 1 1/2"
- CURING ADDITIVES

CALCIUM CHLORIDE	≤ 10%	TOTAL VOLUME GROUT
BENTONITE	≤ 5%	" " "

- minimum SURFACE SEAL length = 20'
- ANNULAR SPACE shall BE completely SEALED.

R12-15-811 Minimum WELL CONSTRUCTION REQUIREMENTS (CONT)

C. ACCESS PORT

casing 4" Φ or greater shall have access port.

port min Φ = 1/2"

. . .

H. MONITOR WELLS

1. SCREENED 10' ABOVE highest SEASONAL STATIC WATER level

2. A monitor well shall BE IDENTIFIED ON THE VAULT COVER or TOP OF STEEL CASING

~ indd - well registration number

R12-15-822. CAPPING OF OPEN WELLS

A. INSTALL A CAP OF ABANDON the WELL.

- File NOTICE OF CAPPING within 5 DAYS

B. NO CASING / OF INSUFFICIENT INTEGRITY

- INSTALL A SURFACE SEAL

C. TAMPER-RESISTANT BY WELDING the CAP TO THE TOP.

IMPORTANT HYDROGEOLOGIC INFORMATION:

1) Stratigraphic information concerning the aquifer and overlying sediments.

2) Transmissivity and storage coefficient values for the aquifer.

3) Current and long-term water balance conditions in the aquifer.

4) Grain-size analysis of unconsolidated aquifer materials and identification of rock or mineral types.

5) Water quality.

National® Brand 42-381 50 SHEETS EYE-EASE® 5 SQUARE 42-382 100 SHEETS EYE-EASE® 5 SQUARE 42-389 200 SHEETS EYE-EASE® 5 SQUARE 42-392 100 RECYCLED WHITE 5 SQUARE 42-399 200 RECYCLED WHITE 5 SQUARE Made in U.S.A.

MONITOR WELL CONSTRUCTION:

minimum SCREEN & CASING DIAMETER = 4"

SCREEN CRITERIA:

- INERT MATERIAL
- maximize OPEN AREA
- SLOT SIZE CONSISTENT with FORMATION PARTICLE SIZE
- ALLOW EFFECTIVE DEVELOPMENT

FACTORS FOR SELECTION

1) CONTAMINANTS TO BE sampled
2) chemical REACTIVENESS/ INERTNESS
3) STRENGTH OF MATERIAL
4) EASE OF INSTALLATION.
5) COST OF MATERIAL

INFORM ANALYTICAL LABORATORY OF MATERIAL USED.

- PLACE SCREENS IN MATERIAL HAVING EXTREMELY LOW hydraulic conductivity.

SCREEN SHOULD approximate NATURAL porosity.

- SLOT OPENINGS ARE DEVELOPED UNIFORMLY AROUND CIRCUMFERENCE.

- OPENINGS WIDEN INWARD.

- SCREENS USED FOR collecting WATER SAMPLES ARE TYPICALLY 2-5' in Length. ~~should~~ BECAUSE SAMPLES should come FROM SPECIFIC Depths.

- SCREENS @ SURFACE OF WATER TABLE ARE ABOUT 10-20' in Length AND ALWAYS EXTEND ABOVE W.T.

FILTER PACK DESIGN

- THE grain size DISTRIBUTION CURVE for the Filter pack is selected by multiplying the 70-% retained size of the FINEST formation sample by 3 or 4.

- UNIformity coefficients for filter packs material should range from 1 to 3.

- Pack should be washed prior to USE

  - Sample pack material for contaminants.

INSTALLATION

- All screens and casings used for monitor wells should be in a sterile and contaminant free condition.

Joining screens to casing.

- No solvent welds

- All plastic screens and casing should be joined by threads, couplings, or flush threads.

- make joins watertight by TEFLON TAPE or O-Ring s.

- PLACE BENTONITE or cement grout in the borehole above the filter pack.

- Drill cuttings should not be placed in any open borehole annulus.

- Filter pack extends 2-10' above top of screen. except not into an overlying formation.

- Cement seal shaped so surface water flows away from the casing.

- THE PRESENCE OF bentonite AFFECTS THE chemical ANALYSIS OF samples FOR AT LEAST 90 DAYS AFTER completion OF THE well

- Drilling ADDitives for 1 TO 2 years.

National® Brand
42-381 50 SHEETS EYE-EASE® 5 SQUARE
42-382 100 SHEETS EYE-EASE® 5 SQUARE
42-389 200 SHEETS EYE-EASE® 5 SQUARE
42-392 100 RECYCLED WHITE 5 SQUARE
42-399 200 RECYCLED WHITE 5 SQUARE
Made in U.S.A.

ARIMETCO INC.

MONITOR WELL DESIGN

NAME: _____

PROJECT: _____

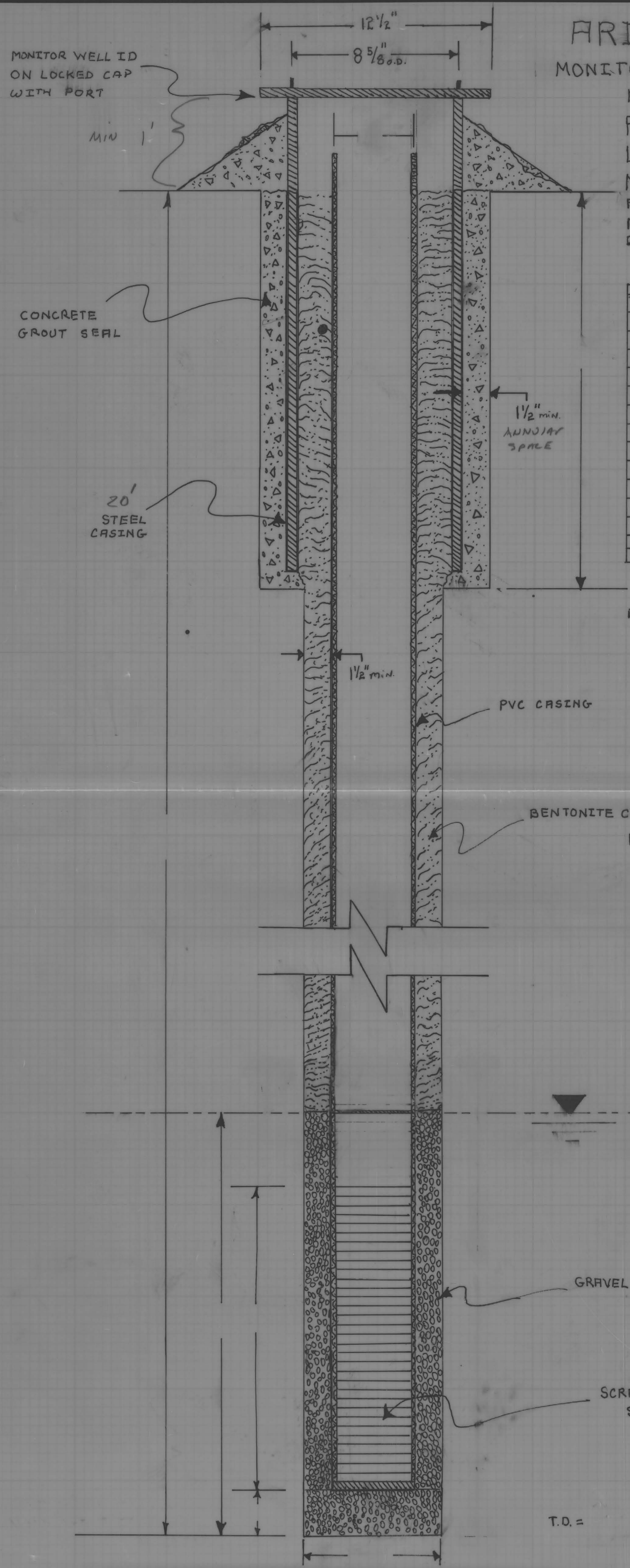
LOCATION: _____

METHOD OF DRILLING: _____

ADWR FILE #: _____

N: _____ E: _____ ELEV: _____

DATE WELL COMP.: _____



SPECIFICATIONS	
DESCRIPTION	QUANTITY

DRAWN BY: A.E.W.
SEPT 3, 1993

AQUIFER CHARACTERISTICS

S.W.L.: _____

P.W.L.: _____

AFTER: _____ hrs @ _____

SPECIFIC CAPACITY: _____

PUMP CHARACTERISTICS

TYPE:

H.P.:

VOLTS:

CAPACITY:

APPENDIX 12.A.
Representative Open Areas of Screens

Screen Diameter	Slot Size	Continuous Slot in²/ft	Continuous Slot %	Louvered (Minimum open area) in²/ft	Louvered (Minimum open area) %	Louvered (Maximum open area) in²/ft	Louvered (Maximum open area) %	Bridge Slot in²/ft	Bridge Slot %	Bridge Slot in²/ft	Bridge Slot %	Mill Slotted* (Vertical) in²/ft	Mill Slotted* (Vertical) %	Slotted Pipe (Horizontal) slots/ft	Slotted Pipe (Horizontal) in²/ft	Slotted Pipe (Horizontal) %	Plastic Continuous Slot in²/ft	Plastic Continuous Slot %	Slotted Plastic† in²/ft	Slotted Plastic† %	Concrete in²/ft	Concrete %	Fiberglass Reinforced Plastic Continuous Slot‡ in²/ft	Fiberglass Reinforced Plastic Continuous Slot‡ %
4″ ID	20	44	25					—	—			—	—	—	—	—	22	13	—	—			25	12
	30	58	33					—	—			—	—	—	—	—	31	18	—	—			37	17
	40	72	41					13	8			—	—	—	—	—	40	23	13	8			48	23
	50	78	45					—	—			6	4	—	—	—	47	27	—	—			—	—
	60	90	52					19	12			8	5	90	16	3	52	30	18	11			—	—
														130	23	5								
	80	102	59					—	—			—	—	240	43	9								
														90	22	5	—	—	—	—			—	—
														130	31	7								
														240	58	12								
	90	105	60					29	17			—	—	—	—	—	—	—	—	—			—	—
	95	106	61					—	—			12	7	—	—	—	—	—	—	—			—	—
	100	112	64					—	—					90	27	6	—	—	26	16			—	—
														130	39	8								
														240	72	15								
	120	99	57					—	—			—	—	—	—	—	—	—	29	17			—	—
	125	100	58					41	24			16	10	—	—	—	—	—	—	—			—	—
6″ ID	20	45	18	—	—	—	—	—	—			—	—				25	10	12	5			14	5
	30	61	25	—	—	—	—	—	—			—	—				36	14	18	7			—	—
	40	77	31	—	—	—	—	14	6			—	—				45	18	23	9			29	9
	50	88	35	—	—	—	—	—	—			9	4				54	22	28	11			—	—
	60	100	40	2	1	7	3	21	8			11	5				62	25	32	13			41	14
	90	124	50	—	—	—	—	31	12			—	—				—	—	—	—			59	20
	95	127	51	4	2	11	5	—	—			17	7				—	—	—	—			—	—
	100	131	53	—	—	—	—	—	—			—	—				—	—	46	18			65	22
	120	141	57	—	—	—	—	—	—			—	—				—	—	51	20			—	—
	125	127	51	5	2	15	7	43	17			23	9				—	—	—	—			—	—
8″ ID	20	58	18	—	—	—	—			—	—	—	—				41	12	—	—				
	30	80	25	—	—	—	—			8	3	—	—				57	18	26	8				
	40	98	30	—	—	—	—			—	—	—	—				72	22	—	—				
	50	114	35	—	—	—	—			—	—	—	—				86	26	—	—				
	60	135	41	4	1	10	3			17	6	15	5				93	29	47	14				
	95	165	51	6	2	15	5			—	—	23	7				—	—	—	—				
	100	169	52	—	—	—	—			—	—	—	—				—	—	67	21				
	125	166	51	7	2	20	6			38	13	31	10				—	—	—	—				
10″ ID	20	72	18	—	—	—	—			—	—	—	—						18	4				
	30	100	25	—	—	—	—			10	2	—	—						26	6				
	40	122	30	—	—	—	—			—	—	—	—						33	8				
	50	143	35	—	—	—	—			—	—	15	4						39	10				

Author: Fletcher G. Driscoll
ISBN: 0961645601

Appendix 12.A. Continued

Screen Diameter	Slot Size	Continuous Slot in²/ft	Continuous Slot %	Louvered (Minimum open area) in²/ft	Louvered (Minimum open area) %	Louvered (Maximum open area) in²/ft	Louvered (Maximum open area) %	Bridge Slot in²/ft	Bridge Slot %	Bridge Slot in²/ft	Bridge Slot %	Mill Slotted* (Vertical) in²/ft	Mill Slotted* (Vertical) %	Slotted Pipe (Horizontal) slots/ft	Slotted Pipe (Horizontal) in²/ft	Slotted Pipe (Horizontal) %	Plastic Continuous Slot in²/ft	Plastic Continuous Slot %	Slotted Plastic† in²/ft	Slotted Plastic† %	Concrete in²/ft	Concrete %	Fiberglass Reinforced Plastic Continuous Slot‡ in²/ft	Fiberglass Reinforced Plastic Continuous Slot‡ %
	60	135	33	4	1	16	4			22	5	19	5						45	11				
	90	174	43	—	—	—	—			—	—	—	—						—	—				
	95	179	44	7	2	24	6			—	—	28	7						—	—				
	100	186	46	—	—	—	—			—	—	—	—						65	16				
	120	203	50	—	—	—	—			—	—	—	—						72	18				
	125	207	51	9	2	32	8			48	12	38	9						—	—				
12″ ID	20	69	14	—	—	—	—	—	—	—	—	—	—						—	—			32	6
	30	77	16	—	—	—	—	—	—	12	3	—	—						—	—			—	—
	40	99	21	—	—	—	—	22	5	—	—	—	—						38	8			64	12
	50	117	24	—	—	—	—	—	—	—	—	17	4						—	—			—	—
	60	135	28	6	1	20	4	33	7	27	6	21	5						52	11			94	18
	90	176	37	—	—	—	—	49	10	—	—	—	—						—	—			138	26
	95	182	38	9	2	30	7	—	—	—	—	32	7						—	—			—	—
	100	189	39	—	—	—	—	—	—	—	—	—	—						75	16			154	30
	120	209	44	—	—	—	—	—	—	—	—	—	—						83	18			—	—
	125	214	45	12	3	39	9	68	14	59	13	43	9						—	—			—	—
16″ OD	20	68	11	—	—	—	—			—	—	—	—	—	—	—			35	6			40	6
	30	97	16	—	—	—	—			16	3	—	—	—	—	—			52	9			—	—
	40	124	21	—	—	—	—			—	—	—	—	—	—	—			69	11			81	12
	50	-146	24	—	—	—	—			—	—	22	4	—	—	—			86	14			—	—
	60	169	28	7	1	24	4			35	6	27	5	104	19	3			—	—			119	17
														141	29	5								
														192	35	6								
	80	206	34	—	—	—	—			—	—	—	—	104	25	4			138	23			—	—
														141	34	6								
														192	46	8								
	90	221	37	—	—	—	—			—	—	—	—	—	—	—			—	—			176	26
	95	228	38	11	2	35	6			—	—	41	7	—	—	—			—	—			—	—
	100	238	40	—	—	—	—			—	—	—	—	104	31	5			173	29			196	29
														141	42	7								
														192	58	10								
	125	268	45	15	2	47	8			78	13	55	9	—	—	—			—	—			—	—
17″ OD (13″ ID)	190																				25	4		
18″ OD	20	76	11	—	—	—	—			—	—			—	—	—								
	30	109	16	—	—	—	—			18	3			—	—	—								
	40	137	20	—	—	—	—			—	—			—	—	—								
	60	187	28	7	1	28	4			40	6			121	22	3								
														199	36	5								
														336	61	9								

Appendix 12.A. Continued

Screen Diameter	Slot Size	Continuous Slot in²/ft	Continuous Slot %	Louvered (Minimum open area) in²/ft	Louvered (Minimum open area) %	Louvered (Maximum open area) in²/ft	Louvered (Maximum open area) %	Bridge Slot in²/ft	Bridge Slot %	Bridge Slot in²/ft	Bridge Slot %	Mill Slotted* (Vertical) in²/ft	Mill Slotted* (Vertical) %	Slotted Pipe (Horizontal) slots/ft	Slotted Pipe (Horizontal) in²/ft	Slotted Pipe (Horizontal) %	Plastic Continuous Slot in²/ft	Plastic Continuous Slot %	Slotted Plastic† in²/ft	Slotted Plastic† %	Concrete in²/ft	Concrete %	Fiberglass Reinforced Plastic Continuous Slot‡ in²/ft	Fiberglass Reinforced Plastic Continuous Slot‡ %
	80	228	34	—	—	—	—			—	—			121	29	4								
														199	48	7								
	95	255	38	11	2	41	6							336	81	12								
	100	263	39	—	—	—	—			—	—			—	—	—								
										—	—			121	36	5								
														199	60	9								
	125	236	35	15	2	55	8			88	13			336	101	15								
21″ OD (16″ ID)	190													—	—	—								
23″ OD (18″ ID)	190																				30	4		
																					40	5		

This chart is to give the reader a representative guide to typical open areas for various types of screens. The actual open area may vary somewhat above or below these figures depending on the materials used to build the screen, the collapse and column strength requirements, and the manufacturing techniques. Screen manufacturers should be contacted for specific open area information.

*Diameter of 4″ screen is 4.5″ OD.
†Screen diameters are 4.5″ OD, 6.5″ OD, and 12.5″ OD.
‡Screen diameters are 4.5″ ID, 6.5″ ID, 12″ ID, and 16″ ID.

APPENDIX 12.B.
Correlation Chart of Screen Openings and Sieve Sizes

Geologic Material Grain-size Range	Johnson Slot No.	Gauze No.	Tyler			U.S. Standard	
			Sieve No.	Size of Openings Inches	Size of Openings mm	Sieve No.	Size of Openings Inches
clay & silt	—	—	400	0.0015	0.038	400	0.0015
	—	—	325	0.0017	0.043	325	0.0017
	—	—	270	0.0021	0.053	270	0.0021
	—	—	250	0.0024	0.061	230	0.0024
	—	—	200	0.0029	0.074	200	0.0029
fine sand	—	—	170	0.0035	0.088	170	0.0035
	—	—	150	0.0041	0.104	140	0.0041
	—	—	115	0.0049	0.124	120	0.0049
	6	90	100	0.0058	0.147	100	0.0059
	7	80	80	0.0069	0.175	80	0.0070
	8	70	65	0.0082	0.208	70	0.0083
	10	60	60	0.0097	0.246	60	0.0098
medium sand	12	50	48	0.0116	0.295	50	0.0117
	14	—	42	0.0138	0.351	45	0.0138
	16		35	0.0164	0.417	40	0.0165 (1/64)
	18	40	—	0.0180	0.457	—	0.0180
	20		32	0.0195	0.495	35	0.0197
	23		28	0.0232	0.589	30	0.0232
coarse sand	25	30	—	0.0250	0.635	—	0.0250
	28		24	0.0276	0.701	25	0.0280
	31		—	0.0310	0.788	—	0.0310 (1/32)
	33		20	0.0328	0.833	20	0.0331
	35	20	—	0.035	0.889	—	0.0350
	39		16	0.039	0.991	18	0.0394
very coarse sand	47		14	0.046	1.168	16	0.0469
	56		12	0.055	1.397	14	0.0555
	62		—	0.062	1.590	—	0.062 (1/16)
	66		10	0.065	1.651	12	0.0661
	79		9	0.078	1.981	10	0.0787
very fine gravel	93		8	0.093	2.362	8	0.0931
	94		—	0.094	2.390	—	0.094 (3/32)
	111		7	0.110	2.794	7	0.111
	125		—	0.125	3.180	—	0.125 (1/8)
	132		6	0.131	3.327	6	0.132
fine gravel	157		5	0.156	3.962	5	0.157
	187		4	0.185	4.699	4	0.187 (3/16)
	223		3½	0.221	5.613	3½	0.223
	250		—	0.250	6.350	¼	0.250 (1/4)
	263		3	0.263	6.680	—	0.263
	312		2½	0.312	7.925	5/16	0.312 (5/16)
	375		0.371	0.371	9.423	⅜	0.375 (3/8)
	438		0.441	0.441	11.20	7/16	0.438 (7/16)
	500		0.525	0.525	13.33	½	0.500 (1/2)

APPENDIX 11.L.
Volume of Water in Casing or Hole

Diameter of Casing or Hole (In)	Gallons per foot of Depth	Cubic Feet per Foot of Depth	Liters per Meter of Depth	Cubic Meters per Meter of Depth
1	0.041	0.0055	0.509	0.509×10^{-3}
1½	0.092	0.0123	1.142	1.142×10^{-3}
2	0.163	0.0218	2.024	2.024×10^{-3}
2½	0.255	0.0341	3.167	3.167×10^{-3}
3	0.367	0.0491	4.558	4.558×10^{-3}
3½	0.500	0.0668	6.209	6.209×10^{-3}
4	0.653	0.0873	8.110	8.110×10^{-3}
4½	0.826	0.1104	10.26	10.26×10^{-3}
5	1.020	0.1364	12.67	12.67×10^{-3}
5½	1.234	0.1650	15.33	15.33×10^{-3}
6	1.469	0.1963	18.24	18.24×10^{-3}
7	2.000	0.2673	24.84	24.84×10^{-3}
8	2.611	0.3491	32.43	32.43×10^{-3}
9	3.305	0.4418	41.04	41.04×10^{-3}
10	4.080	0.5454	50.67	50.67×10^{-3}
11	4.937	0.6600	61.31	61.31×10^{-3}
12	5.875	0.7854	72.96	72.96×10^{-3}
14	8.000	1.069	99.35	99.35×10^{-3}
16	10.44	1.396	129.65	129.65×10^{-3}
18	13.22	1.767	164.18	164.18×10^{-3}
20	16.32	2.182	202.68	202.68×10^{-3}
22	19.75	2.640	245.28	245.28×10^{-3}
24	23.50	3.142	291.85	291.85×10^{-3}
26	27.58	3.687	342.52	342.52×10^{-3}
28	32.00	4.276	397.41	397.41×10^{-3}
30	36.72	4.909	456.02	456.02×10^{-3}
32	41.78	5.585	518.87	518.87×10^{-3}
34	47.16	6.305	585.68	585.68×10^{-3}
36	52.88	7.069	656.72	656.72×10^{-3}

1 Gallon = 3.785 Liters
1 Meter = 3.281 Feet
1 Gallon Water Weighs 8.33 lbs. = 3.785 Kilograms
1 Liter Water Weighs 1 Kilogram = 2.205 lbs.
1 Gallon per foot of depth = 12.419 liters per foot of depth
1 Gallon per meter of depth = 12.419×10^{-3} cubic meters per meter of depth