

April 3, 2009

To: Amy Blain, P.E.  
City of Longview  
1525 Broadway  
Longview, WA 98632

Re: Construction and Drilling of the Shallow Sentinel Wells

Dear Amy,

This letter summarizes the drilling activities conducted on behalf of the City of Longview for the construction of seven shallow sentinel wells. Boart Longyear of Fife, Washington was retained as the drilling contractor for the project and completed the wells with their track-mounted sonic drilling rig.

From February 17<sup>th</sup> thru February 24<sup>th</sup>, Boart Longyear drilled and installed the seven shallow observation wells. The location of the seven sentinel well sites is displayed in Figure 1, attached to this document. The GPS locations, drilling depth, total assembly length, and depth to water of the seven sentinel wells are presented in Table 1.

**Table 1. Sentinel Wells Summary Data**

Well No.	Latitude (GPS decimal)	Longitude (GPS decimal)	Drilling Depth (feet)	Total Assembly depth (feet below top of casing)	Depth to water (feet below top of casing)	WA Ecology Well ID
SW-1	46.13203	-122.97694	50	37.3	10.79	BBE 905
SW-2	46.14223	-122.98923	50	37.3	8.14	BBE 908
SW-3	46.14167	-122.96191	50	39.5	6.29	BBE 904
SW-4	46.14839	-122.97320	40	42.1	6.67	BBE 906
SW-5	46.13934	-122.98932	50	37.3	7.69	BBE 907
SW-6	46.13700	-122.98526	40	33.8	9.68	BBE 910
SW-7	46.13457	-122.98114	40	30	10.27	BBE 909

Geologic and construction logs for each of the seven wells are attached to this document. Copies of the Washington State Department of Ecology driller's geology and construction logs are also attached. The geology encountered during the drilling of the sentinel wells was predominantly fine-grained silts, clayey silts, and sands. These materials are typical of alluvial sediments deposited by the Cowlitz and Columbia Rivers.

April 3, 2009

Page 2

Thank you for the opportunity to continue working with the City of Longview. If there are any questions or concerns regarding the drilling or construction of the sentinel wells, please do not hesitate to contact us.

Sincerely,

**Robinson, Noble & Saltbush, Inc.**



Michael P. Brady  
Project Hydrogeologist



Michael F. Piechowski, LHG  
Project Manager

Attachments:

- Site Location Diagram
- Construction and Geology Diagrams
- Ecology Driller's Logs
- Site Photographs



**MICHAEL F. PIECHOWSKI**

# BOART LONGYEAR

## Resource Protection Well Report

Project Name Mint for WA  
 Well Identification # BBE-910  
 Drilling Method Sonic  
 Driller Thomas Crowley  
 License # 2409

Date 7-23-09  
 County Cowlitz, SW 1/4 NE 1/4  
 Section 31 T. 7 R. 2W  
 Street Address Ind & WA way  
 Start Card RE03075  
 Consulting Firm Robinson & Noble

AS-BUILT	WELL DATA	FORMATION DESCRIPTION
	MONUMENT TYPE: <u>standup</u> CONCRETE SURFACE SEAL <u>2</u> ft.	<u>0 - 16</u> ft. DK Brown silt
	PVC BLANK <u>2" x 15'</u> BACKFILL <u>8</u> ft. TYPE: <u>Grout</u> <u>Bentonite 12-10</u>	<u>16 - 30</u> ft. DK Grey silt w/ wet seams
	PVC SCREEN <u>2" x 15'</u> SLOT SIZE: <u>.20</u> TYPE: <u>Flush Thread</u>	- ft.
	GRAVEL PACK <u>17</u> ft. MATERIAL: <u>10 x 20 silica</u>	- ft.
	WELL DEPTH <u>30'</u>	REMARKS <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>

Signature Thomas W. Crowley

# BOART LONGYEAR

## Resource Protection Well Report

Project Name MINT farm  
 Well Identification # BBE 904  
 Drilling Method Sonic  
 Driller Thomas Craney  
 License # 2409

Date 2-17-09  
 County Cowlitz NE 1/4 SW 1/4  
 Section 31 T. 8 R. 2W2  
 Street Address Ind + WA way  
 Start Card RE03076  
 Consulting Firm Robinson + Noble

AS-BUILT	WELL DATA	FORMATION DESCRIPTION
	MONUMENT TYPE: <u>flush</u>	
	CONCRETE SURFACE SEAL <u>2 ft.</u>	<u>0 - 16 ft.</u> med Brn Red silt
	PVC BLANK <u>2" x 20'</u>	<u>16 - 40 ft.</u> course grey sand with pumice gravels water bearing
	BACKFILL <u>15 ft.</u> TYPE: <u>Grout</u>	- ft.
	PVC SCREEN <u>2" x 20'</u> SLOT SIZE: <u>120</u> TYPE: <u>flush Thread</u>	- ft.
	GRAVEL PACK <u>23 ft.</u> MATERIAL: <u>10x20 silica</u>	- ft.
	WELL DEPTH <u>40.4'</u>	
		<b>REMARKS</b> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>

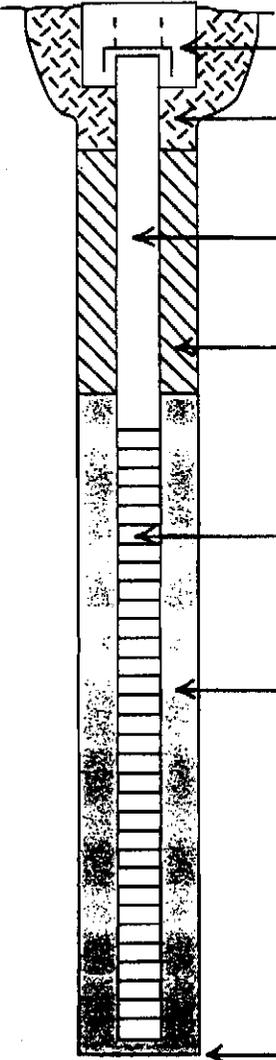
Signature Thomas W. Craney

# BOART LONGYEAR

## Resource Protection Well Report

Project Name Mint farm  
 Well Identification # BBE 905  
 Drilling Method sonic  
 Driller Thomas Craney  
 License # 2409

Date 2-18-09  
 County Cowlitz NW 1/4 SE 1/4  
 Section 29 T. 7 R. 24W  
 Street Address 30th Ave + Larch St  
 Start Card RE03077  
 Consulting Firm Robinson & Noble

AS-BUILT	WELL DATA	FORMATION DESCRIPTION
	MONUMENT TYPE: <u>Stand up</u> CONCRETE SURFACE SEAL <u>2 ft.</u>	<u>0 - 12 ft.</u> med BRN silt
	PVC BLANK <u>2" x 15'</u>	<u>12 - 35 ft.</u> DK grey silt with wet seams
	BACKFILL <u>7 ft.</u> TYPE: <u>GROUT</u>	
	Bentonite Pellets <u>12-9</u>	- ft.
	PVC SCREEN <u>2" x 15'</u> SLOT SIZE: <u>.20</u>	- ft.
	TYPE: <u>Flush Thread</u>	
	GRAVEL PACK <u>22 ft.</u> MATERIAL: <u>10X20 silica</u>	- ft.
	<u>2" x 5' sump</u>	
	WELL DEPTH <u>35'</u>	<b>REMARKS</b> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>

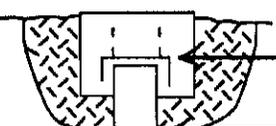
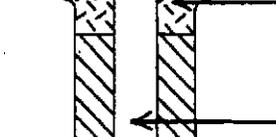
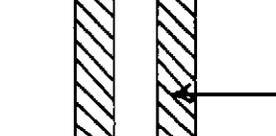
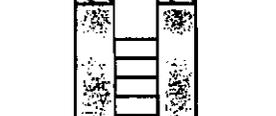
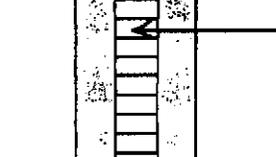
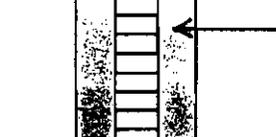
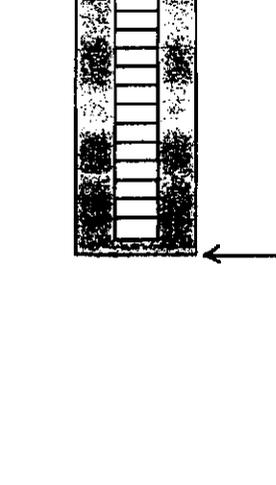
Signature Thomas W. Craney

# BOART LONGYEAR

## Resource Protection Well Report

Project Name mint farm  
 Well Identification # BBE 906  
 Drilling Method Sonic  
 Driller Thomas Craney  
 License # 2409

Date 2-18-09  
 County Cowlitz SW 1/4 NW 1/4  
 Section 30 T. 7 R. 2W  
 Street Address olive way + Wetland Buffer  
 Start Card RF03078  
 Consulting Firm Robinson & Noble

AS-BUILT	WELL DATA	FORMATION DESCRIPTION
	MONUMENT TYPE: <u>stand up</u> CONCRETE SURFACE SEAL <u>2</u> ft.	<u>0 - 17 ft.</u> Brown Red silt
	PVC BLANK <u>2" x 18'</u>	<u>17 - 36 ft.</u> DK Grey silt with wet seams
	BACKFILL <u>8</u> ft. TYPE: <u>Grout</u>	_____ ft.
	<u>Bentonite 13'-10'</u>	_____ ft.
	PVC SCREEN <u>2" x 15'</u> SLOT SIZE: <u>20</u> TYPE: <u>Flush Thread</u>	_____ ft.
	GRAVEL PACK <u>23</u> ft. MATERIAL: <u>10x20 silica</u> <u>2" x 5' sump</u>	_____ ft.
	WELL DEPTH <u>35'</u>	<b>REMARKS</b> _____ _____ _____ _____ _____

Signature Thomas W. Craney

# BOART LONGYEAR

## Resource Protection Well Report

Project Name Mint Farm  
 Well Identification # BBE 907  
 Drilling Method Sonic  
 Driller Thomas Craney  
 License # 2409

Date 2-19-09  
 County Cowlitz SW 1/4 NE 1/4  
 Section 31 T. 7 R. 2W  
 Street Address Ind + WA Way  
 Start Card RE03208  
 Consulting Firm Robinson + Noble

AS-BUILT	WELL DATA	FORMATION DESCRIPTION
	MONUMENT TYPE: <u>Stand up</u>	
	CONCRETE SURFACE SEAL <u>2 ft.</u>	<u>0 - 16 ft.</u> med Brown Red claylike silt
	PVC BLANK <u>2" x</u>	<u>16 - 36 ft.</u> DK grey silt with wet seams
	BACKFILL <u>7 ft.</u> TYPE: <u>Grout</u> <u>Bentonite 13-9</u>	- ft.
	PVC SCREEN <u>2" x 15'</u> SLOT SIZE: <u>.20</u> TYPE: <u>Flush Thread</u>	- ft.
	GRAVEL PACK <u>23 ft.</u> MATERIAL: <u>10x20 silica</u>	- ft.
	WELL DEPTH <u>35'</u> <p style="text-align: center;"><u>5'x2" sump</u></p>	
		<b>REMARKS</b> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>

Signature Thomas W. Craney

# BOART LONGYEAR

## Resource Protection Well Report

Project Name Mint Farm  
 Well Identification # BBE 908  
 Drilling Method Sonic  
 Driller Thomas Craney  
 License # 2409

Date 2-19-09  
 County Cowlitz SW 1/4 NE 1/4  
 Section 31 T. 7 R. 2W  
 Street Address Ind. & WA Way  
 Start Card RE03208  
 Consulting Firm Robinson & Noble

AS-BUILT	WELL DATA	FORMATION DESCRIPTION
	<p>MONUMENT TYPE: <u>Stand up</u></p> <p>CONCRETE SURFACE SEAL <u>2 ft.</u></p> <p>PVC BLANK <u>2" x 20'</u></p> <p>BACKFILL <u>12 ft.</u> TYPE: <u>Grout</u></p> <p>Bentonite seal <u>17-14</u></p> <p>PVC SCREEN <u>2" x 20'</u> SLOT SIZE: <u>20</u> TYPE: <u>Flush Thread</u></p> <p>GRAVEL PACK <u>22 ft.</u> MATERIAL: <u>10x20 silica</u></p> <p>WELL DEPTH <u>40'</u></p>	<p><u>0 - 16 ft.</u> <u>med Brown Red claylike silt</u></p> <p><u>16 - 40 ft.</u> <u>Course Dark grey sand some Pumice gravels water Bearing</u></p> <p><u>- ft.</u></p> <p><u>- ft.</u></p> <p><u>- ft.</u></p> <p><b>REMARKS</b></p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>

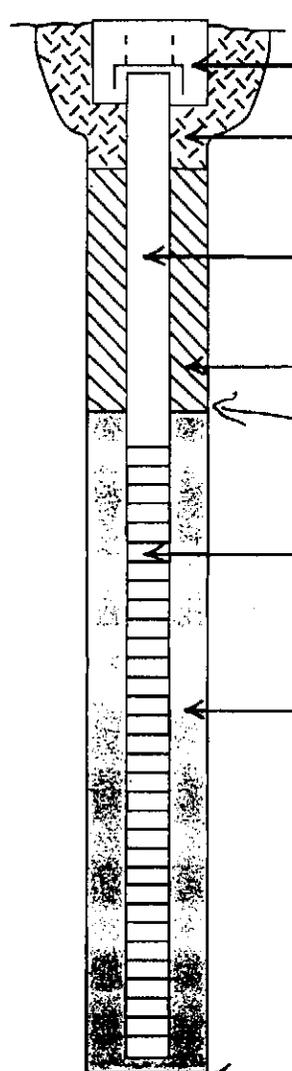
Signature Thomas W. Craney

# BOART LONGYEAR

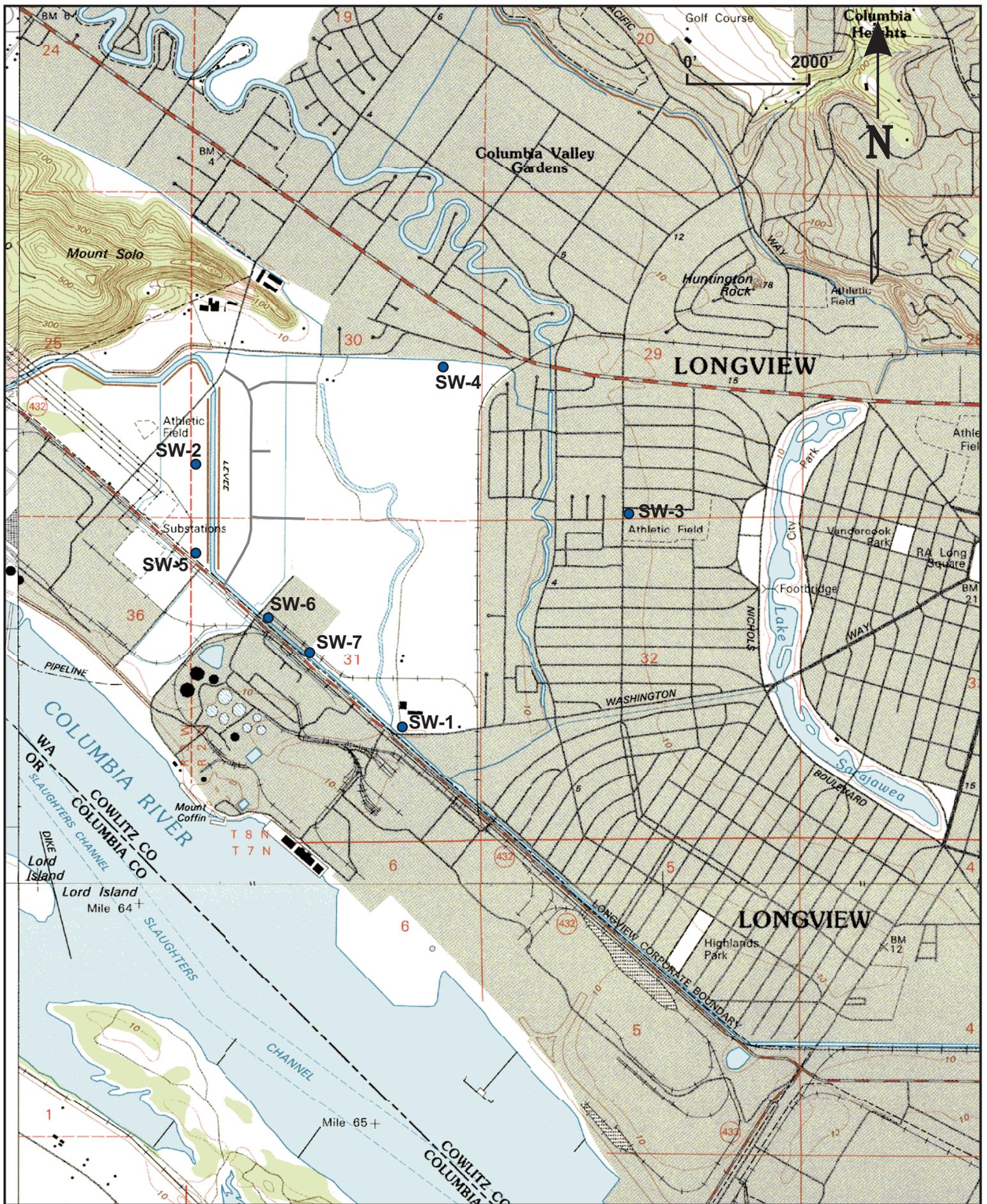
## Resource Protection Well Report

Project Name Mint Farm  
 Well Identification # RBE 909  
 Drilling Method Sonic  
 Driller Thomas Craney  
 License # 2409

Date 2-23-09  
 County Cowlitz SW 1/4 NE 1/4  
 Section 31 T. 7 R. 2W  
 Street Address Ind & WA Way  
 Start Card RE03208  
 Consulting Firm Robinson & Noble

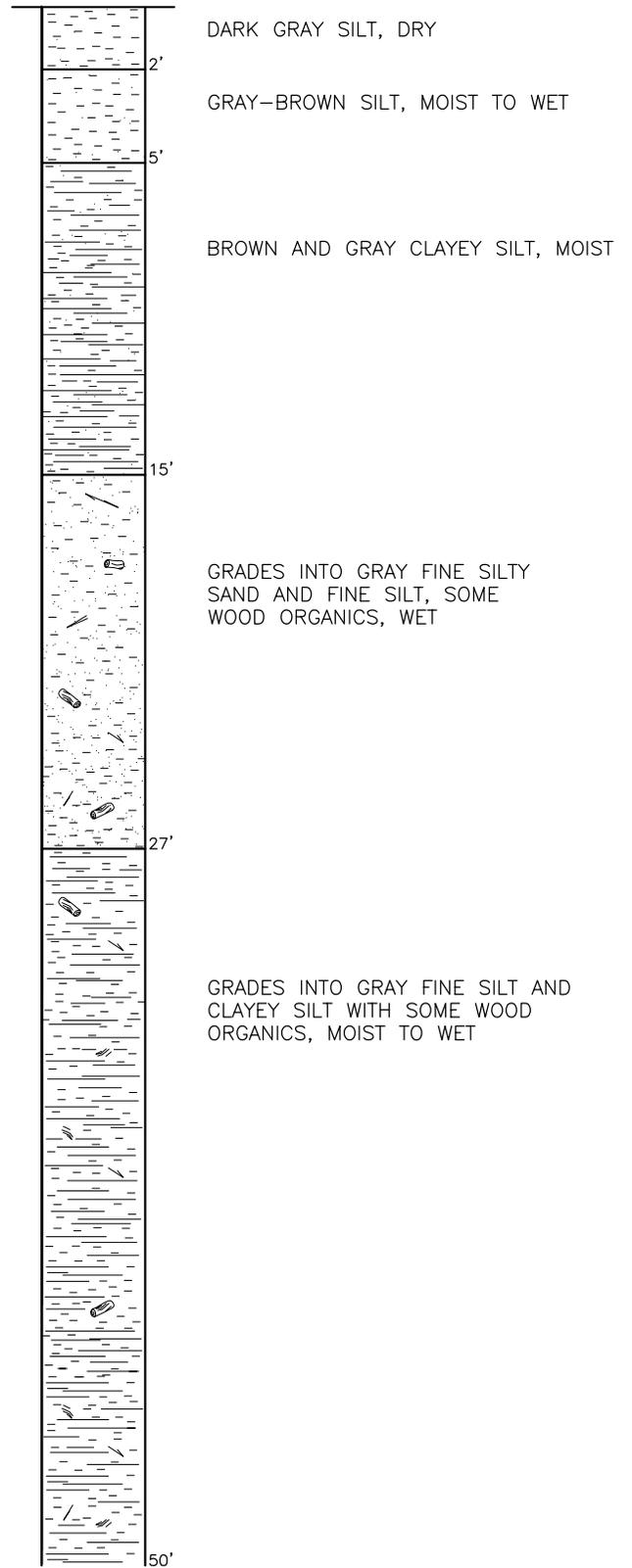
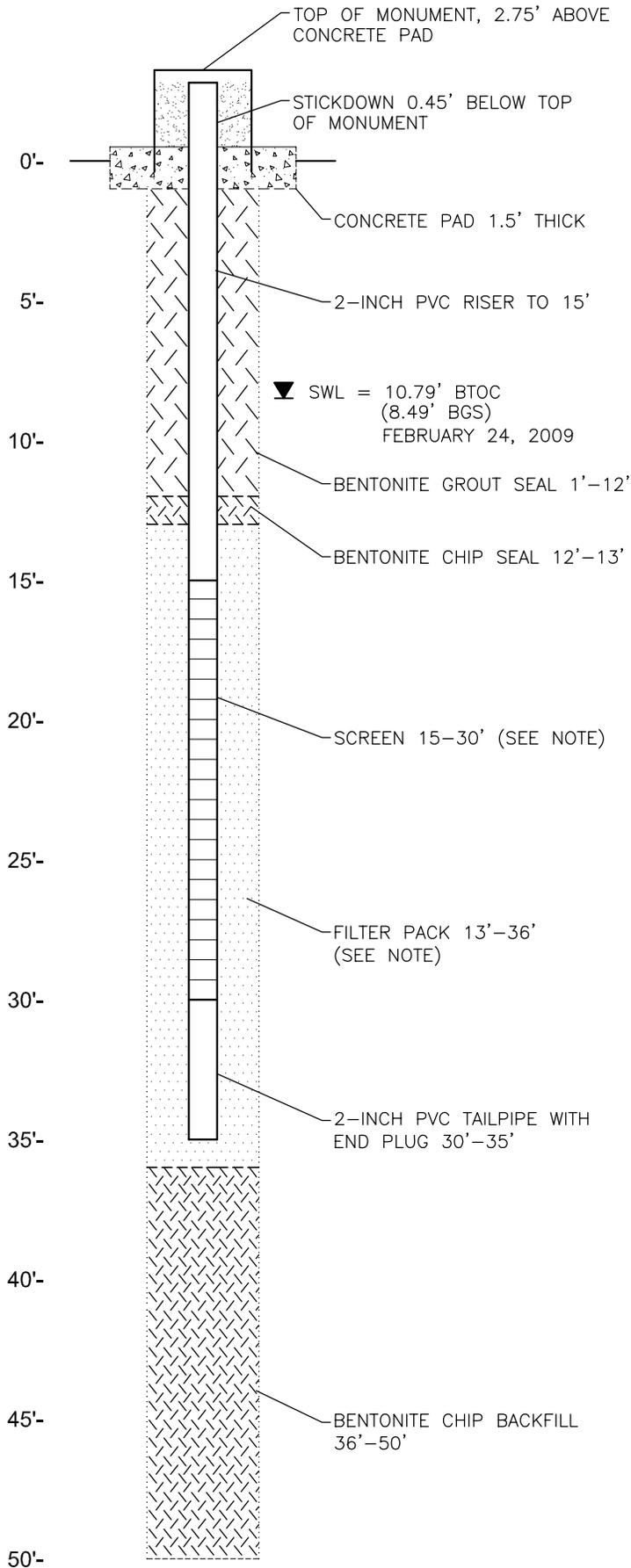
AS-BUILT	WELL DATA	FORMATION DESCRIPTION
	MONUMENT TYPE: <u>stand up?</u>	
	CONCRETE SURFACE SEAL <u>2</u> ft.	<u>0 - 17 ft.</u> DK Brown silt
	PVC BLANK <u>2" x 15'</u>	<u>17 - 40 ft.</u> DK grey silt with wet seams
	BACKFILL <u>15</u> ft.	
	TYPE: <u>GROUT</u> Bentonite <u>20-17'</u>	- ft.
	PVC SCREEN <u>2" x 15'</u> SLOT SIZE: <u>.20</u>	- ft.
	TYPE: <u>flush Thread</u>	
	GRAVEL PACK <u>17</u> ft. MATERIAL: <u>10x20 silica</u>	- ft.
	WELL DEPTH <u>32'</u>	REMARKS <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>

Signature Thomas W. Craney



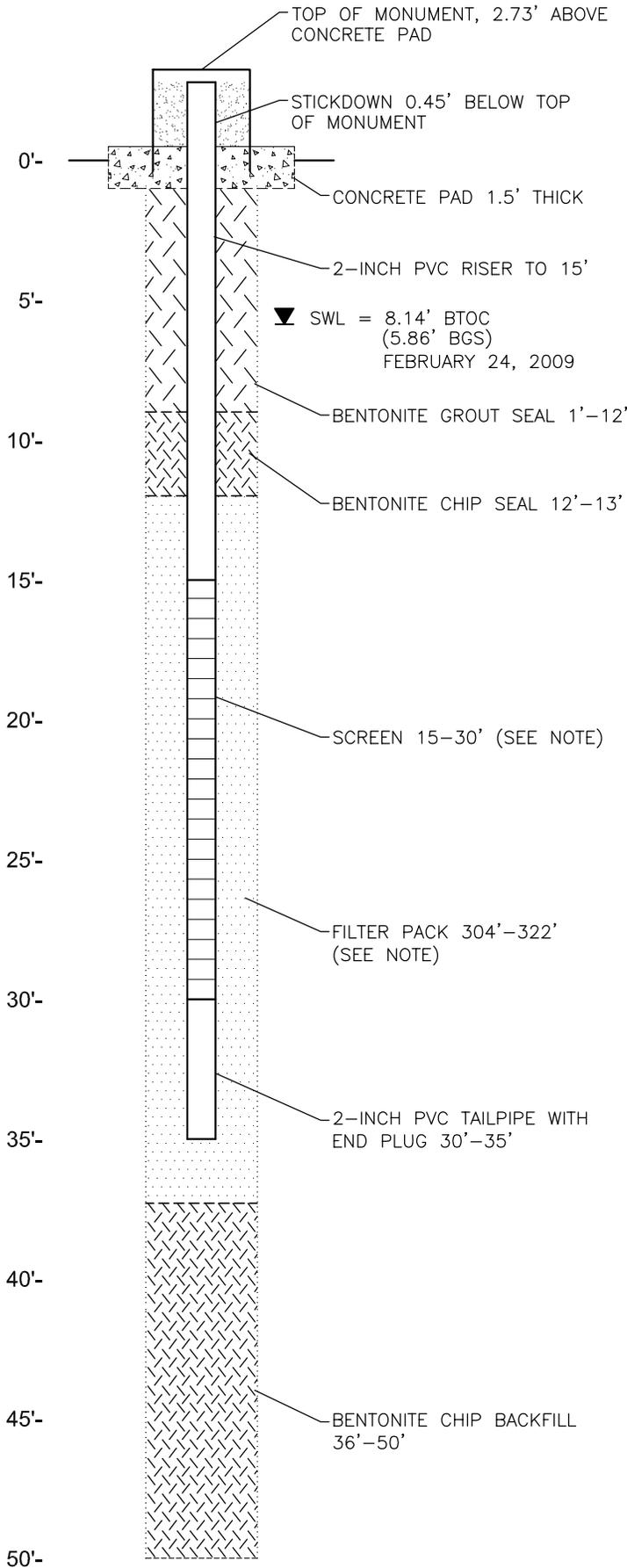
### Construction Detail

### Geologic Log

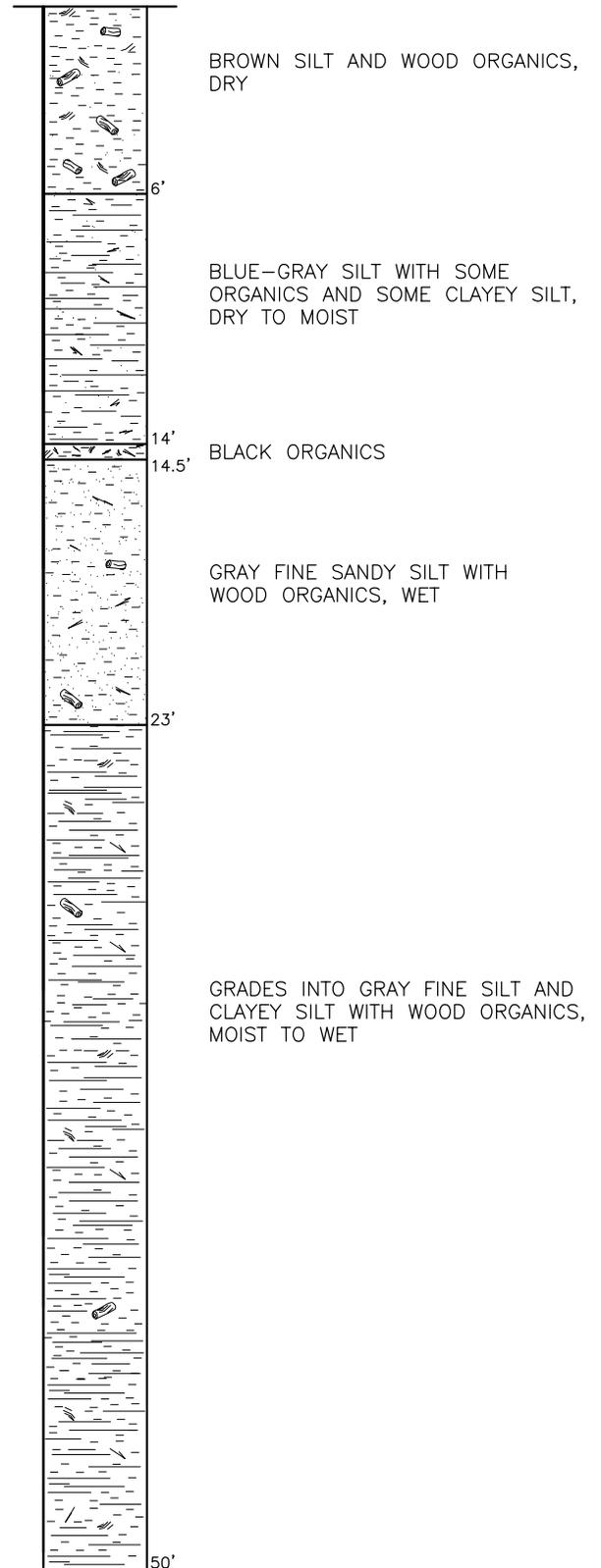


UNIQUE WELL ID: BBE 905

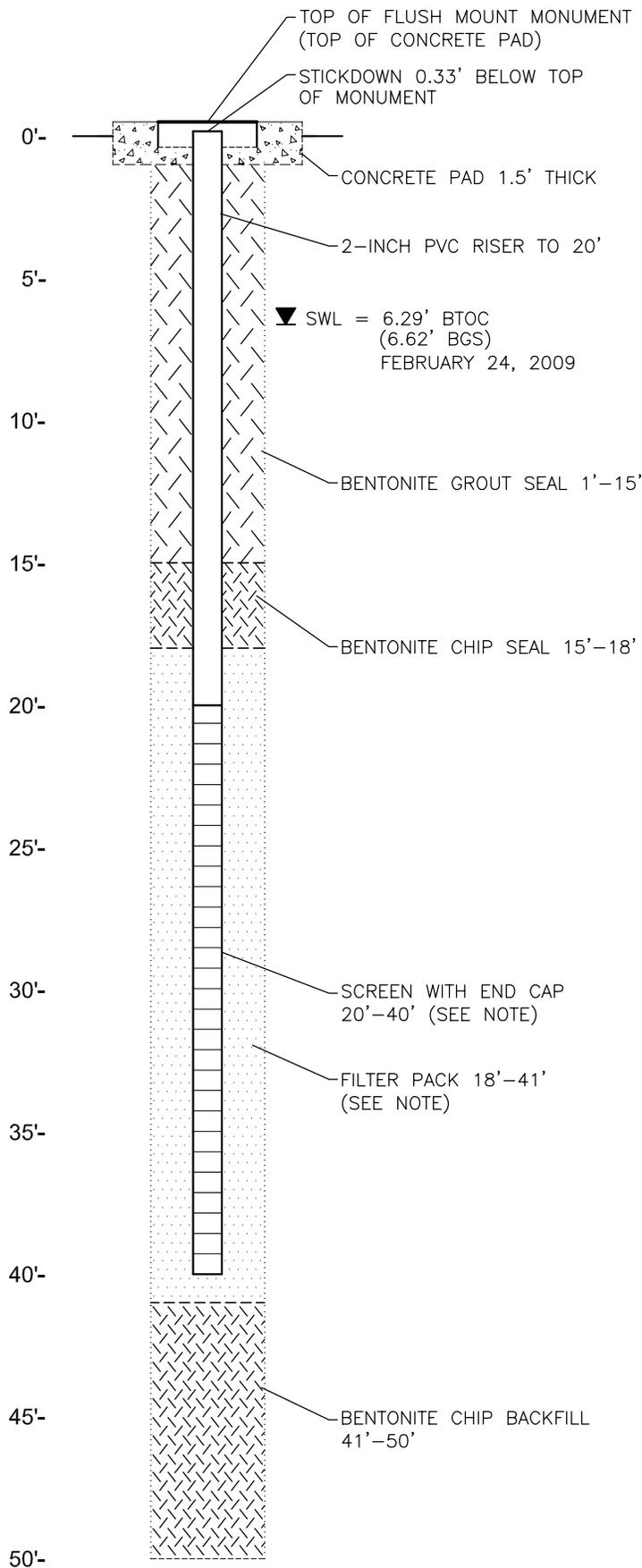
### Construction Detail



### Geologic Log

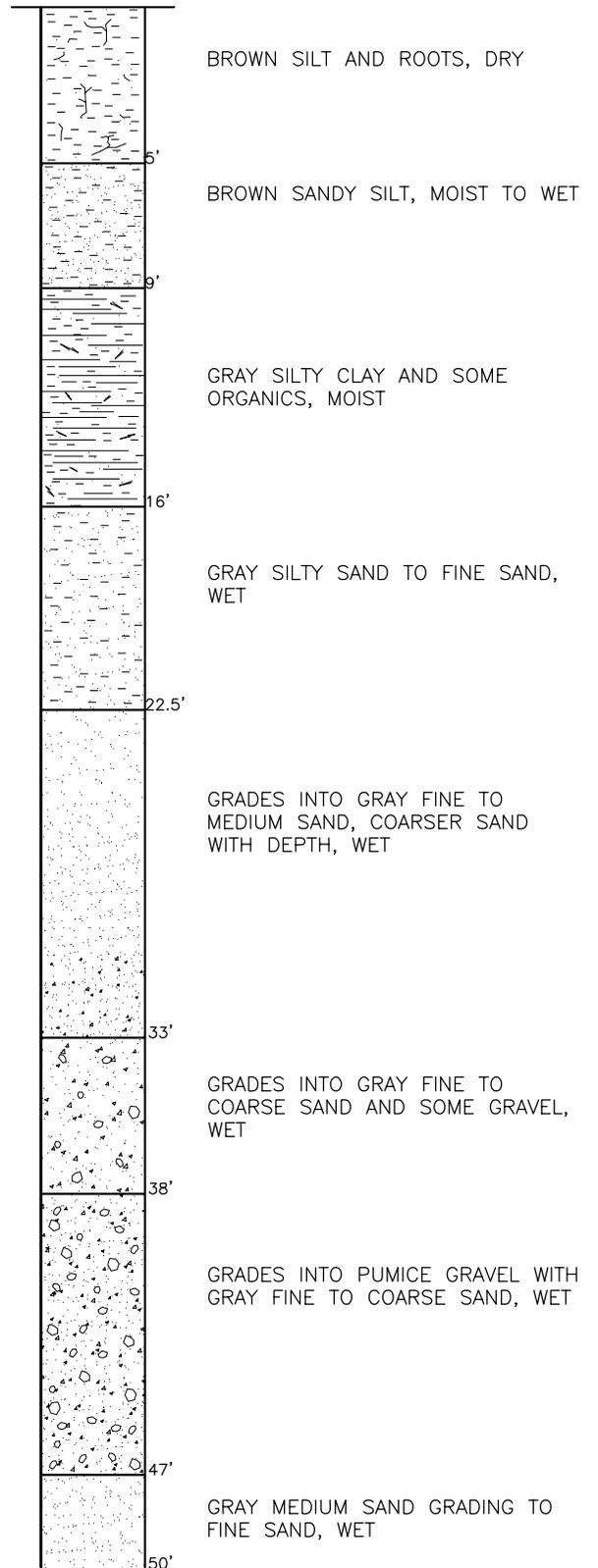


### Construction Detail



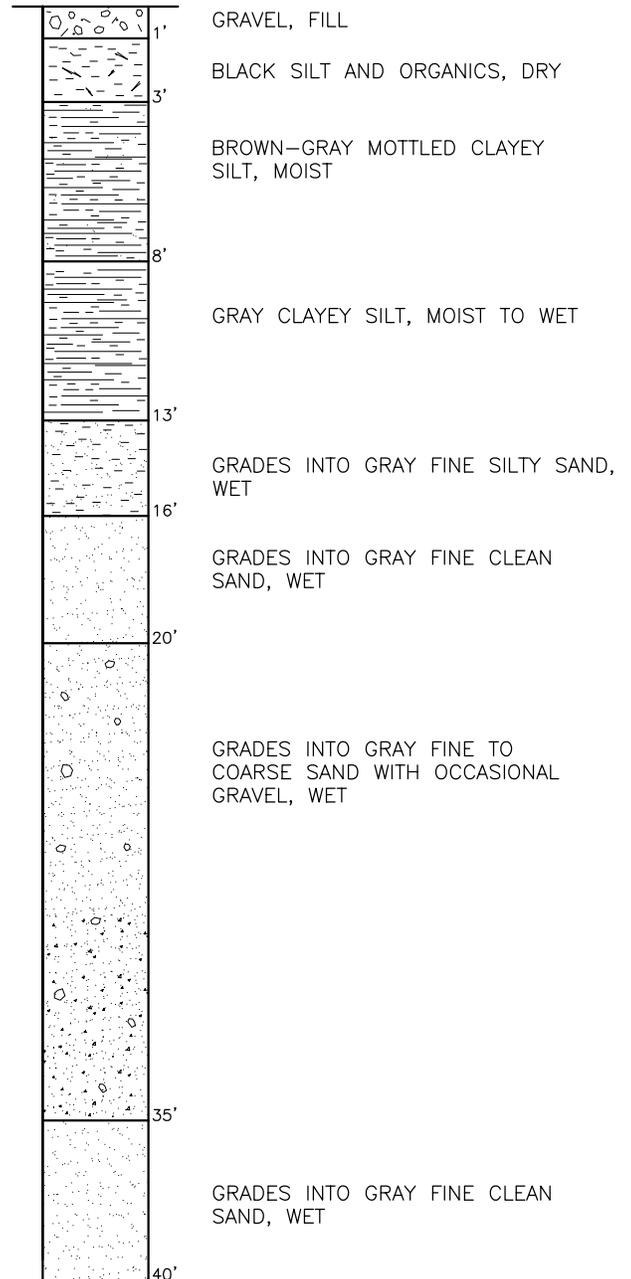
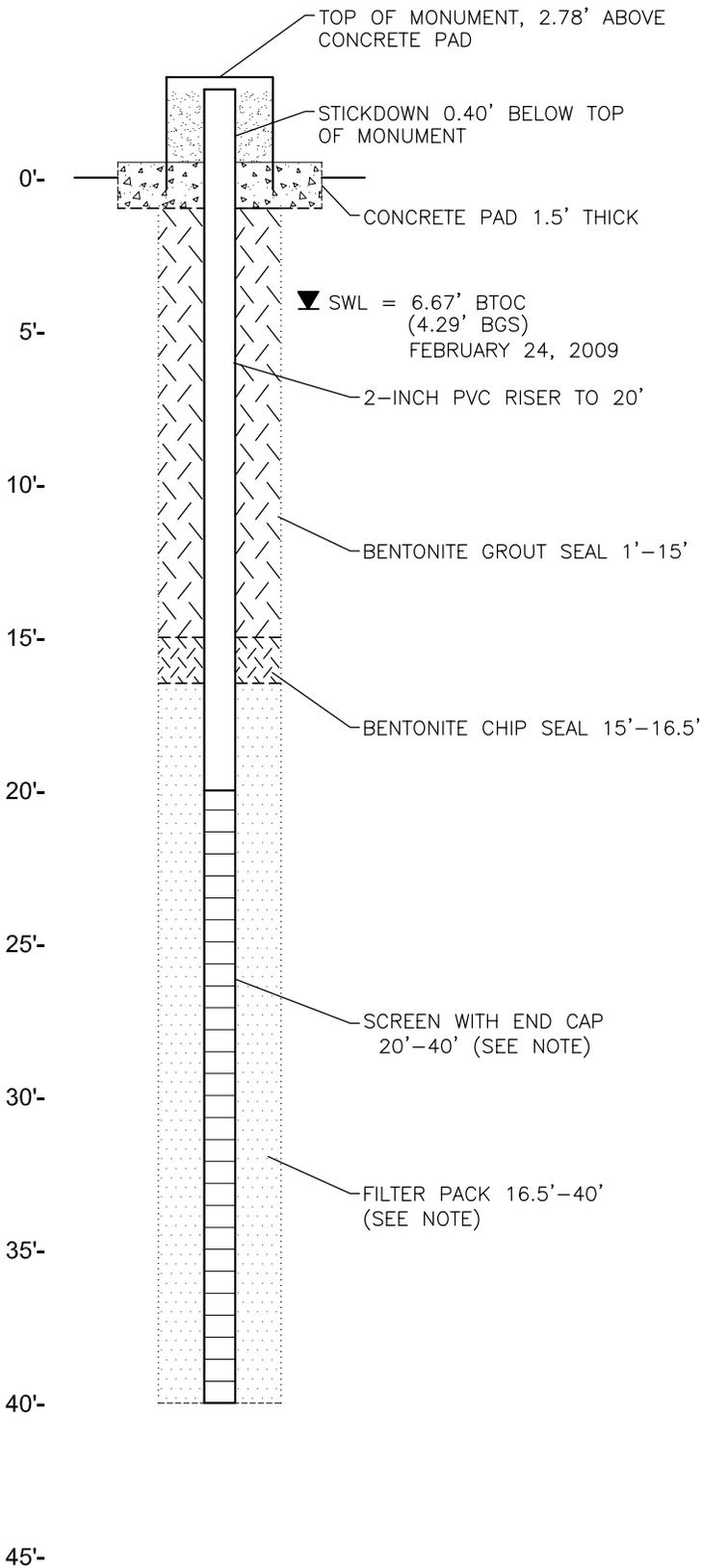
UNIQUE WELL ID: BBE 904

### Geologic Log



### Construction Detail

### Geologic Log



UNIQUE WELL ID: BBE 906

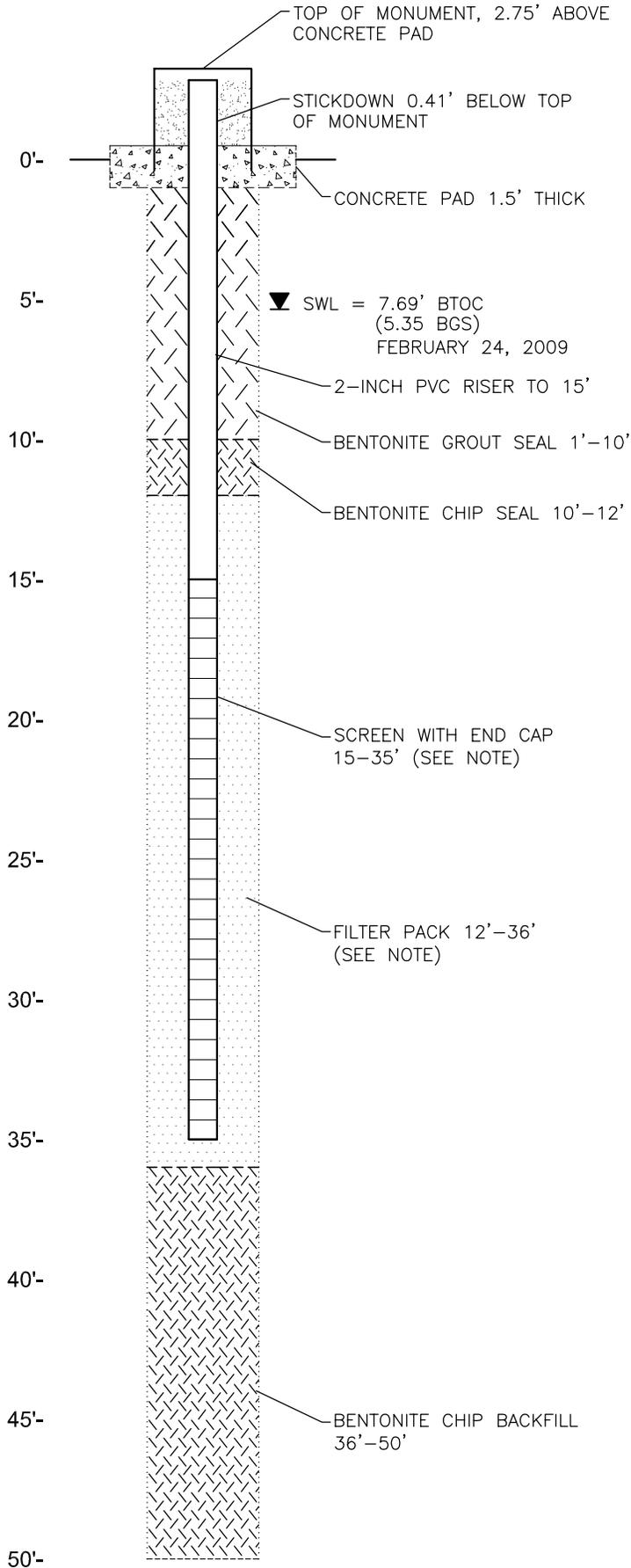


PM: MFP  
 T 08 N/R 02 W  
 Cowlitz County  
 April 2009

NOTE: WELL SCREEN IS 2-INCH SCHEDULE 40 PVC PIPE, 20-SLOT (0.020 OPENING). FILTER PACK IS 10x20 COLORADO SILICA SAND PRODUCT.

Figure 5  
 Construction Detail and Geologic Log for SW-4  
 City of Longview: Mint Farm Aquifer Characterization

### Construction Detail

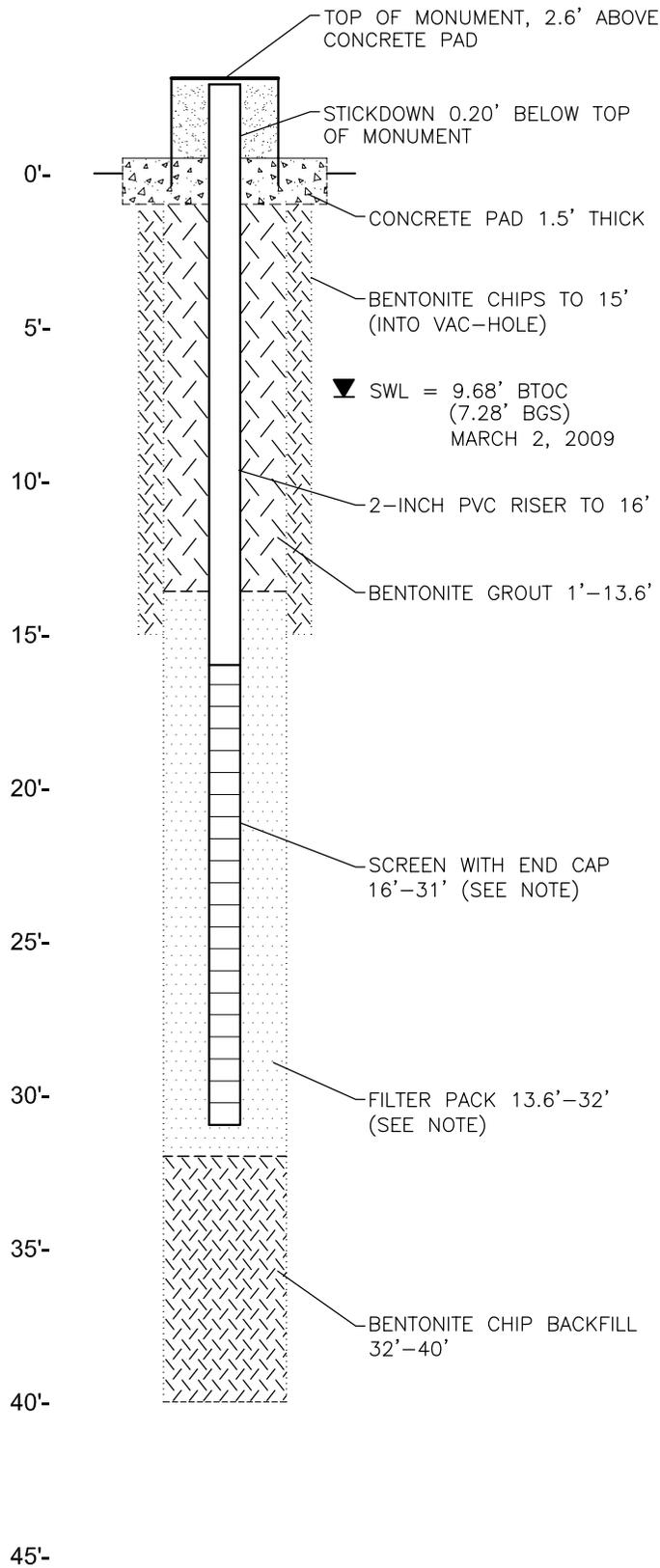


### Geologic Log

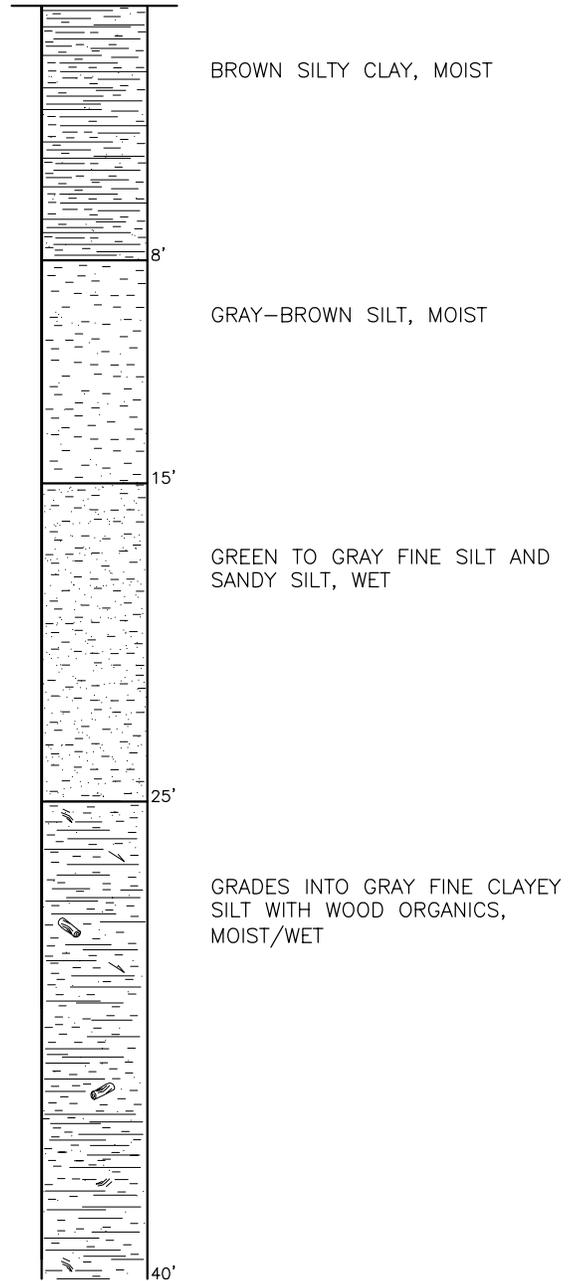


UNIQUE WELL ID: BBE 907

### Construction Detail

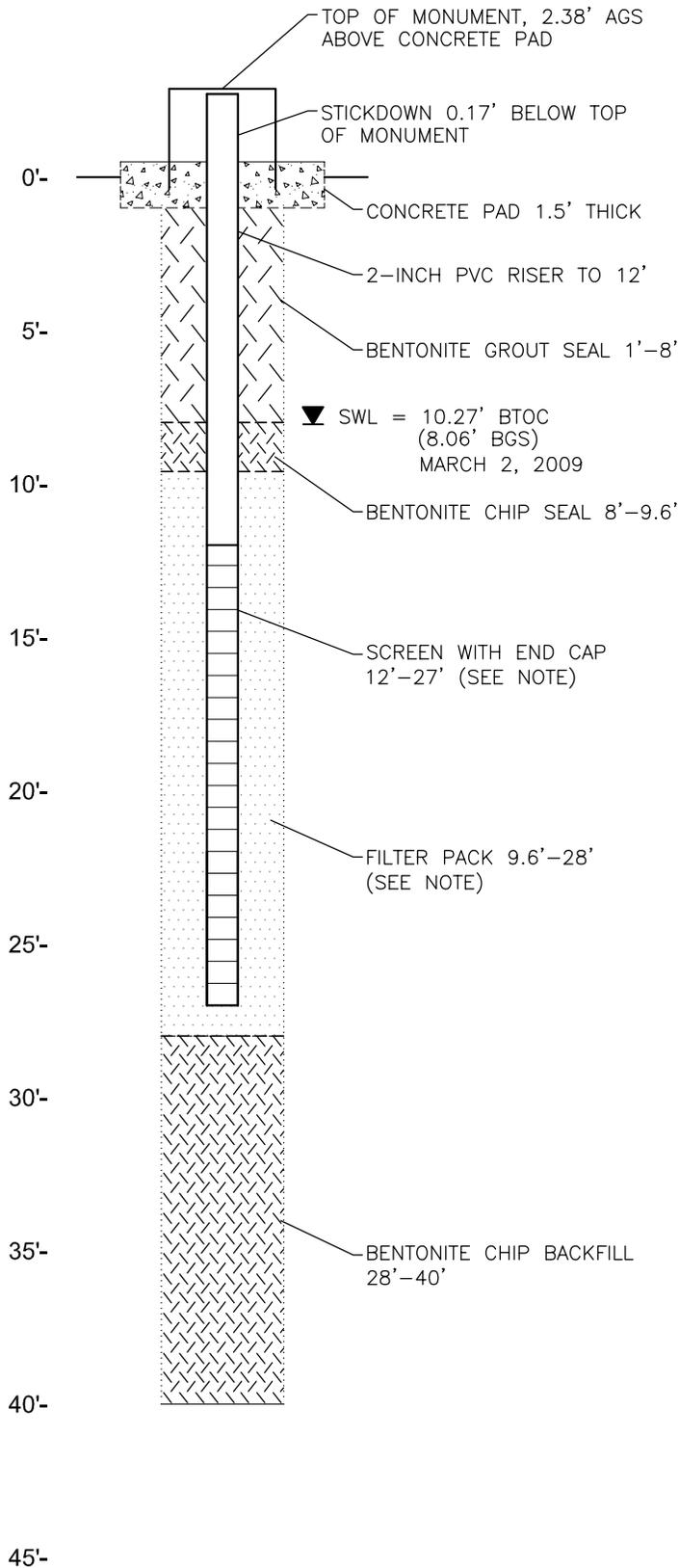


### Geologic Log

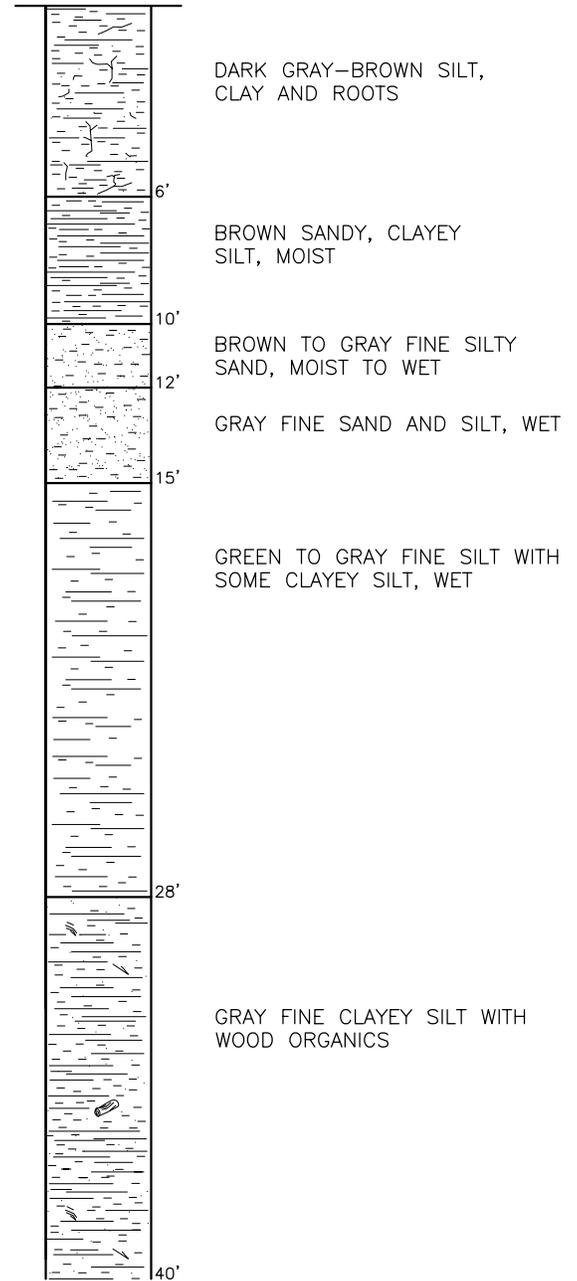


UNIQUE WELL ID: BBE 910

### Construction Detail



### Geologic Log



UNIQUE WELL ID: BBE 909