Santa Barbara County
PUBLIC Health
DEPARTMENT

Environmental Health Services

225 Camino del Remedio ◆ Santa Barbara, CA 93110
805/681-4900 ◆ FAX 805/681-4901

2125 S. Centerpointe Pkwy. #333 ◆ Santa Maria, CA 93455-1340
805/346-8460 ◆ FAX 805/346-8485

Takashi M. Wada, MD, MPH *Director/Health Officer*
Anne M. Fearon *Deputy Director*
Suzanne Jacobson, CPA *Chief Financial Officer*
Susan Klein-Rothschild, MSW *Deputy Director*
Elizabeth Snyder, MHA *Deputy Director*
Peter Hasler, MD *Medical Director*

Lawrence D. Fay, Jr. *Director of Environmental Health*

How to Pressure Grout LUFT and SMU Wells in Santa Barbara County

All well abandonments must comply with well destruction standards set forth in the Water Well Standards: State of California, Bulletin 74-81 (December 1981), California Well Standards, Bulletin 74-90 (June 1991), and Santa Barbara County Code, Chapter 34A.

Overdrilling of a well is required in the following cases:

- The construction log is not available;
- Narrow diameter sparge wells (e.g. w1/4" tubing, ¾" PVC, etc.); and/or
- The well was not constructed or maintained per the above referenced well standards.

Pressure grouting is allowed if none of the above conditions apply.

Where wells are destroyed by pressure grouting, the following will apply:

- Grout calculations shall be submitted to EHS for each well with the well destruction application (See next section for using the EHS Grout Calculator). The **EHS Grout Calculator** is available on this website;
- Grout shall be mixed in accordance to the specifications set forth in Bulletin 74-81, Section 9, Part D.
- Grout shall be placed into the well using a tremie pipe from the bottom of the well up.
- Any fluid exiting the wellhead shall be containerized and properly disposed.
- Pressure shall be applied to the well for a sufficient time and PSI to force the grout into the filterpack.
- The top five feet of the well shall be removed. A one foot thick "mushroom cap" shall be placed in the borehole atop the well. The remaining borehole shall be filled with suitable backfill material such that it is not it is not structurally tied to the well. The surface patch shall match existing grade materials in thickness and material.
- If a well does not take the calculated grout volume, then the well will be deemed to not have been properly pressure grouted and will have to be overdrilled. With nested wells all separate well zone must meet their individual calculated grout volume. If that does not occur in any separate zone, then the well zones that have not met the criteria will have to be overdrilled.

Grout Calculations –Standard Wells

Grout calculations can be made using the **EHS Grout Calculator** spreadsheet using the "Calcs – Standard Well" worksheet. Calculations are based upon five parts of the well:

1. Borehole Filterpack Below Casing;
2. Borehole Filterpack;

3. Casing Screen & Blank Adjacent to Filterpack;
4. Casing Blank Adjacent to Sealing Material; and
5. Mushroom Cap.

The following example is for a 4 inch diameter (2 inch radius) well inside a 10 inch diameter (5 inch radius) boring (see diagrams):

- Line 9, Borehole Filterpack Below Casing: In some cases, the well was constructed where the casing did not extend to the bottom of the borehole. For these wells, you will have to include the volume of filterpack below the casing. Most wells do not require this calculation. If there is no filterpack below the casing, enter "0" in the height column (Cell F9). In the example, this portion of the borehole extends from 37 to 40 feet, and would thus have a height of 3 feet (Cell F9). Enter "5" in the radius column B (Cell B9).
- Line 8, Borehole Filterpack: Enter the length of the filterpack. Do not include the length of any filterpack below the casing, as this was entered in Line 9. In the example, this portion of the borehole extends from 17 to 37 feet, and would, thus, have a height of 20 feet (Cell F8). Enter "5" in the radius column B (Cell B8).
- Line 7, Casing Screen & Blank Adjacent to Filterpack: Enter the total length of the screen plus the length of any blank casing adjacent to the filterpack. This would include any silt sumps below the screen and the 1-2 feet of blank casing that is above the screen. This number is usually the same as Line 8. In the example, this portion of the well extends from 17 to 37 feet, and would thus have a height of 20 feet (Cell F7). Enter "2" in the radius column B (Cell B7).
- Line 6, Casing Blank Adjacent to Sealing Material: Enter length of blank casing adjacent to the sealing material, minus 5 feet (as this will be drilled out). Do not include the length of blank casing adjacent to the filterpack, as that is included in Line 7. In the example, this portion of the well extends from 5 to 17 feet, and would thus have a height of 12 feet (Cell F6). Enter "2" in the radius column B (Cell B6).
- Line 10, Mushroom Cap: Enter the length of the mushroom cap, which is typically 1 foot. The radius of the mushroom cap will be based upon the radius of the auger used to overdrill the top 5 feet of the well. In the example page, the mushroom cap extends from 4 to 5 feet, and would thus have a height of 1 foot (Cell F10). Enter "5" in the radius column B (Cell B10), as a 10 inch diameter auger is used.
- Thus, our example would require 49.20 gallons of grout to properly abandon the well.
- **Remember to use the Radius of the borehole and casing and not the diameter.**

Grout Calculations –Nested Wells

Grout calculations can be made using the **EHS Grout Calculator** spreadsheet using the "Calcs – Nested Well" worksheet. Calculations are made separately for each well within the borehole.

The "Deeper well" calculations are based upon the following five parts of the well:

1. Borehole Filterpack Below Casing;
2. Borehole Filterpack;
3. Casing Screen & Blank Adjacent to Filterpack;
4. Casing Blank Adjacent to Sealing Material; and
5. Mushroom Cap.

The following example is for a 2 inch diameter (1 inch radius) well inside a 10 inch diameter (5 inch radius) boring:

- Line 9, Borehole Filterpack Below Casing: In some cases, the well was constructed where the casing did not extend to the bottom of the borehole. For these wells, you will have to include the volume of filterpack below the casing. Most wells do not require this calculation. If there is no filterpack below the casing, enter "0" in the height column (Cell F9). In the example, this portion of the borehole extends from 42 to 44 feet, and would thus have a height of 2 feet (Cell F9). Enter "5" in the radius column B (Cell B9).
- Line 8, Borehole Filterpack: Enter the length of the filterpack. Do not include the length of any filterpack below the casing, as this was entered in Line 9. In the example, this portion of the borehole extends from 30 to 42 feet, and would thus have a height of 12 feet (Cell F8). Enter "5" in the radius column B (Cell B8).
- Line 7, Casing Screen & Blank Adjacent to Filterpack: Enter the total length of the screen plus the length of any blank casing adjacent to the filterpack. This would include any silt sumps below the screen and the 1-2 feet of blank casing that is above the screen. This number is usually the same as Line 8. In the example, this portion of the well extends from 30 to 42 feet, and would thus have a height of 12 feet (Cell F7). Enter "1" in the radius column B (Cell B7).
- Line 6, Casing Blank Adjacent to Sealing Material and Shallower Well Filterpack: Enter length of blank casing adjacent to the sealing material and the shallower filterpack, minus 5 feet (as this will be drilled out). Do not include the length of blank casing adjacent to the deeper filterpack, as that is included in Line 7. In the example, this portion of the well extends from 5 to 30 feet, and would have a height of 25 feet (Cell F6). Enter "1" in the radius column B (Cell B6).
- Line 10, Mushroom Cap: Enter the length of the mushroom cap, which is typically 1 foot. The radius of the mushroom cap will be based upon the radius of the auger used to overdrill the top 5 feet of the well. In the example, the mushroom cap extends from 4 to 5 feet, and would have a height of 1 foot (Cell F10). Enter "5" in the radius column B (Cell B10), as a 10 inch diameter auger is used.
- Thus, our example would require 26.66 gallons of grout to properly abandon the deeper portion of the well.
- **Remember to use the Radius of the borehole and casing and not the diameter.**

The shallower well volume must now be calculated. The "Shallower well" calculations are based upon the following six parts of the well:

1. Borehole Filterpack below casing;
2. Borehole Filterpack;
3. Casing Screen & Blank Adjacent to Filterpack;
4. Casing Blank Adjacent to Sealing Material;
5. Deeper Casing within Shallow Filterpack, Adjacent to Shallow Screen; and
6. Deeper Casing Within the Filterpack, Below the Shallow Screen.

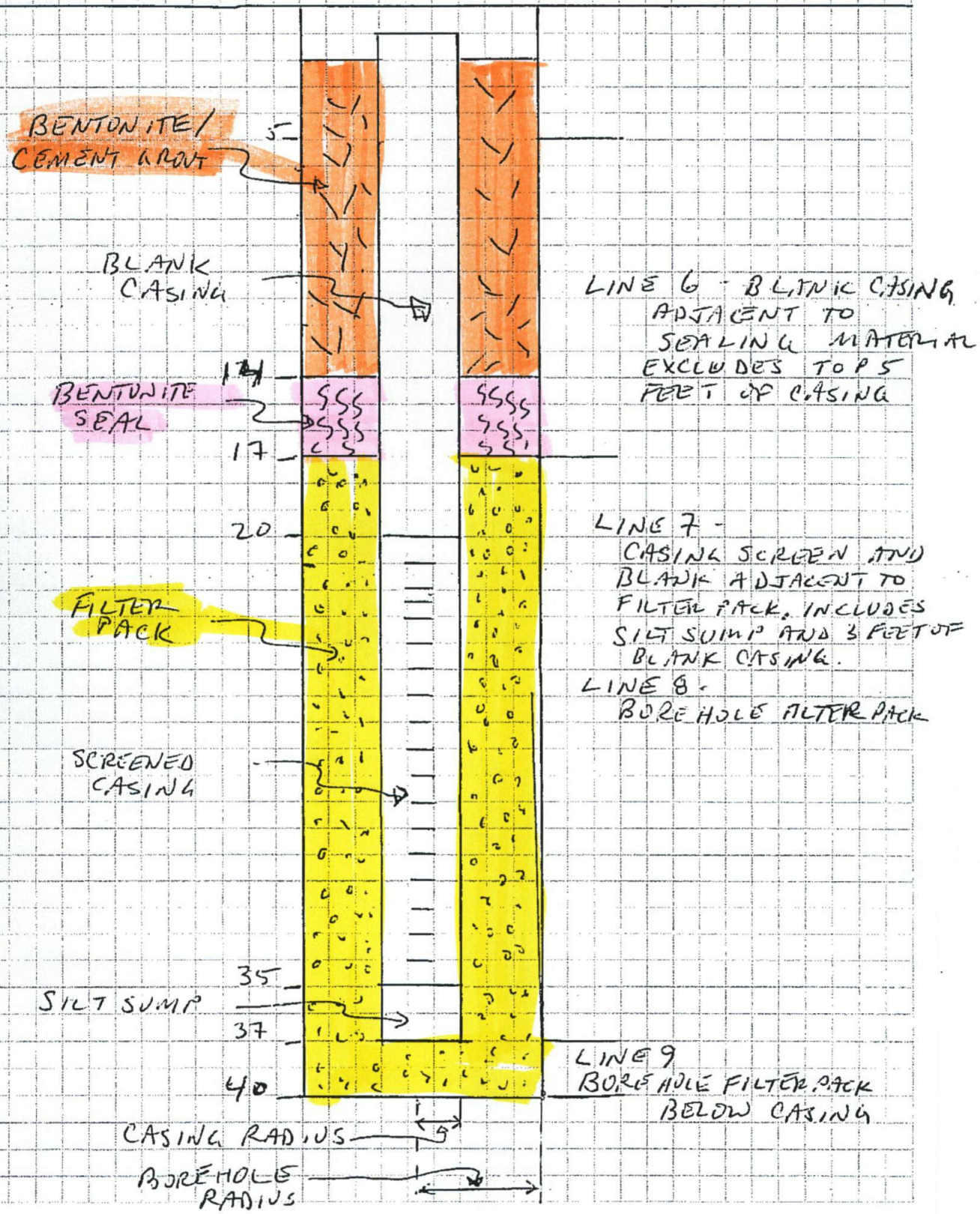
The following example is for a 2 inch diameter (1 inch radius) well inside a 10 inch diameter (5 inch radius) boring:

- Line 18, Borehole Filterpack Below Casing: In some cases, the shallow well was constructed where the casing did not extend to the bottom of the bentonite seal, which isolates the shallow and deep filterpacks. For these wells, you will have to include the volume of filterpack below the casing. Most wells do not require this calculation. If there is no filterpack below the casing, enter "0" in the height column (Cell F18). In the example, this portion of the well extends from 22 to 25 feet, and would have a height of 3 feet (Cell F18). Enter "5" in the radius column B (Cell B18). This line will also automatically subtract out the volume of the deeper casing that passes through this section of the shallow Filterpack (Line 20).
- Line 17, Borehole Filterpack: Enter the length of the filterpack. Do not include the length of any filterpack below the shallow casing, as this was entered in Line 18. In the example, this portion of the borehole extends from 15 to 22 feet, and would thus have a height of 7 feet (Cell F17). Enter "5" in the radius column B (Cell B17). This line also will automatically subtract out the volume of the deeper casing that passes through this section of the shallow Filterpack (Line 19).
- Line 16, Casing Screen & Blank adjacent to Filterpack: Enter the total length of the screen plus the length of any blank casing adjacent to the shallow filterpack. This would include any silt sumps below the screen and the 1-2 feet of blank casing that is above the screen. This number is usually the same as Line 17. In the example, this portion of the well extends from 15 to 22 feet, and would thus have a height of 7 feet (Cell F16). Enter "1" in the radius column B (Cell B16).
- Line 15, Casing Blank Adjacent to Sealing Material: Enter length of blank casing adjacent to the sealing material, minus 5 feet (as this will be drilled out). Do not include the length of blank casing adjacent to the shallow filterpack, as that is included in Line 16. In the example, this portion of the well extends from 5 to 15 feet, and would thus have a height of 10 feet (Cell F15). Enter "1" in the radius column B (Cell B15).
- Line 19, Deeper Casing Within the Filterpack, Adjacent to Shallow Screen: Enter the length of the deeper casing within the shallow filterpack. This volume will be automatically subtracted out of the shallow filterpack volume in Line 17. In the example, this portion of the well extends from 15 to 22 feet, and would have a height of 7 feet (Cell F19). Enter "1" in the radius column B (Cell B19).
- Line 20, Deeper Casing Within the Filterpack, Below the Shallow Screen: Enter the length of the deeper casing within the shallow Filterpack that is below the shallow screen. This length will be equal to the length entered in Line 18. This volume will be automatically subtracted out of the shallow filter pack volume in Line 18. In the example, this portion of the well extends from 22 to 25 feet, and would have a height of 3 feet (Cell F20). Enter "1" in the radius column B (Cell B20).
- A Mushroom Cap volume is not calculated for this well as it was already included in the deeper well calculations.
- Thus, our example would require 14.18 gallons of grout to properly abandon the shallow portion of the well.
- **Remember to use the Radius of the borehole and casing and not the diameter.**

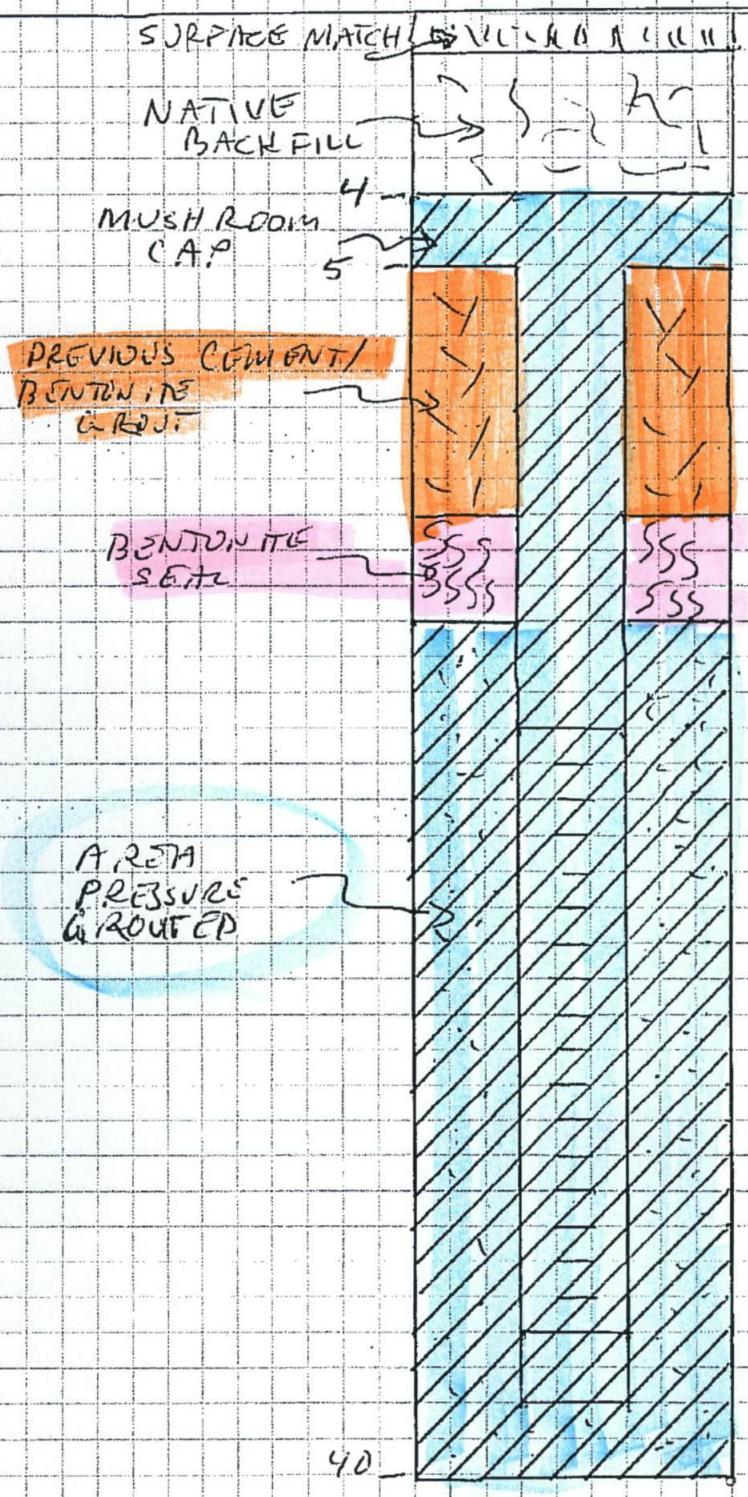
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Standard Well														
2															
3		radius in inches	pi	radius (ft)	radius^2 (ft^2)	height (ft)	Volume (ft^3)	Convert ft^3 to gals.	Volume (gals)	Total Filter pack vol. (gals)	Filter pack porosity	Effective Filter pack Vol. (gals)	Total volume (gals)		Actual Grout Used (gals)
4															
5															
6	Casing Blank adjacent to sealing material	2	3.1415	0.1667	0.0278	12	1.05	7.48	7.83				7.83		
7	Casing Screen & Blank adjacent to filter pack	2	3.1415	0.1667	0.0278	20	1.75	7.48	13.05				13.05		
8	Borehole Filterpack	5	3.1415	0.4167	0.1736	20	10.91	7.48	81.59	68.54	0.30	20.56	20.56		
9	Borehole Filterpack Below casing	5	3.1415	0.4167	0.1736	3	1.64	7.48	12.24		0.30	3.67	3.67		
10	Borehole Mushroom cap	5	3.1415	0.4167	0.1736	1	0.55	7.48	4.08				4.08		
11													49.20		
12															
13															
14															
15	Casing Blank = Length of Blank Casing Adjacent to seal/grout backfill (do not include 5 ' length to be drilled out)														
16	Casing Screen & Blank = Length of casing adjacent to filterpack														
17	Borehole Filterpack = Length of borehole annulus filled with filterpack														
18	Borehole Filterpack Below screen = Length of borehole filled with filterpack only below the well screen; Usually does not exist in most wells.														
19	Borehole Mushroom cap = length of borehole above casing cut off filled with grout (typically 1 foot)														
20	radius in inches = radius of casing or borehole (Not diameter)														
21	pi = 3.1415														
22	radius in feet = Radius in inches/12														
23	height = height of borehole or casing in feet														
24	ft^3= cubic feet, pi*r^2*h														
25	Feet to gallon = 7.48, conversion factor														
26	Volume in gallons = ft^3*7.48														
27	Total Filter pack volume = Borehole Filterpack volume - casing screen														
28	filterpack porosity = Assumed porosity of 30%														
29	Effective Filterpack Volume = Total Filter pack volume * Filterpack porosity														
30	Total Volume = Blank Casing + Screen Casing + Effective Filterpack Volume + Mushroom Cap														
31	User Defined Value														

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Nested Well														
2															
3		radius in inches	pi	radius (ft)	radius^2 (ft^2)	height (ft)	Volume (ft^3)	Convert ft^3 to gals.	Volume (gals)	Total Filter pack vol. (gals)	Filter pack porosity	Effective Filter pack Vol. (gals)	Total volume (gals)		Actual Grout Used (gals)
4															
5	**Deeper Well**														
6	Casing Blank adjacent to sealing material and Shallow well Filter	1	3.1415	0.0833	0.0069	25	0.55	7.48	4.08				4.08		
7	Casing Screen & Blank adjacent to filter pack	1	3.1415	0.0833	0.0069	12	0.26	7.48	1.96				1.96		
8	Borehole Filterpack	5	3.1415	0.4167	0.1736	12	6.54	7.48	48.96	47.00	0.30	14.10	14.10		
9	Borehole Filterpack Below casing	5	3.1415	0.4167	0.1736	2	1.09	7.48	8.16		0.30	2.45	2.45		
10	Borehole Mushroom cap	5	3.1415	0.4167	0.1736	1	0.55	7.48	4.08				4.08		
11													26.66		
12		radius in inches	pi	radius (ft)	radius^2 (ft^2)	height (ft)	Volume (ft^3)	Convert ft^3 to gals.	Volume (gals)	Total Filter pack vol. (gals)	Filterpack porosity	Effective Filterpack Vol. (gals)	Total volume (gals)		Actual Grout Used (gals)
13															
14	**Shallower Well**														
15	Casing Blank adjacent to sealing material	1	3.1415	0.0833	0.0069	10	0.22	7.48	1.63				1.63		
16	Casing Screen & Blank adjacent to filter pack	1	3.1415	0.0833	0.0069	7	0.15	7.48	1.14				1.14		
17	Borehole Filterpack	5	3.1415	0.4167	0.1736	7	3.82	7.48	28.56	26.27	0.30	7.88	7.88		
18	Borehole Filterpack Below casing	5	3.1415	0.4167	0.1736	3	1.64	7.48	12.24	11.75	0.30	3.52	3.52		
19	Deeper Casing within Filter Pack, adjacent to Shallow Screen	1	3.1415	0.0833	0.0069	7	0.15	7.48	1.14						
20	Deeper Casing within Filter Pack, below the Shallow Screen	1	3.1415	0.0833	0.0069	3	0.07	7.48	0.49						
21													14.18		
22															
23															
24	Casing Blank = Length of Blank Casing Adjacent to seal/grout backfill (do not include 5 ' length to be drilled out)														
25	Casing Screen & Blank = Length of casing adjacent to filterpack														
26	Borehole Filterpack = Length of borehole annulus filled with Filter pack														
27	Borehole Filterpack Below screen = Length of borehole filled with filterpack only below the well screen; Usually does not exist in most wells.														
28	Borehole Mushroom cap = length of borehole above casing cut off filled with grout (typically 1 foot)														
29	radius in inches = radius of casing or borehole (Not diameter)														
30	pi = 3.1415														
31	radius in feet = Radius in inches/12														
32	height = height of borehole or casing in feet														
33	ft^3= cubic feet, pi*r^2*h														
34	Feet to gallon = 7.48, conversion factor														
35	gallon = ft^3*7.48														
36	Total Filter pack volume = Borehole Filterpack volume - casing screen														
37	filterpack porosity = Assumed porosity of 30%														
38	Effective Filterpack Volume = Total Filter pack volume * Filterpack porosity														
39	Total Volume = Blank Casing + Screen Casing + Effective Filterpack Volume + Mushroom Cap														
40	User Defined Value														

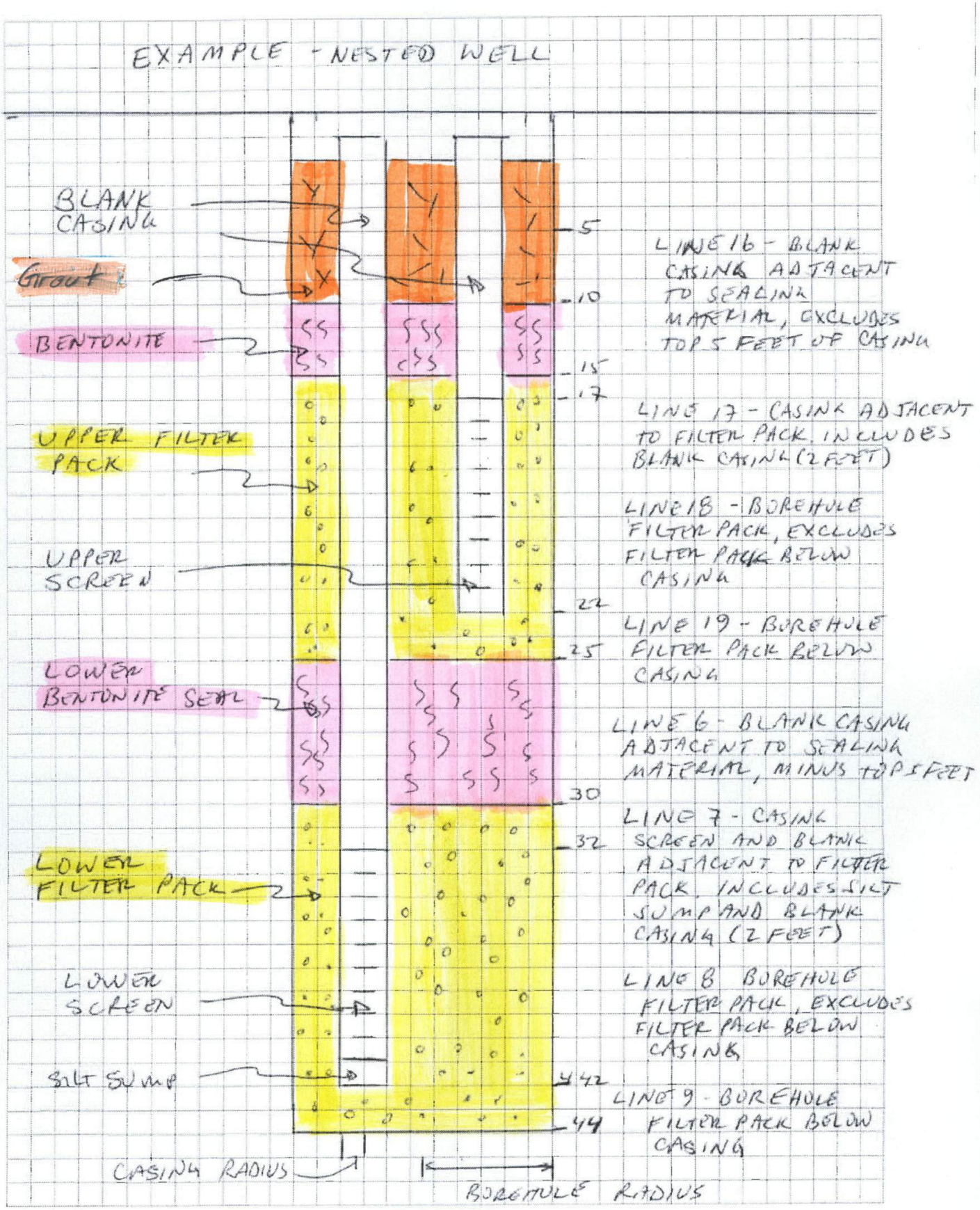
EXAMPLE WELL DIAGRAM



COMPLETED ABANDONED WELL



EXAMPLE - NESTED WELL



COMPLETED ABANDONMENT - NESTED WELL