1. **Class B Designer authority and responsibility** - statute and rules WWR pg.49

   A. 1,350 GPD, shared systems, individual pipe connections, non-public systems.

   B. The design authority for a project may be split between an engineer and a non-engineer with one person doing either the water system or the wastewater system and the other person doing the other system.

   C. If any portion of the water or wastewater system requires that an engineer prepare the design, the entire water or wastewater system shall be designed by an engineer.

   D. A Class B Designer can design a shared water supply serving two single family residences, with each residence on its own lot, prior to completing the training and testing process. A Class B Designer may design a single pipe municipal water line connection serving a single family residence on its own lot. A Class B designer may not design a water system when the project involves anything other than one single family residence on a lot, even if the buildings are detached and each served by its own water supply, until completing the training and testing process.

   E. When the inspection certification must be done by a designer, the designer shall be qualified to design what is being inspected. Some inspections may be performed by an installer, such as the well driller. The Rules and permit conditions determine the requirements for inspections.

   F. Expectations of quality work.

2. **Basic authority of the Water Supply Rules (WSR)**

   A. Difference between the WSR and the Wastewater System and Potable Water Supply Rules (WWR) (page 55 of the WWR Rules)

   B. Definitions in the Water Supply Rule – WSR Appendices A, page 102

   C. Which water supplies are regulated? – review the exemption forms

   D. Variances – page 22 of the WSR and page 61 of the WWR

3. **Source approval**

A. Basis of Design, plans and specifications, WSR Appendices page 104 **checklist**

B. Design flow – average day demand, WSR Appendices page 106, WWR page 65 **worksheet**

C. Maximum day demand – minimum well yield Appendices page 106, Appendices page 122

D. Peak demand – plumbing code fixture units concepts, Appendices page 106, continuous flow fixtures versus intermittent flow fixtures, IPC 2009 **worksheet**

E. Isolation distances – Appendices page 107

Confined versus unconfined aquifers – Appendices page 111

Well Shield – **worksheet**

F. Construction standards – Appendices page 112

G. Quantity testing – Appendices page 113

i. Pump testing (usually based on ½ well driller's yield)

ii. Interference testing

iii. Long term yield calculations

H. Quality testing – Appendices page 116

4. **Distribution system issues**

A. Requirements for flow and pressure at buildings – including systems with more than one building – based on calculations of static and dynamic head and friction loss. **checklist and worksheet**

B. General details – Appendices page 118

C. Disinfection – Appendices page 118 and 137

D. Storage requirements – Appendices page 122

i. Instantaneous peak yield testing

ii. Storage volume required – **worksheet**

iii. Casing storage – Appendices page 123 – **worksheet**

iv. Construction details – Coatings – Use NSF Certified Potable Water materials. Website: WWW.NSF.ORG

v. Disinfection – Appendices page 127

vi. Reasons and methods to avoid storage

E. Distribution system design – Appendices page 128

i. Standard construction issues – tap, corporation stop, gooseneck, curb stop, valve box, piping materials, joint systems

ii. Trenching, bedding, roadways, source protection areas

iii. Crossing and parallel installation issues

iv. Pumps – sizing for flow and head worksheet

v. Booster pumps – prohibition of inline booster pumps

vi. Cross connections

5. **Well construction standards for various types of wells**

A. Shallow wells – Appendices page 112

B. Drilled wells – Appendices page 137

C. Decisions that must be made by the licensed designer versus the well driller including:

1. Well relocation from approved plans

2. Change from bedrock to gravel

3. Change in storage or pump capacities

D. What must be certified on the plans and in the inspection by the licensed designer versus the well driller? Primarily storage and distribution issues.

6. Well abandonment issues – Appendices page 139

Water Supply Design Checklist 10-15-2014

Note: This is an incomplete start at a checklist which might be a basis for developing your own more complete checklist.

1. Average day demand _____
2. Maximum day demand _____
3. Instantaneous peak demand _____
4. Source capacity _____
5. Storage capacity _____
6. Pump capacities
   - A. Well pump _____
   - B. Booster pump _____

     Note: See restrictions on page 132 of the WSR Appendices
7. Operating pressures _____
   - A. At highest fixture _____
   - B. At pressure tank _____
   - C. Highest pressure in the system _____
8. Flood plain issues

   Located within the floodplain but not floodway?

   If yes:
   - A. Elevation of grading around well _____
   - B. Elevation of top of casing _____

   Note: new sources in the floodway are prohibited except by variance (note e. on page 107 of the WSR Appendices
9. Hazardous site issues _____
10. Plans and specifications
    - A. Plan view
    - B. Surface drainage and general topography
    - C. Neighboring wells, wastewater systems, and their piping locations

D. Well shields

E. Location of system components – piping, valving, storage

F. Specific construction standards

11. Isolation distances

A. If the well is not cased into competent bedrock, is the well finished in the unconsolidated aquifer to which a wastewater system discharges? If so, use shallow well isolation distances.

B. Check for agricultural cropland and ROW where herbicides are used.

12. Quantity testing

A. Well driller's estimate _____GPM

B. Long term yield based on pump test _____GPM

C. Instantaneous yield test _____ GPM

D. Checked for interference

13. Quality testing

A. Required for anything other than SRF

B. Required for SFR when there is reason to suspect contamination

Worksheet for Water System and Wastewater System Design Flow Calculations 10-15-2014

For the purposes of this worksheet, use the minimum possible design flow.

1. Three SFRs with 4 bedrooms each connected to a municipal wastewater collection system with a design flow of at least 50,000 GPD and individual drilled wells.

   Water system average daily demand _____

   Water system maximum daily demand _____

   Wastewater system design flow _____

2. One SFR with 3 bedrooms, plus an office building with 15 employees with a total of three bathroom groups, plus a one bedroom owner's quarters, all connected to the same soil based wastewater system of less than 50,000 GPD design flow and connection to a shared on-site drilled well.

   Water system average daily demand _____

   Water system maximum daily demand _____

   Wastewater system design flow _____

Worksheet for Peak Demand Calculations 10-15-2014

1. Basic concepts

   A. A project may have more than one connection, particularly when a municipal water supply is involved. All calculations are based on the plumbing fixtures and other uses supplied through a particular pipe, not on the total for the whole project. (Review Diagram)

   B. Plumbing fixtures such as toilets and lavatories use the conversion charts to determine peak demand as these are considered to be intermittent flow fixtures. The calculation starts with fixture units and is converted to GPM.

      Hose bibbs, lawn watering systems, and similar uses are considered continuous flow fixtures and their flow is calculated based on the GPM flow of those fixtures. Sillcocks (hose bibbs) are listed at 5 GPM in the Plumbing Code. Other flows are not listed in the plumbing code as they vary with the particular unit used. Use conservative assumptions of flow or determine the capacity of the particular unit proposed for installation.

      Peak demand is determined by adding the two numbers together.

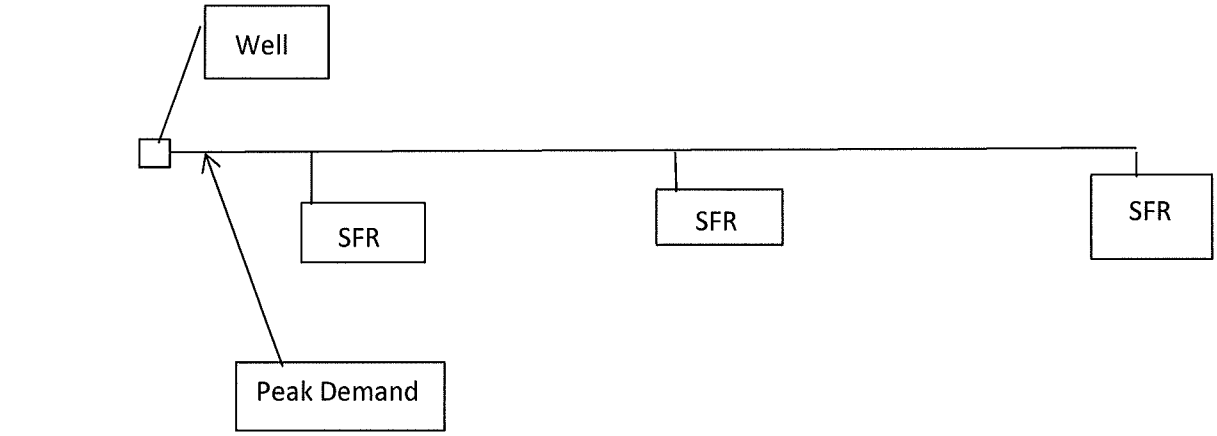
(Use fixture unit method, not an assumption of 5 GPM per unit.)

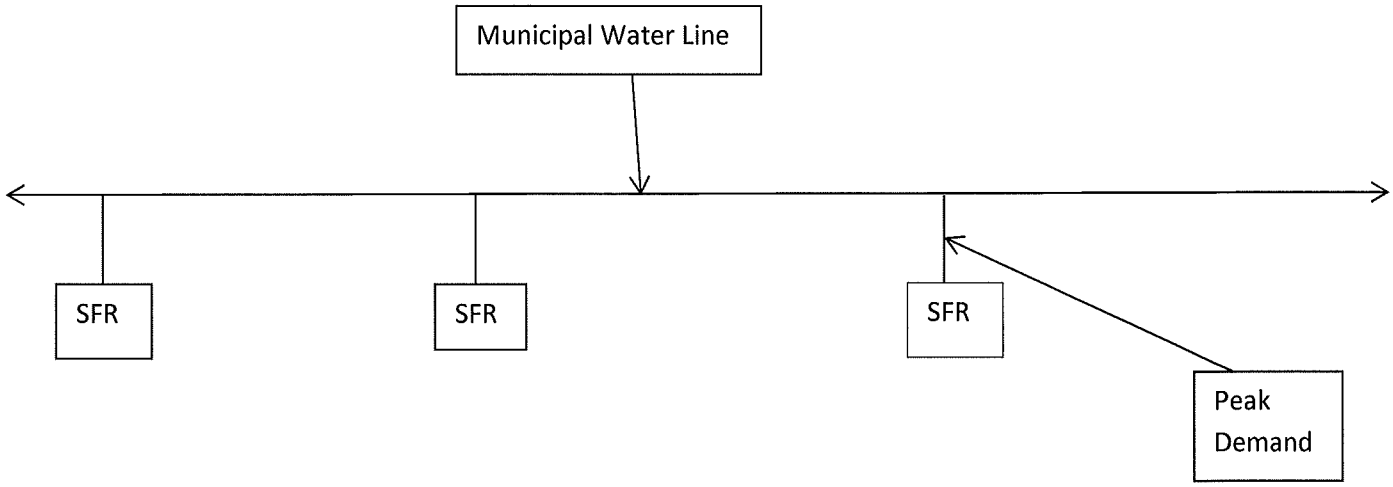
1. Three SFR with two full baths, a kitchen sink, and one hose bibb for each unit.

2. One SFR with full bath and a kitchen sink, plus three office spaces with ½ bath in each office space.

3. Store with ½ bath for employees and a deli operation. Deli has a three bay sink, a handwash sink, and a dishwasher.

Diagram for Peak Flow Calculation 10-15-2014





BACKWATER VALVE. A device or valve installed in the *building drain* or *sewer* pipe where a *sewer* is subject to backflow, and which prevents drainage or waste from backing up into a lower level or fixtures and causing a flooding condition.

BASE FLOOD ELEVATION. A reference point, determined in accordance with the building code, based on the depth or peak elevation of flooding, including wave height, which has a 1 percent (100-year flood) or greater chance of occurring in any given year.

BATHROOM GROUP. A group of fixtures consisting of a water closet, lavatory, bathtub or shower, including or excluding a bidet, an *emergency floor drain* or both. Such fixtures are located together on the same floor level.

BEDPAN STEAMER OR BOILER. A fixture utilized for scalding bedpans or urinals by direct application of steam or boiling water.

BEDPAN WASHER AND STERILIZER. A fixture designed to wash bedpans and to flush the contents into the sanitary drainage system. Included are fixtures of this type that provide for disinfecting utensils by scalding with steam or *hot water*.

BEDPAN WASHER HOSE. A device supplied with hot and cold water and located adjacent to a water closet or clinical sink to be utilized for cleansing bedpans.

BRANCH. Any part of the piping system except a riser, main or *stack*.

BRANCH INTERVAL. A vertical measurement of distance, 8 feet (2438 mm) or more in *developed length*, between the connections of horizontal branches to a drainage *stack*. Measurements are taken down the *stack* from the highest horizontal *branch* connection.

BRANCH VENT. A vent connecting one or more individual vents with a vent *stack* or *stack* vent.

[A] BUILDING. Any structure occupied or intended for supporting or sheltering any *occupancy*.

BUILDING DRAIN. That part of the lowest piping of a drainage system that receives the discharge from soil, waste and other drainage pipes inside and that extends 30 inches (762 mm) in *developed length* of pipe beyond the exterior walls of the building and conveys the drainage to the *building sewer*.

Combined. A *building drain* that conveys both sewage and storm water or other drainage.

Sanitary. A *building drain* that conveys sewage only.

Storm. A *building drain* that conveys storm water or other drainage, but not sewage.

BUILDING SEWER. That part of the drainage system that extends from the end of the *building drain* and conveys the discharge to a *public sewer*, *private sewer*, individual sewage disposal system or other point of disposal.

Combined. A *building sewer* that conveys both sewage and storm water or other drainage.

Sanitary. A *building sewer* that conveys sewage only.

Storm. A *building sewer* that conveys storm water or other drainage, but not sewage.

BUILDING SUBDRAIN. That portion of a drainage system that does not drain by gravity into the *building sewer*.

BUILDING TRAP. A device, fitting or assembly of fittings installed in the *building drain* to prevent circulation of air between the drainage system of the building and the *building sewer*.

CIRCUIT VENT. A vent that connects to a horizontal drainage *branch* and vents two traps to a maximum of eight traps or trapped fixtures connected into a battery.

CISTERN. A small covered tank for storing water for a home or farm. Generally, this tank stores rainwater to be utilized for purposes other than in the potable water supply, and such tank is placed underground in most cases.

CLEANOUT. An *access* opening in the drainage system utilized for the removal of obstructions. Types of cleanouts include a removable plug or cap, and a removable fixture or fixture trap.

[A] CODE. These regulations, subsequent amendments thereto, or any emergency rule or regulation that the administrative authority having jurisdiction has lawfully adopted.

[A] CODE OFFICIAL. The officer or other designated authority charged with the administration and enforcement of this code, or a duly authorized representative.

COMBINATION FIXTURE. A fixture combining one sink and laundry tray or a two- or three-compartment sink or laundry tray in one unit.

COMBINATION WASTE AND VENT SYSTEM. A specially designed system of waste piping embodying the horizontal wet venting of one or more sinks, lavatories, drinking fountains or floor drains by means of a common waste and vent pipe adequately sized to provide free movement of air above the flow line of the drain.

COMBINED BUILDING DRAIN. See "*Building drain*, combined."

COMBINED BUILDING SEWER. See "*Building sewer*, combined."

COMMON VENT. A vent connecting at the junction of two fixture drains or to a fixture *branch* and serving as a vent for both fixtures.

CONCEALED FOULING SURFACE. Any surface of a plumbing fixture which is not readily visible and is not scoured or cleansed with each fixture operation.

CONDUCTOR. A pipe inside the building that conveys storm water from the roof to a storm or combined *building drain*.

[A] CONSTRUCTION DOCUMENTS. All of the written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of the project necessary for obtaining a building permit. The construction drawings shall be drawn to an appropriate scale.

age pits (see Section 605.1 for soil and groundwater conditions).

SECTION 604
DESIGN OF BUILDING WATER DISTRIBUTION SYSTEM

604.1 General. The design of the water distribution system shall conform to *accepted engineering practice*. Methods utilized to determine pipe sizes shall be *approved*.

604.2 System interconnection. At the points of interconnection between the hot and cold water supply piping systems and the individual fixtures, appliances or devices, provisions shall be made to prevent flow between such piping systems.

604.3 Water distribution system design criteria. The water distribution system shall be designed, and pipe sizes shall be selected such that under conditions of peak demand, the capacities at the fixture supply pipe outlets shall not be less than shown in Table 604.3. The minimum flow rate and flow pressure provided to fixtures and appliances not listed in Table 604.3 shall be in accordance with the manufacturer's installation instructions.

TABLE 604.3
WATER DISTRIBUTION SYSTEM DESIGN CRITERIA REQUIRED CAPACITY AT FIXTURE SUPPLY PIPE OUTLETS

FIXTURE SUPPLY OUTLET SERVING	FLOW RATE[a] (gpm)	FLOW PRESSURE (psi)
Bathtub, balanced-pressure, thermostatic or combination balanced-pressure/thermo-static mixing valve	4	20
Bidet, thermostatic mixing valve	2	20
Combination fixture	4	8
Dishwasher, residential	2.75	8
Drinking fountain	0.75	8
Laundry tray	4	8
Lavatory	2	8
Shower	3	8
Shower, balanced-pressure, thermostatic or combination balanced-pressure/thermo-static mixing valve	3	20
Sillcock, hose bibb	5	8
Sink, residential	2.5	8
Sink, service	3	8
Urinal, valve	12	25
Water closet, blow out, flushometer valve	25	45
Water closet, flushometer tank	1.6	20
Water closet, siphonic, flushometer valve	25	35
Water closet, tank, close coupled	3	20
Water closet, tank, one piece	6	20

For SI: 1 pound per square inch = 6.895 kPa,
1 gallon per minute = 3.785 L/m.

a. For additional requirements for flow rates and quantities, see Section 604.4.

604.4 Maximum flow and water consumption. The maximum water consumption flow rates and quantities for all plumbing fixtures and fixture fittings shall be in accordance with Table 604.4.

Exceptions:

1. Blowout design water closets having a water consumption not greater than $3^1/_2$ gallons (13 L) per flushing cycle.
2. Vegetable sprays.
3. Clinical sinks having a water consumption not greater than $4^1/_2$ gallons (17 L) per flushing cycle.
4. Service sinks.
5. Emergency showers.

TABLE 604.4
MAXIMUM FLOW RATES AND CONSUMPTION FOR PLUMBING FIXTURES AND FIXTURE FITTINGS

PLUMBING FIXTURE OR FIXTURE FITTING	MAXIMUM FLOW RATE OR QUANTITY[b]
Lavatory, private	2.2 gpm at 60 psi
Lavatory, public (metering)	0.25 gallon per metering cycle
Lavatory, public (other than metering)	0.5 gpm at 60 psi
Shower head[a]	2.5 gpm at 80 psi
Sink faucet	2.2 gpm at 60 psi
Urinal	1.0 gallon per flushing cycle
Water closet	1.6 gallons per flushing cycle

For SI: 1 gallon = 3.785 L, 1 gallon per minute = 3.785 L/m,
1 pound per square inch = 6.895 kPa.

a. A hand-held shower spray is a shower head.

b. Consumption tolerances shall be determined from referenced standards.

604.5 Size of fixture supply. The minimum size of a fixture supply pipe shall be as shown in Table 604.5. The fixture supply pipe shall terminate not more than 30 inches (762 mm) from the point of connection to the fixture. A reduced-size flexible water connector installed between the supply pipe and the fixture shall be of an *approved* type. The supply pipe shall extend to the floor or wall adjacent to the fixture. The minimum size of individual distribution lines utilized in gridded or parallel water distribution systems shall be as shown in Table 604.5.

604.6 Variable street pressures. Where street water main pressures fluctuate, the building water distribution system shall be designed for the minimum pressure available.

604.7 Inadequate water pressure. Wherever water pressure from the street main or other source of supply is insufficient to provide flow pressures at fixture outlets as required under Table 604.3, a water pressure booster system conforming to Section 606.5 shall be installed on the building water supply system.

604.8 Water pressure reducing valve or regulator. Where water pressure within a building exceeds 80 psi (552 kPa) static, an *approved* water-pressure reducing valve conforming to ASSE 1003 or CSA B356 with strainer shall be

Peak Demand Page 1

TABLE E103.3(2) LOAD VALUES ASSIGNED TO FIXTURES[a]

FIXTURE	OCCUPANCY	TYPE OF SUPPLY CONTROL	LOAD VALUES, IN WATER SUPPLY FIXTURE UNITS (wsfu)		
			Cold	Hot	Total
Bathroom group	Private	Flush tank	2.7	1.5	3.6
Bathroom group	Private	Flush valve	6.0	3.0	8.0
Bathtub	Private	Faucet	1.0	1.0	1.4
Bathtub	Public	Faucet	3.0	3.0	4.0
Bidet	Private	Faucet	1.5	1.5	2.0
Combination fixture	Private	Faucet	2.25	2.25	3.0
Dishwashing machine	Private	Automatic	—	1.4	1.4
Drinking fountain	Offices, etc.	$^3/_8$" valve	0.25	—	0.25
Kitchen sink	Private	Faucet	1.0	1.0	1.4
Kitchen sink	Hotel, restaurant	Faucet	3.0	3.0	4.0
Laundry trays (1 to 3)	Private	Faucet	1.0	1.0	1.4
Lavatory	Private	Faucet	0.5	0.5	0.7
Lavatory	Public	Faucet	1.5	1.5	2.0
Service sink	Offices, etc.	Faucet	2.25	2.25	3.0
Shower head	Public	Mixing valve	3.0	3.0	4.0
Shower head	Private	Mixing valve	1.0	1.0	1.4
Urinal	Public	1" flush valve	10.0	—	10.0
Urinal	Public	$^3/_4$" flush valve	5.0	—	5.0
Urinal	Public	Flush tank	3.0	—	3.0
Washing machine (8 lb)	Private	Automatic	1.0	1.0	1.4
Washing machine (8 lb)	Public	Automatic	2.25	2.25	3.0
Washing machine (15 lb)	Public	Automatic	3.0	3.0	4.0
Water closet	Private	Flush valve	6.0	—	6.0
Water closet	Private	Flush tank	2.2	—	2.2
Water closet	Public	Flush valve	10.0	—	10.0
Water closet	Public	Flush tank	5.0	—	5.0
Water closet	Public or private	Flushometer tank	2.0	—	2.0

http://publicecodes.cyberregs.com/icod/ipc/2009/icod_ipc_2009_appe_sec003.htm#top

Peak Demand Page 2

TABLE E103.3(3) TABLE FOR ESTIMATING DEMAND

SUPPLY SYSTEMS PREDOMINANTLY FOR FLUSH TANKS			SUPPLY SYSTEMS PREDOMINANTLY FOR FLUSH VALVES		
Load	Demand		Load	Demand	
(Water supply fixture units)	(Gallons per minute)	(Cubic feet per minute)	(Water supply fixture units)	(Gallons per minute)	(Cubic feet per minute)
1	3.0	0.04104	—	—	—
2	5.0	0.0684	—	—	—
3	6.5	0.86892	—	—	—
4	8.0	1.06944	—	—	—
5	9.4	1.256592	5	15.0	2.0052
6	10.7	1.430376	6	17.4	2.326032
7	11.8	1.577424	7	19.8	2.646364
8	12.8	1.711104	8	22.2	2.967696
9	13.7	1.831416	9	24.6	3.288528
10	14.6	1.951728	10	27.0	3.60936
11	15.4	2.058672	11	27.8	3.716304
12	16.0	2.13888	12	28.6	3.823248
13	16.5	2.20572	13	29.4	3.930192
14	17.0	2.27256	14	30.2	4.037136
15	17.5	2.3394	15	31.0	4.14408
16	18.0	2.90624	16	31.8	4.241024
17	18.4	2.459712	17	32.6	4.357968
18	18.8	2.513184	18	33.4	4.464912
19	19.2	2.566656	19	34.2	4.571856
20	19.6	2.620128	20	35.0	4.6788
25	21.5	2.87412	25	38.0	5.07984
30	23.3	3.114744	30	42.0	5.61356
35	24.9	3.328632	35	44.0	5.88192
40	26.3	3.515784	40	46.0	6.14928
45	27.7	3.702936	45	48.0	6.41664
50	29.1	3.890088	50	50.0	6.684
60	32.0	4.27776	60	54.0	7.21872
70	35.0	4.6788	70	58.0	7.75344
80	38.0	5.07984	80	61.2	8.181216
90	41.0	5.48088	90	64.3	8.595624
100	43.5	5.81508	100	67.5	9.0234
120	48.0	6.41664	120	73.0	9.75864
140	52.5	7.0182	140	77.0	10.29336
160	57.0	7.61976	160	81.0	10.82808
180	61.0	8.15448	180	85.5	11.42964
200	65.0	8.6892	200	90.0	12.0312
225	70.0	9.3576	225	95.5	12.76644
250	75.0	10.026	250	101.0	13.50168

Form for Peak Demand Calculations 10-15-2014

Intermittent Flow Fixtures

Type of Fixture	Load Value per Unit	# of Units	Total

Total load value for all fixtures _____

GPM based on conversion using table _____

Continuous Flow Fixtures

Type of Fixtures	GPM per Unit	# of Units	Total GPM

Total GPM for Continuous Flow Fixtures _____

GPM (from load values) + GPM (continuous flow) = Peak Demand in GPM _____

Form for Peak Demand Calculations 10-15-2014

Intermittent Flow Fixtures

Type of Fixture	Load Value per Unit	# of Units	Total

Total load value for all fixtures _____

GPM based on conversion using table _____

Continuous Flow Fixtures

Type of Fixtures	GPM per Unit	# of Units	Total GPM

Total GPM for Continuous Flow Fixtures _____

GPM (from load values) + GPM (continuous flow) = Peak Demand in GPM _____

Form for Peak Demand Calculations 10-15-2014

Intermittent Flow Fixtures

Type of Fixture	Load Value per Unit	# of Units	Total

Total load value for all fixtures _____

GPM based on conversion using table _____

Continuous Flow Fixtures

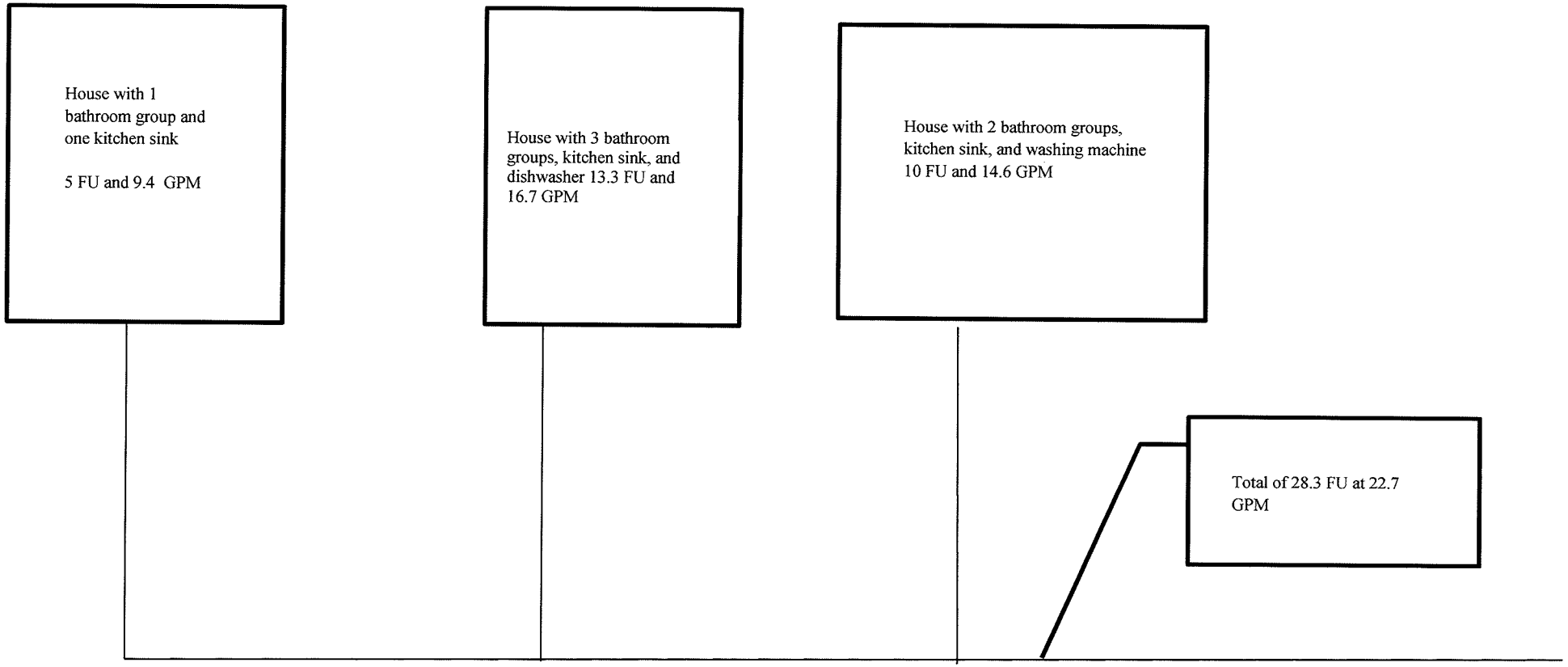
Type of Fixtures	GPM per Unit	# of Units	Total GPM

Total GPM for Continuous Flow Fixtures _____

GPM (from load values) + GPM (continuous flow) = Peak Demand in GPM _____

Peak Flow Diagram 10-15-2014

Note: If the GPM is calculated by adding the amount at each house the instantaneous peak is 40.7 GPM rather than 22.7 GPM.



Potable Water Supply Training

Source Well Shields

Isolation Distances

- VT Water Supply Rules Appendices,

  Section 11.4 (Appendices Page 106)

  – Table A11-1 – Horizontal Minimum Separation Distances from Various Sources of Contamination

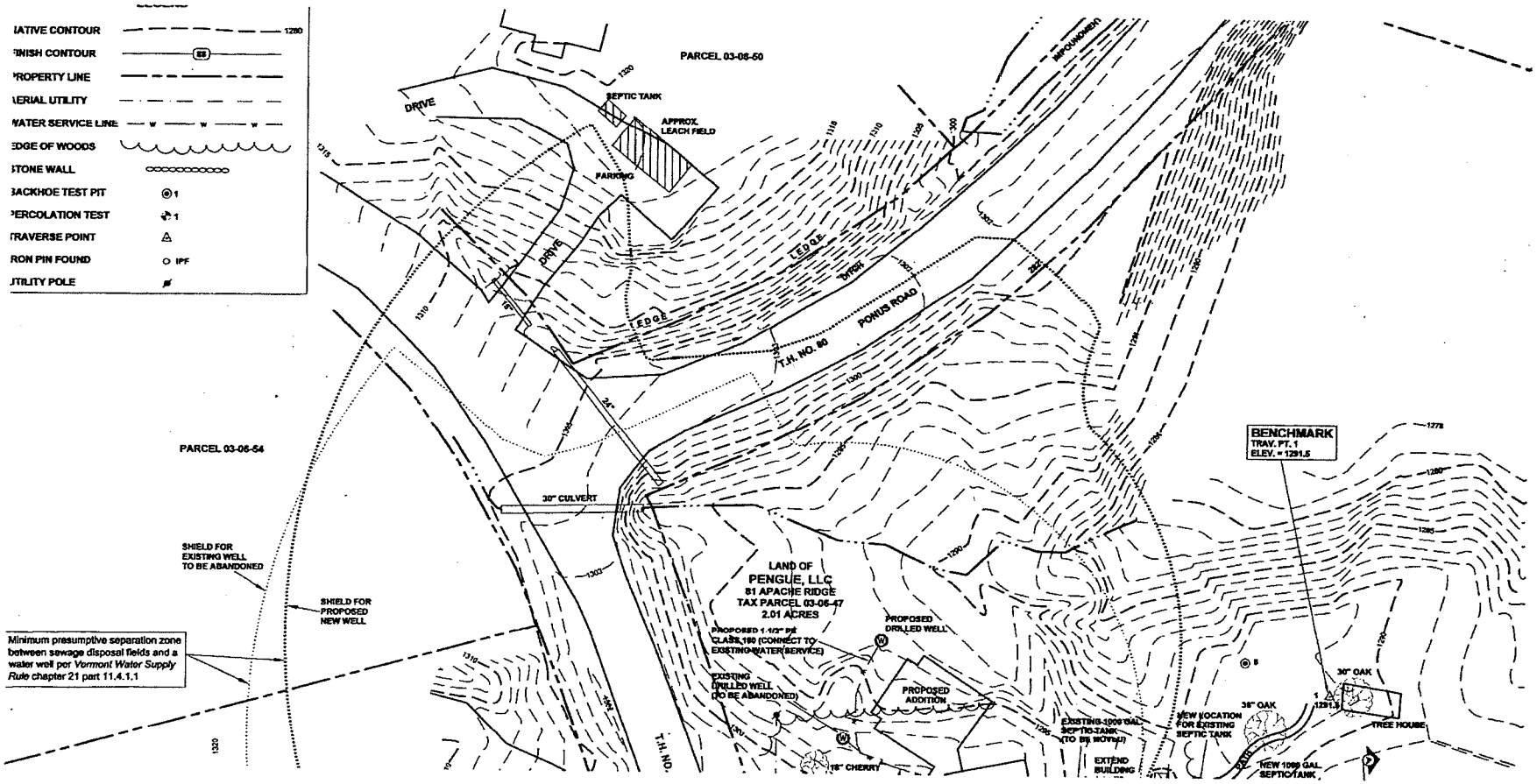
  – Table A11-2 – Horizontal Separation Distances to Sewage Disposal Systems

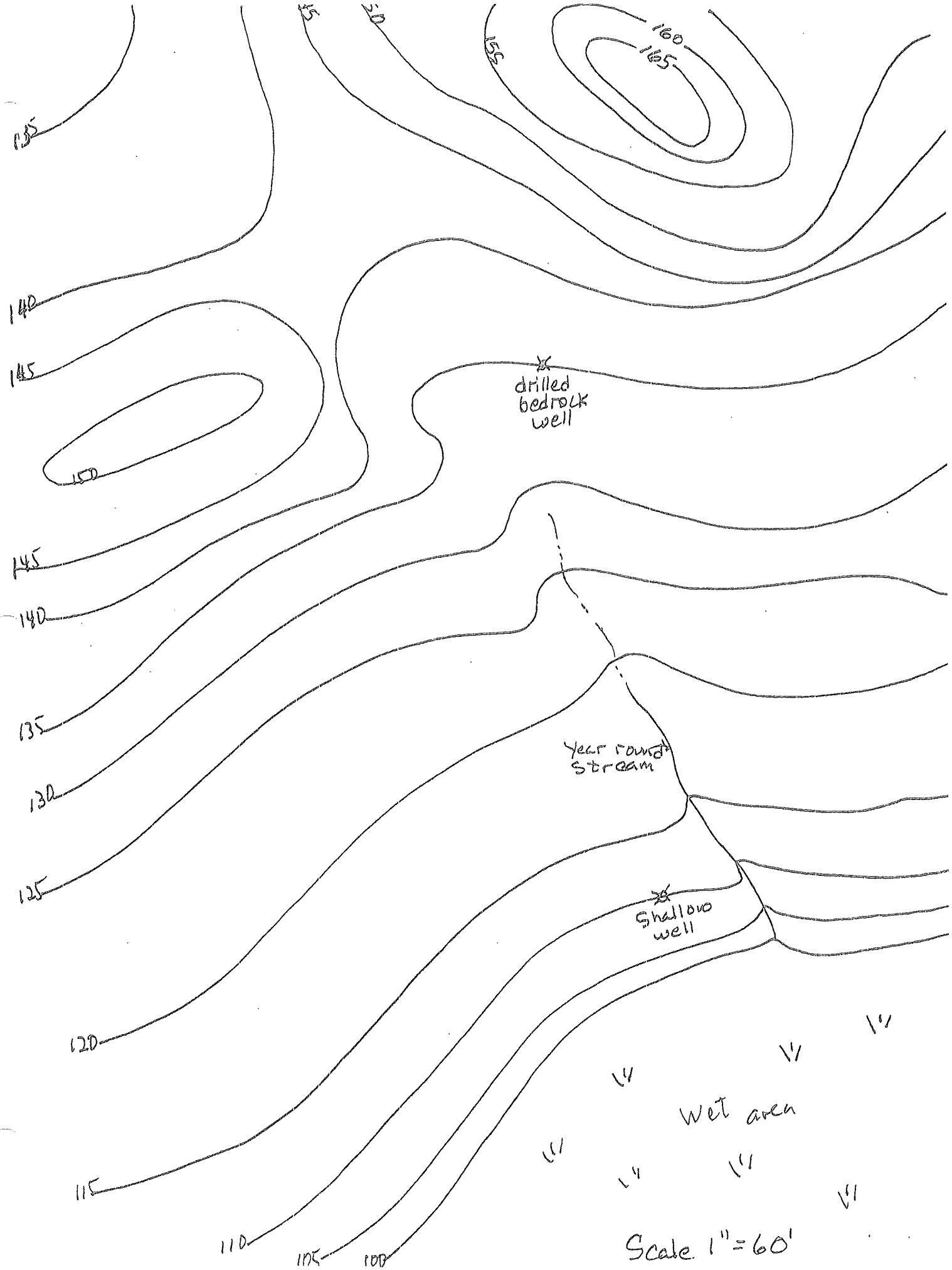
  – Figure 11-1 – Minimum Separation Distances to Domestic Sewage Disposal Fields

Confined/Unconfined Aquifers

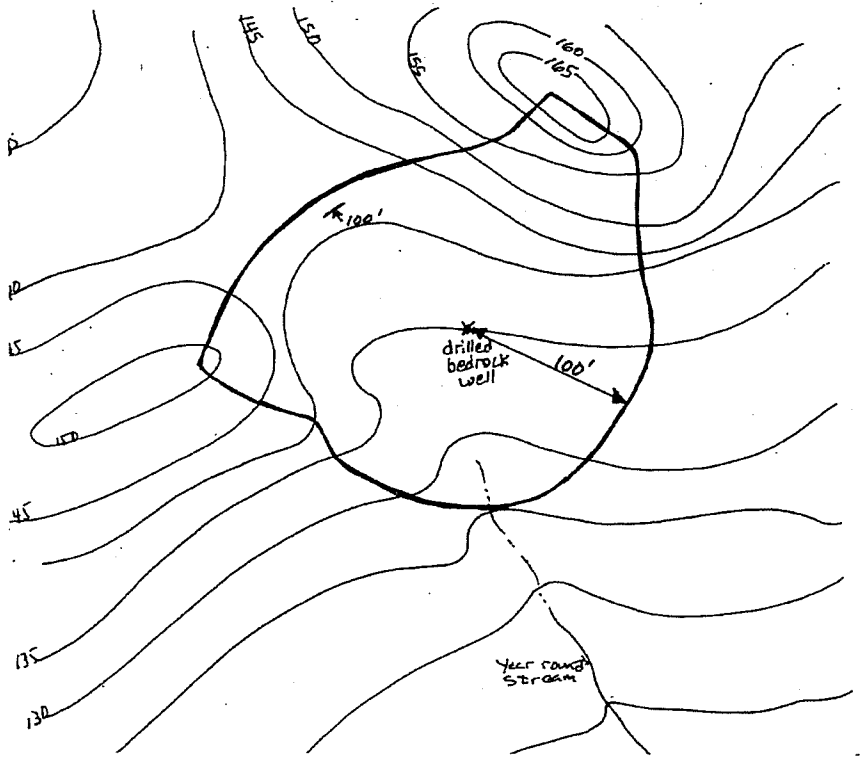
- Presumptive Minimum Separation Zone Methods for a Confined Source (11.4.1.1)
- Presumptive Minimum Separation Zone Methods for an Unconfined Source (11.4.1.2)
- Reductions of the Minimum Separation Zone (11.4.2.0.2)
- Two Year Time of Travel (11.4.2.1)

Exception to Presumptive Method

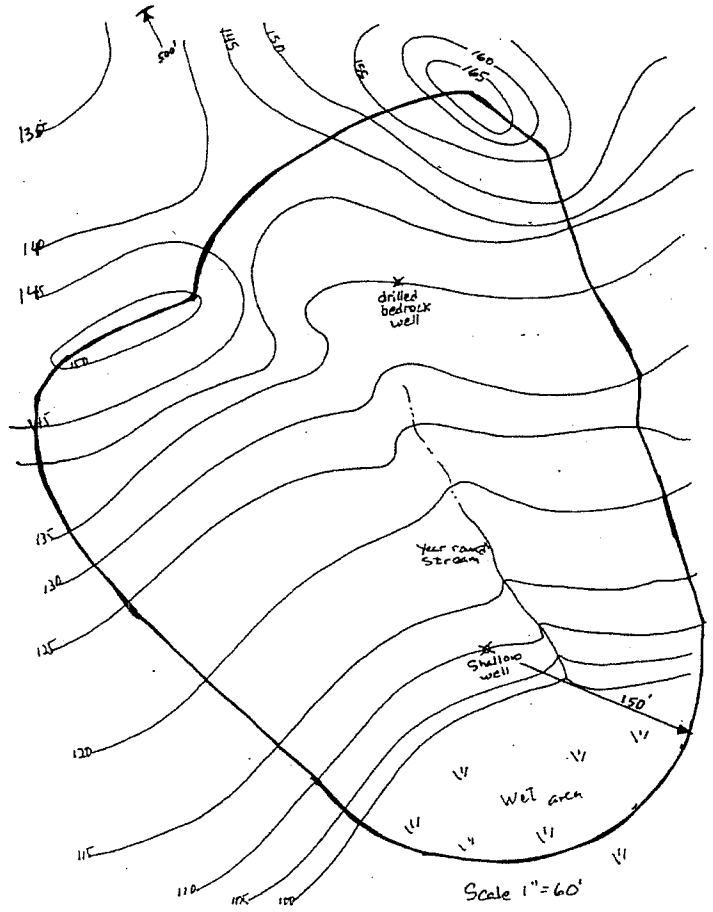



160
155
155
135
140
145
drilled bedrock well
150
145
140
135
130
125
year round stream
shallow well
120
115
110
105
100
Wet area
Scale 1" = 60'

Drilled Source Well Shield



Shallow Source Well Shield



Checklist for Sizing Water Distribution System 10-15-2014

1. Instantaneous peak demand

   A. Demand from intermittently used fixtures, WSFU converted to GPM

\+ B. Demand from continuous flow fixtures in GPM, including sprinkler heads

2. Pressure required at fixtures to produce required flow, or to make the fixture operate properly

3. Static pressure, if municipal connection

4. Static head from source to fixtures

5. Friction loss through meter

6. Friction loss through taps in water main

7. Friction loss through filters, softeners, backflow prevention devices, and pressure regulators

8. Friction loss through valves and fittings

9. Friction loss through pipe

Use International Plumbing Code, Appendix E, Table 103.3(2), 103.3(3), 103.3(6), Figure 103.3(2)

Peak Demand Page 3

TABLE E103.3(4) LOSS OF PRESSURE THROUGH TAPS AND TEES IN POUNDS PER SQUARE INCH (psi)

GALLONS PER MINUTE	SIZE OF TAP OR TEE (inches)						
	5/8	3/4	1	1 1/4	1 1/2	2	3
10	1.35	0.64	0.18	0.08	—	—	—
20	5.38	2.54	0.77	0.31	0.14	—	—
30	12.10	5.72	1.62	0.69	0.33	0.10	—
40	—	10.20	3.07	1.23	0.58	0.18	—
50	—	15.90	4.49	1.92	0.91	0.28	—
60	—	—	6.46	2.76	1.31	0.40	—
70	—	—	8.79	3.76	1.78	0.55	0.10
80	—	—	11.50	4.90	2.32	0.72	0.13
90	—	—	14.50	6.21	2.94	0.91	0.16
100	—	—	17.94	7.67	3.63	1.12	0.21
120	—	—	25.80	11.00	5.23	1.61	0.30
140	—	—	35.20	15.00	7.12	2.20	0.41
150	—	—	—	17.20	8.16	2.52	0.47
160	—	—	—	19.60	9.30	2.92	0.54
180	—	—	—	24.80	11.80	3.62	0.68
200	—	—	—	30.70	14.50	4.48	0.84
225	—	—	—	38.80	18.40	5.60	1.06
250	—	—	—	47.90	22.70	7.00	1.31
275	—	—	—	—	27.40	7.70	1.59
300	—	—	—	—	32.60	10.10	1.88

Peak Demand Page 4

TABLE E103.3(5) ALLOWANCE IN EQUIVALENT LENGTHS OF PIPE FOR FRICTION LOSS IN VALVES AND THREADED FITTINGS (feet)

FITTING OR VALVE	PIPE SIZE (inches)							
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3
45-degree elbow	1.2	1.5	1.8	2.4	3.0	4.0	5.0	6.0
90-degree elbow	2.0	2.5	3.0	4.0	5.0	7.0	8.0	10.0
Tee, run	0.6	0.8	0.9	1.2	1.5	2.0	2.5	3.0
Tee, branch	3.0	4.0	5.0	6.0	7.0	10.0	12.0	15.0
Gate valve	0.4	0.5	0.6	0.8	1.0	1.3	1.6	2.0
Balancing valve	0.8	1.1	1.5	1.9	2.2	3.0	3.7	4.5
Plug-type cock	0.8	1.1	1.5	1.9	2.2	3.0	3.7	4.5
Check valve, swing	5.6	8.4	11.2	14.0	16.8	22.4	28.0	33.6
Globe valve	15.0	20.0	25.0	35.0	45.0	55.0	65.0	80.0
Angle valve	8.0	12.0	15.0	18.0	22.0	28.0	34.0	40.0

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 degree = 0.0175 rad.

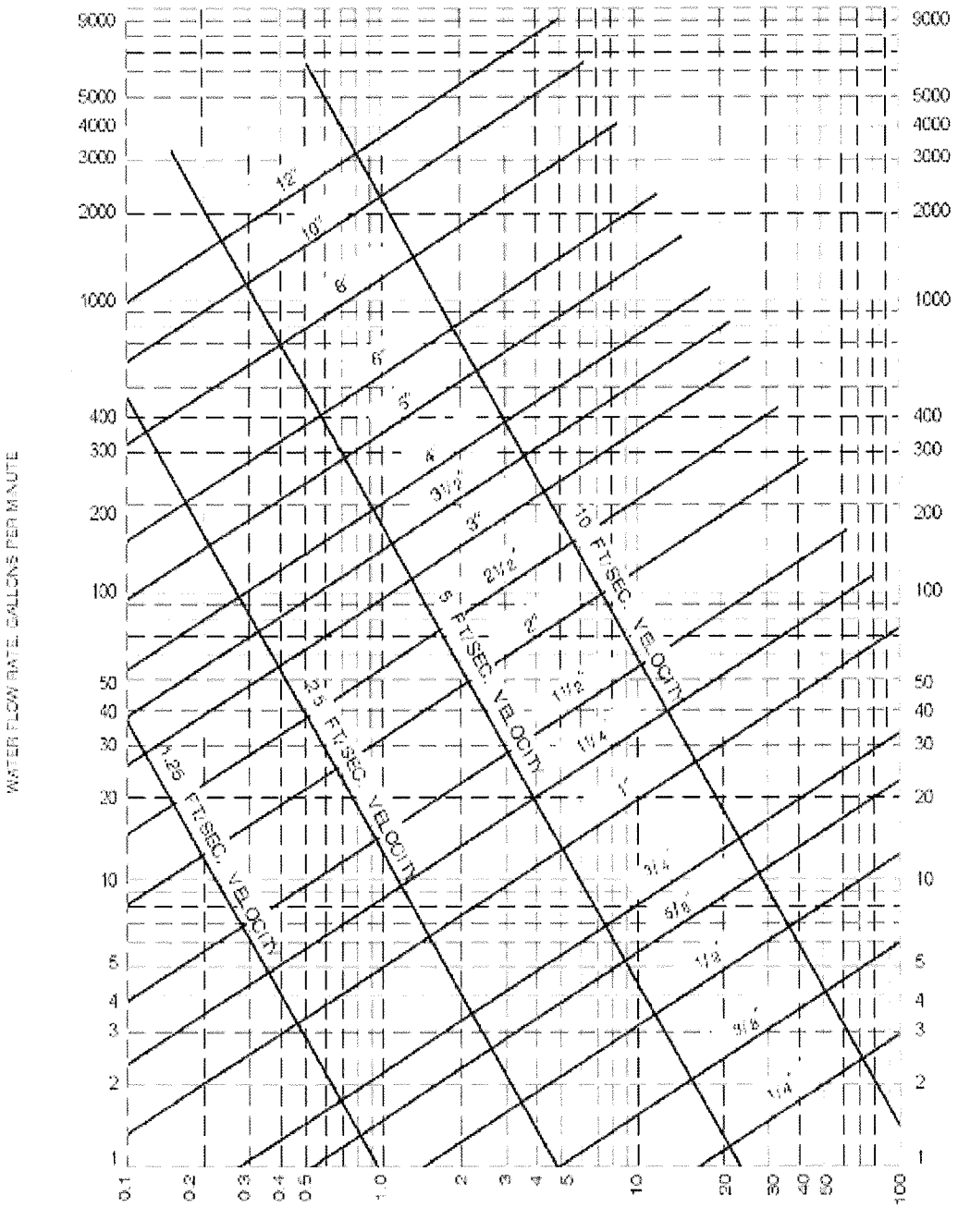
TABLE E103.3(6) PRESSURE LOSS IN FITTINGS AND VALVES EXPRESSED AS EQUIVALENT LENGTH OF TUBE[a] (feet)

NOMINAL OR STANDARD SIZE (inches)	FITTINGS					VALVES			
	Standard EII		90-Degree Tee						
	90 Degree	45 Degree	Side Branch	Straight Run	Coupling	Ball	Gate	Butterfly	Check
3/8	0.5	—	1.5	—	—	—	—	—	1.5
1/2	1	0.5	2	—	—	—	—	—	2
5/8	1.5	0.5	2	—	—	—	—	—	2.5
3/4	2	0.5	3	—	—	—	—	—	3
1	2.5	1	4.5	—	—	0.5	—	—	4.5
1 1/4	3	1	5.5	0.5	0.5	0.5	—	—	5.5
1 1/2	4	1.5	7	0.5	0.5	0.5	—	—	6.5
2	5.5	2	9	0.5	0.5	0.5	0.5	7.5	9
2 1/2	7	2.5	12	0.5	0.5	—	1	10	11.5
3	9	3.5	15	1	1	—	1.5	15.5	14.5
3 1/2	9	3.5	14	1	1	—	2	—	12.5
4	12.5	5	21	1	1	—	2	16	18.5
5	16	6	27	1.5	1.5	—	3	11.5	23.5
6	19	7	34	2	2	—	3.5	13.5	26.5
8	29	11	50	3	3	—	5	12.5	39

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 degree = 0.01745 rad.

a. Allowances are for streamlined soldered fittings and recessed threaded fittings. For threaded fittings, double the allowances shown in the table. The equivalent lengths presented above are based on a C factor of 150 in the Hazen-Williams friction loss formula. The lengths shown are rounded to the nearest half-foot.

Peak Flow Page 5



Note: Fluid velocities in excess of 5 to 8 feet/second are not usually recommended

FIGURE E103.3(2) FRICTION LOSS IN SMOOTH PIPE[a] (TYPE K, ASTM B 88 COPPER TUBING)

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 gpm = 3.785 L/m, 1 psi = 6.895 kPa, 1 foot per second = 0.305 m/s.

a. This chart applies to smooth new copper tubing with recessed (streamline) soldered joints and to the actual sizes of types indicated on the diagram.

First Worksheet for Pressure Loss Calculations – 10-15-2014

Pressure loss and residual pressure is usually expressed as pounds per inch.

Residual head = static head (+/-) difference in elevation minus (-) friction loss

Assume 2.3' of head per 1 PSI

1. Pressure at main 75 PSI
2. Elevation at main 100'
3. Elevation at highest fixture 135'
4. 89' of 3/4" copper line
5. 2 bends of 90^0
6. 1 gate valve
7. 14 GPM instantaneous peak demand

What is the residual pressure at the highest fixture? _____

Second Worksheet for Pressure Loss 10-15-2014

Pressure loss and residual pressure is usually expressed as pounds per square inch

Residual pressure = static pressure (+/-) difference in elevation (-) friction loss

Assume 2.3' of head per 1 PSI

1. Elevation at entrance to building 97'
2. Static pressure at the water main 60 PSI
3. 125' of 3/4" copper line between the main and the entrance to the building
4. Elevation at the water main 95'
5. The pipe to the first building includes 3 bends of 45 degrees
6. The required flow is 5 GPM

What is the residual pressure at the building entrance? _____

Third Worksheet for Pressure Loss 10-15-2014

Pressure loss and residual pressure is usually expressed as pounds per square inch

Residual pressure = static pressure (+/-) difference in elevation (-) friction loss

Assume 2.3' of head per 1 PSI

1. Elevation at entrance to first building 100'
2. Static pressure at the water main 60 PSI
3. 125' of 3/4" copper line between the main and the entrance to the first building
4. Elevation at the water main 105'
5. The pipe to the first building includes 3 bends of 45 degrees
6. The required flow for the first building is 5 GPM
7. The water supply runs from the first building to a second building which has a required design flow of 5 GPM.
8. The pipe from the entrance to building #1 to the entrance to building #2 is 100' of 3/4" copper.
9. The elevation at the entrance to the second building is 90'

What is the residual pressure at each building entrance?

_____

Water Storage Tank Design Checklist 10-15-2014

This is an attempt at creating a design checklist that you can start with and modify for your use. It does not cover every item that may be required for every possible situation that you might encounter.

1. Basic parameters:

   A. The volume of water that must be stored _____

   B. Tank location relative to:

      a. SHWT

      b. Surface water

      c. Will it be flood proof?

      d. Isolation to sewers, drains, standing water and similar sources of contamination

2. Protection

   A. Against unauthorized access

   B. Must have suitable water tight roof which excludes birds, animals, insects, and excessive dust

3. Drains, vents, and overflows

   A. All tanks must have a vent and an overflow which must include proper screening and construction. There are requirements for the construction of the overflow outlet.

      Sections 11.8.2.4.4 and 11.8.2.4.6

4. Access design standards – Section 11.8.2.4.5

4. Pump controls and alarms

   A. Controlled from tank levels. The controls should be set to maintain the full volume of water within the storage tank without excessive pump cycling. The design goal is to maintain the tank volume to deal with peak demand situations.

   B. All tanks must have a low level alarm. The alarm should be set high enough to provide adequate notice to the user but not so high that there will be frequent nuisance alarms.

Worksheet for Water Storage 10-15-2014

Specify the minimum amount of storage capacity for the following situation:

1. Two single family residences of 3 bedrooms each, connected to a shared well. The two residences have a combined instantaneous peak demand of 10 GPM. The well has a long term yield of 2 gallons per minute.

Water Storage Tank Calculation Worksheet 10-15-2014

There are three options that need to be checked to determine the required size (11.8.2.3)

A. Storage equals average day demand if long-term yield equals or exceeds maximum day demand.

Average Daily Demand in gallons/day _____

Maximum Day Demand in gallons/ minute _____X2/3 = _____ gallons/minute

Long term well yield in gallons per minute _____

If the long term yield equals or exceeds 2/3 of the maximum day demand, the storage tank capacity equals or exceeds the average daily demand of _____gallons.

B. Storage equals 55% of the average daily demand if the long term yield equals or exceeds the maximum day demand.

Average Daily Demand in gallons/day _____

Long-term well yield in gallons/minute _____

Maximum Day Demand in gallons/ minute _____

If the long-term well yield equals or exceeds the maximum day demand the tank capacity must equal or exceed 55% of the Average Daily Flow

Average Daily Flow X 55% = _____ gallons of storage capacity.

C. Storage equals or exceeds the volume calculated by the following equation when the long-term well yield equals or exceeds the maximum day demand.

S=D(1-Y/P) where

S is storage volume in gallons

D is average daily demand in gallons

P is the project instantaneous peak demand in gallons per minute]

Y is the well yield either long-term well yield or peak yield per section 11.8.2.2

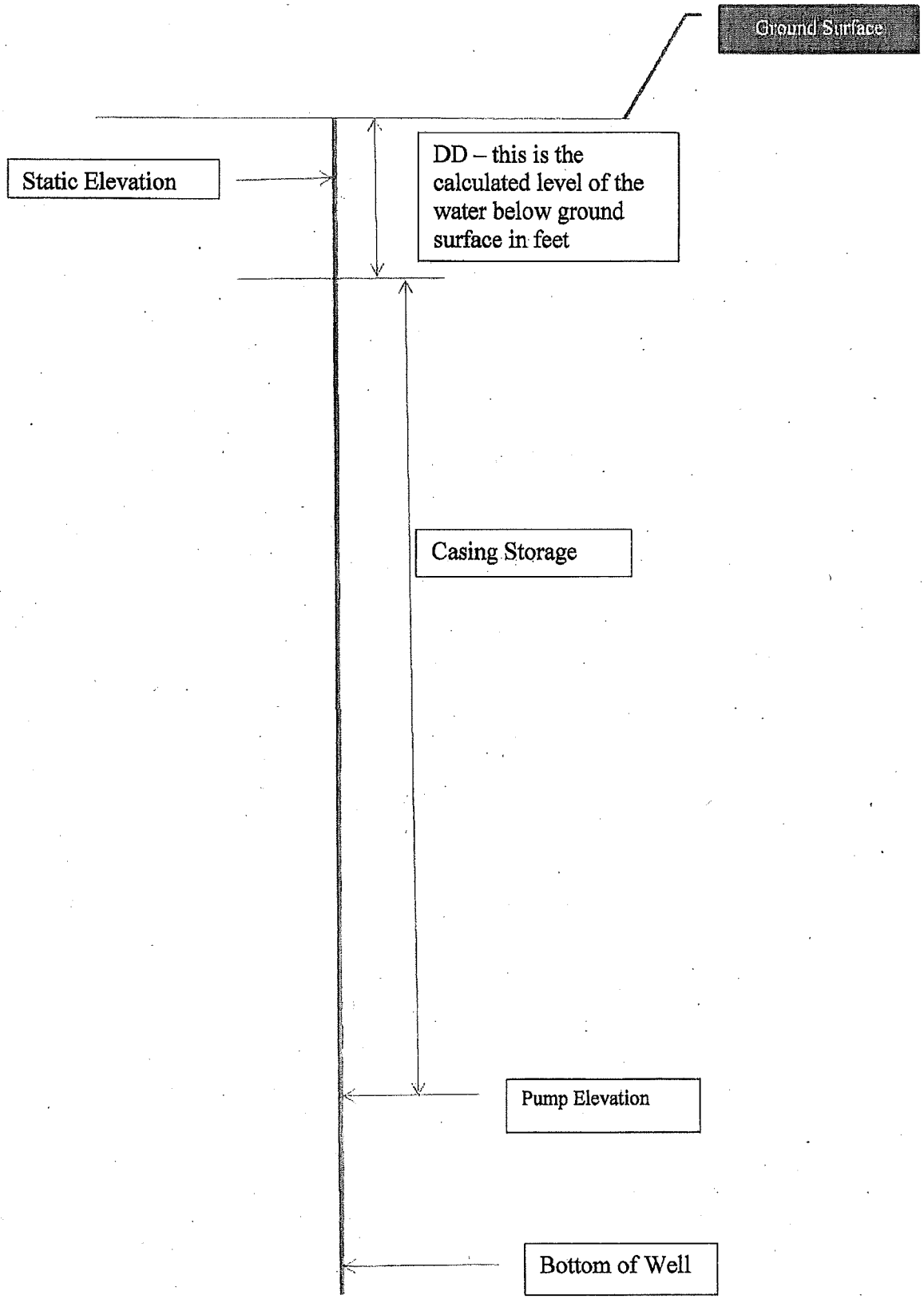
Average Daily Flow in gallons/day _____

Long-term well or peak yield in gallons/minute _____

Instantaneous peak demand in gallons/minute _____

S = _____X (1 - _____÷_____) or _____gallons of storage capacity.

Casing Storage Diagram 10-15-2014



Worksheet for Casing Storage 10-15-2014

See WSR section 11.8.2.3.1, appendices page 123

1. Standard 6" well casing (assume 1.5 gallons per foot of casing)

2. Ground surface elevation 1000'

3. Static water elevation 980'

4. Elevation of bottom of well 811'

5. Well pump installed 20' above bottom of well.

6. Maximum day demand (MDD) is 1.9 GPM

7. Long term yield (Y) is 3.8 GPM

DD = depth to predicted drawdown level below ground surface (ft.)
SE = depth to static water level in well, below ground surface (ft.)
TAH = is the distance from the static water level down to the pump or pump shutoff level (ft.)
MDD = maximum daily demand (gpm)
Y = long term yield per section 11.6 (gpm)

DD = SE + (TAH X (MDD/Y))

SE =

TAH =

MDD/Y =

What is the predicted depth to the drawdown water level below ground surface in the well? DD = _____

How much casing storage exists? _____

Second Worksheet for Casing Storage 10-15-2014

See WSR section 11.8.2.3.1, appendices page 123

1. Standard 6" well casing (assume 1.5 gallons per foot of casing)

2. Ground surface elevation 500'

3. Static water elevation 30' below ground surface

4. Elevation of bottom of well 200'

5. Well pump installed 20' above bottom of well.

6. Maximum day demand (MDD) is 2 GPM

7. Long term yield (Y) is 5 GPM

DD = depth to predicted drawdown level below ground surface (ft.)
SE = depth to static water level in well, below ground surface (ft.)
TAH = is the distance from the static water level down to the pump or pump shutoff level (ft.)
MDD = maximum daily demand (gpm)
Y = long term yield per section 11.6 (gpm)

DD = SE + (TAH X (MDD/Y))

SE =

TAH =

MDD/Y =

What is the predicted depth to the drawdown water level below ground surface in the well? DD = _____

How much casing storage exists? _____

Worksheet for Selecting a Deep Well Pump 10-15-2014

1. System must supply 5 GPM at pressure tank

2. Elevation of water level in well at maximum expected drawdown. 735'

3. Elevation of pressure tank 980'

4. Pump off pressure 50 PSI
   Pump on pressure 30 PSI

   Assume pressures have been selected to provide adequate flow to all fixtures.

5. Head loss in pipe from pump to pressure tank 8 PSI.

At what head must the pump supply 5 GPM? _____

What is the maximum head the pump must supply? _____

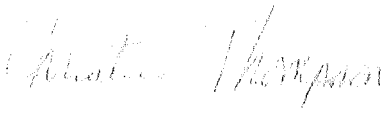
Using the pump specifications, select an appropriate well pump. _____

Guidance Related to the Wastewater System and Potable Water Supply Rules Effective September 29, 2007

Guidance Document 2011-03

Groundwater Sources that are Protected when Permitting a Wastewater System

Issued July 13, 2011



Christine Thompson, Director Wastewater Management Division

This guidance document is intended to establish the criteria for when groundwater sources (Sources) will be protected or not protected when permitting a new wastewater system or site, or an increase in design flows to an existing wastewater system. For the purpose of this guidance document and the Wastewater System and Potable Water Supply Rules (Rules), a Source is a potable water supply, as defined by Section 1-201(a)(47) of the Rules, that obtains water from the ground and includes drilled wells, driven well points, shallow wells, and springs. A licensed designer preparing a plan for a new wastewater system or site that will receive a Wastewater System and Potable Water Supply Permit (Permit) issued by the Wastewater Management Division (Division) is required to identify all Sources that may be affected by the wastewater system.

Sources fall into the following categories:

1. **Sources that have a Permit but are not yet developed:**

   - These Sources shall be protected so that the project may be developed in accordance with the conditions of the Permit.

2. **Sources that have a Permit and have been developed in compliance with the permit conditions :**

   - These Sources shall be protected.
   - The Rules allow for deviations from the stamped plan and Permit provided a qualified licensed designer submits record drawings and the required post installation certification for the relocated source.

Such sources shall be protected if the above provisions have been met.

3. **Sources that have a Permit that are developed but are not in compliance with the Permit :**

   - Sources developed after January 1, 2007 with a Permit issued to develop the Sources either before or after that date and where the Sources are not in the location approved by the Permit are not protected unless they meet the requirements for record drawings.
   - The original Source location identified on a stamped plan referenced by a Permit shall be protected when the existing Source does not meet the requirements for record drawings. For example, in projects where the Source was relocated and is therefore subject to an enforcement action to obtain a Permit for the revised Source location, the originally permitted location shall be protected rather than the revised location unless the original location has also been compromised due to the relocation of the permitted wastewater system, house, etc. As another example, in a project permitted for a drilled well where the drilled well was replaced by a dug well that requires an increase in isolation distances to wastewater systems, the dug well will not be protected but a drilled well located according to the Permit and replacing the dug well will be protected.

4. **Sources in existence prior to January 1, 2007 that are exempt under Section 1-304(a)(1) of the Rules (the "Clean Slate" exemption). These Sources may or may not have a Permit and/or a Permit:**

   - These Sources shall be protected.

5. **Replacement Sources that are installed according to the exemption under Section 1-304(a)(22) of the Rules "Construction of a Replacement Well that serves only one Single Family Residence on its own Individual Lot":**

   - The development of these Sources must meet the specific criteria stated in the Rules in order to be exempt including the filing in the land records of the document "Exemption Form for construction of a Replacement Water Supply that serves only one single family residence on its own Individual Lot". Sources that have the document recorded in the land records prior to the receipt of an administratively complete application for a new wastewater system that would affect that Source shall be protected. These replacement Sources will not be protected until the document is recorded in the land records. Regardless of the filing of the document, the

replacement Source will not be protected from exempt and/or permitted wastewater systems that existed prior to development of the replacement Source.

- Note: A single family residence that constructs a replacement Source and files the exemption document in the land records must utilize the replacement Source and properly abandon the original Source. The replacement Source exemption applies only when one Source is replaced with another Source. A Permit is required if the proposal is to connect an additional Source to an existing single family residence

6. **Sources that are subject to a deeded water right that are not part of a potable water supply system and do not have a Permit:**

    - These Sources are not protected unless the source qualifies for an exemption in Category 7. The Division can only protect Sources that receive a Permit following a determination that the source meets all necessary isolation distances from existing or permitted wastewater systems and the Source location complies with the Rules or qualifies for an exemption in Category 7.

7. **Sources that serve an undeveloped project and/or qualify for an exemption under the Rules:**

    - These Sources shall be protected provided the source is developed in accordance with the applicable exemption of the Rules. Such exemptions include those under Section 1-304(a)(3) when the lot has a valid municipal permit issued prior to November 1, 2004 and Section 1-304(a)(4) or (5) for a Source developed for a primitive camp.

8. **Sources that exist that are not part of a potable water supply system and do not have a Permit:**

    - These sources are not protected. The Rules can only protect sources that exist as part of a potable water supply. Examples of these types of Sources include ones used to water animals and ones used for other purposes not involving human consumption, bathing, laundering, or the preparation of food.

9. **Sources that exist and are part of a potable water supply system that are not exempt and do not have a Permit:**

    - Sources that exist that required a permit and are not exempt under the "Clean Slate" or any other provisions of this document are not protected.

- There are existing Sources that are part of a permitted or exempt potable water supply system that required a Permit or Permit amendment based on operational changes to the water supply system that occurred after January 1, 2007 where the required Permit or Permit amendment was never obtained. These Sources shall be protected for the use of the Source that existed prior to January 1, 2007. For example, prior to January 1, 2007, a Source that served a project that had a maximum day demand of 1.9 gallons per minute required a specific isolation zone for protection. Post January 1, 2007 and without first obtaining a Permit, there was an operational change to the potable water supply for the project that increased the maximum day demand to greater than 2.0 gallons per minute which in turn required an increase to the isolation zone. The pre-January 1, 2007 isolation zone shall be protected unless a permit application was received or Permit was issued prior to the application for a new wastewater system.

10. "First in Time"

- The Division reviews each application based on the "first in time" principle. Exempt or Permitted Sources are "first in time" and are protected as specified in this Guidance. An application for a proposed wastewater system received prior to an application for a proposed Source is "first in time" and may be approved even if the wastewater shield includes the Source for the second application. A replacement Source to serve one single family residence on its own lot that filed the document "Exemption Form for construction of a Replacement Water Supply that serves only one single family residence on its own Individual Lot" in the land records and that complies with all other aspects for the replacement well exemption shall be considered "first in time" provided the exemption form was filed prior to the receipt of an administratively complete application for a new wastewater system affecting that Source.