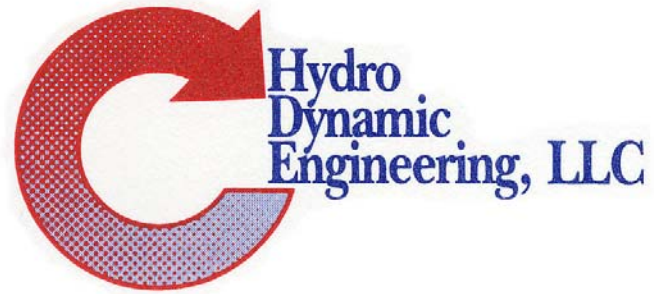


Geothermal Drilling Regulations in Connecticut



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Presented to Northeast Regional Geothermal Workshop
EPA Northeast Regional Laboratory
March 29, 2011

Topics

- Geoexchange Borehole Diameter
- Closed-loop geoexchange fluid
- Closed-loop geoexchange system piping
- Separating distances
- Grouting

Topics (ctd.)

- Borehole Termination
- Abandonment
- Reporting
- Licensing
- Permits

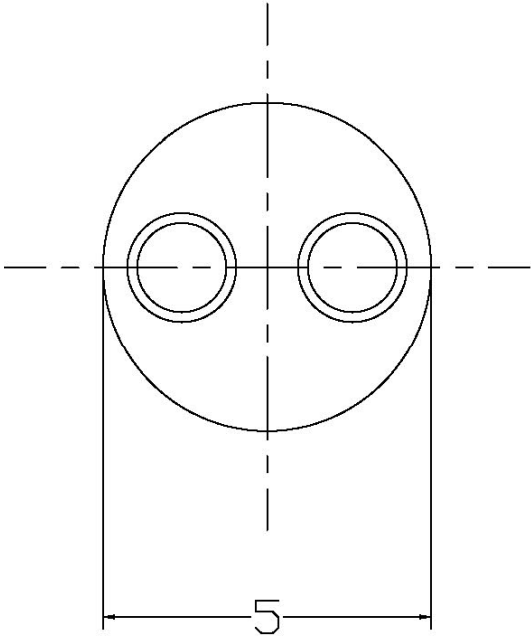
Status of the Regulations

- These regulations have completed their review and public comment period.
- Promulgation is expected this summer.

Geoexchange Borehole Diameter

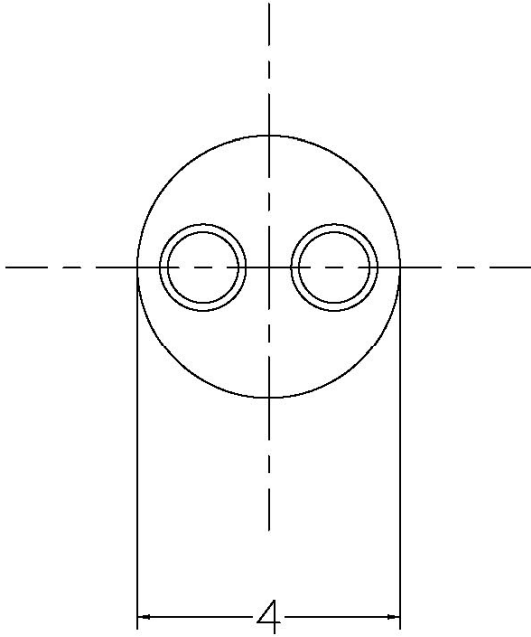
- Minimum four (4) times the Inside Diameter of largest loop pipe employed in the borehole
 - Allows for proper placement of pipe and grout

1-1/4" Loops



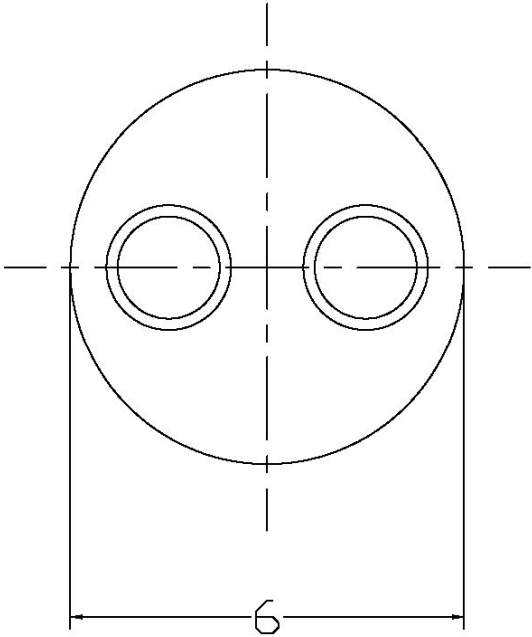
minimum 5" hole

1" Loops



minimum 4" hole

1-1/2" Loops



minimum 6" hole

Closed Loop Geoexchange Fluids

- Refrigerants R-134a, R-407c, R-410a
- Potable Water
- Mixtures of max 20% food grade Propylene Glycol or Potassium Acetate
- Other geoexchange system fluids or additives approved by the Department of Consumer Protection in consultation with Department of Public Health

Closed Loop Geoexchange Fluids

- All chemicals used or added to potable water, circulating through a closed-loop geoexchange system, shall meet NSF/ANSI Standard 60 or 61, or be approved by the DCP in consultation with DPH and DEP

Closed Loop Geoexchange System Piping

- Copper, provided that a cathodic protection system be employed where soil conditions are judged by registered contractor, or local or state authority, to be beneficial to the longevity of the copper.

Closed Loop Geoexchange System Piping

- High Density Polyethylene having cell classification of PE 345434c or PE 355434c , and listed as a PE 3408
- Materials approved by DCP, in consultation with DPH and DEP

Approved Pipe-Joining Methods

- For Copper – brazed joints
- For Polyethylene – heat fusion according to manufacturer's specifications, OR by mechanical stab fittings approved by IGSHPA
- For Other – by methods approved by DCP in consultation with DPH and DEP

Connections to Domestic Water Supply

- Must include a reduced pressure backflow preventer

Closed-Loop Geo Wells

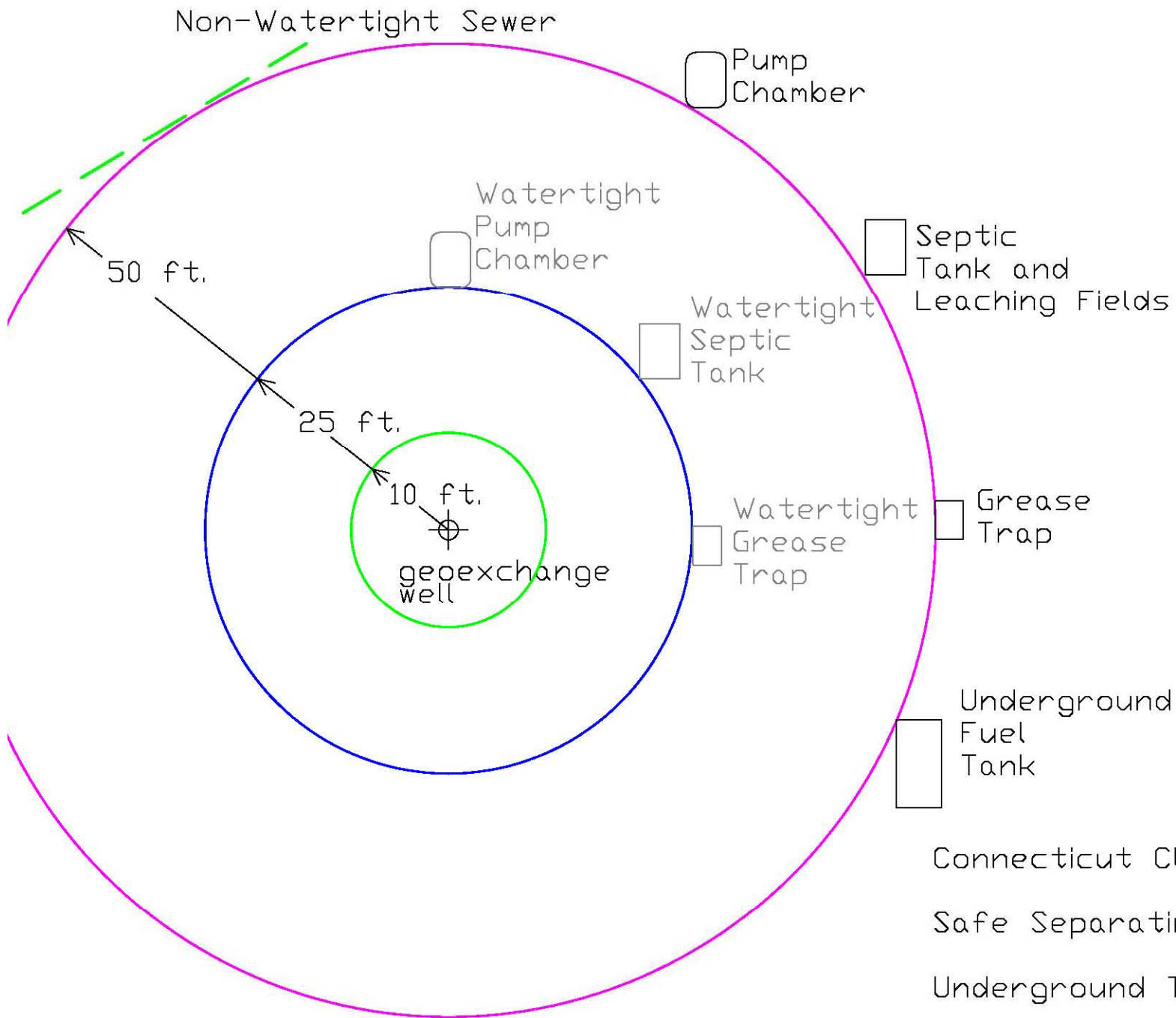
Minimum Separating Distances

- 25 feet from:
 - Watertight Septic tanks
 - Watertight Grease traps (tanks)
 - Watertight Pump chambers
 - (In practice, CT DPH does not consider any of these to be watertight)

Closed-Loop Geo Wells

Minimum Separating Distances

- 50 feet from:
 - Subsurface sewage disposal leaching system
 - Septic Tanks
 - Grease Traps
 - Pump Chambers
 - Non-watertight sewer mains
 - Underground fuel tanks



Connecticut Closed Loop wells

Safe Separating Distances

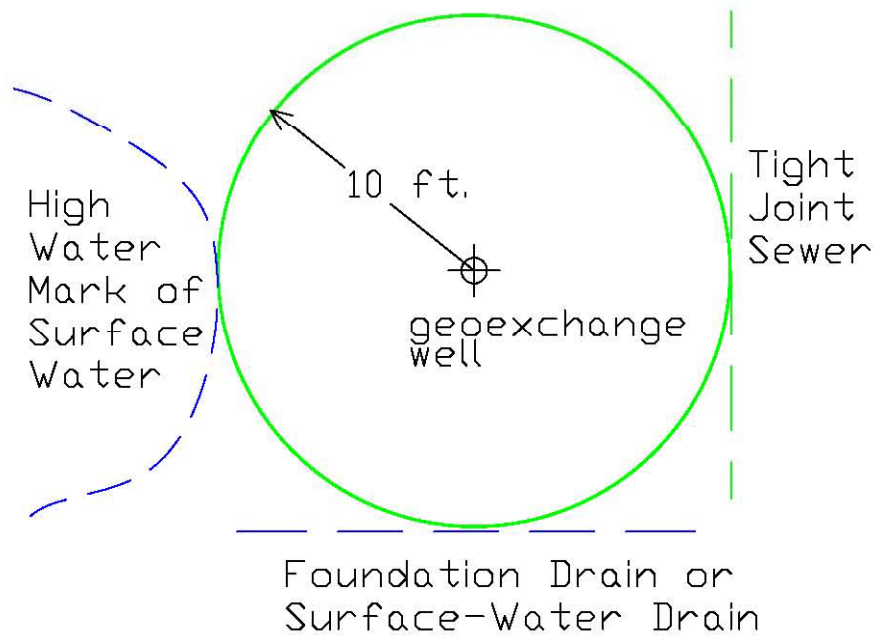
Underground Tanks

geo well separating dists 1.dwa

Closed-Loop Geo Wells

Minimum Separating Distances

- 10 feet from:
 - Tight-Joint sewer pipes
 - High water mark of surface water body
 - Drain carrying surface water
 - Foundation drain
 - (Note – geoexchange piping that is not using a well may be placed directly in a body of water)



Connecticut Closed Loop Wells
Safe Separating Distances
Water and Buried Pipes

Closed-Loop Geo Wells

Minimum Separating Distances

- 25 feet from:
 - Private water supply well with withdrawal rate less than 10 gpm
 - Public water supply well with withdrawal rate less than 10 gpm

Closed-Loop Geo Wells

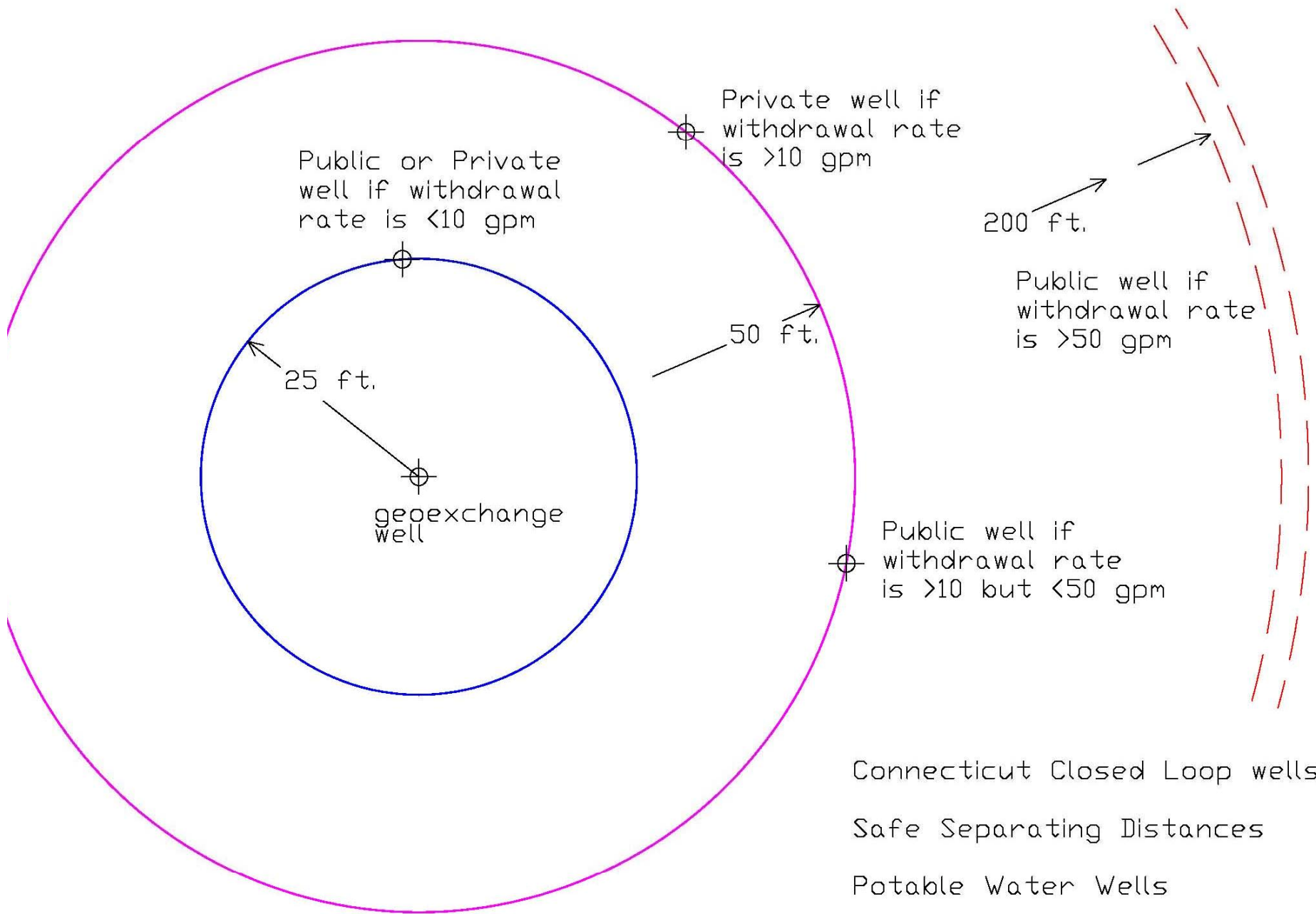
Minimum Separating Distances

- 50 feet from:
 - Private supply well with withdrawal rate greater than 10 gpm
 - Public water supply well with withdrawal rate greater than 10 gpm, but less than 50 gpm

Closed-Loop Geo Wells

Minimum Separating Distances

- 200 feet from:
 - Public water supply well with withdrawal rate greater than 50 gpm



Open-Loop Geo Wells

Minimum Separating Distances

- Minimum Separating Distances are the same as for potable supply wells (see Section 19-13-B51d)
- For required withdrawal less than 10 gpm:
 - Septic leaching, etc. - 75'
 - Tight-joint sewer - 25'
- This includes Standing Column wells

Open-Loop Geo Wells

Minimum Separating Distances

- For withdrawal rate greater than 10, but less than 50 gpm:
 - Septic leaching, etc. - 150'
 - Tight-joint sewer - 50'

Open-Loop Geo Wells

Minimum Separating Distances

- For withdrawal rate greater than 50 gpm:
 - Septic leaching, etc. - 200'
 - Tight-joint sewer - 100'

- (b) All structures or facilities for the treatment or disposal of sewage or septage shall be located at least 50 feet from any open water source and 100 feet from any public supply reservoir, unless designed and constructed to prevent the leakage or overflow of raw or treated sewage to the ground or surface water.
- (c) All structures, facilities or locations containing sewage or septage which is exposed to the atmosphere shall be located at least 150 feet from any school, residential building or institution, and shall be fenced or otherwise made inaccessible to the public.
- (d) The following minimum separating distances shall be maintained between any discharge or overflow of treated sewage or septage to the ground waters and any drinking water supply well or spring.

Required Withdrawal Rate	Minimum Separation Distance
Under 10 gallons per minute	75 feet
10 to 50 gallons per minute	150 feet
Over 50 gallons per minute	200 feet

- (e) The following minimum separating distances shall be maintained between any sewer, structure or facility for the conveyance or treatment of sewage or septage and any drinking water supply well or spring.

Required Withdrawal Rate	Minimum Separation Distance
Under 10 gallons per minute	25 feet
10 to 50 gallons per minute	75 feet
Over 50 gallons per minute	100 feet

Statement of Purpose

Underground Piping Minimum Separating Distances

- Piping (trenches) located between 5 ft. and 25 ft. from subsurface sewage disposal system shall not be backfilled with free-draining material.
- See *Technical Standards for Subsurface Sewage Disposal Systems, Table 1* for distances to utility trenches.

II. LOCATION OF SUBSURFACE SEWAGE DISPOSAL SYSTEMS

A. Minimum separating distance

The minimum separating distances specified in Table No. 1 are required and shall be maintained by any part of a subsurface sewage disposal system, except certain piping, and the cited items. Tables 2, 2-C and 2-D list specific applications whereby specified piping shall have reduced separating distances.

Table No. 1

Item	Separating Distance (Feet)	Special Provisions
A. Water supply well (potable, open loop geothermal, irrigation), spring or domestic water suction pipe. <u>Required withdrawal rate:</u> < 10 gal. per minute 10 to 50 gal. per minute > 50 gal. per minute	 75 150 200	1. Separating distance to the leaching system shall be doubled where percolation rate is faster than one minute/inch and the leaching system is 8 feet above ledge rock. 2. Separating distance shall be increased as necessary to protect the quality of a public water supply well.
B. Human habitation on adjacent property	15	Building without drains. See items G & H for distance to buildings.
C. Building served	15	Building without drains. See items G & H for distance to buildings. Separating distance to a septic tank/septic tank/pump chamber/gravel tank shall be reduced to 10 feet for buildings without drains.
D. Open watercourse	50	When not located on a public water supply watershed, distance shall be necessary to not less than 25 feet on lots in existence prior to the date of this regulation (8/16/82) and thereafter recorded as required by statute.
E. Public water supply reservoir	100	
F. Surface or groundwater drain constructed of solid pipe	25	Tight pipe with rubber gasketed joints or accepted equivalent (see Table 2) shall be exempted from this requirement as long as the pipe excavation is backfilled with free draining material, however no tight pipe shall be less than 10 feet from any building.

foundation, etc.), storm water infiltration or retention/detention system located up gradient, or on the side of system.	25	
H. Groundwater drains (curtain, footing, foundation, etc.), storm water infiltration or retention/detention system located down gradient.	50	1. No such drain shall be constructed down gradient of the leaching system purpose of collecting sewage effluent regardless of the distance. 2. Distance to septic tank/pump chamber/grease interceptor tank shall be reduced to 25 feet if tank is verified to be watertight (Concrete tanks: See Section X)
I. Top of embankment (Down gradient and on sides)	10	Cuts within 50 feet down gradient of leaching systems shall not be allowed if bleed-out conditions are possible.
J. Property line	10	1. Separating distance between the primary leaching system and a down gradient property line shall be increased to 25 feet whenever MLSS is applicable. 2. Separating distance to the leaching system shall be increased to 15 feet whenever the top of the leaching system is above natural grade unless grant rights from the affected property owner are secured or retaining walls are present (See Section VIII A for retaining wall provisions).
K. Potable water and/or irrigation lines which flow under pressure	10	Excavations between 10 – 25 feet from system shall not be backfilled with draining material.
L. Below ground swimming pool	25	See item H for down gradient pools with drains.
M. Above ground swimming pool	10	Includes hot tubs.
N. Accessory structure	10	Structure shall have no footing drains. See items G & H if drains provided. Structures without full wall, frost protected footings shall be reduced to 5 feet.
O. Utility service trench (Underground electric, gas, phone services, etc.)	5	Excavations between 5 – 25 feet from system shall not be backfilled with draining material.
P. Water treatment wastewater disposal system	10	See Section X.
Q. Closed loop geothermal system		Separating distance from borehole to leaching system and watertight tanks shall be reduced to 50 feet and 25 feet, respectively, as long as a CT licensed well contractor installs borehole with a permit certifying construction standards per Department of Public Health EHS Circular Letter #2007-12 dated April 27, 2007. Excavations between 10 – 25 feet from system shall not be backfilled with free draining material.
Borehole (Vertical)	75	
Horizontal loop/geothermal piping	10	

Non-Vertical Closed Loop Minimum Separating Distances

- Namely – “DX” closed loop wells
- Measure separating distances from any point along the borehole

Grout Materials

- Grout 111
 - 94 lb Portland Cement
 - 6.19 gallons water
 - 200 lb. Sand (specific gradation and composition)
 - 21 oz. Superplasticizer
 - 1.04 lb. Bentonite (optional)

Grout Materials

- High Grade Bentonite or Thermally Enhanced Bentonite
 - Minimum 20% (by weight) of Bentonite, and coefficient of permeability of 10^{-7} cm/sec.
- Other
 - Other materials approved by Dept. Consumer Protection in consultation with DPH

Grout Mixing and Installation

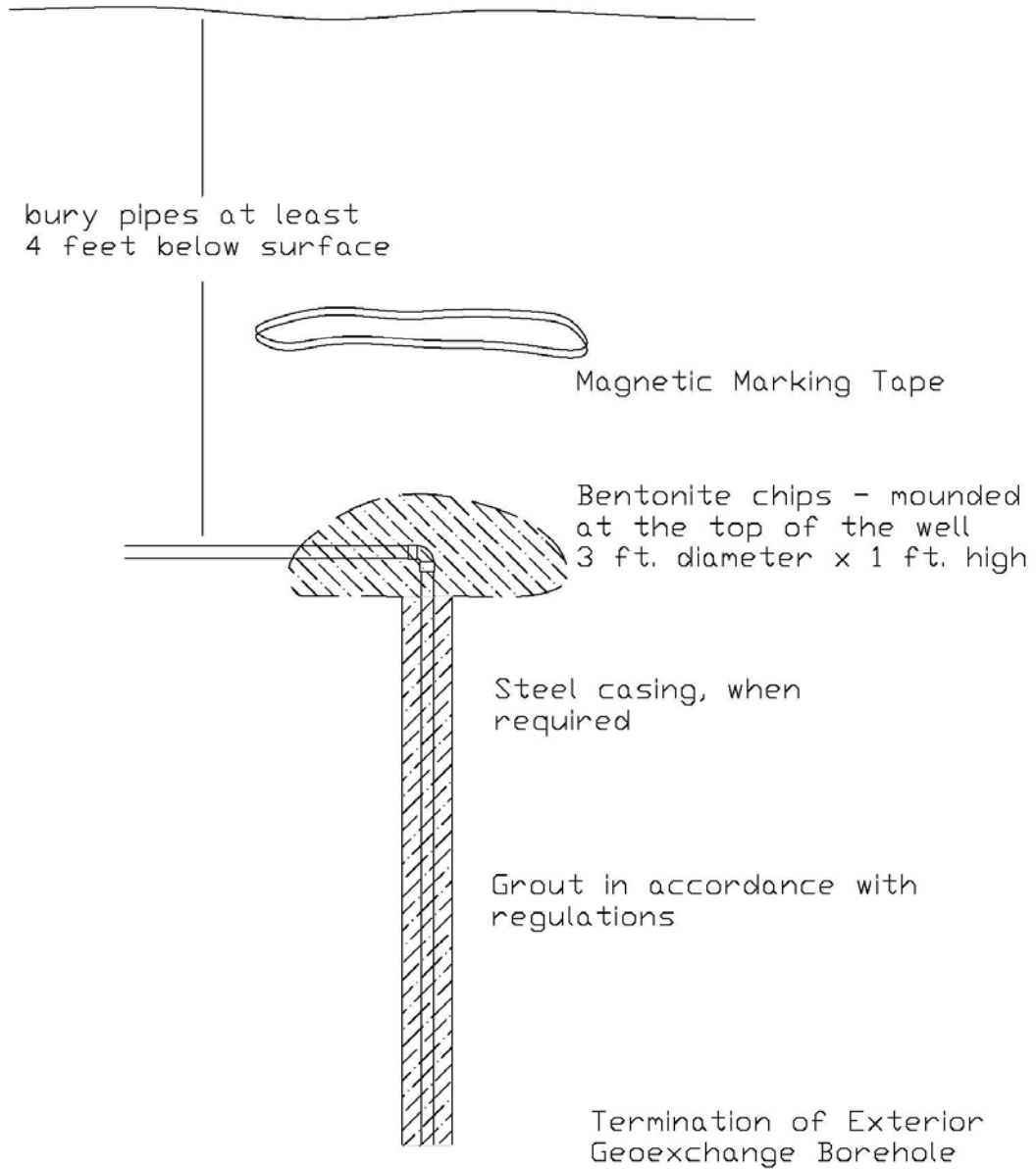
- Follow manufacturer's specifications
- Use whether formation is consolidated or unconsolidated
- Grout within 7 days of completion of drilling
- Cover borehole with protective layer of bentonite solids 1 ft thick x 3 ft wide
- Install detectable tape over boreholes

Grout Installation Methods

- Use Tremie Method
- Fill the entire borehole, beginning at the bottom
- Minimum diameter for uncased boreholes is 3.5 inches (to ensure room for tremie)
- Minimum diameter for cased boreholes is 4 inches
- Drilling mud and cuttings shall not be mixed into the borehole

Borehole Termination

- Outdoors - Minimum 4 feet below surface
- Indoors – Flush with finished floor
- Cap the casing prior to grouting
- Casing may be removed as borehole is grouted



ref: geothermal termination
exterior.dwg

Geoexchange tubes

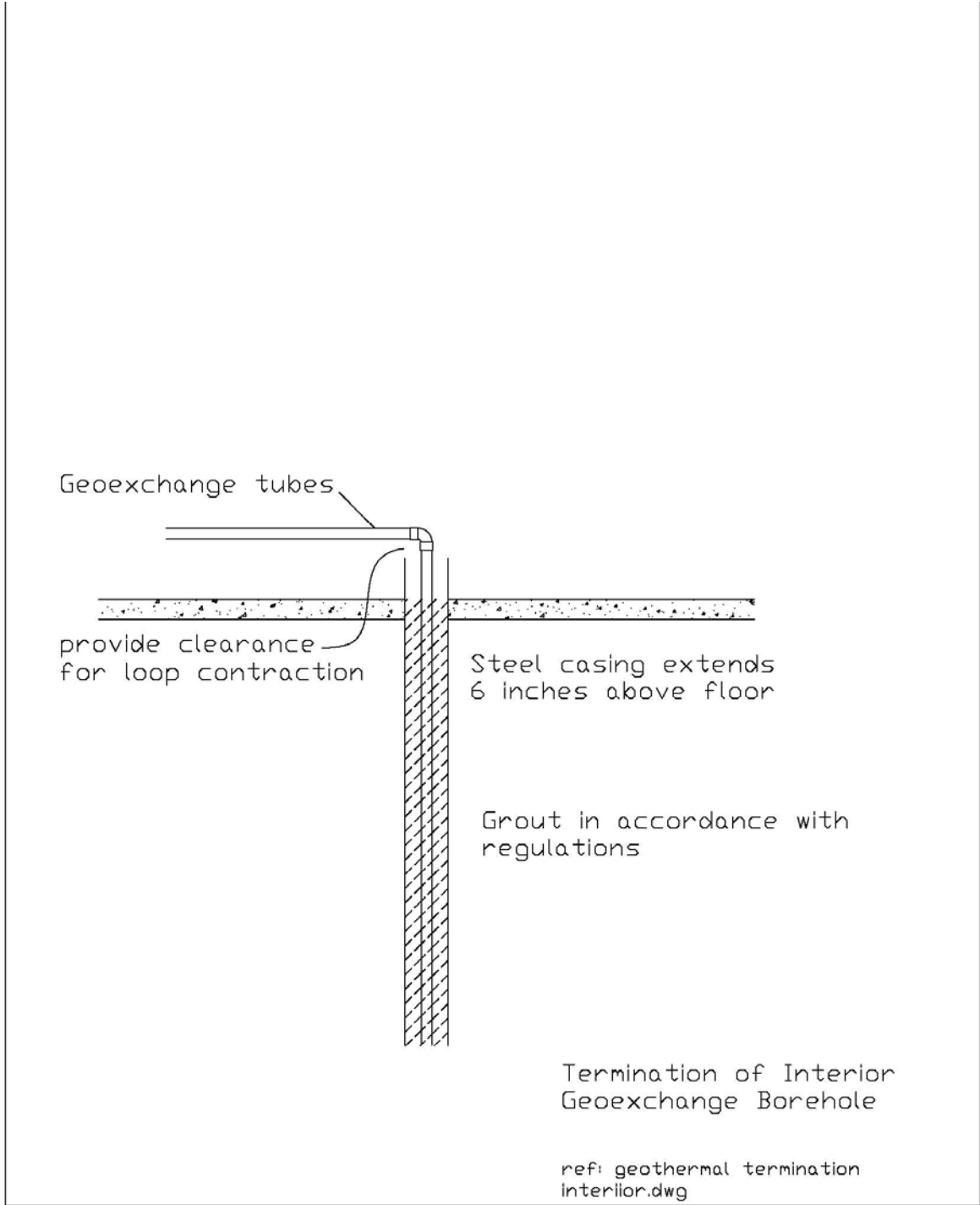
provide clearance
for loop contraction

Steel casing extends
6 inches above floor

Grout in accordance with
regulations

Termination of Interior
Geoexchange Borehole

ref: geothermal termination
interior.dwg



Abandonment

- When decommissioning a geoexchange system:
 - Displace fluid with bentonite grout or evacuate it by an approved method
 - Cover borehole with bentonite solids at least 12 inches thick
 - Properly dispose of fluids removed

Completion Report - Filing

- File a report, within 60 days of completion, in a format acceptable to Dept. of Consumer Protection (DCP)
- Send copies to Owner, DCP, DEP, and Local Health dept.

Completion Report - Content

- Location – address, GPS coordinates, nearest two cross streets
- Owner – name, address, phone number
- Borehole specifications – date finished, number of boreholes, depths, spacings, depths to bedrock, descriptions of materials encountered, amounts of casing, static water levels

Completion Report - Content

- Loop fields – Installer's name, registration number, piping material used, number of loops, depths of loops, date last loop installed, date grouting finished, type of grout, bags (and weight) of grout per each borehole, cubic feet of grout per borehole

Completion Report - Content

- Type and volume of geothermal fluid to be used
- Confirm that detectable underground tape was used over boreholes
- Attach a diagram showing major buildings, septic systems, and water supply wells

Registration of Workmen

- Unlimited Drilling Contractor – W1
- Unlimited Well Driller – W2
- Limited Geothermal Contractor – W7
- Limited Geothermal Driller – W8
- Limited DX Geothermal Contractor – W9
- Limited DX Geothermal Driller – W10
- Trainees work under supervision of above

Permits

- Required for geoexchange wells
- Format of permit application must be approved by DCP
- Reviewed / approved by local health dept.
- Include map showing location of each borehole to roads and permanent land features
- Signed by registered contractor