

MassDEP Underground Injection Control Program Guidelines for Ground Source Heat Pump Wells

**Presented at:
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History of UIC Requirements for GSHP Wells



- **May 1982 – MassDEP requires UIC registration of GSHP wells**
- **2003 – MassDEP issues a GSHP fact sheet (posted on Well Driller Registration Program’s web site)**
- **February 2009 – MassDEP adopts Guidelines for GSHP Wells**
- **March 2009 – minor revisions to guidelines**

What Wells Require a UIC Registration?



- **Any well receiving return flow or system bleed from an open-loop system**
- **All closed-loop and Direct Exchange (DX) wells**

Note: UIC registration is required for all of the above unless a Groundwater Discharge Permit (GDP) is required.

What Wells Are Excluded from Obtaining a UIC Registration?



- **Open-Loop if:**
 - **raw water exceeds primary drinking water MCLs (may require a Groundwater Discharge Permit (GDP))**
 - **any chemical addition requires a GDP**
 - **drawing water from a Public Water System (other than make-up fluid)**
- **Any GSHP well if using any material or additive not discussed specifically in the guidelines**
 - **May require a pilot test installation**

Responsibilities



- **Owner/Operator** - properly operate and maintain system and notify UIC Program of changes to registration information
- **Designer** – MA PE or certified by International Ground Source Heat Pump Association (IGSHPA), Canadian Geotexchange Coalition (CGC), or the equipment manufacturer
- **Installer** - certified by IGSHPA, CGC, or manufacturer
- **Well Driller** - regardless of well type must be a Massachusetts Registered Well Driller

Setback Distances



If the open-loop well is also a private water supply well then all standard setback distances apply

All others:

- **25 feet from potential sources of contamination including but not limited to:**
 - septic tanks/fields
 - lagoons
 - livestock pens
 - oil or hazardous materials storage tanks
- **10 feet from property boundary (some towns require further setbacks from public road)**

Closed-loop and DX wells:

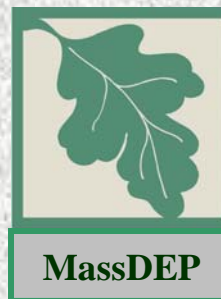
- **50 feet from private drinking water wells**

Allowable Additives



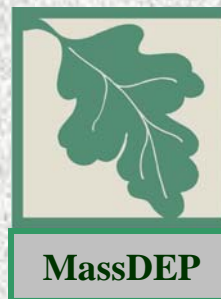
- **Open-loop: no chemical additives currently allowed under UIC registration (GDP required)**
- **Closed-loop: propylene glycol and ethanol**
- **DX: R-22, R-407A, and R-410A refrigerants, food grade lubricating oils, and polyol ester**

Grouting Requirements



- **Open-loop:** see MassDEP *Private Well Guidelines*
- **Closed-loop:** Due to concerns associated with the expansion/contraction of plastic tubing (HDPE), high solids bentonite slurry grout required:
- **DX:** Same grouting requirements as closed-loop but a cement-based grout may be used in place of bentonite slurry grout
- **Note:** sand/bentonite mixture grouts (thermal grouts) are acceptable as long as the cured grout's hydraulic conductivity does not exceed 10^{-7} centimeters per second.

Other Requirements



- **All GSHP wells: leak detection and emergency shut-offs**
 - for closed-loop these are required for leaks in both the water loop and the refrigerant loop
- **Open-loop: discharge below the operating water level in the well**
- **DX: cathodic protection (some exceptions)**

Other Requirements (continued)



- **Dual use as a Private drinking water well**
 - cross connection device prior to the heat pump
 - BOH approval for Private Drinking Water Well
 - Requires local plumbing inspector approval (currently some will not approve dual use wells)
- **Make-up water from Public Water System (PWS)**
 - approval from PWS
 - backflow prevention device at PWS connection to building and 2nd device just prior to GSHP heat exchanger
 - MassDEP does not allow automatic feed systems

Proposed Guidelines Changes



All GSHP wells:

- 10-foot setback from water and sewer lines

Open-loop wells:

- 25-foot setback from other potable water supply wells
- Backflow prevention on system bleed line

Dual use (potable water supply and GSHP discharge) wells:

- Return flow discharge must be located above pump withdrawal depth

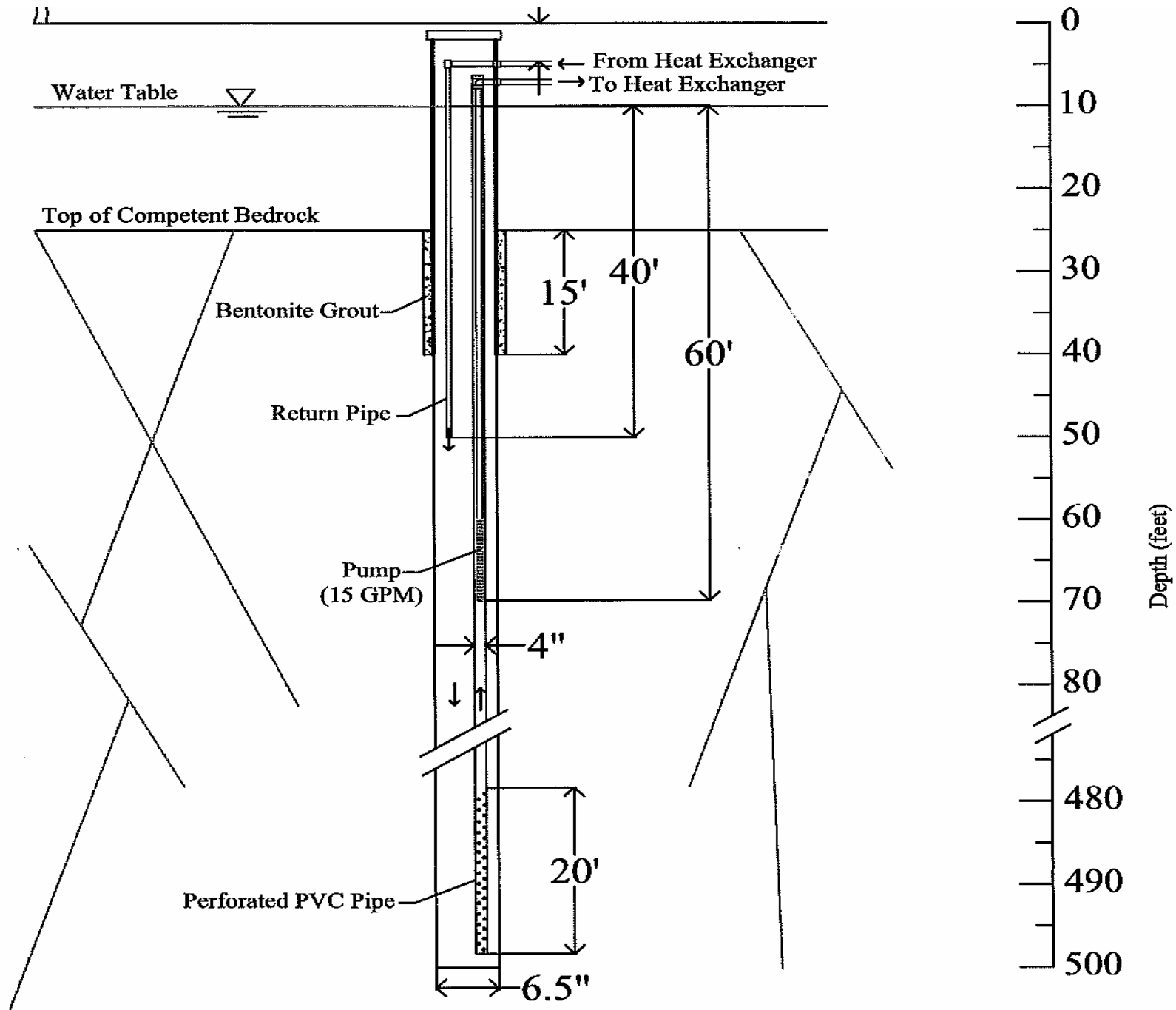
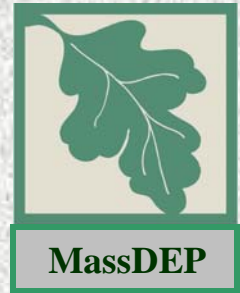


Figure copied from UIC submittal from GeoHydroCycle, Inc.

UIC Registration Application Process



**Residential applications up to 4 household units: BRP WS06e
– fee exempt**

**All others: BRP WS06a,b,c – fee applies unless applicant is a
municipal government**

Application Process Closed-Loop or DX Wells



- 1. Submit application package prior to well installation.**
- 2. MassDEP issues UIC registration number for well installation and system start-up.**
- 3. Applicant submits a project completion statement and includes a copy of the Well Completion Report.**
- 4. MassDEP issues final approval letter.**

Application Process Open-Loop Wells



Additional steps for open-loop wells:

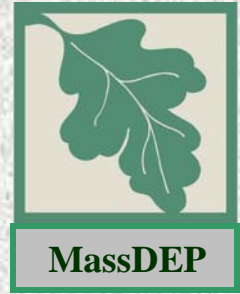
- 1. After obtaining UIC registration number and installing the well applicant submits raw water analytical results.**
- 2. MassDEP approves raw water quality results.**
- 3. Applicant submits post heat pump bacteria results.**
- 4. MassDEP issues system start-up approval.**
- 5. 90 to 120 days after system start-up, applicant collects a post heat pump water sample and submits analytical results for lead and copper to MassDEP.**
- 6. MassDEP issues final approval letter.**

UIC Registration Application Submittal Requirements



- **Site Plan**
- **Cross Section of GSHP well and bleed well (if applicable)**
- **Open-Loop - Design rate of system and of bleed well and anticipated bleed volumes (daily maximum and total annual)**

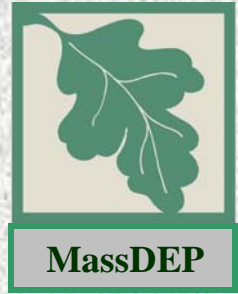
Submittal Requirements (continued)



Site Plan (Title 5 plans as base map are preferred) including:

- **GSHP well location**
- **GSHP bleed well location (if applicable)**
- **location of supply and return lines**
- **footprints of building structures**
- **location of septic tank and leach field**
- **property boundaries**
- **locations of any nearby drinking water wells (including abutting properties)**

Submittal Requirements (continued)



Cross section of proposed well construction including:

- **well depth**
- **boring diameter**
- **tubing diameter & material**
- **grout interval**
- **grout material**
- **depth of supply/return lines to wellhead**
- **include cross section of bleed well (if applicable)**

Submittal Requirements (continued)



Raw water analytical requirements for open-loop wells:

- **VOCs – all of them**
- **Arsenic**
- **Nitrate (As N)**
- **Nitrite (As N)**
- **Perchlorate**
- **Gross alpha radiation**
- **Radium (226 + 228)**
- **Uranium**
- **Sodium**
- **Chloride**
- **Corrosivity**
- **Iron**
- **Manganese**
- **pH**

Notes: Radium(226 +228 only required if gross alpha \geq 5 pCi/L

Uranium only required if gross alpha \geq 15 pCi/L

MassDEP raw water testing requirements typically exceed local BOH

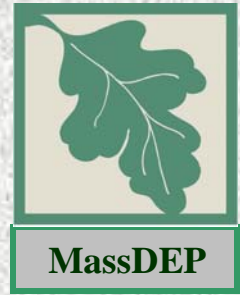
Additional Approvals Required Open-Loop, Closed-Loop, & DX



- **Construction Dewatering - must apply for approval (UIC or NPDES)**
- **Working within a wetland or surface water buffer (check with local Conservation Commission)**
- **Some BOH have adopted their own GSHP regulations and BOH permits may be required for some or all of the GSHP categories**

Note: BOH may adopt stricter standards than MassDEP and BOH may exclude certain types of GSHP wells

Lessons Learned Open-Loop Wells



- **Unacceptable post heat pump lead and copper results**
 - often caused by electrolysis resulting from insufficient grounding of the electrical system
- **Coastal Environments**
 - salt water intrusion and contamination of fresh water aquifers
 - corrosion concerns for plumbing and heat pump equipment

MassDEP UIC Information & Contact



Guidelines for Ground Source Heat Pump Wells & UIC forms and instructions available on MassDEP's UIC Web page:

<http://www.mass.gov/dep/water/drinking/uic.htm>

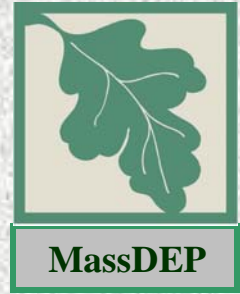
For GSHP UIC Registration:

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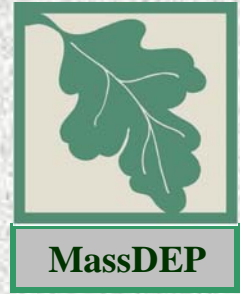


Lessons Learned Open-Loop Wells (continued)



- **Open doublet - pressurization of injection wells**
 - It's typically a lot easier to pump water from a well than it is to inject
 - **What can happen if I pressurize the injection well?:**
 - Break-out of ground water at ground surface resulting in flooding and the icing of walkways, roads, and driveways in the winter
 - Blow-outs or sink holes and the resulting concern for the structural integrity of nearby roads and building structures and damage to landscaping features

Lessons Learned Open-Loop Wells (continued)



- **For every 1 foot of water table height above mean sea level expect salt water to occur approximately 40 feet below mean sea level**

Example:

- **Static water table elevation = 10 feet above mean sea level**
- **Estimated depth to salt water interface = 400 feet below mean sea level**