POLICY BRIEFING · AUGUST 2026

# A Shared Duty

Well-control competency and licensure in Great Lakes geoexchange drilling.

A comparative review of seven state regulatory frameworks, with three requests of rule makers.

> *"The equipment evolved. The depths evolved.* **Well control has not evolved proportionally.***"*
>
> — Well Control for Closed-Loop Geoexchange

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Prepared for Michigan's Geothermal Workshop, August 2026 · Licensed CC BY-NC 4.0

EXECUTIVE SUMMARY

On July 16, 2026, a drilling rig near Wauseon, Ohio, encountered natural gas that ignited, injuring two workers. The incident remains under investigation, and this briefing draws no conclusion about cause. It was not, however, an isolated event: over the past twenty-five years, North America and Europe have recorded repeated incidents in which water wells, geothermal boreholes, and other shallow drilling operations encountered unexpected gas, flowing groundwater, reactive formations, or uncontrolled subsurface pathways — at Oakville, at Wheatley, at Hutchinson, at Kerrisdale, at Staufen, at Cleat Hill, and elsewhere. The question before regulators is therefore broader than the outcome of any single investigation: whether current licensure systems require the person at the controls to demonstrate well-control competency for drilling operations that may encounter gas, pressure, or loss zones.

This review compares the licensure and registration frameworks of Michigan, Ohio, Indiana, Illinois, New York, Minnesota, and Wisconsin. The findings are that these states regulate finished-well construction in detail, but the review located no requirement in any of them that a driller demonstrate competency in well-control concepts such as hydrostatics, pressure management, influx recognition, or loss detection; New York and Wisconsin partially reach drilling fluids as a topic, and no state reaches the rest. The briefing therefore recommends three practical updates: competency verification, documentation of flow checks, and pre-drilling risk assessment.

The closed-loop geoexchange driller is also the least comprehensively regulated category surveyed. In New York and Ohio, closed-loop drilling requires no state credential of any kind; in Michigan, it is governed by a county-by-county patchwork. The survey found no depth-based trigger for closed-loop bores, even where those bores penetrate formations materially different from shallow domestic wells. These are not abstractions: the authors have first-hand knowledge of county-permitted closed-loop bores at 1,600 ft and greater than 10,000 ft measured depth (Section 8).

The construction codes themselves assume the missing knowledge. Every state surveyed requires that flowing artesian wells be controlled and confined; none verifies that the driller has been taught what makes a well flow, or how a fluid column holds it. **This briefing identifies that gap and proposes three specific responses.**

## THE ASKS

ASK 01

### Competency

Drillers should demonstrate knowledge of well-control concepts, and be able to monitor and manage a primary barrier at all times while drilling. Recognition-level competency, proportionate to the work — teachable in days, and addable to existing examinations under authority states already hold.

ASK 02

### Documentation

Drillers should document flow checks and other well-control activities, and report them in the driller's log submitted to the state. A controlled influx that goes unrecorded teaches no one. A recorded and reported influx becomes a life-saving record for future drillers.

ASK 03

### Risk Assessment

The Engineer of Record (or equivalent) should give the driller and the AHJ a risk assessment before drilling begins — base of fresh water, known abnormal-pressure zones, injectors and other induced sources — so the driller can plan appropriate prevention and mitigation. No licensed engineer of record is required — a driller or homeowner may complete it from public records, an exercise Michigan's own EGLE formation-tops data makes especially low-effort.

**How the asks bind.** New rules should be applied fairly. Contractors already licensed, with documented experience, should enter the competency requirement through approved continuing education or a challenge examination, and a grace period should be extended to facilitate compliance. The requirements should apply to every drilling process, whether it is for water, brine, injection, geothermal, geotechnical, or another purpose.

**The non-asks.** We are not asking for blanket required use of secondary or tertiary barriers, like diverters or blowout preventers, on every bore. The great majority of geoexchange bores may not need these. We ask that those planning and constructing bores identify and manage risk to protect life, health, property, and the environment. We are not asking for oil-and-gas-style permitting, for moratoria, for new licensure fees, or for any requirement that scales beyond the demonstrated risk of the bore being drilled. The equipment these asks imply is modest: a mud balance, body-worn and/or site-stationed gas detectors, and weighting material staged if required. And we are not asking that reported well-control events become instruments of enforcement against the drillers who report them. We ask the opposite: that reporting be open, transparent, and life-saving.

## 01 THE COMPARATIVE PICTURE

Table 1 summarizes the regulatory dimensions of each state's framework as they apply to the drilling of vertical closed-loop geoexchange bores. Table 2 states the central finding competency by competency — for each state credential, is the subject required, examined, or verified? Full citations for every cell are in Appendix A.

TABLE 1 — REGULATORY DIMENSIONS BY STATE

| DIMENSION | MI | OH | IN | IL | NY | MN |
|---|---|---|---|---|---|---|
| **State credential to drill closed-loop** | None — county-dependent, waivable | None — registration doesn't reach it | Water-well license | Dedicated certification | None — exempt at any depth | Limited license |
| **Exam for that credential** | County-dependent | None | Yes — law/rules; specialty optional | Yes — siting, drilling, grouting; waived for water-well licensees | None (NGWA exams for water wells only) | Yes — nc publishe content |
| **Experience required** | County-dependent | None | None | 180 days | None | 3 years |
| **Continuing education** | None | 6 hr/yr, no set subjects | 6 hr / 2 yr | 6 hr / 2 yr | None | 2 hr/yr |
| **Depth trigger to a stricter regime** | None | None | None | None | Repealed 2023; replacement overdue | None |
| **Flowing wells addressed** | Construction only | Construction only | Absent from rules | Construction only | Construction only | Construc only |

TABLE 2 — COMPETENCY MATRIX: REQUIRED, EXAMINED, OR VERIFIED FOR ANY DRILLER CREDENTIAL?

✓ required / examined  △ partially present  ✗ no requirement located

| COMPETENCY | MI | OH | IN | IL | NY | MN |
|---|---|---|---|---|---|---|
| **Drilling fluid measurement & management** | ✗ | ✗ | ✗ | ✗ | △ | ✗ |
| **Mud weight & hydrostatic calculation** | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| **Equivalent circulating density** | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| **Lost-circulation identification** | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| **Kick recognition** | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| **Flowing-well response (as a competency)** | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| **Well control as a discipline** | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |

The two partial entries deserve their footnotes. **New York's partial entry** arises because its statute adopts the National Ground Water Association's certification exams, whose 2003 task blueprint includes “prepare drilling fluids” and “manage drill cuttings and fluids” — the fluid as a tool of the trade, with no task on hydrostatics, pressure, losses, or flow events. **Wisconsin's entries** arise because drilling fluids are named exam content for its heat-exchange driller license and named coursework for its water-well drillers, and because Wisconsin's code is the only one surveyed that states an actual mud weight — a 9 lb/gal minimum in flowing-well construction — with a duty to confine artesian flow and notify the department. These are the region's high-water marks. Neither reaches kick detection, pressure control, or well control as such.

## 02 WHY THIS REVIEW EXISTS NOW

The Toledo-area incident renewed attention on a question that predates it. The events below are drawn from the public record; several remain under investigation, and this briefing draws no conclusion about the cause of any open case. They are presented not as a set of common causes but as a common risk family: each illustrates the consequences of losing control of the subsurface during or after shallow drilling.

## A History of Warning Signs

Significant incidents in water-well, geothermal, and shallow drilling operations across North America and Europe over the past twenty-five years.

**2001** — **Hutchinson, KS**

Storage-field gas migrated miles to old brine wells

`Explosions in a town center; two deaths`

**2007** — **Staufen, Germany**

Groundwater reached anhydrite through poorly sealed geothermal bores

`Progressive heave; hundreds of buildings damaged`

**2012** — **Oakville, ON**

Pressured gas at 380–540 ft on a residential geothermal bore

`Neighborhood evacuation; provincial rule changes`

**2015** — **Kerrisdale, BC**

Pressurized aquifer pierced by a geothermal bore

`~2 M L/day for nearly two years; ~$9.9M public cost`

**2021** — **Wheatley, ON**

$H_2S$ and methane via legacy gas wells

`Explosion; ~20 injured; downtown evacuated >1 yr`

**2023** — **Orland, CA**

Gas pocket on a water-well job

`Rig fire`

**2024** — **Cleat Hill, England**

Gas migration after heat-pump drilling

`Two deaths; months of evacuation; >£1M response`

**2026** — **Wauseon, OH**

Natural gas — cause under investigation

Two workers critically injured

THE LESSON

*“A controlled influx that goes unrecorded teaches no one. A recorded and reported influx becomes a life-saving record for future drillers.”*

TABLE 3 — THE PUBLIC RECORD

| INCIDENT | SUBSURFACE SOURCE | PUBLIC CONSEQUENCE | COMPETENCY DOMAI IMPLICATED |
|---|---|---|---|
| **Wauseon (Toledo area), OH, 2026** | Natural gas — cause under investigation | Two workers critically injured | Hazard recogni (pending findi |
| **North Aceh, Indonesia, 2026** | Gas pocket at ~300 ft on a water well | Blowout and fire | Shallow-gas aw barrier manage |
| **Cleat Hill, England, 2024** | Gas migration after heat-pump drilling — investigation open | Two deaths; months of evacuation; >£1M response | Gas-pathway re (pending findi |
| **Orland, CA, 2023** | Gas pocket on a water-well job | Rig fire | Kick recogniti mud column |
| **Wheatley, ON, 2021** | $H_2S$ and methane via legacy gas wells | Explosion; ~20 injured; town center evacuated over a year | Offset and leg screening |
| **Kerrisdale, BC, 2015–17** | Pressurized aquifer pierced by a geothermal bore | ~2 million litres/day for nearly two years; ~$9.9M public cost | Artesian predi flow control |
| **Oakville, ON, 2012** | Pressured gas at 380–540 ft on a residential geothermal bore | Neighborhood evacuation; provincial rule changes followed | Gas detection; study |
| **Staufen, Germany, 2007** | Groundwater reaching anhydrite through inadequately sealed geothermal bores | Progressive heave; hundreds of buildings damaged | Zonal isolatio reactive-forma awareness |
| **Hutchinson, KS, 2001** | Storage-field gas migrating miles to old brine wells | Explosions in a town center; two deaths | Regional pathw awareness |

These cases had varying geologies, rig types, and proximal causes; but they all share at least one characteristic — an identifiable subsurface risk that could have been prevented or mitigated. The regulatory question this review examines is whether any Great Lakes licensure system verifies that drillers, engineers, and regulators can recognize and manage these risks.

## 03 WHAT “WELL CONTROL” MEANS — A PRIMER

Readers from the oil-and-gas industry know these terms; for understandable reasons, many geothermal drillers and most regulators may not.

# The Primary Barrier: Fluid Under Pressure

A fluid column in the borehole, properly weighted and managed, prevents formation fluids and gas from entering the well.

## WHAT THE DRILLER DOES

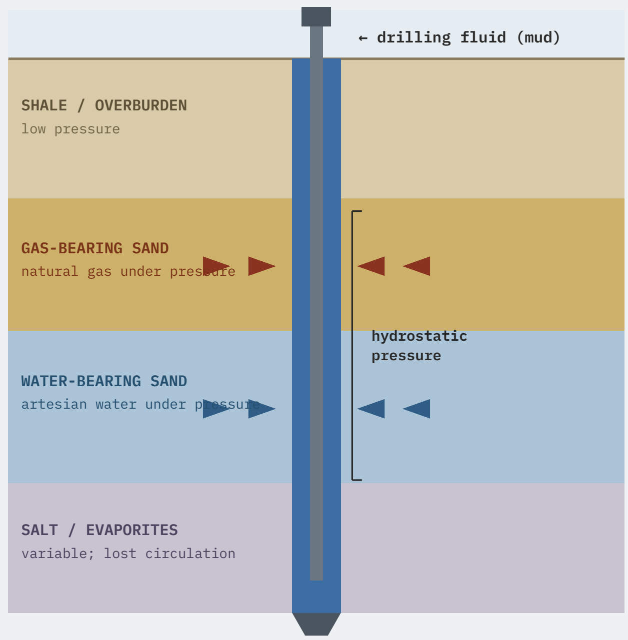
**MEASURE**
Check drilling-fluid weight and viscosity regularly.

**MANAGE**
Adjust fluid properties to hold the correct hydrostatic pressure.

**MONITOR**
Perform flow checks to detect gains or losses.

**RECOGNIZE**
Identify early signs of influx (kick) or lost circulation.

**RESPOND**
Take corrective action immediately to regain and keep control.




## WHAT CAN GO WRONG

**FLUID TOO LIGHT**
Hydrostatic pressure falls below formation pressure.

**INFLUX (KICK)**
Formation gas or water enters the borehole.

**UNCONTROLLED FLOW**
Influx expands and rises, cutting effective hydrostatic pressure.

**LOSS OF CONTROL**
Well flows at surface — blowout, fire, injury, or environmental damage.

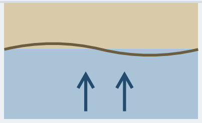
**WELL CONTROL IS NOT ABOUT EQUIPMENT · IT IS ABOUT KNOWLEDGE, JUDGMENT, AND DISCIPLINE · THE DRILLER IS THE PRIMARY BARRIER**

### FORMATION PRESSURE (PORE PRESSURE)

Fluid in the pores of rock carries pressure. Normally it equals the weight of a fresh-water column to that depth — about 0.433 psi per vertical foot. Deep formation waters in this region are brines, whose columns weigh more — up to roughly 0.46 to 0.52 psi per foot — so a “normal” brine zone already exceeds a fresh-water column's holding pressure. Some formations carry more still (they push fluid at the bore); some carry less (they pull fluid from it). Abnormal pressure can be natural (incomplete compaction, artesian flows, unconformities, uplift, salt tectonics, plate tectonics) or induced (injection wells, mineral wells, forced-advection geothermal wells). This list is illustrative, not exhaustive; other natural or induced sources of abnormal pressure may be present and should be considered on a site-specific basis.

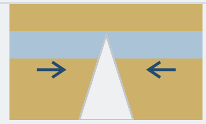
## Natural Pressure Sources

Geologic conditions that can create overpressure and drive fluids toward the bore.



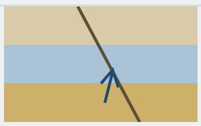
**1 UNCONFORMITY**

Younger permeable strata overlie older low-permeability rock; pressure builds below the seal.



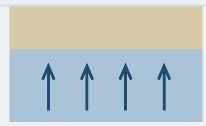
**2 SALT TECTONICS**

Moving salt structures fracture and trap fluids, generating abnormal pressure.



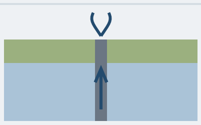
**3 FAULTS**

Faults juxtapose permeable and impermeable layers, opening paths for fluid and pressure to migrate.



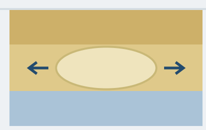
**4 UNDERCOMPACTION**

Rapid burial traps pore water, leaving excess pore pressure behind.



**5 ARTESIAN FLOW**

Formation pressure exceeds surface elevation, driving water up the bore on its own.



**6 GAS EXPANSION**

Gas expands as temperature rises or pressure drops, raising pore pressure.

### INFLUX (KICK)

Formation fluid — gas (methane, hydrogen sulfide, carbon dioxide, and others), water, brine, or oil — entering the borehole because formation pressure exceeds the pressure of the fluid column. The early signs are modest: a gain in the pits, a change in returns, bubbles at the surface, even a significant change in drilling rate. Recognized early, a kick is a manageable event. Unrecognized, it becomes the incident reports in Table 3.

### LOST CIRCULATION

The opposite case: the fluid column draining into a weak, fractured, or depleted zone. Losing fluid is losing the primary barrier. Because pressure is 0.052 × MW × TVD, it falls in proportion to the change in fluid-column height. Fluid losses are one of the most common predictors of influx, and drilling without returns (a discontinuous drilling fluid column) is not recommended without additional barrier(s).

### EQUIVALENT CIRCULATING DENSITY (ECD)

Pumping and pipe movement change the effective pressure the column exerts — often called “surge” and “swab.” Not unlike a piston that compresses or draws a vacuum, bits and casing leave very little annular space, and moving them quickly can induce flow into or out of the rock pores.

### PRIMARY BARRIERS

Most often, the column of fluid standing in the borehole — the drilling mud. Its weight, a function of density, holds back every formation the bore penetrates: `P = 0.052 × MW × TVD`, where MW is fluid density in lb/gal and TVD is true vertical depth (not the length of the bore). Air drilling is the special case: with no fluid column in the hole, there is no primary barrier. The diverter air drilling relies on is not a primary barrier — it cannot shut the well in; it routes flow away from the crew and ignition sources and buys time until a kill-weight column can be established. A diverter may be credited as a barrier element only where installed on casing cemented and pressure-tested to an API or other AHJ-accepted standard — and even then, it is the fluid column that ends the influx.

### SECONDARY & TERTIARY BARRIERS

Most mineral-well drilling is performed under a multi-barrier mandate: two functional barriers must always be in place. Where risk justifies it — or at the disposition of the AHJ — diverters and blowout preventers may be required. We recognize, however, that the economics of many geoexchange projects may not support this equipment.

### WELL CONTROL

The means and methods of using barriers, and if necessary emergency-response techniques, to ensure that drilling fluids and pore fluids are managed in a manner that reasonably prevents and/or mitigates threats to life, health, property, and the environment.

## 04 FLOW CHECKS & DOCUMENTATION — THE SECOND ASK, IN PRACTICE

A flow check is the simplest well-control observation there is — a procedure done in the normal course of operation when making a connection. The driller turns pumps off, stops rotating, and the crew watches the well for a defined period until the fluid level is stable. The interval is a function of the bore itself: larger and deeper bores may show elastic “ballooning” from equivalent-circulating-density pressure, and the window must be long enough to rule that out. A stable level means the primary barrier is holding. A rising level or flow at surface means the formation is delivering fluid. A falling level means the bore is losing its barrier. The check requires no equipment beyond the crew's eyes and some basic measuring tools.

**When flow checks should be mandatory.** Flow checks are recommended regardless of the depth or type of bore — geotechnical, water-well, geothermal, and others. Regular checks should be mandatory whenever there is a reasonably expected risk of influx, or once the bore is drilled below the base of fresh water. Any flowing zone below the base of fresh water is a clear and present risk to the public and should be monitored carefully. This is a departure from the water-well tradition of actively avoiding brackish or contaminated zones. Checks should be performed at AHJ-specified depth intervals, or when a change in rock type could indicate new fluid, pressure, or rock properties.

**Flow checks on air.** On air, the check is similar in purpose and changes only in form: follow the rig manufacturer's guidelines for making a connection, then monitor the bore for self-initiated pressure and/or flow, with a gas-detector reading taken at the discharge. A bore that flows on air is a bore that needs a fluid column or pressure-tested secondary or tertiary barriers.

**What a flow check should record.** Information that is reasonable, readily available, and required for well control — at least: the depth of the bore (TVD preferred if available), the mud weight currently in the bore, any flow or losses observed, estimates of the rate of gains or losses, any steps taken to stop them, and the resultant mud weight when gains or losses abated.

TABLE 4 — MODEL FLOW-CHECK RECORD

| MD (FT) | TVD (FT) | DATE / TIME | MUD WT (LB/GAL) | FLOW OBSERVED | FLUID TYPE | PIT GAIN / LOSS | CONTROL MUD |
|---|---|---|---|---|---|---|---|
| **480** | 480 | 7/20, 09:40 | 8.6 | None (5 min) | — | None | — |
| **1,120** | 1,105 | 7/20, 14:25 | 8.6 | Slow rise, self-flowing | Brine | +3 bbl | 9.4 |

The “no flow” entries matter as much as the flow entries: they are the evidence, presently nonexistent, of how often these bores encounter nothing — and where that stops being true.

**What the record is worth.** Widespread flow checks become the basis of a universal hydrogeological study and can be the most valuable information for de-risking future drilling. It must be stressed, however, that drillers should be encouraged to report flows. The AHJ should consider incentives and/or statutory protections for reporting that outweigh the potential cost of lost time or project complexity, which otherwise inhibit transparency.

## 05 ADDRESSING OBJECTIONS & BIASES

The recommendations in this briefing will draw predictable objections. We address them here not to dismiss them, but because each one highlights the same regulatory gap: current frameworks assume knowledge and monitoring practices that they do not consistently require.

BIAS 01 · SURVIVOR BIAS

*“We drilled across the street and didn't have any issues, so we won't have a problem here.”*

A comment the author heard from regional geothermal drillers — a common heuristic that is often a precursor to disaster. The July 2026 tragedy near Toledo demonstrates it exactly: on the local news, the homeowner recounted how no one expected the event because they were drilling near an existing well on the property that had never had gas issues.

BIAS 02 · NORMALCY BIAS

*“We do this all the time and we don't see this problem.”*

This sounds like data but is not — because the data does not exist. To the author's best knowledge, no jurisdiction surveyed requires a driller to report a gas show that was controlled, or one that did not reach the finished well. Flow checks are not required, so their results are not recorded. Reporting is typically triggered only when someone is hurt or when gas flows into a completed well — and even then, brine and other contaminants may fall outside the requirement entirely. Whatever the objection intends, it is an argument *for* the second ask: if influx truly is rare, the flow-check record will show it, cheaply and permanently.

BIAS 03 · STATUS QUO

Concerns about cost and training are common in any regulatory change, but they should be weighed against demonstrated safety benefits. Many now-standard protections, including seat belts, hard hats, gas detectors, and lockout training, were once resisted before becoming routine. The relevant question is not whether change has a cost, but whether the cost is justified by the risk reduction it produces.

## 06 CONSTRUCTION STANDARDS VS. COMPETENCY STANDARDS

The distinction that organizes the entire briefing is simple: construction standards describe what a completed well must *achieve*; competency standards verify whether the person drilling the well understands the physics that make those standards meaningful.

Every state surveyed has rules stating that wells must be grouted, cased, sealed, and, where artesian conditions exist, controlled. Those are important outcome requirements. They do not answer a different question: whether the person operating the rig has ever been taught what hydrostatic head is, how to weight a fluid, or what a pit gain means.

The question is not whether a state has rules about flowing wells or drilling fluid — the states surveyed all do. The question is whether anyone verifies that the driller understands the physics those rules assume. The construction codes are, in effect, an examination the well must pass after the fact. **The review located no comparable examination that the driller must pass on the same subjects in advance.**

## 07 FIVE PRINCIPAL FINDINGS

The review's five principal findings are set out below. Full legal analysis appears in Appendix A.

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**01** The review located **no requirement, in any of the seven states,** that any driller credential include training or demonstrated competency in hydrostatics, pressure control, equivalent circulating density, lost-circulation identification, flowing-well response, or well control generally. The two partial exceptions — New York's adopted private exam and Wisconsin's named drilling-fluids content — reach the fluid as a tool of the trade, and stop there.

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**02** The **closed-loop geoexchange driller is the least-regulated driller in the region.** New York exempts closed-loop drilling from registration, examination, and reporting at any depth; Ohio's contractor registration does not reach it; Michigan's framework is a county-by-county patchwork over a state-level vacuum, waivable case by case. Indiana, Illinois, Minnesota, and Wisconsin require a credential — and none examines fluids or pressure for it, while Illinois waives its closed-loop examination entirely for licensed water-well contractors.

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**03** **Depth-based permitting or risk triggers do not appear to exist in the region.** Rather, permits per well, casing programs, pressure control, bonding, and plugging are triggered by the *purpose* of the borehole, instead of its depth or the formations it penetrates. A bore drilled for heat fits no regulated purpose, and defaults, at any depth, to a sanitary well code, a county desk, a log filing, or nothing. New York is the exception that proves the point: it captured deep closed-loop bores for years, released them by statute in September 2023, and set a December 2024 deadline for replacement rules that remains unmet as of this writing.

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**04** Where a new technology strained the categories — the **submerged heat exchanger,** which pumps groundwater between zones within an open borehole while its heat-transfer fluid stays in pipe — two states redrew the category around the vendor rather than examining the physics: Minnesota by statute (its health department barred from limiting system count or size, its rules containing no thermal limit, monitoring, or neighbor remedy), Wisconsin by case-by-case variance with genuine conditions. Whether such systems are Class V injection wells under the federal UIC program is a substantial, unresolved question no agency, vendor, or commenter has publicly analyzed; the review's analysis of that question is in Appendix A.

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**05** Every state writes flowing-well and drilling-fluid requirements into its construction code **as outcomes,** and no jurisdiction appears to connect those outcomes to the competency of the person at the controls. The rules assume knowledge that the credentialing system does not verify and does not require anyone to teach.

## 08 THE SEVEN STATES, BRIEFLY

Full statutory analysis, with every citation and verbatim quotation, is in Appendix A. What follows is the shape of each state's answer to the competency question — as understood by the authors.

## Michigan MI

Water-well drilling contractors register annually with EGLE after two years and twenty wells of supervised experience, a 200-question written exam, and a hands-on exercise — the hands-on element being submersible-pump electrical troubleshooting, not drilling. The applicant must document having personally operated the rig on twenty wells; no rule requires demonstrated understanding of the drilling system as a hydraulic system. The rules contain the word “mud” zero times; drilling fluid appears only in material and product standards; flowing wells appear only as construction and abandonment outcomes. There is no continuing-education requirement. Michigan's own *Flowing Well Handbook* (EGLE, reformatted 2020) teaches fluid weighting against artesian flow — as guidance no rule requires anyone to read. Closed-loop drilling sits outside the state well code entirely, by EGLE's published position; regulation exists only where local health departments adopt it, and local requirements may be waived.

Two observed facts, stated as fact and separated from analysis, both known to the authors at first hand. A closed-loop bore was permitted in a Michigan county to 1,600 ft — terminating at the top of an anhydrite section, the same rock family whose hydration heaved Staufen — under a waiver of the county's water-well drilling licensure requirement (2026). The waiver was not carelessness: the driller demonstrated practice far beyond anything the framework required — a blowout preventer, a diverter, full solids control, and routine flow checks — and the county, reasonably, was satisfied. That is precisely the gap. The county had no standard against which to make that judgment; it went well because the applicant happened to bring that discipline, and nothing in the framework would have distinguished that rig from the next applicant who brought only confidence.

Second: a closed-loop well with a measured depth greater than 10,000 ft was likewise permitted through a county health department under the water-well framework. The analysis those facts support: in Michigan, the sole gate for a closed-loop bore of any depth is a county permitting framework written for domestic water supply, discretionary in adoption and discretionary in waiver, with no competency standard available to inform either.

## Ohio OH

Registration of private water-systems contractors is annual and consists of a fee, a surety bond, and liability insurance. There is no examination of any kind, no experience requirement, and no initial training; the only competency language in the scheme is a post-hoc revocation ground for "demonstrated incompetency." Six hours of annual continuing education (no required subjects) can be replaced by credentials including the NGWA Certified Well Driller — available, required of no one. Ohio's construction rules address flowing wells in detail, and even excuse the requirement to flush drilling fluids from the annulus before grouting "except for flowing artesian conditions" — the one case where fluid management matters most. Closed-loop drilling is not reached by the contractor registration at all; on the drilling side, the review identified a single state-level duty for a closed-loop bore of any depth — filing a well log with ODNR within thirty days after completion. (Commercial installations engage mechanical trade licensure and building-code approvals on the heat-pump side; those govern the mechanical system, not the drilling.)

## Indiana IN

The water-well driller license reaches geoexchange by definition — a "well" includes a hole drilled to "utilize the geothermal properties of earth formations" — making Indiana, together with Minnesota, one of two states where the closed-loop driller must be licensed with no exemption of workable scope — Indiana's statute does carve out personal-use wells, but the carve-out is capped at 1¼ inches in diameter and 24 feet deep (IC 25-39-1.5-3), far too narrow to reach an actual closed-loop bore, which typically runs 150 feet or more at 4 to 6 inches in diameter. The license requires references and a written exam but no formal experience minimum. The statute publishes the exam's eighteen-topic outline — the only state to do so — and drilling fluid, hydrostatics, pressure, lost circulation, and flowing wells appear in none of the eighteen; the exam's optional specialty sections permit a candidate to skip the rotary and geothermal questions entirely. The rule texts contain zero occurrences of "mud," "flowing well," or "artesian." An instructive inversion: a deep geothermal *exploration* borehole plausibly requires an oil-and-gas-division permit as a structure test well, while the deeper permanent bore drilled beside it does not.

## Illinois IL

The state took closed-loop drilling seriously enough to create a dedicated certification with its own statutory board — and scoped its examination to "the location of closed-loop wells in relation to water wells and sources of contamination, drilling of boreholes and grouting of the borehole." Siting, drilling, grouting; nothing on fluids, hydrostatics, losses, or flow events. The certification requires 180 days of geothermal drilling experience — and is granted without examination or fee to any licensed water-well contractor. Across the statutes and rules, "well control" and "lost circulation" appear zero times. The closed-loop construction section is silent on flowing artesian conditions; its nearest approach to loss zones is a karst-bridging provision that does not name lost circulation. Southern Illinois adds a formation-scale footnote: Illinois Basin oil pay zones commonly sit between 500 and 4,000 ft, and no rule requires notice to anyone when a closed-loop bore penetrates them.

## New York NY

The regional high-water mark for water wells, by delegation: the statute requires on-site drilling supervisors to pass the NGWA's two-part exams, whose task blueprint includes preparing and managing drilling fluids. The blueprint contains no task on hydrostatics, pressure control, lost circulation, or flowing-well response, and it dates to 2003. For closed-loop geoexchange, New York is the region's starkest story: deep closed-loop boreholes were regulated under the state's oil-and-gas-style framework until September 2023, when legislation released them effective immediately; the February 2024 follow-on law required replacement regulations by December 31, 2024; as of July 2026 the rulemaking remains pre-proposal, and the department states that closed-loop wells of any depth require no registration, examination, or reporting. The draft replacement rules — contractor registration, per-borehole permits, and, for the first time in the region, certification for the individual supervising drilling — exist on paper and are in force nowhere.

## Minnesota MN

The most differentiated license structure in the survey: a full well-contractor license (four years of documented experience) and a dedicated limited license for bored geothermal heat-exchanger contractors (three years, with footage and hour minimums). The examination rule names no required subjects at all, and no content outline is published; continuing education for the limited license is two hours per year. Minnesota's flowing-well construction standards are the region's most developed — tiered by flow and pressure, with mandatory flow control — and none of it attaches to the driller's knowledge. Minnesota also enacted the region's newest category: the submerged closed-loop heat exchanger, a statutory classification developed with a single vendor, for devices that pump groundwater between zones of an aquifer inside an open borehole while the heat-transfer fluid stays in pipe. The health department is statutorily barred from limiting the number or size of such systems; the adopted rules contain no groundwater-temperature limit, no thermal monitoring, no setbacks, no neighbor notification, and no interference remedy; and the department has stated on the record that it has no limit on how much groundwater temperature may be changed. A neighboring well owner's remedies, examined in Appendix A, are effectively nil under current Minnesota law.

## Wisconsin WI

The strongest competency framework in the survey — and the measure of how low that bar sits. Wisconsin licenses heat-exchange drilling as its own examined trade: two years as a registered rig operator, ten projects and 5,000 ft of pressure-grouted drillhole, approved training, and an exam whose published content includes geology, drilling methods, drilling fluids, grouting, and calculations. Water-well drillers face 33 hours of named coursework including drilling fluids. The code states a 9 lb/gal minimum fluid weight for flowing-well construction and requires artesian flow to be confined, with department notification. Deep bores above 400 ft require case-by-case department approval — within the same sanitary framework. Nothing in the licensure or code reaches kick detection, pressure control as a discipline, gas hazards, or well control in the sense this briefing uses the term. Wisconsin has also confronted the submerged heat exchanger, choosing case-by-case variances with conditions — single aquifer only, water as the only exchange fluid, licensed driller required — over Minnesota's statutory accommodation.

## 09 TWO OPEN STRUCTURAL QUESTIONS

### Q1 Should depth affect well-control requirements?

Seven states, one architecture: drilling regimes with well-control content are purpose-triggered — oil-and-gas law captures bores drilled for oil and gas, mineral law captures bores drilled for minerals — and a bore drilled for heat fits no category. The framework presently contains no depth or formation trigger of any kind for closed-loop bores in any surveyed state. The practical consequence is that the same county desk, sanitary code, or log-filing duty that governs a 150-foot residential loop also governs a bore penetrating evaporites, brine systems, or gas-bearing rock thousands of feet down. As geoexchange moves toward deeper, district-scale systems, whether some depth, formation, or risk threshold should escalate requirements — and to whom — is unaddressed everywhere in the region. New York's experience offers the cautionary template: a depth trigger repealed before its replacement existed produces a vacuum, not a transition.

### Q2 How do we treat a geothermal classification outlier?

The submerged heat exchanger is a device that is closed-loop in its plumbing and open in its physics: it deliberately alters the pressure gradient across at least two intervals of an aquifer, moving groundwater between zones that may otherwise interact slowly or not at all. State frameworks have so far answered by classification — “closed loop,” “nonconsumptive” — rather than by analysis of the aquifer effects, and the review located no state requirement addressing thermal impacts, interference with neighboring wells, or subsurface thermal migration from such systems. At the federal level, whether these systems are Class V injection wells under the UIC program — with the inventory, non-endangerment, and enforcement consequences that classification carries, particularly in Minnesota, where EPA administers the program directly — raises a substantial unresolved question under EPA's existing interpretations, which treat standing-column wells and same-water cooling-return wells as Class V and define closed-loop systems as those whose water circulates “entirely within a system of closed pipes.” No agency has publicly analyzed the question. The full analysis, with the strongest arguments in both directions, is in Appendix A.

## 10 WHAT REGULATORS & RULEMAKERS CAN DO

This briefing's authors are drilling practitioners, not legislators, and the options below are offered as a menu rather than a program. They are ordered by how quickly each could take effect.

### IMMEDIATELY · WITHOUT REGULATION

Well-control competency can be taught now, voluntarily, at no cost to the state. Michigan's own *Flowing Well Handbook* already teaches fluid weighting against artesian flow. The authors are publishing, under a Creative Commons license, a free open well-control course written specifically for closed-loop geoexchange drilling — its introductory module and its first technical module (pressure: where it comes from, how it hides, and how it releases) are complete, with modules on influx fluids, pre-drilling risk identification, detection, mitigation, zonal isolation, and reporting to follow. Contractors, associations, and training providers may teach from it freely. Insurers and project owners need not wait for statute — specifying well-control training in contracts and underwriting standards moves faster than rulemaking. Nor need county health departments wait: a county may, today and under authority it already holds, attach the flow-check triggers of Section 4 and completion of the free course as conditions on any closed-loop permit.

### NEAR TERM · WITHIN EXISTING AUTHORITY

Most surveyed states could add primary-barrier content — fluid measurement, the hydrostatic calculation, flowing-well response, kick recognition — to existing examinations and approved continuing-education lists without new legislation, because exam content in most states is set administratively. Michigan's advisory board controls its exam content today;

Minnesota's commissioner sets exam content by rule that names no subjects; Indiana's DNR already approves CE courses on application.

STRUCTURALLY · WHEN LEGISLATION IS CONTEMPLATED

Three gaps recur across the region and define the agenda: a **state-level baseline credential** for closed-loop drilling where none exists (Michigan, Ohio, New York), so competency does not depend on the county where the rig is parked; a **depth- or risk-based escalation trigger**, so the bore that penetrates brine, gas-bearing rock, or evaporites receives more scrutiny than the residential loop — designed to take effect with its replacement in place, not before; and a **data foundation** — no surveyed jurisdiction requires reporting of gas shows or influx events that were successfully controlled, so every debate about how common these events are proceeds without data. The flow-check reporting of the second ask (Section 4), protected from punitive use, would give the next version of this conversation an evidentiary base.

## 11 CONCLUSION

The seven Great Lakes states have built detailed, often thoughtful construction codes for wells, and a licensure architecture that verifies many things about the people who drill them — their experience, their references, their knowledge of the code, and in one state their ability to troubleshoot a submersible pump.

What the architecture does not verify, anywhere in the region, is whether the person at the controls understands the column of fluid that stands between a routine day and the events of Table 3. That is not an accusation of any driller, agency, or state; the historical reasons are plain enough, since the framework was built for shallow water wells in familiar geology. But the bores are no longer shallow, the geology may no longer be familiar, and the incident record is no longer hypothetical.

This briefing asks the meeting to name that verification for what it is: a duty — owed to the public, whose aquifers and neighborhoods stand downstream of every bore, and owed to each other, because every crew inherits the subsurface the last crew left behind and the reputation the last incident created.

## The law of the region does not yet recognize that duty, but the readers of this document can.

## APPENDIX — SOURCES

Full statutory analysis, with every citation, quotation, and verification note, accompanies this briefing as Appendix A. Primary sources cited are listed below.

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