



A Hard Rain's

Gonna Fall

By **Michelle Moore**
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Regulations Help California Well Owners Weather the Storm

Sonoma County, California, best known for its endless miles of sun-drenched vineyards, comes very close to being paradise on Earth. An hour north of San Francisco, pristine beaches, regal redwood forests, rolling hills, and inland lakes add up to create the region's peaceful and enviable environment. But, come November, things change. The rains begin, and for the next four or five months, Sonoma County gets drenched.

The Russian River runs through the region from the north in Mendocino County, wending its way to the Pacific Ocean. The Russian is wide and slow moving. When the rains are falling, instead of surging and pounding against its banks, the river creeps out over the land, rising to the height of roofs in some low-lying areas.

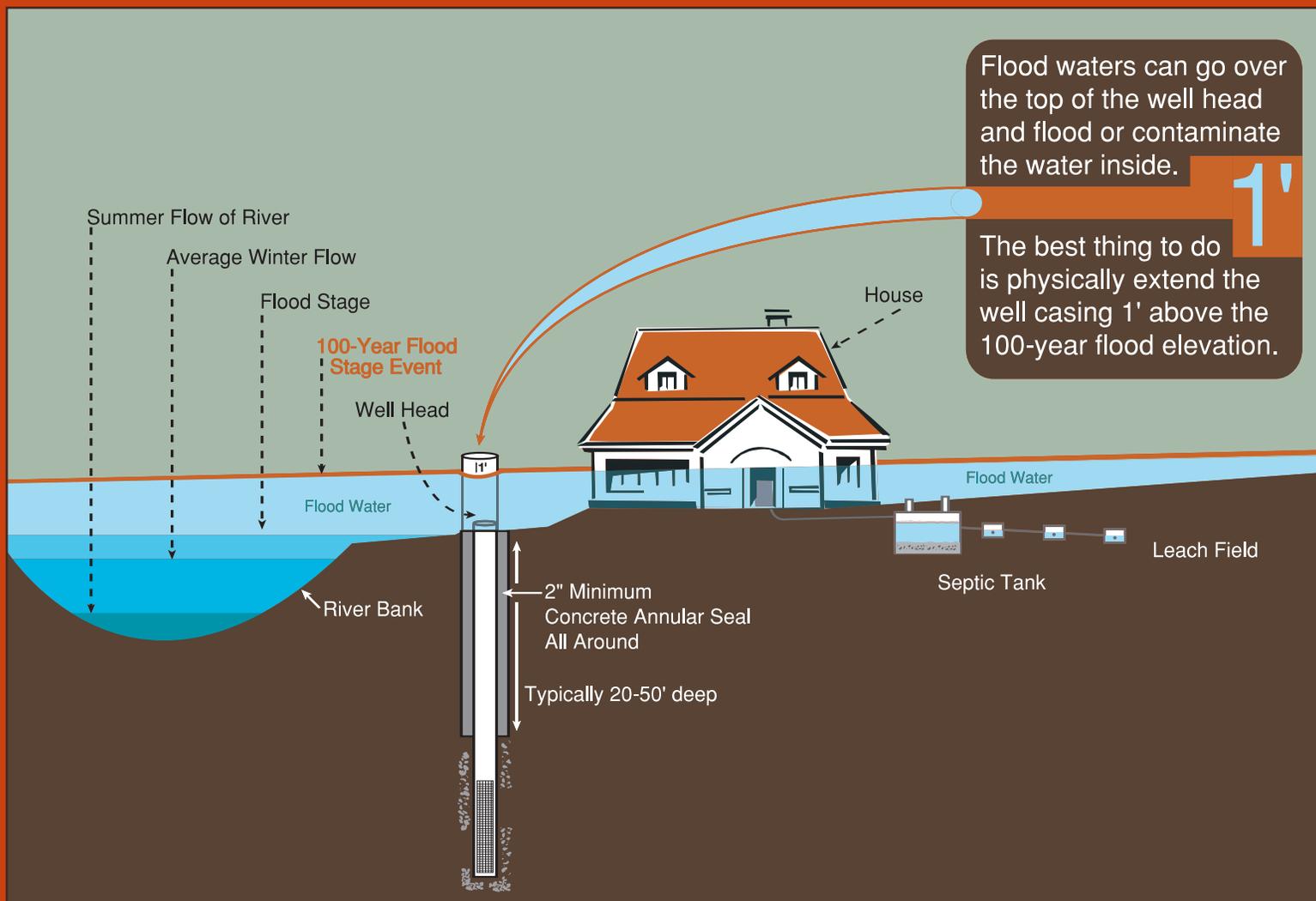
"Homes close to the river will be under water half or part of the way," says Ted Walker with the Sonoma County Health Department, "so there's mud intrusion, and structural damage will occur. New houses are restricted in the flood way, and the first floor elevation, according to FEMA, has to be one foot above the hundred-year event level."

Elevating a house is an effective way to protect the structure, but without some adjustments, a home's private water system is also at risk when the river rises over the banks. Dirty river water plus anything that is swept up into it can make its way into a well. With 40,000 or so wells operating in Sonoma County (serving about 25 percent of the population) there are plenty that may be vulnerable to flooding.

Walker says that the health department distributes handouts and flyers to private well owners, and public notices are posted during flooding to educate people about the potential hazards of contaminated well water. Many people with private water sources rely on bottled water, and some boil their drinking water. But, Walker says, most people don't use their well water for drinking during flood stage if they think the well has been affected.



Photo courtesy of DAVE GATLEY/FEMA News



Flood waters can go over the top of the well head and flood or contaminate the water inside.

1'

The best thing to do is physically extend the well casing 1' above the 100-year flood elevation.

Two Means of Contamination

Infiltration of wells by flood water can occur in two ways: water seeps down through the soil around the outside of the well casing to the intake perforations, or it rises high enough to flow directly into the wellhead and down the inside of the well. Either way, both the well and the underlying aquifer are at risk of contamination.

To remedy the first problem, Sonoma County created an ordinance in the early 1970s requiring that all new wells have a minimum of a 20-foot-deep annular seal around the outside of the casing. Prior to that time, annular seals were optional, and people frequently chose to have newly drilled wells backfilled with native soil instead. Unfortunately, the backfilled soil provides an easy avenue for water to make its way down the outside of the casing. A minimum two-inch annular seal, on the other hand, works well for excluding flood water.

Charlie Judson, president of Weeks Drilling and Pump Company, says the seals, which consist of cement grout or a bentonite clay mixture, are “by far the most effective thing that can be done to prevent surface contamination.”

The bentonite clay mixture or the cement grout is pumped down a pipe into the annular space, and the pipe (known as a tremie pipe) is withdrawn as the material packs into the void. This practice helps avoid gaps that might form if the material was just poured around the well casing from the surface.

“We have a pretty good view here of how well these seals work because, generally, people who have wells drilled since 1974 do not have any issues with surface water contamination,” Judson says. “But, people who have wells that were drilled prior to that, if they did not opt for one of these annular seals, they often do [have problems].”

Judson says that many people still have the old style of well, and that when it rains heavily, the turbidity or clarity of the water is degraded.

The second avenue for well contamination—infiltration via the wellhead—is difficult to prevent unless the height of the well casing reaches above the highest point of potential flood water. Although the county doesn’t require it, Walker says the health department urges people to elevate the height of their well casing.

Determining how high a casing should be depends on knowing the potential maximum height of flooding, which is estimated by using the 100-year flood level. In 1986, flooding was severe, and that year’s high water mark has become today’s standard for the minimum a well casing should extend above ground level.

In a newly constructed well, the casing is made long enough to stand up out of the ground to that height. With an existing well, casing is added to reach that height. But, Judson adds, “We can still have a problem if the well doesn’t have a proper annular seal, because then the water can be forced down the outside of the

casing and the net effect is the same, although it's not quite as dramatic."

Aquifer Contamination

Judson says that if a well is inundated by flood water, the flooding usually lasts for days, and the underlying aquifer "can be inoculated with the worst imaginable water." When an aquifer becomes contaminated during a flood, it takes a long time to clear up. Judson says that they sometimes have to pump a well for weeks before it returns to its original water quality. "It's hard to define when to call it a success," he says. "We normally base that on the results of a coliform bacteria test, and it can be really difficult to achieve that unless the well has been pumped for a long time after a flooding event."

Reliably sealing a well against surface inundation is difficult because "wells need to breathe," Judson says. If the well is sealed so tightly that water can't leak in, it is also sealed against air moving in and out. The water level in the well needs to fluctuate up and down for the pump to work properly, and air is required to make that happen. Raising the casing height is a much better solution for protecting the integrity of the well.

Private Wells at Risk

Private wells are more at risk than publicly owned wells for obvious reasons. Well upkeep and water quality depend entirely on the owner's motivation and pocketbook, whereas upkeep of public supply wells is supported through state and county regulations and through customer billing.

"The individual property owners are most affected because they don't have the financial resources to maintain their water supply and protect it as well as the public water systems," says Walker. "The public water wells are inspected by state engineers, and they do a lot to protect the wells from flood waters. But the individual wells, they typically don't have an elevated wellhead and can be influenced by flood waters. So the ones we're most concerned with are the private wells."

Public supply wells must be built with a minimum 50-foot seal, versus the 20-foot seal required for a private well, offering that much more barrier to contamination. Public well operations also have regulations in place that provide oversight and emergency procedures during times of flooding.

Judson says there are 500 small, public water systems in the area, 95 percent of which use groundwater, and some of them using multiple supply wells. These systems range from mobile home parks to hotels to very small communities.

Consumer fraud in well construction is rare, but Judson related a story of an inadequately sealed well that was only discovered following a mudslide. Heavy rain caused the hillside into which the well was drilled to slip, exposing about eight feet of the well casing. (See photo—lower right.) The line where the seal hit ground level is distinct, as is the line where the seal ends down on the pipe, a distance of about 18 inches.

"That grout seal is supposed to extend to a depth of 20 feet," Judson says. "And the homeowners would have no way to know that, because all they can see is a piece of casing sticking out of the ground."

This well, which serves a population of about 300 people, is located in the flood plain of the Russian River. The well was built so the casing terminates above the maximum expected flood level.

Photo by Charlie Judson



A mudslide exposed the fraudulent work of a well driller who left this well casing with an inadequate annular seal. The light-colored area shows the 18-inch seal, whereas the current California standard requires a 20-foot seal.

Photo by Charlie Judson



Disinfecting Contaminated Water

During and after a flood, Judson urges private well owners to boil their water if they suspect that flood water has contaminated it. "Public agencies recommend a formula for disinfecting water in a flood emergency by adding drops of bleach: "x" number of drops if the water is clear and "x" number if the water is cloudy," he says. "What we recommend is that people boil it. It's so easy to go wrong on the bleach count, and boiling works 100 percent of the time. When a customer calls, we don't try to talk him through a bleaching technique, we just tell him to boil it."

Judson, who is president of Weeks Drilling and Pump Company in Sebastopol, California, has been a certified operator since 1978. In addition to drilling wells and other water services the company performs, the Weeks Drilling's water treatment division operates 35 or so small public water systems in the surrounding region. Judson says these systems are "just small enough that they can't afford to hire their own staff." He also teaches an environmental technology course about operating public water systems at the Santa Rosa Junior College.

The well had never been able to pass a coliform bacteria test, and once the mudslide exposed the casing, anyone could see why. An unscrupulous well driller neglected to pour the annular seal to the proper depth.

"That's why public health authorities want to inspect the depth of the annular space before the seal is put in to make sure that this kind of thing doesn't happen," Judson says.

Permitting agencies have differing requirements for inspecting well construction. Depending on the county and its regulations, an inspector may need to be on site when the annular seal is completed to make sure that it's done properly. But other jurisdictions may only require the contractor to give the inspector a time when the seal is going to be done, and if the inspector doesn't show up, the well is sealed anyway.

Protecting Public Health

"Public education and outreach is number one," Walker says, to prevent people from getting sick from contaminated water. "When wells are constructed, the county standard requires a vertical annular seal around the well. Many times people go to a deeper seal, maybe 50 feet . . . and some water users voluntarily put on disinfection units. During the summer months, the well might be protected, but during flood stage they might get turbidity, and disinfection helps reduce total coliform."

Flooding of the Russian River varies from year to year. Private well owners can never be sure if this is the year they're going to be hit. When the rains start falling in November, the risk of flooding increases through December and January, and sometimes it continues through February and on into March. The 100-year flood event of 1986 occurred on Valentine's Day. With each year's flooding, more people become prepared for what to expect, especially when they live in the floodplain.

Walker says that two lakes, Lake Pillsbury in Mendocino County and Lake Sonoma, are regulated by the Army Corps of Engineers and help control flooding of the Russian River. With these two reservoirs, flooding is predicted to be a lot less severe than before the dams were built. But, for well owners, it would be better to be safe than sorry when it comes to their drinking water supply.

For More Information

For more information about private wells and what steps to take to restore the water supply after a flood visit the U.S. EPA Web site at www.epa.gov/privatewells/whatdo.html. 



Several articles about wells and flooding, including the articles "Disinfecting Private Wells," "How Well is Your Well," and an entire newsletter devoted to private wells, are available on the NESC Web site at www.nesc.wvu.edu/ndwc.



Michelle Moore, *On Tap* associate editor, welcomes reader feedback—both positive and negative—on her articles. Contact her at michelle.moore@mail.wvu.edu.

The combination of an elevated wellhead plus having the required depth of an annular seal work well to prevent contamination of water wells. The height of an elevated wellhead depends upon where the well is located and that area's expected maximum flood level.

Photo by Charlie Judson



Approximate
1986 and 1997
Water Level

Original casing
elevation before
1986 flood