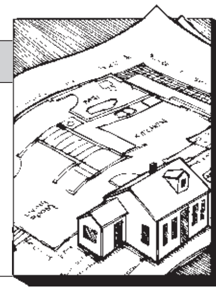

Groundwater Hard To Second-Guess

by Gordon Tully

Everyone knows that water must be kept out of basements and away from slabs. The theory of how to do this is well developed and simple. The practice, however, is not always so simple.

As with most other building problems, there is a logical process to solving foundation water problems, and that process can be broken down into a few steps. These are illustrated by the following case study.

House on a Hill

In southern New Hampshire, we have a house under construction with a basement located on a broad terrace near the top of a large hill. The hill is noted for its ledge and its springs. The side of the site on the downhill (east side of the hill actually rises a bit because there is a small stream valley to the west of the site. The prevailing local slope is to the northwest, while the hill as a whole slopes to the east (see Figure 1). A neighbor indicated that there may have been a branch of the stream on the site.

We recognized that during very heavy spring rains, the water might rise locally and flood the basement.

The soil is bony with a moderate percolation rate. During a dry spring, we observed that the groundwater was 5 feet below the basement. At the eastern side of the building, we had to cut down the ledge to create a crawl space, making the basement floor below the downhill from the ledge. Since the house occupies most of the small lot, the leaching catch basins required to collect water from the roof are close to the house. The bottoms of the catch basins are at or above the level of the basement. Most important, there is no place on the site that is lower than the basement floor (see Figure 2).

Standards. The owners are very concerned with low maintenance, and they want to maintain a high technical standard. For example, even though there is little evidence of high radon levels in the area, the owners have installed radon collection piping under the slab-if only to insure future resale value. Nevertheless, they do not have an unlimited budget.

The problems. It is not at first obvious that there is a problem, and I suspect the builder and the architect could justify doing nothing at all about the foundation water. However, we recognized that during very heavy spring rains, the local configuration of rock might cause water to rise locally and flood the basement. With this possibility in mind, a host of questions occurred.

First, if this water did appear, how could we get rid of it, since there is no natural outfall for footing drains? If we were to pump it into the catch basins, the same water might just return to the basement. So, we imagined pumping it onto the surface but where?

Even more variables are involved here. For instance, how often might this water rise? How long would it last, a few days or a longer period of time? We also had to consider how fast the water would accumulate. And if we pumped it out, would we end up pumping the same water faster and faster around in a loop, trying to make a depression in the local water table?

Solutions. The first questions that arose were whether to put in footing drains and where to install them. We assumed that it was quite possible for water to perch on the ledge, regardless of the state of the surrounding soil. This perched water must be drained away. So, we insisted on footing drains at the upper-level crawl space.

We then looked at footing drains continuing around the rest of the basement, ending in a sump pump within the basement. But this would create a new problem: a sump pit would puncture the slab and leave a hole for the invasion of radon gas. That problem was easily solved, however, by providing a tight fitting cover over the hole.

The next issue was the design of the sump pump and associated piping. The pump itself was a simple matter, but where would we lead the water? And was the effort justified? We might add a substantial investment and incur a maintenance problem for a pump that might well never be needed. If it were needed, it could be installed later (see Figure 3).

In order to decide whether to install a pump now or later, we needed to help the owners asses the risk of waiting. We could not definitively answer any question about water flow rates, but at this point we made some educated guesses.

It seemed to us that if water accumulated, it would be a local phenomenon, and not a general flow of water from up the hill. Why? Because the general flow of water down the hill was probably well below the basement, as indicated by the springtime test of the water table. If the water were localized, it would probably not be a substantial flow fed from afar. Therefore it could be controlled with relative ease.

With a modest flow of water, we could safely empty the pumped water into the leaching basins. Here too there are many considerations. For instance, since the basins are fed with roof drainage water, would they cause the basement water to rise, assuming the local groundwater was already high? We decided this was unlikely to be a problem, because we were using large basins and the perc rate was relatively slow.

Decisions. Based on our analysis of the problem, the owners agreed to install a complete footing drain system leading to a sump pit. If water did rise to the level of the pit, they would use a temporary pump that emptied down the driveway. This would give them time to assess the extent of the problem. Then they could install an appropriately sized system. (We will probably install a drainage line from the basement to one of the catch basins so the ground does not have to be disturbed if the pump is added.)

A final word of caution: Dry ground for 5 to 10 feet under a slab will ultimately become heated and act as permanent insulation under the basement slab. If the water table rises to slab level, even for a short time, this heated soil will cool off, and the accumulated heat will be lost.

If you suspect the water table might rise, it is a good idea to insulate under the basement slab. If you are deliber-

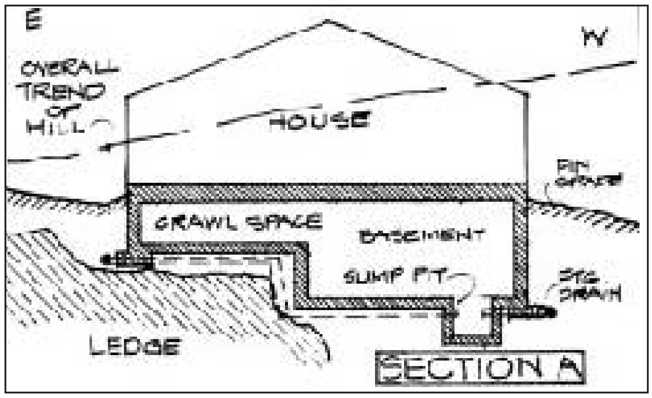

Figure 1. *The hill we are building on is noted for its ledge and its springs. Even though groundwater was 5 feet below the basement, the owners wanted a sump pump installed.*

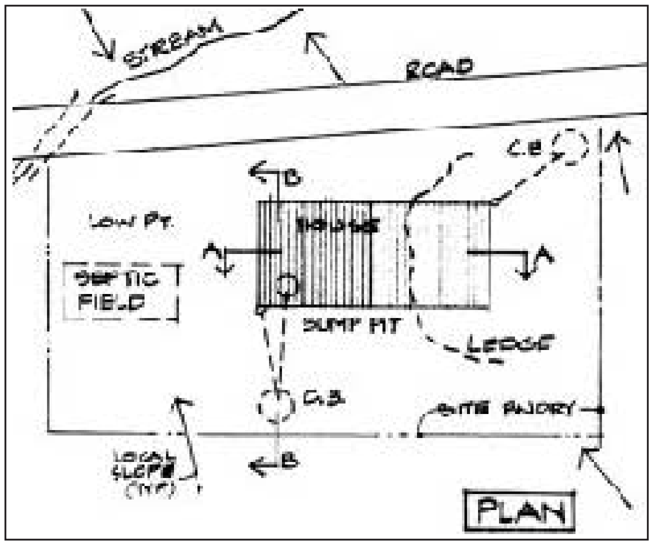

Figure 2. *Since the house occupies most of the small lot, the catch basins for the roof water had to be close to the house, and the bottoms of the catch basins are at or above the level of the basement.*

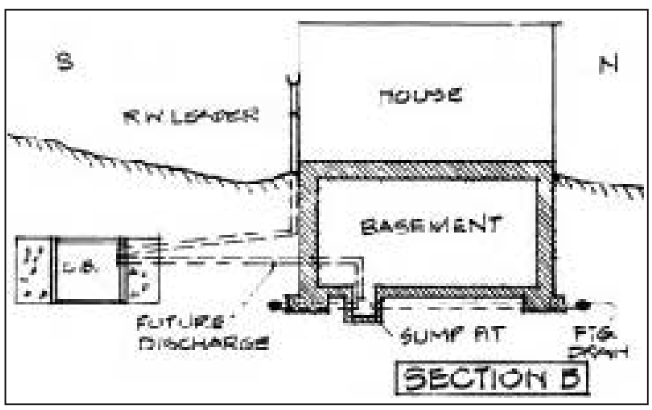

Figure 3. *A sump pit would puncture the slab and leave a hole for invasion of radon gas. We solved that easily with a tight-fitting cover over the hole, but where would we lead the water?*

ately using the slab to store heat, insulation is a must if high water is possible. In this case, the lost energy seemed to be a minor and unlikely problem. It did not justify the substantial added expense of slab insulation.

Step by Step

You can solve any foundation water problem by following the same general method we used on the hilltop house. The step by step process is described below.

First, define the conditions. Collect all the data you can about the nature of the soil and rock, the height and variability of groundwater, and the surface drainage characteristics. Find out what problems the neighbors have.

Second, set standards. In addition to what building codes, state and local ordinances, and engineering standards predict, the owner must establish a level of tolerable risk. This is an important step because what will be a problem for one owner (for example, someone building and expensive custom home) may not be a problem for a spec builder who would rather save money now and fix a problem later if it occurs.

Next, you must define the problem. Give the building design and site conditions and the owner's aversion to risk, what problems are likely to occur? How often will they occur? And what will be the consequences?

Now, choose a solution. The designer, builder, and consultants provide information and professional judgment; the owner decides where to stop. If the designer or builder does not provide options, the owner is likely to assume that no problem will arise and all possible precautions have been taken. If the owner wishes to take unreasonable risk, the builder or designer should either insist on higher standards, secure a release from responsibility, or resign.

The last step is the one that trips up many inexperienced builders and architects. When making cost estimates, don't fix the cost of protection from underground water, just as one excludes and does not fix the cost for blasting or removing oversized rocks. Don't assume or imply to the owner that you can solve the problem for a given price. And in the worst cases, don't imply the problem can be solved at all unless you are sure it can. When you consult with an owner who intends to buy a lot to build on, be sure the owner understands the risks before buying.

This mundane sounding decision-making process is actually quite exciting because each step must be taken with highly imperfect information. Houses cost about 25 cents per pound, and only one example of each design is built. By contrast, a jetliner costs about $250 per pound and is produced by the hundreds or thousands. One must be hundreds of times more careful designing a jetliner, and the quality of design data is proportionately more precise. We in the building trades simply can't afford such precision.

The Moral

If there is a moral in all of this, I guess it is that one had better not take chances with groundwater, because groundwater problems are difficult to solve after the fact. Problems with high groundwater abound, and there are many people who run dehumidifiers all year round to keep their basements dry because they did not pay enough attention to it. If groundwater rises above the basement slab for some part of the year, the basement might become useless. ■

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