WET BREACHING DAMS -- EMERGENCY AND NON-EMERGENCY SITUATIONS

by

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Performing breaches of dams is commonplace; they are often a routine first-level step of major rehabilitation efforts. It is preferred that these breaches be performed on dams with drained reservoirs. However, more and more breach situations involve dams with full (or partially full) reservoirs. The reasons for this situation is multi-faceted, particularly as we respond to the national movement to rehabilitate a large number of older dams exhibiting severe safety deficiencies. We often face financial constraints due to austere fiscal times, hydraulic emergencies, and the ever-present inoperable outlet works. The bottomline is easy to find: more and more dam breach situations involve cutting dams retaining great volumes of water. I am reminded of an old Bob Dylan line when thinking about wet breach situations: cutting a dam with a full reservoir behind it is like "balancing a mattress on a bottle of wine"; if anything can go wrong, it probably will. It is little wonder the elusive art of wet breaching is only beginning to rise above a level of traditional civil engineering taboos.

As in any engineering situation, a comprehensive evaluation of all existing conditions is mandatory. Look at hazard classification of the dam, structure type, types of equipment available, and the seriousness of the situation. Check on downstream structures such as bridges, campgrounds, fishery improvements, etc. Look for armor materials close to your breach area: rock, gravel, old tires, brush, anything that will help protect stream channels and the lower end of your breach. I feel the key component of wet breaching is proper equipment; I prefer starting with two D-9 class bulldozers with operators who can take instruction (for instance, "I need you to make a six inch cut on this invert.") without calling you foul names. Oftentimes a couple of bottles of Bourbon are key negotiating tools (promised at the end of a job well done, if you don't drink them yourself during the effort). I offer a word of warning about using a backhoe, especially a small one... -DON'T! That advice serves across the board; if you aren't able to secure good equipment for a job which could destroy your
career if things go wrong, then take a pass.

Another key to keeping a wet breach within control is timing. Under emergency situations, you're obviously hurting for time, but you should never forget that whatever you do is better than what might happen anyway; you simply have to remember not to do anything worse before it happens on its own. One should begin with site preparation. Select the most accommodating spot for your cut. I suggest capitalizing on the abutment or existing spillway if possible, if not, use a section of the dam. No matter where you decide to make your cut, you can channelize breach releases into an acceptable receiving stream. Don't forget to call your local stream alteration permitting person (State or Corps of Engineers) for emergency permission for cutting channels, etc. Defining the cut is probably the singlemost important step at this point. Define your invert section and a control section extending downstream (can be sectioned for better assessment) at least twenty feet beyond the toe of the dam. I like to keep the control section on a three-to-one slope and I often stake it laterally and along a centerline. This section is usually the most critical of the effort; if it begins to backcut and migrate upstream, you're probably in trouble, ie: the dam is probably going to open beyond your control limits.

I like using two D-9 class bulldozers. After cutting the invert section and storing a large stockpile of material (lots of rocks and clay if possible) adjacent to the invert section, define the control area, running a bulldozer up and down it repeatedly. There is some compaction benefit here, but more important, it defines the control section floor with bulldozer track prints which offer some visual comparison (between

releases) and hydraulic benefit. I let one bulldozer stand by next to the stockpiled material (keep the motor and the operator awake) as the other bulldozer makes the initial cut. I always try to start with a cut in the six inch to one foot range, pushing cut wastes upstream into the reservoir (this adds a little buffer to that invert inlet and eliminates messing up your control section). I never cut a wet breach wider than the width of one bulldozer blade. Now comes the observation period. I watch the hydraulics and remain ready to call the waiting bulldozer into action to shove the stockpiled material into the breach. If things begin to get out of control, pivot one bulldozer across the breach (perpendicular) in the invert section while the other bulldozer shoves the stockpiled material downstream of its tracks. This is how you can halt flows for the night (or any other reason) should the need arise.

Duration and amount of releases depends upon the size of the reservoir. A six inch to one foot cut may release water for twenty minutes or two hours. DON'T RUSH THINGS---ESPECIALLY AT FIRST!! My favorite saying is, "Far be from me to rush a breach job!" As the first release subsides, inspect all portions of the channel. You may need to repair or supplement with armor. You may luck out and have the confidence to make another cut. I usually keep the first three or four cuts within the same size limits as the first. If everything appears to be performing within your sphere of comfort, cuts can be increased above one foot; I never exceed anything over two feet and I always observe channel behavior between flow periods.

The process continues as long as needed. In cases where there is absolutely no outlet release, I have used pumps and irrigation pipes (for siphoning), but these are slow and often costly. You may also need to armor the control section of your breach with old tires or heavy rip-rap; be creative.

Timing for non-emergency wet breaches must be considered. Schedule actions during low inflow periods such as autumn or winter. Always check the possibility of intercepting reservoir inflows through diversion, especially during emergency situations. Also remember the wet breach impacts upon fisheries. Check with your local fish-squeezer to make sure you're not increasing sediment loads during critical fish cycles.

CASE HISTORY: TWIN LAKES DAM, MANTI-LASAL NATIONAL FOREST, UTAH, 1983

1983 was a year of hydraulic disaster in the Inermountain West. Snowpacks in much of Utah ranged at levels of 600 to 900 percent of normal. In fact snowpacks were being added to during early June. However, during the middle of June, most of these snowpacks melted, assaulting almost every watershed in the State. The US Forest Service handled numerous 'mud and flood' emergencies, but the events surrounding Twin Lakes Dam above the small town of Mayfield, Utah was one no one will ever forget.

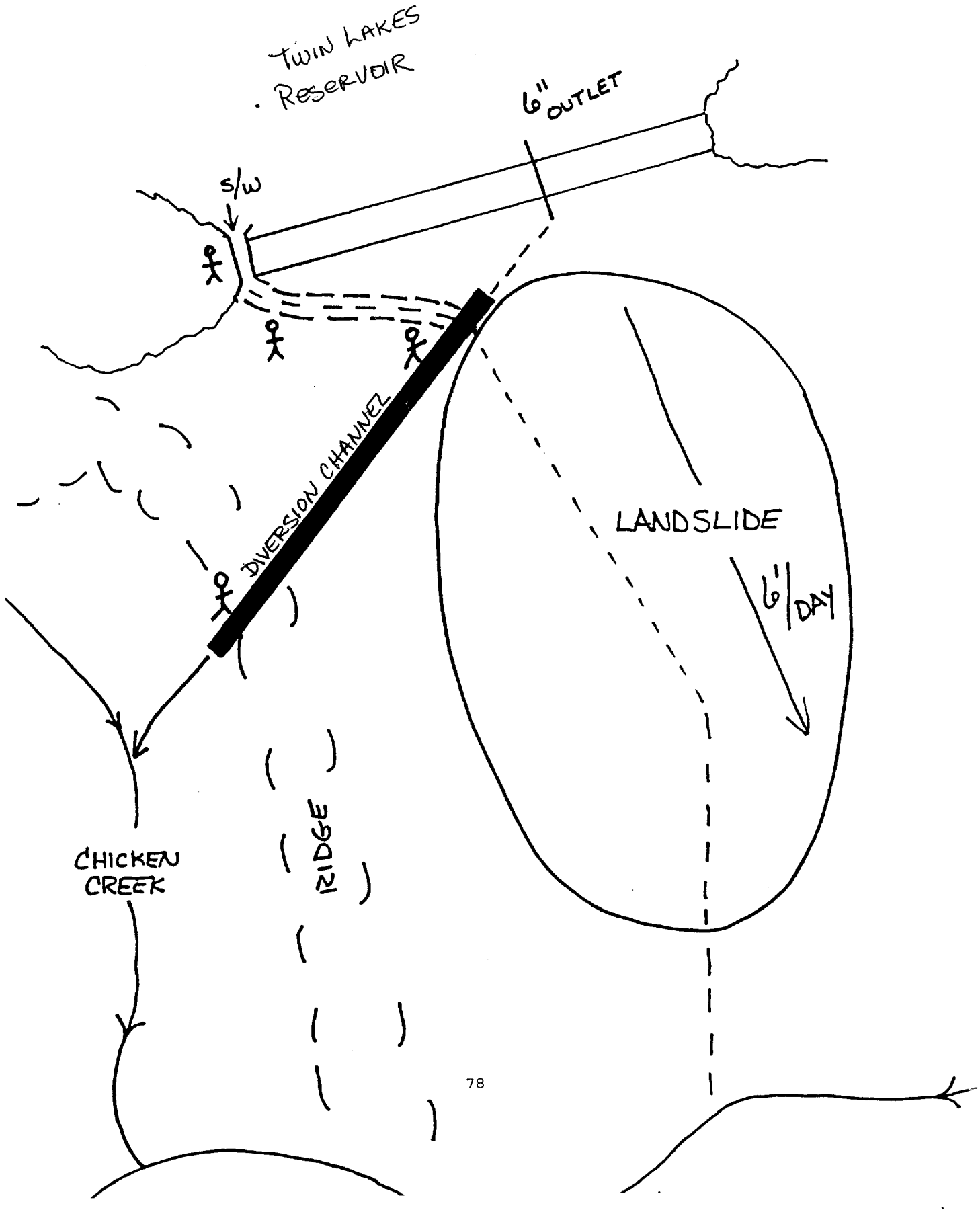
Perched 2,000 feet up the mountain above the town, Twin Lakes Dam (capacity 1400 acre feet) was becoming the victim of a huge landslide which was creeping away from its toe. The lower terminus was being eaten away by a stream which was flowing at the 6,000 cfs level (normal maximum channel capacity was less than 1,000 cfs). The outlet of the dam was a six inch pipe which was controlled by the insertion of a chunk of Aspen log. The problem revealed itself as one in which the dam's contents had to be released in a controlled fashion without endangering the town or loading and lubricating the landslide.

Two D-9 bulldozers were used for the work. First, the contents of the reservoir had to be diverted away from the head of the landslide. A diversion channel was cut across two ridges to achieve this need. All channel cuts were made into existing slopes with casting to the outside; large rocks and trees were used as possible for channel reinforcement. The system described above was used for cutting the dam. During the first three releases, four radio-equiped observers were stationed downstream at critical stretches of the diversion channel to relate performance.

The breach took two days. It was basically uneventful in terms of problems, at least partially due to our being conservative during cuts and always inspecting all portions of the invert and control sections of the breach between cuts. The event was featured in Engineering News Record (June 30, 1983 Vol. 210 No. 26).

This paper addresses wet breaching earthfill dams. Not all dams are of this type, but they all have an earthen abutment and the rules apply across the board. You may find that cutting a diversion channel for your breach offers multiple benefits.

Wet breaches are tricky and could well be career makers or breakers for those who attempt them. The legal aspects are horrifying. I suggest doing wet breaches in a team situation. Also, when breaching a non-federal dam, I always address the dam owner with suggestions for his/her acceptance, rather than calling the shots as a government representative. The key to any wet breach is a combination of site assessment, preparation, securing proper equipment, and taking one's time to do the job correctly. It appears that the frequency of wet breaches is on the increase. Within six years, I have gone from my initial experience to a total of seven dams. The materials of record, including video tape of one experience remain available to anyone who might benefit from their use. Please don't hesitate to call. Bill C. Self, Regional Dams & Hydraulics Engineer, US Forest Service, 324 25th Street, Ogden, Utah 84401. Commercial: 801-625-5227, fts 8-625-5227; home (machine) 801-399-0219.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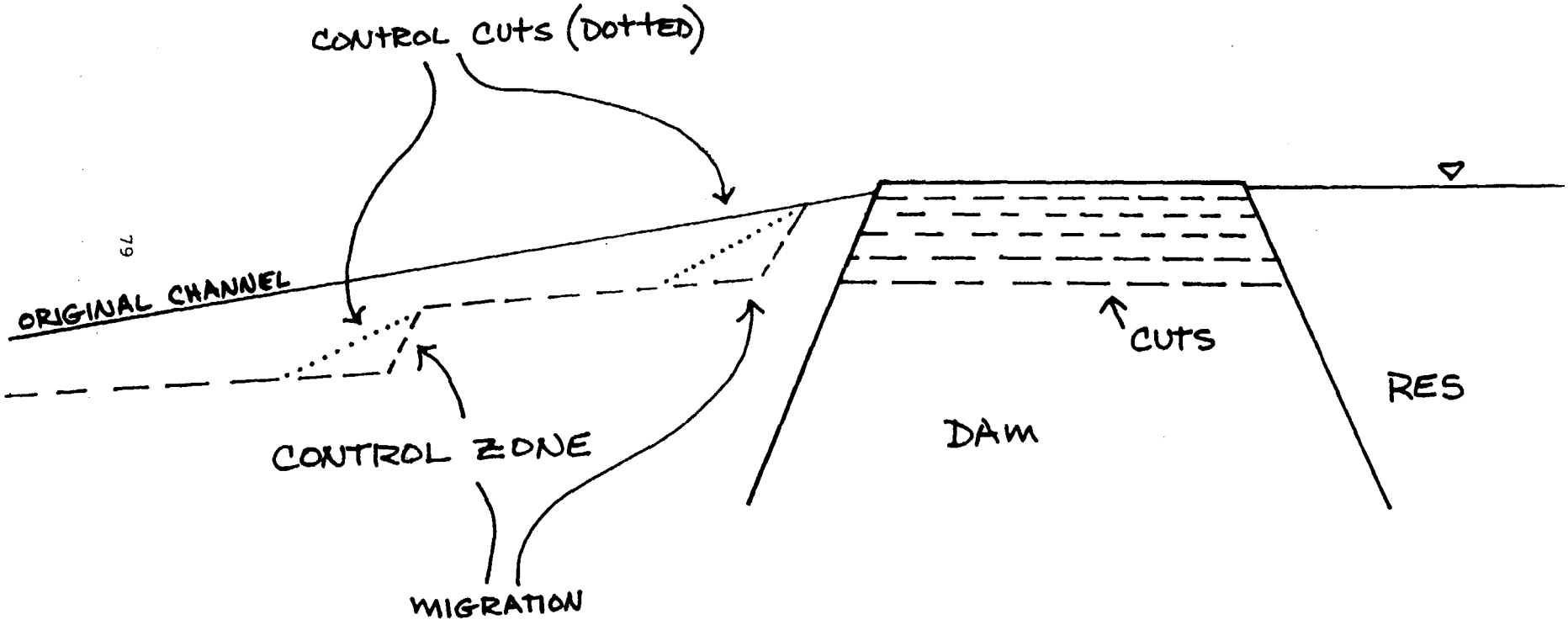
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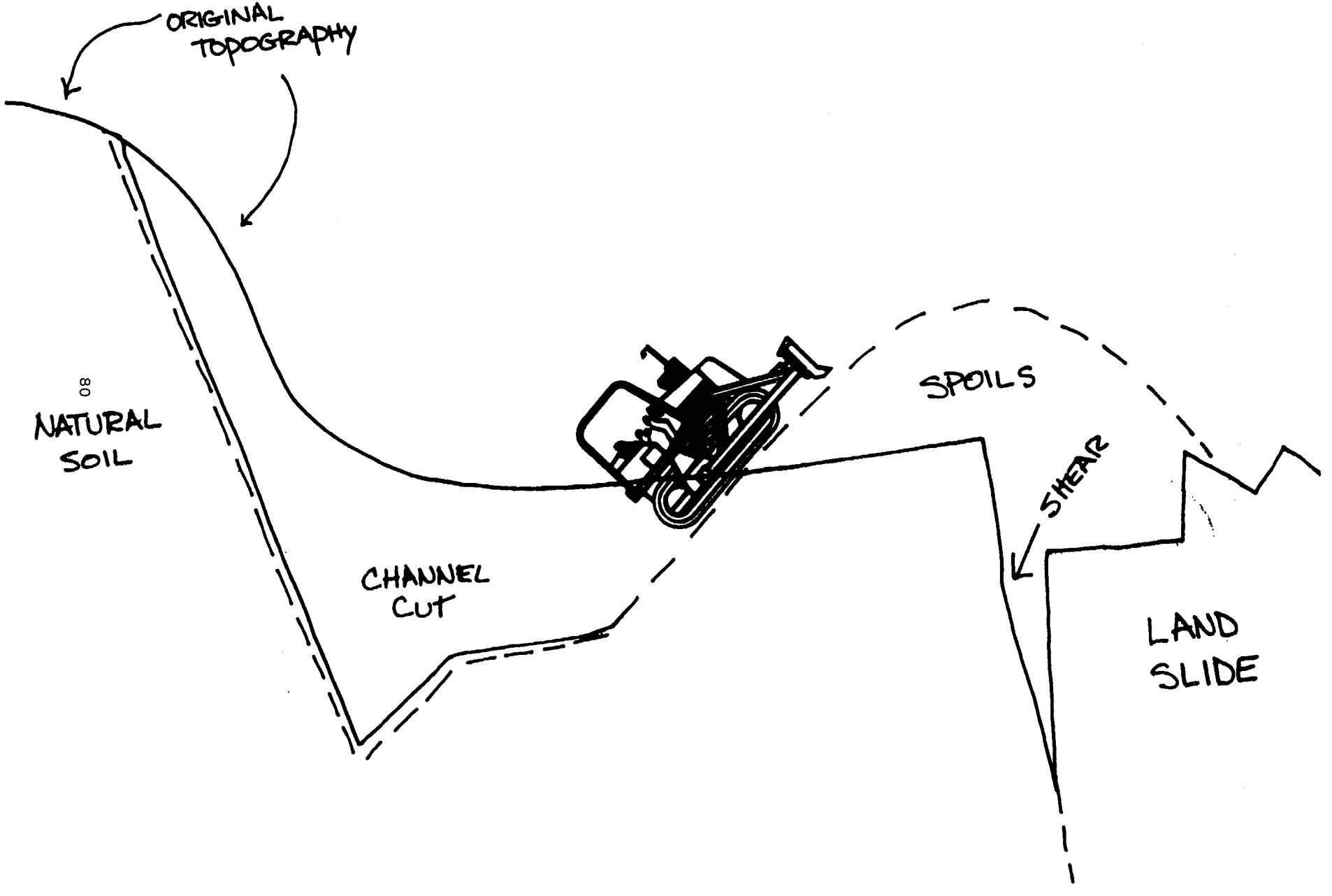
ORIGINAL TOPOGRAPHY
NATURAL SOIL
CHANNEL CUT
SPOILS
SHEAR
LAND SLIDE