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# 12. THE HYDROLOGY OF FLAGSTAFF GULLY

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## INTRODUCTION

Flagstaff Gully, a valley of variable width but flat floor, has a partly alluvial and partly podzolic soil. This is underlain by at least 2 feet of clay, a gravelly clay of variable thickness, and fractured Ferntree Mudstone. Dolerite occurs on the hill E of the valley. Minor faults are known to exist within the mudstone. Evidence of two old stream channels is present.

The property of Mr E. M. Turner is situated on the eastern half of the valley about one quarter of a mile S of the dam (t.w.l. approximately 275 feet; toe approximately 230 feet). The orchard, which forms part of the property, is situated on the flat floor of the valley at approximately 220 feet, the house being 20 feet upslope.

No data are available on hydrological conditions prior to construction of the dam, but according to Mr Turner the area was very dry as distinct from its present waterlogged state. The salinity of the water was not observed at this stage. Further, at the time of dam construction, French drains and a septic tank were also installed by Mr Turner.

## HYDROLOGY

### Observations

*Near the Dam*

Water passing under or through the dam is collected by drains at the toe.

Part of the water draining down slopes will be collected by the same drains.

Some water leaking from the storage by underground routes may be collected by these drains.

This water passes to a channel beside Flagstaff Gully Road, and the water in the channel is at least 2 feet below soil level in the region between the claypits and Mr Turner's orchard.

The water collected by these drains is poor (4000-5000 p.p.m.).

A recently dug trench behind the pumping station above the valley floor filled overnight, quality reasonably good.

At the claypits just S of the dam water seeps slowly in through the clay but enters more rapidly when the gravel is pierced. Quality bad, rate of inflow about 5 gallons per night. Depth to water in these pits is 6-9 inches.

Head of water in the dam is about 50 feet.

*On Mr E. M. Turner's Property*

Orchard: Intermittent pumping of saline water from the NE corner of the orchard maintains a drawdown of about 7 feet. Permeability is such that the water level in the centre of the orchard is very saline, and from a confined source.

Tennis court: Water level is again high. Springs have been observed in the past.

House: The water level beside the house is approximately 6 inches. Parts of the lawns are very damp locally.

French drains and septic tank empty onto the southern end of the orchard.

*Property to S of Mr Turner*

Water on this property is not saline.

This property appears to be part of a more recent stream course.

No details of the section are available at present, but it is probably different by association with that on the western side of the valley.

**Discussion**

The problem concerns an excess of saline water in the area. The following possibilities should be considered—

1. Seepage through the core of the dam: In view of the amount of salts removed, the lack of piping and the uniformity of flows it is not thought that this is the answer.
2. Seepage under the dam: This water would be expected to be relatively fresh. Although some such water must be expected to pass into the valley at various points it cannot be the source of the trouble since the problem is associated with highly saline water.

   Further, if original saline water were present in the mudstone and was being forced out by dam pressure and seepage the quality should be improving. This is not the case.
3. The saline water may be connate or otherwise stagnant groundwater trapped previously in the mudstone in this area. Thus when the gravel is pierced this trapped water rises in the hole. This rise apparently has only occurred since the construction of the dam.

   Two possible mechanisms may exist.

   The water in storage may be connected hydraulically with the water below the clay of the valley. Thus when the confined conditions are destroyed the water enters the higher levels of the profile. Calculation on the rate of flow to be expected if this pressure is effectively applied would be of the order of that observed assuming a value of permeability of the gravel based on estimates of inflow rates.

Alternatively the pressure may be transmitted only by a membranous action through the clay cover on the valley floor below the actual storage. This is more likely since the quality is not improving, as would be expected if the former were the case. A very indirect hydrological connection could explain the complete head loss in the short distance from the dam to the claypits.

4. The presence of high water levels near the house suggests leaky pipes, certainly the levels are such here that the dam is unlikely to be the cause. Further, there is negligible drainage down the slopes behind the house.

Part of the waterlogging in the orchard may be ascribed to the drains and septic tank. These of course would not be the source of the saline water.

**Conclusion**

At present it cannot be shown definitely that the dam is the cause of the problem. However, it may be said that water is not coming from the dam, rather that the applied pressure appears to be forcing connate water out of the system through the various breaks in the confining clay, e.g., diggings of Mr Turner, tree roots and various holes.

Further work may not resolve all problems of groundwater flow, nor solve the problem since the prior conditions are unknown.

Downstream there appears to be a different regime or alternatively the balance has not been broken by the piercing of the clay horizons.

At this stage the dam appears to have pressurized the groundwater of the area and this has caused it to be forced through all available channels to higher levels where it causes problems. Diggings for the dam must also be remembered in the above context.

**Recommendations**

If further work is considered necessary, the following suggestions are made:—

1. Make a resistivity survey to indicate extent of gravel band and/or saline water.
2. Dig series of holes over valley, measure levels, investigate depth of gravel and its quality. It is noted that this may worsen the situation since it is believed that the disruption of the gravel caused the problem to become noticeable. It may also be extended next door since holes would be required there also.

The results of such surveys may be inconclusive.