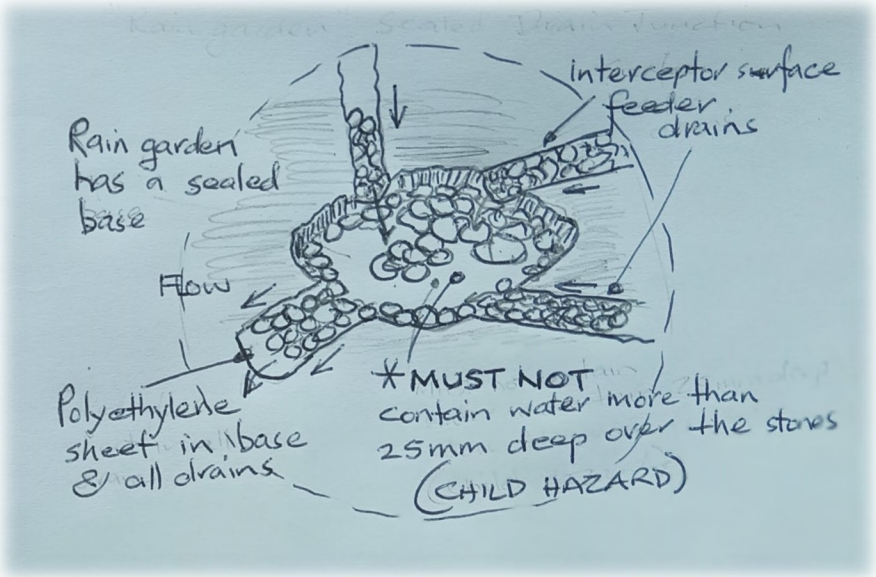
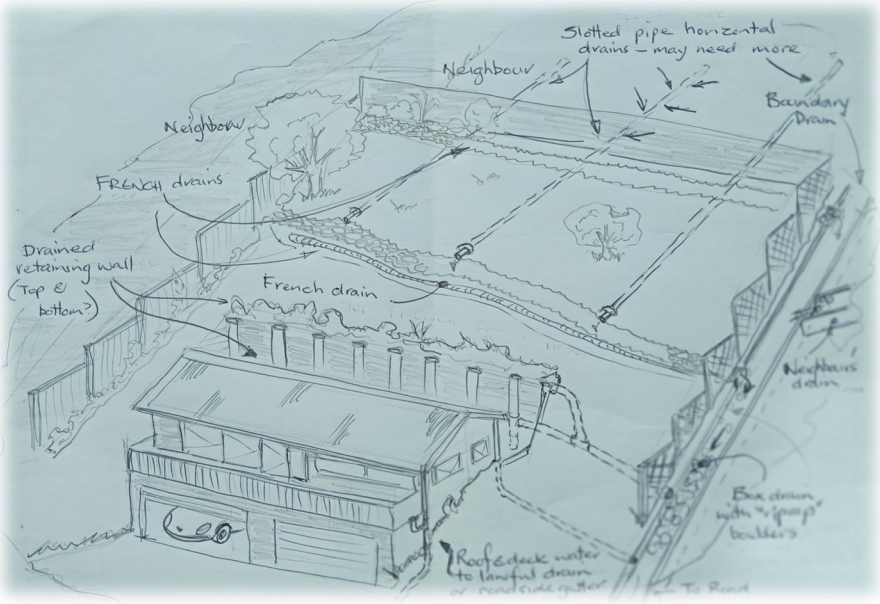


Rain garden junction drain: Has feeder drains and exits to a legal stormwater drain or watercourse



A fully drained property, missing only a piezometer

RAIN READY
OMOKOROA

Design Choices and Tools for (Homeowner DIY - or Contractor) Stormwater Management and Drainage

A Community Initiative to reduce risk caused by heavy rain and unstable slopes

Know the water Know the risks Work together for a safer Omokoroa

Introduction:

In this booklet

- Sophie will explain unfamiliar technical terms .
- She reveals solutions that you can instal to man-age stormwater and groundwater.
- Her glossary precedes the drawings and sketches but you can flip back and forth to the sketches of solutions as you read
- She strongly recommends you work with your neighbours because rain and weakened soils don't recognise boundaries
- A joint community effort is required—piecemeal efforts won't solve the whole problem—even though we'll build small steps at a time.

Need help with your design? Email us: [redacted] rainreadyomo-

What are we trying to do?

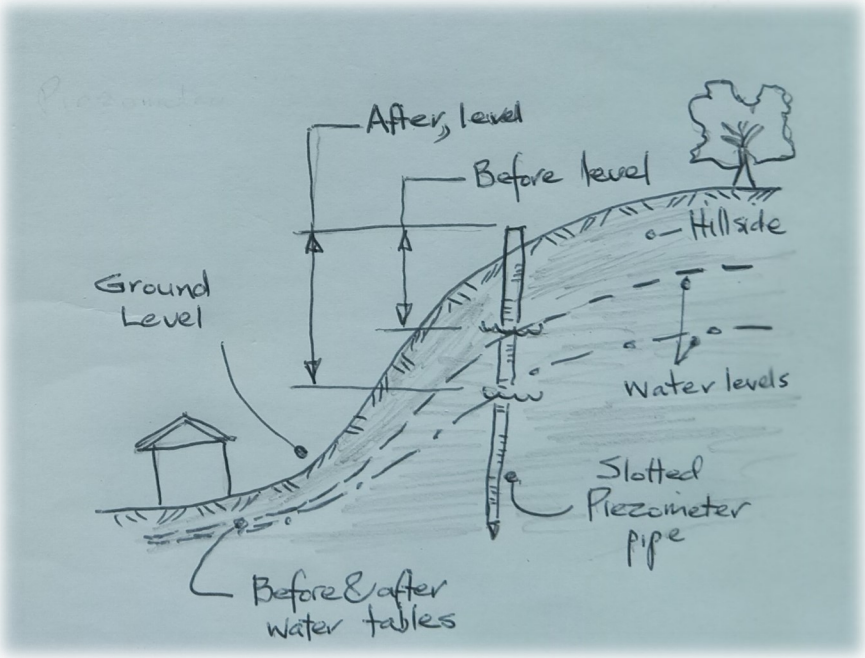
Our goal is to prevent Omokoroa soils from becoming unstable.

What is the most likely cause of that instability?

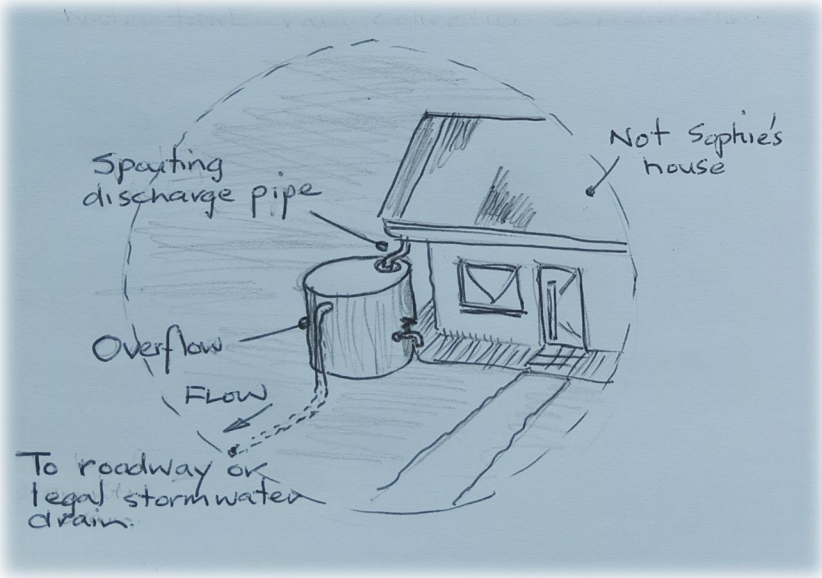
Wet soil.

And the cure is?

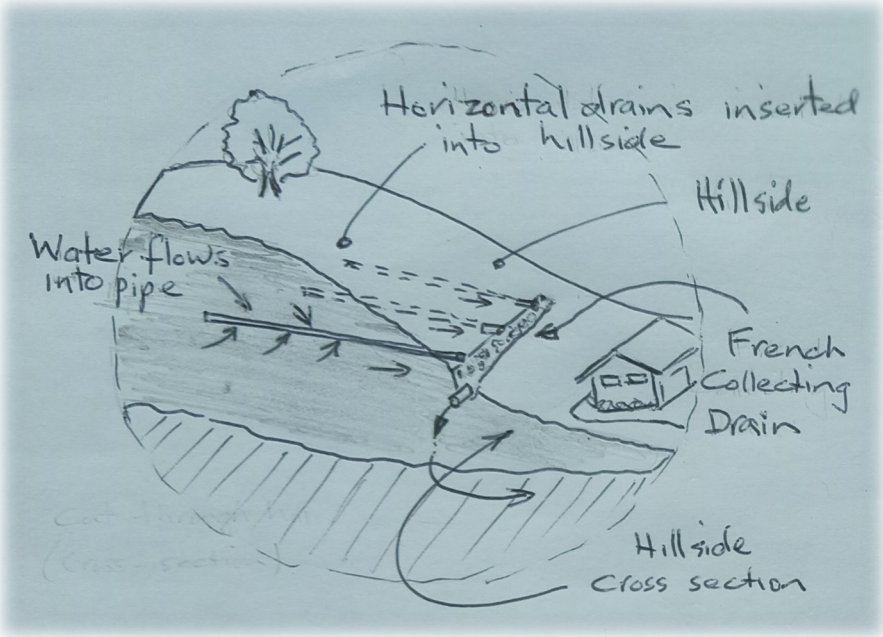
- To limit the water getting in to the soil
- To drain from the soil water that by-passed our preventive measures.
- To plant trees and shrubs which "pump'" water from the deep soils.



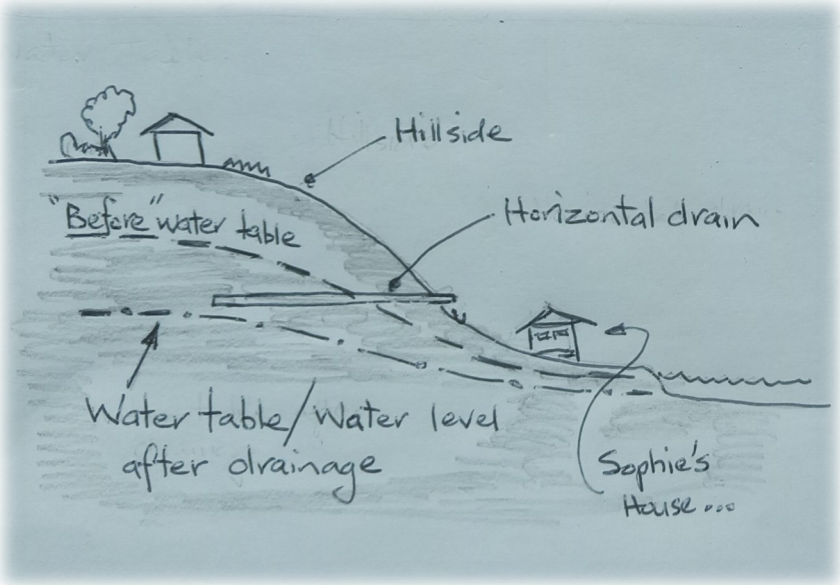
Piezometers: These are vertical perforated pipes by which we can measure the depth of the water table below the ground. They indicate changing water table levels.



Rain water harvesting tanks must have an overflow to a legitimate stormwater outlet



Horizontal drains are very effective. Here are three perforated pipes inserted about 10 metres into a hillside. They discharge continuously into ain interceptor or French drain



This image shows how **horizontal drains** lower the water table to improve soil strength

GLOSSARY OF TERMS

There are illustrations of most of these terms on the following pages.

Boundary Drain:

- A *boundary drain* is usually a *surface drain* on the boundary between two properties. It collects the water from other surface drains that connect with it. Some of these other drains may flow under a boundary *fence* to connect with the *boundary drain*.
- The drain is constructed along the lawn or garden surface but "falls" as it goes from a higher point to a lower point. It collects water that flows across the surface during heavy rain. It does this before that overland flow (runoff) escapes over a lower-down neighbouring property.

French drain:

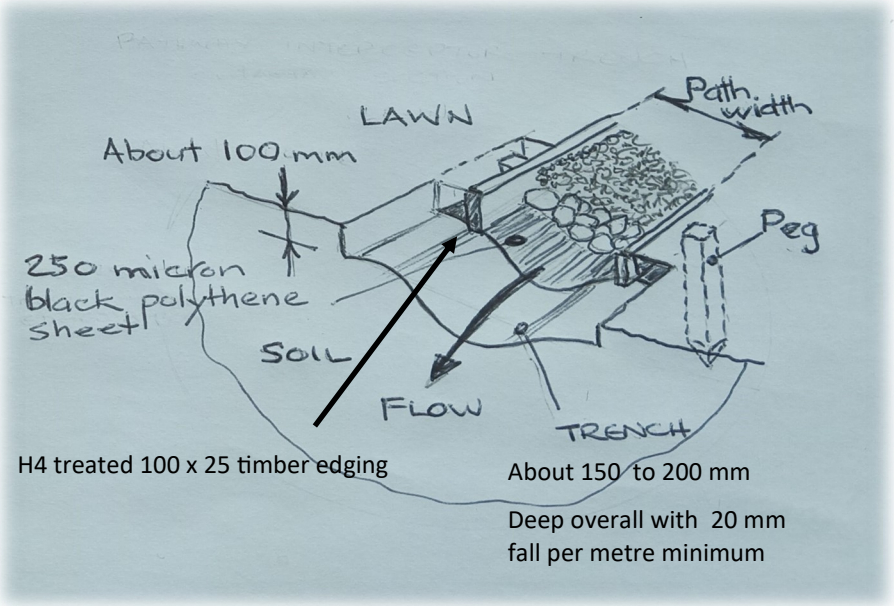
- A *French drain* is a *subsurface drain*, consisting of a deepish trench with a perforated pipe laid in the bottom and which is surrounded by drainage stones. The trench may be left open on the top, or have a layer of weed mat covering the drainage metal about 100 mm below the surface, over which the lawn or garden is re-instated. The pipe and drainage metal allow a more rapid passage of water than the passage of water through soil pores.
- While the land may rise and fall along the trench pathway, the drain itself always gets deeper ("Falls") as it gets closer to its discharge destination. It collects subsurface water that has seeped into the soil.

Fall; Grades; Gradients:

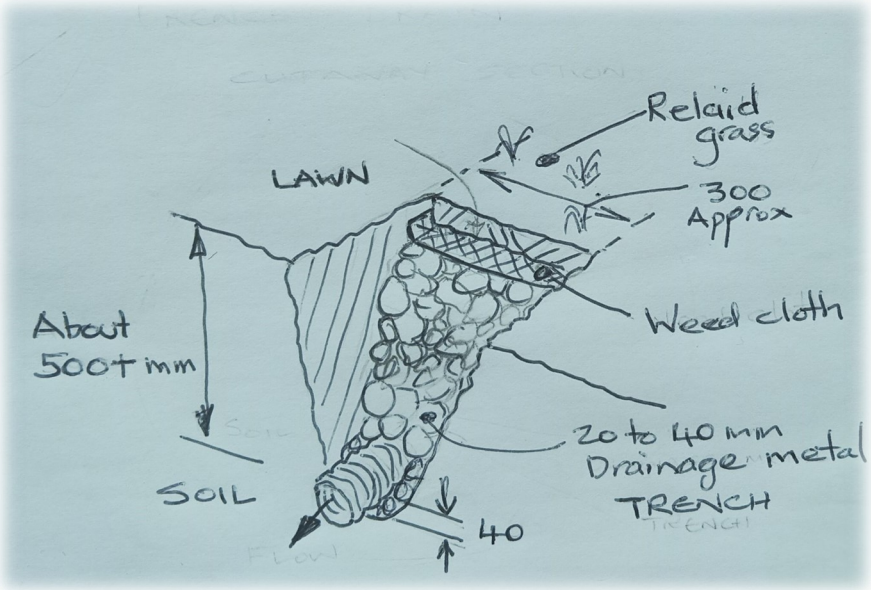
- Drains must have a *fall* or *grade* or *gradient* as they progress. The discharge end of the drain must always be lower than the opposite end for water to flow in the desired direction
- When a drain travels 1 metre (1000 mm) and descends 20 mm, the fall is "20 mm in a metre". This translates to 40 mm in 2 metres and 60 mm in three metres, etc. An alternative expression is as a ratio: e.g. 1 in 50 (1:50) which is the same thing. Why? Well, a fall of 1mm in 50mm is the same as 10 mm in 500 mm is the same as 20 mm in a 1000 mm (1 metre). For rough drains like these, a **minimum** fall of 20 mm fall every metre (1:50) is acceptable. For smooth pipes 1:10 is OK.

Hydrology and soil: Know the water Know the soil Know the risks

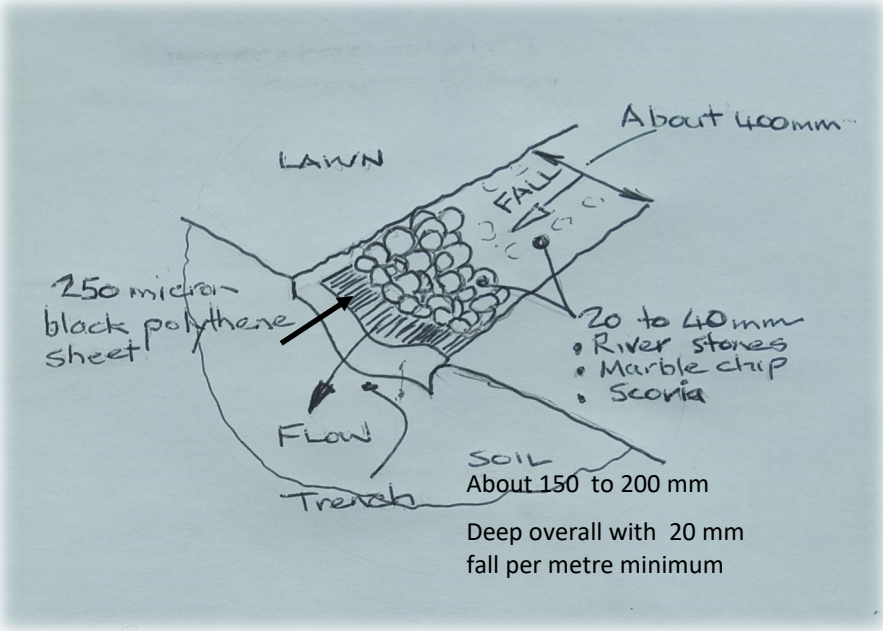
- Nearly all soils contain moisture. In fact moisture levels of between 10 % and 20% give soils their optimum shear *strength.* (Their resistance to slipping.)
- Soil is a mass of miniature compacted particles with tiny gaps between them. Rainwater seeps into these gaps (pores) and the soil now tries to float, and the water also acts like a lubricant. (Take a paper cup full of sand—on a string. Lower the cup into water and feel the weight reduce. The buoyancy in water reduces the sand's weight. The sand is trying to float) When all the soil pores are full of water the soil is saturated. Well before soil saturation is reached, soil *strength* has been seriously compromised. The soil's resistance to slipping can happen suddenly.
- Under normal weather conditions, water migrates down into the soil and establishes a water level where liquid water can be found. This is where the soil is permanently saturated. Above this water level (called the *water table*) soil is in various forms of "dampness".
- This underground water level varies. Under your property it may be deep. But far away, on the lower hillside it may have become shallower. The higher water is seeping underground downhill slowly via soil layers, like a slow underground river. It sometimes wells up and becomes a spring. Often it follows the conductive soil layer through which it travels and this may terminate on a hillside or even under the sea.
- The essential feature here is that properties are linked by water. When it rains on your property, rainwater sinks in to the land, finds the water table and then moves towards an outlet, or if it can't escape fast enough, the water level (water table) begins to rise. During its migration to a spring or the sea it can pass under many kilometres of other properties. It links them.
- The layer where liquid water can be found is called an aquifer. Under the aquifer is a layer that water has trouble passing through. This layer is like a seal on the bottom of a pond. It may leak water through it but that leakage rate is usually slower than the rate at which new rainwater arrives. Not much seeps through.
- During the summer, when rainfall is usually lower, the water will drain from the soil and the water table will lower. During the winter when rainfall is higher and more frequent, the rain recharges the aquifer. This is the usual cycle. But summer storms with heavy rain prevent the soil from reducing its moisture content. This added water in sensitive soils can cause significant lowering of soil strength.



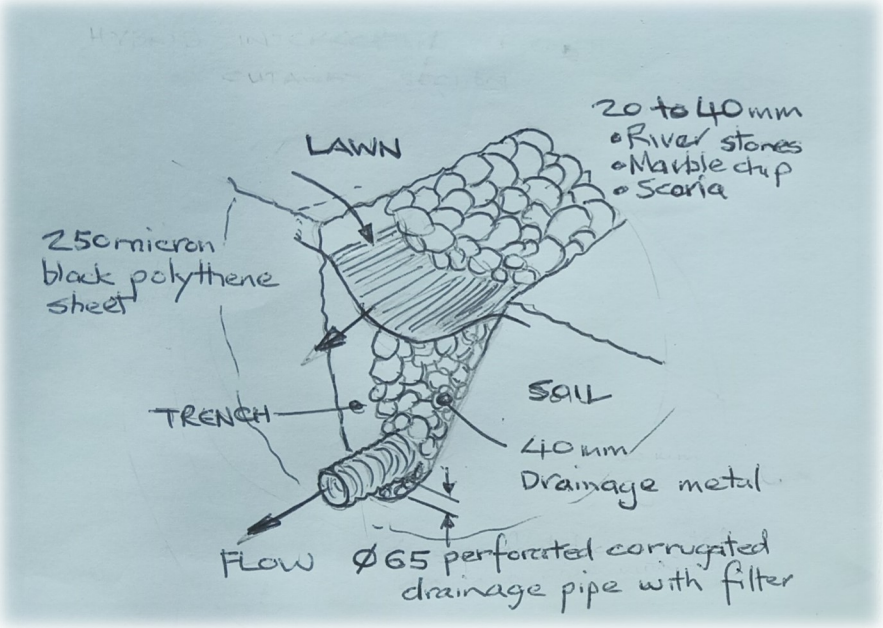
A pathway interceptor drain follows the land contour. Probably connects to a gutter or boundary drain. Like all these drains, it must fall about 20 mm to every metre of length



Typical French drain with 500 mm plus depth and covered with soil/lawn



A typical interceptor drain for run-off (overland flow)



A Hybrid Interceptor drain with both **French drain (**below) and **interceptor drain** (above)

Hydrology and soil, cont'd:

- Much of the Bay of Plenty is formed from layers of ash (tephras) resulting from three primary and a few lesser volcanic eruptions—Hamilton, Taupo, Rotoehu. Each eruption created an undulating layer of thick ash. The coarse ash fell back to land relatively near the volcano. The finer ash drifted to form Omokoroa Peninsular.
- The peninsular is made of these finer ash layers (When we dig we find there are no rocks.) Think of a multi-layer sponge cake. Aquifers can form in these layers which have been twisted over millions of years by the earth's plate movement.
- A constituent to the ash is a material called halloysite, a very creamy, fine, clayey substance. It is mixed into some of these ashes in small proportions. When water is about, halloysite can cause soils to quite suddenly lose their strength.
- A low soil moisture content is essential for solid foundations. Remember, this soil has been pretty stable for hundreds and thousands of years, but increasing rainfall, loss of plant cover and our excavations are big factors in slope instability.
- **Conclusion: We all** need to manage soil moisture content by creating easier and faster drainage pathways for overland flow and to use hillside dewatering. These are well documented, straightforward solutions.

Herringbone drainage pattern:

- When you view multiple properties from above, they may have a common boundary drain with multiple cross drains connecting into it. The pattern you see from above may have a "herringbone" look.

Horizontal drains:

- Horizontal drains are perforated pipes about 10 metres long driven into the hillside with a jack hammer. The water that they collect exits the hill and falls into a surface drain.
- Multiples of horizontal drains may be placed in a matrix across the face of a hillside. Rain Ready Omokoroa has developed a method to allow you to drive these drains in manageable segments into the hill face with an electric jack hammer. DIY keeps costs down. We'll get you started. You do the rest.

Hybrid Interceptor Drains:

- When we combine an *interceptor surface drain* over the top of a French drain, the drain now intercepts surface flow and subsurface flow. The upper drain deals with the runoff that may cause flooding, while the lower drain collects stormwater that has already leaked into the lower (subsurface) soil.

Interceptor Drain:

- An interceptor drain is a *surface drain* that runs across and down a property to collect runoff from a land area of 200 to 300 m^2. It consists of a shallow trench lined with polyethylene plastic sheet and filled to ground level with rocks, gravel or chip. It will generally join a boundary drain and such drains may form a "herringbone" pattern.

- It can have an open top (exposed gravel/chip/rocks), or be a pathway (becomes a gravelly, free-form garden path), or even an edged garden path. If it also has a French drain underneath we call it a *hybrid interceptor drain*.

Landscaping:

- Design your garden, lawns, driveways and pathways with heavy rainfall in mind. Collect surface runoff and get it to a legal drain or water course. Ensure that retaining walls have drainage behind and on top that goes to proper drains. Be careful with cascades of retaining wall where the lower walls give support to higher walls. The low walls really feel the load when soil gets wet and heavy.

Legal drains:

- We use this expression to define the drainage pathways that provide passage of the water to a council stormwater drain, a roadside gutter, an agreed boundary drain, without breaking some law. But we are also seeking changes in the law to eliminate legal costs and complications. Boundary drains, for example, pass through properties.

- We don't want easement legal costs for drains that must cross boundaries and so we are finding ways for neighbours to share drainage painlessly because stormwater may need to pass through your and their property to get to the road, say.

Optimum soil moisture:

- Dead dry soil crumbles. Wet soil oozes and slides. Optimally damp soil of about 10% to 20% moisture content is strongest. (Generally speaking)

Piezometers:

- A piezometer (peetz-*om*-eeter) is a perforated pipe driven vertically deep into the soil through the water table. The ground water enters the pipe and settles at the underground water table level. We use this pipe to collect data—How far is the water table below the surface? Is it rising or falling? How does this compare to the other piezometers in the vicinity? We install them at multiple points on properties around the community and collect the gathered data for analysis.

Polythene/Polyethylene Sheeting:

- One word is an abbreviation of the other. Garden centres have this polyethylene sheeting material which is used in the bottom of drains to stop water seeping into the subsurface soil. Use material 250 micron thick (0.25 mm) so that sharp edges don't cut the material.

Rainwater collection tanks:

- These are useful but in heavy rain they may still overflow. Ensure that the overflow goes to a stormwater drain.

Trees:

- A large tree can soak up to 1400 litres of water a day out of the soil in summer. Deciduous trees soak up much less in winter but evergreen trees draw water all year round, although the rate is less in low growth periods like winter.

Weed mat:

- Weed mat will prevent the roots of plants getting into the drain. However, the weed mat that you buy must still let moisture pass through it.

The following pages have sketches of how you might construct the various drains.