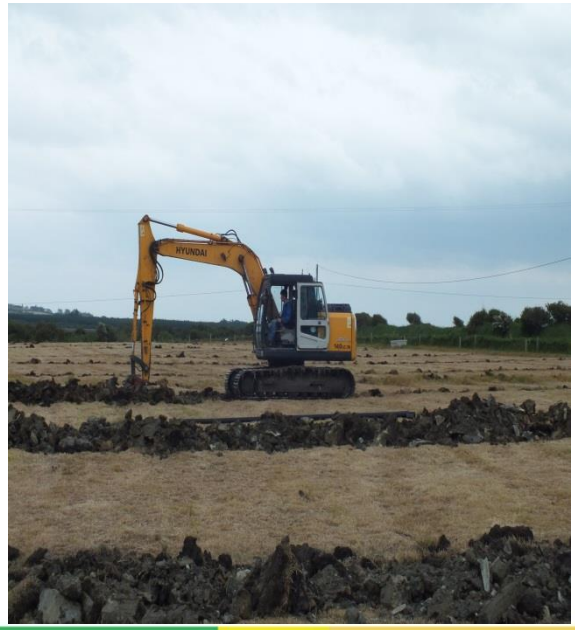
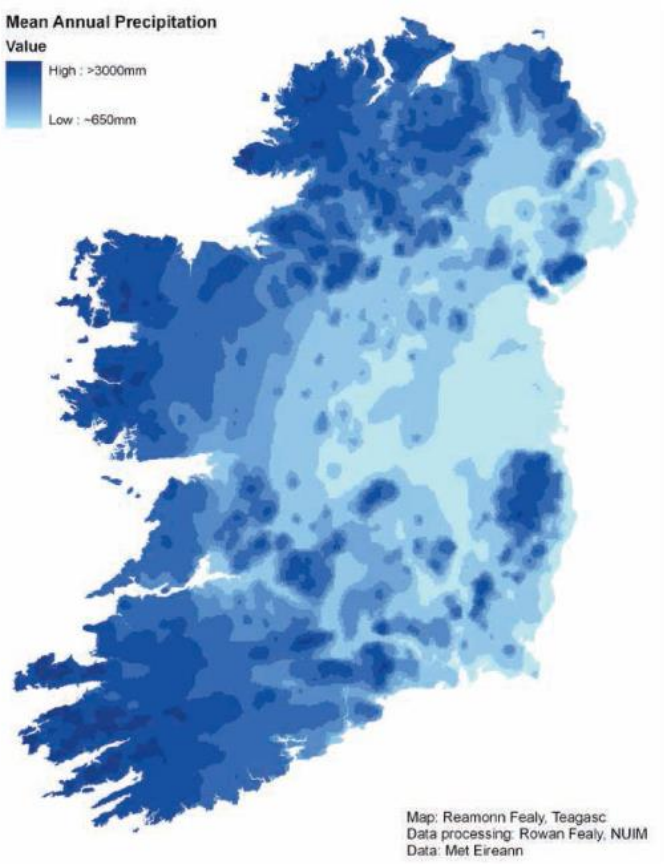
Land Drainage

Johnstown Castle-06Nov2014



Soils and rainfall

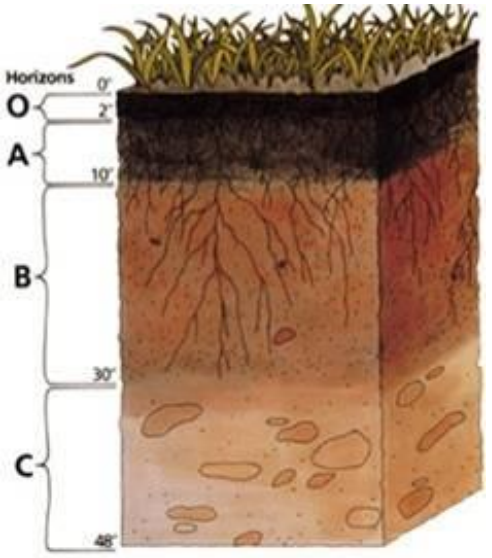
- Marginal land occupies just under 50% of Irish land area
- Trafficability for machinery and livestock is a major limitation in wet conditions
- Use of such soils is curtailed due to;
  - Reduced stocking capacity and grass yields.
  - Increased susceptibility to poaching and machinery damage



Drainage problems

- In free draining soils the rate of water flow through the soil will be higher than all bar very extreme rainfall rates.
- In poorly drained soil the rate of water flow can be regularly exceeded by rainfall rate due to:
  - Low permeability
  - High Water table due to low lying position and poor out-fall
  - Upward movement of water from seepage and springs

Drainage Investigations



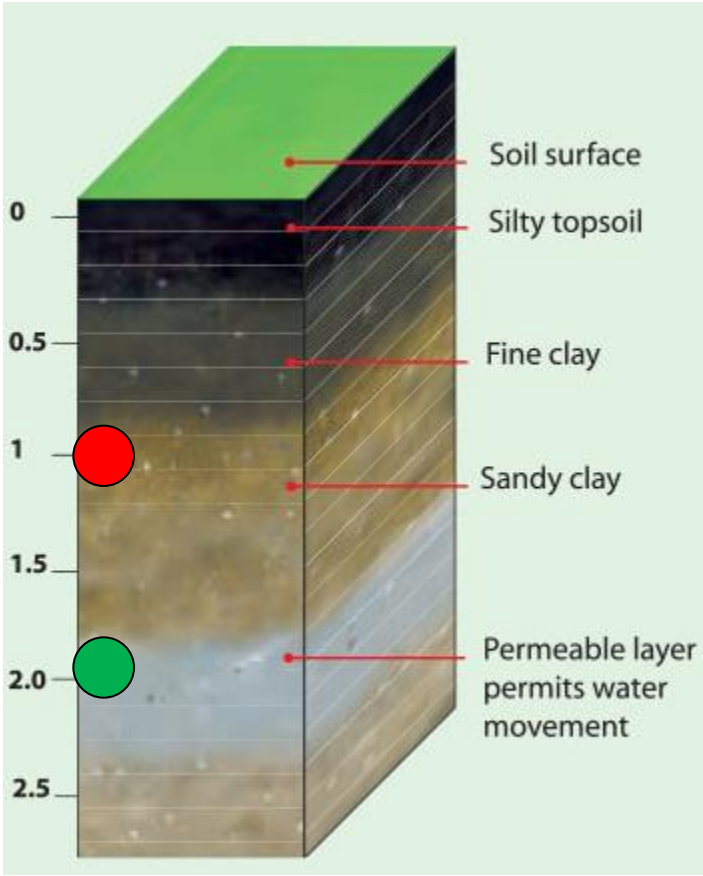
- **Before planning a drainage system the causes of poor drainage must be understood**
- No “one size fits all” solution
- Test pits are dug within the area to be drained
- In test-pits
  - Establish soil type-varying with depth
  - Record depth and rate of water seepage
- Where is water impeded and where is water moving?

Types of drainage system

- Two principle types are distinguished:
  - **Groundwater drainage system:** A network of piped drains exploiting permeable layers.
  - **Shallow Drainage system:** Where movement of water is impeded at all depths.

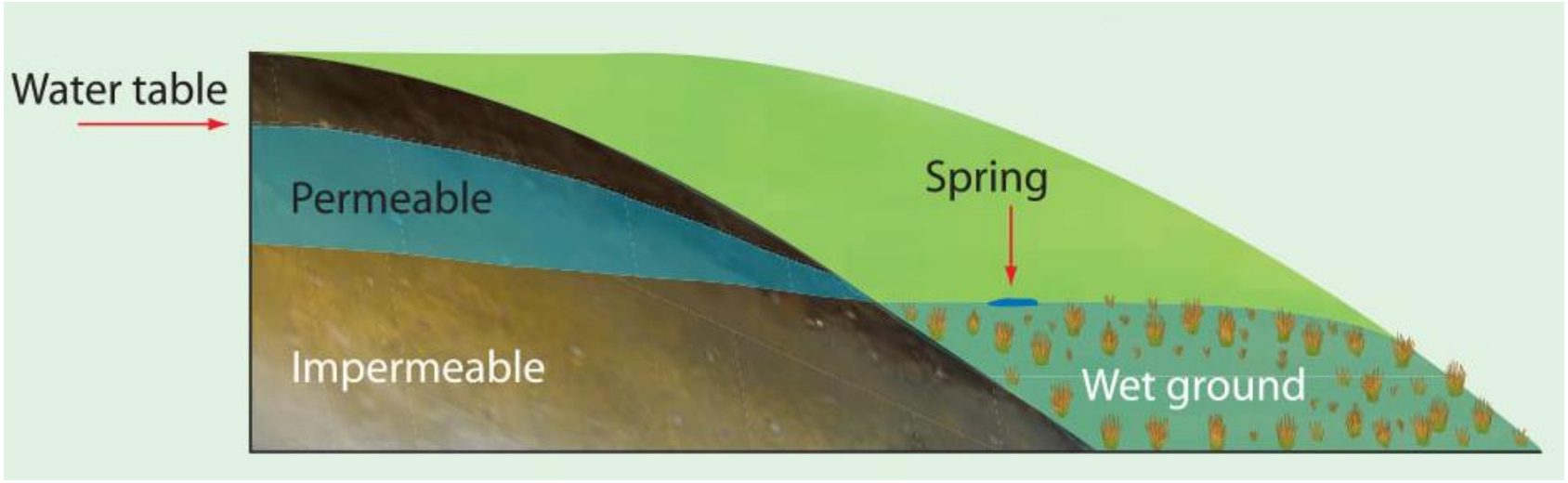
Groundwater Drainage System

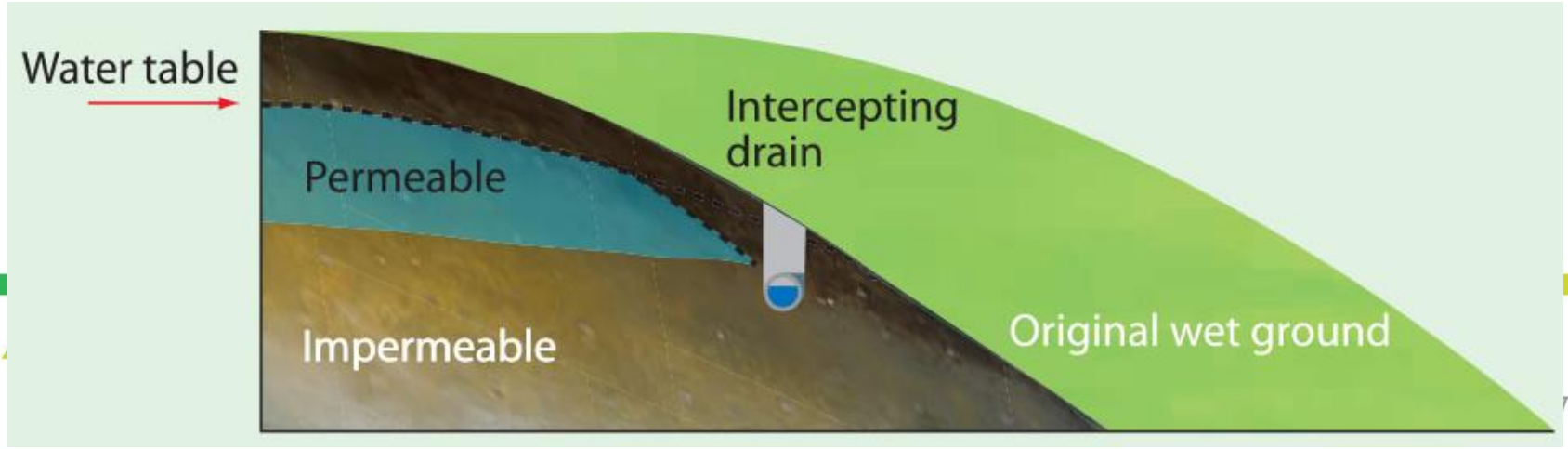
- **Where inflow of water to test pit**
- Controls the watertable by discharging groundwater
- Exploit layers of high permeability → wide spacings
- Lower watertable allows for natural (cracking, root penetration) or artificial (sub-soiling/ripping) improvements in permeability in the shallower layers



Groundwater Drainage System

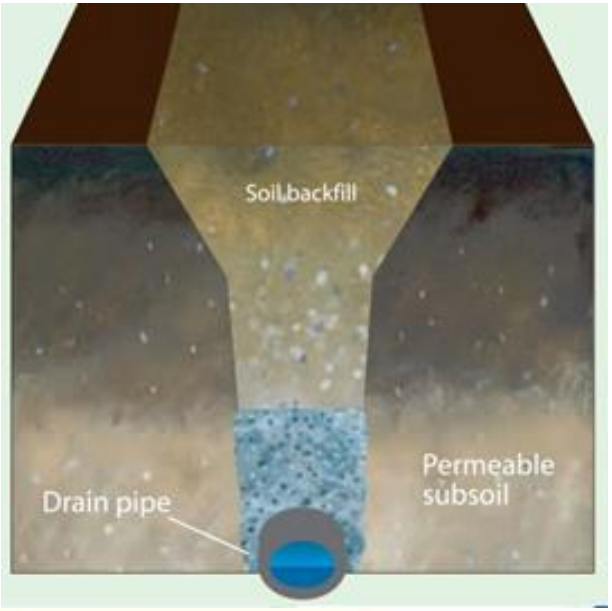
- Groundwater seepage and springs





Backfilling groundwater drains

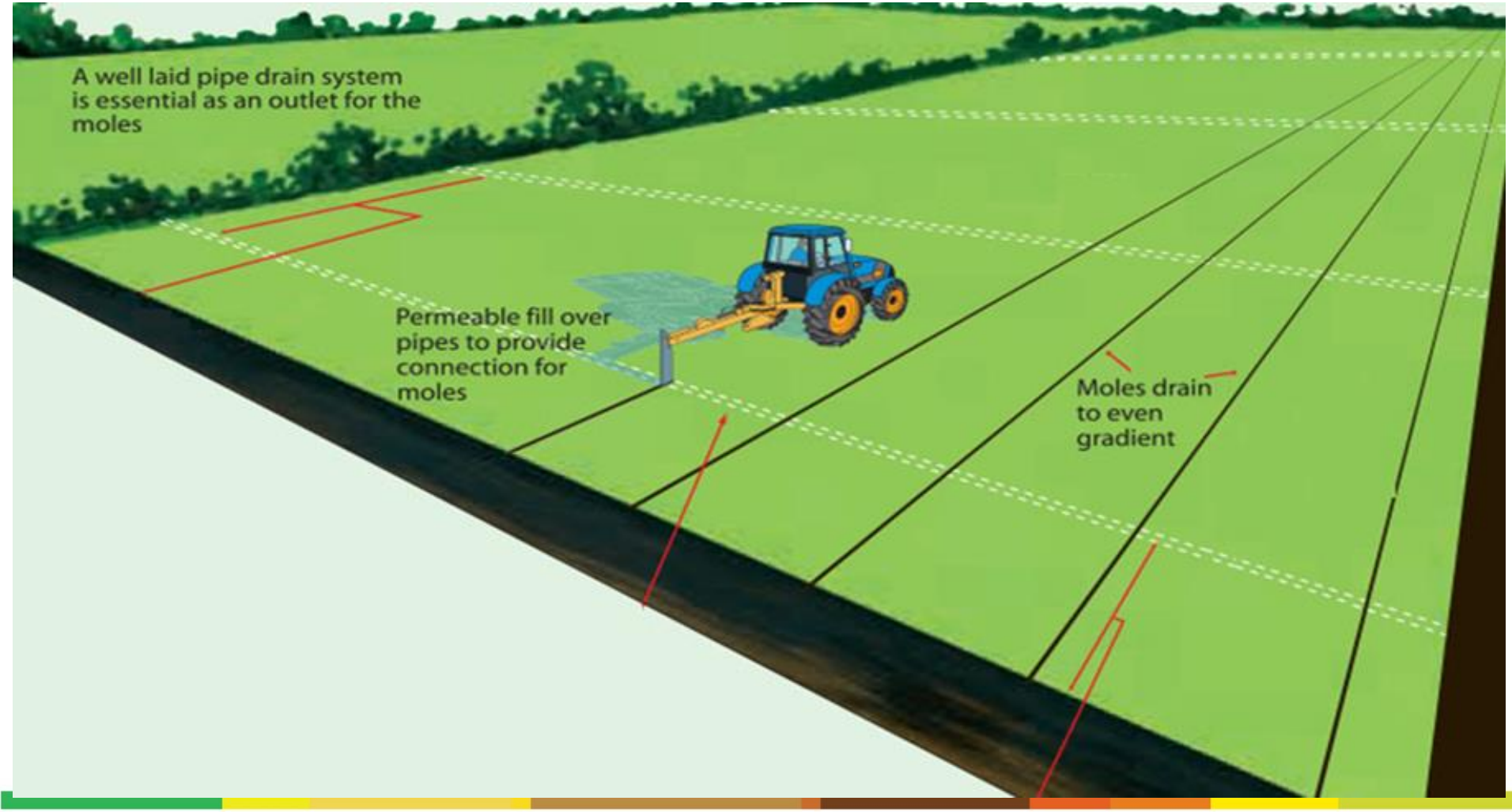
- Drainage stone should:
  - be filled to a minimum depth of 300mm from the drain bottom
  - provide connectivity with layer of high permeability
  - be **clean** aggregate (10-40 mm / 0.4 -1.5 inch)



Shallow Drainage System

- **Where no inflow of water to test pit**
- NO permeable layer to be exploited
- Drainage must incorporate a soil disruption technique in tandem with collector drains.
- The aim of such a system is to improve soil structure and permeability

Shallow drainage-collector drains



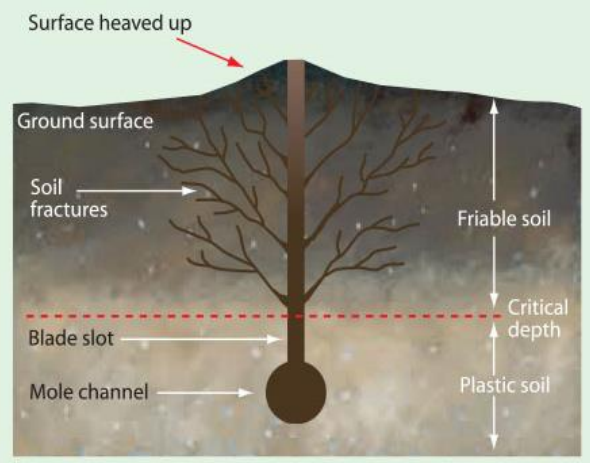
Shallow Drainage

- **Mole drainage**
  - Increased permeability at shallower depths and creates drainage channel

- **Gravel mole drainage**
  - Gravel moles increase lifespan (extra cost)

- **Subsoiling/Ripping**
  - To break a pan at shallow depth or to supplement both shallow and groundwater drainage systems

- **Carried out when upper soil layers are dry**



Mole drainage-soil cracking

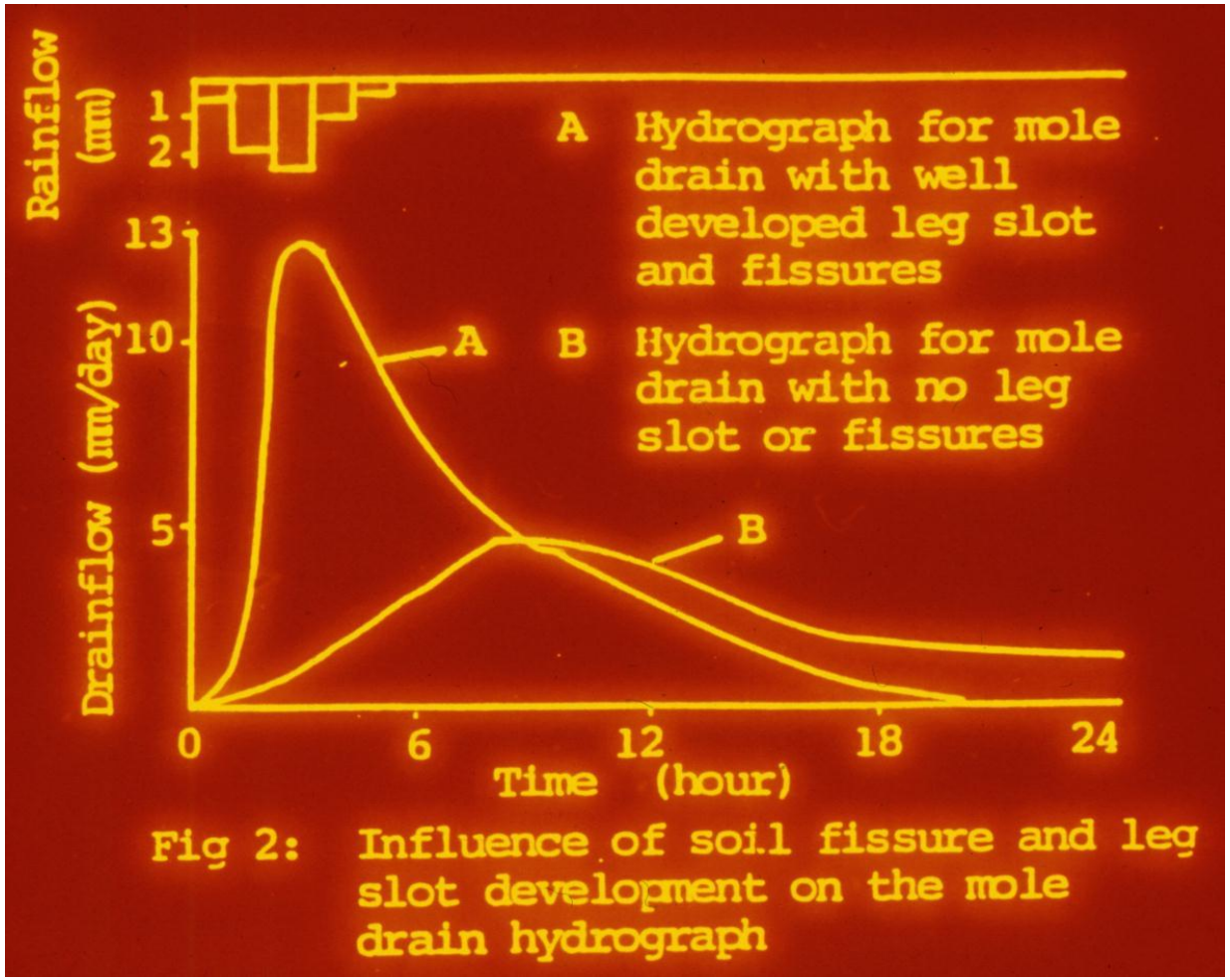
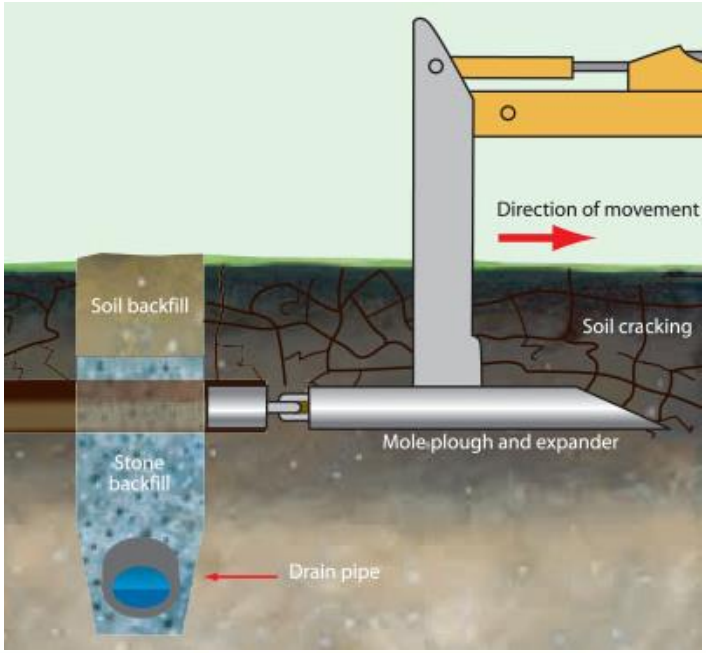
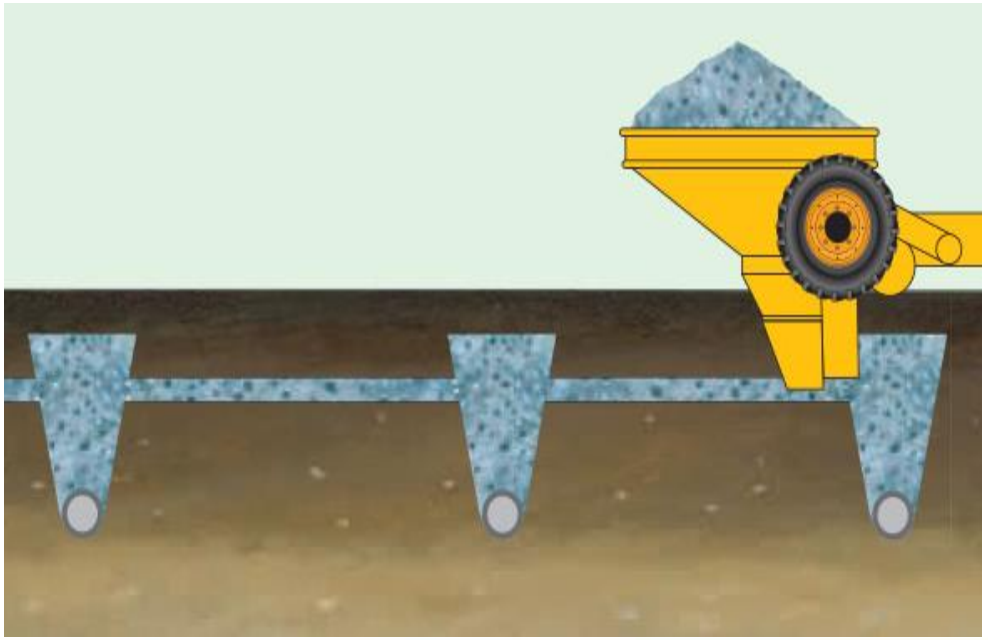


Fig 2: Influence of soil fissure and leg slot development on the mole drain hydrograph

Backfilling collector drains

- Drainage stone should:
  - fill the trench to within 250mm of ground surface
  - provide connectivity with mole channels and topsoil
  - be **clean** aggregate (10-40 mm / 0.4 -1.5 inch)

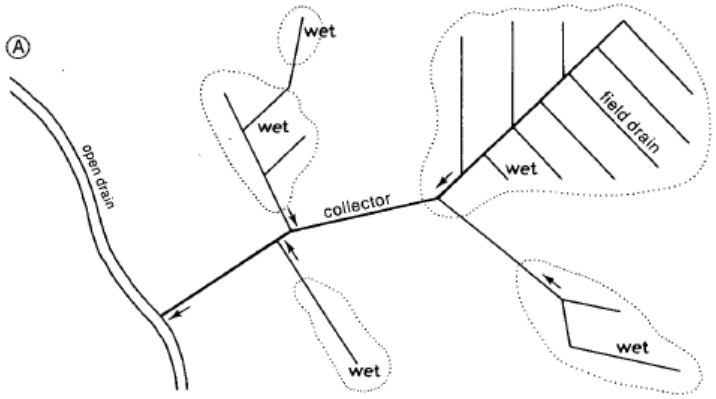




Layout patterns

Drainage system layout patterns:

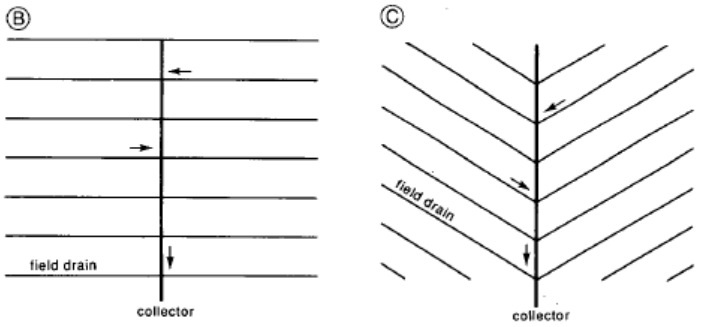
- A: Natural
- B: Parallel
- C: Herringbone



- In uneven terrain drains are most effective when they pass through depressions in the land.

- Where land is relatively flat, a regular network of drains is more suitable.

- In a parallel system field drains should be aligned across the slope with collectors running down the slope.



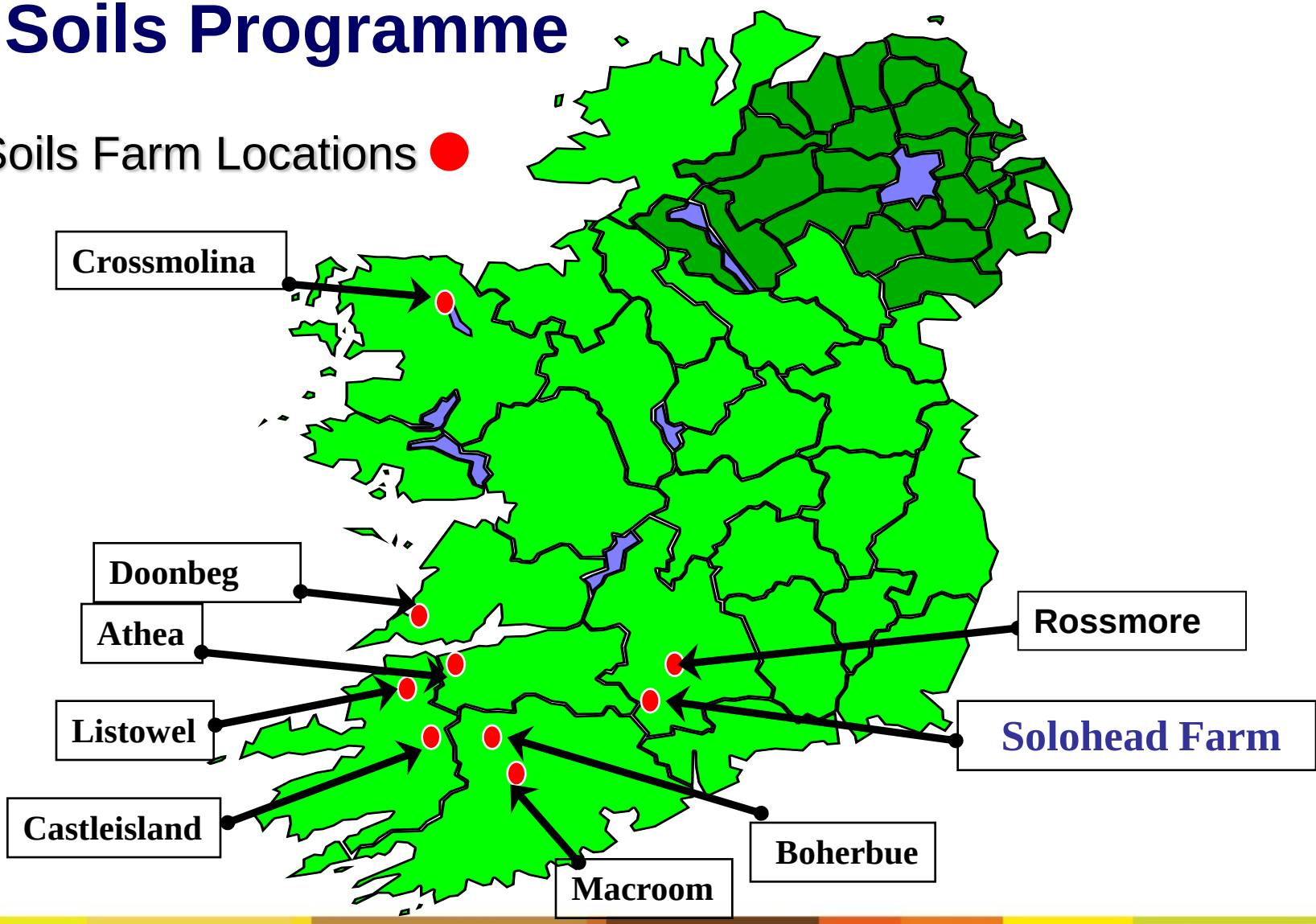
Smedema & Rycroft, 1983

Notes on drainage pipe and stone

- The drainage pipe facilitates a unobstructed flow path from the field drain.
- Only short drain lengths (less than 30 m) are capable o operating at full efficiency without a pipe. (also allows maintenance)
- Perforated corrugated pipe is the cheapest and most convenient
- Drainage stone has three functions
  - Hydraulic: facilitate water flow to the pipe
  - Filter: prevent the entry of fine particles to the pipe
  - Bedding: provide support for the pipe and prevent collapse

Heavy Soils Programme

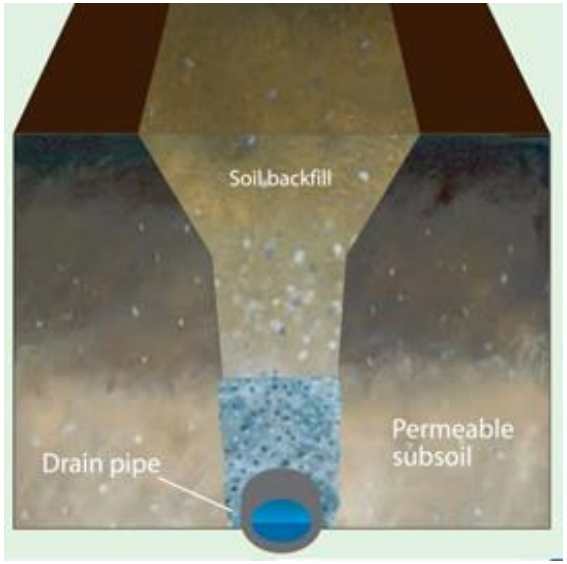
Heavy Soils Farm Locations

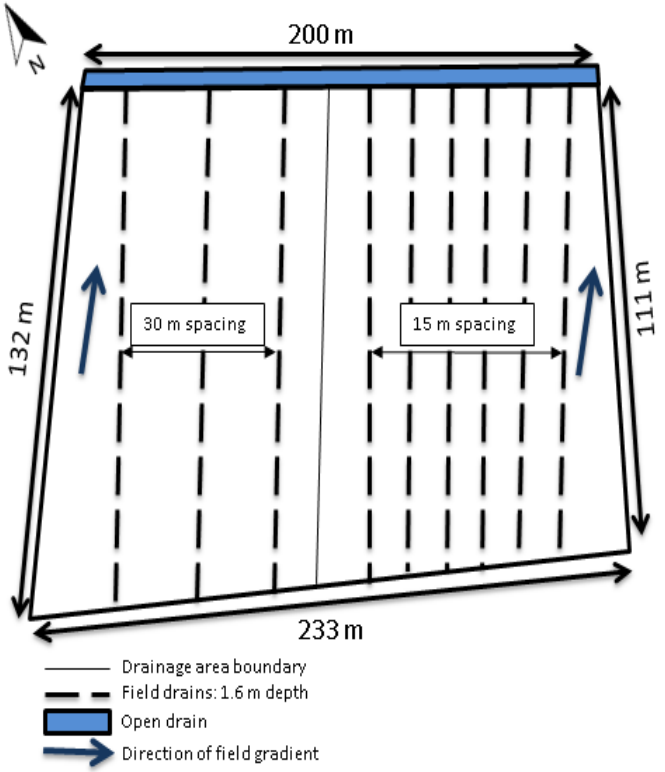


Rossmore: Groundwater drainage system

Problem Diagnosis

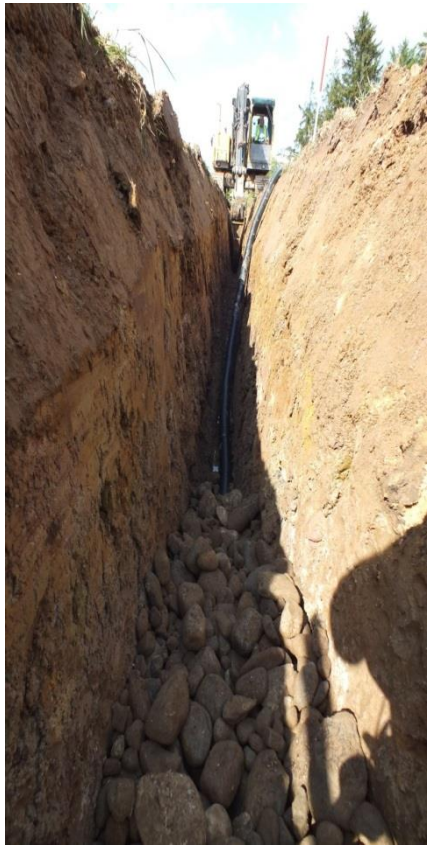
Soil Test pits





- Where a permeable layer will transmit water
- Where water can percolate to watertable
- Most effective way to discharge water

Rossmore: Groundwater drainage work and costs

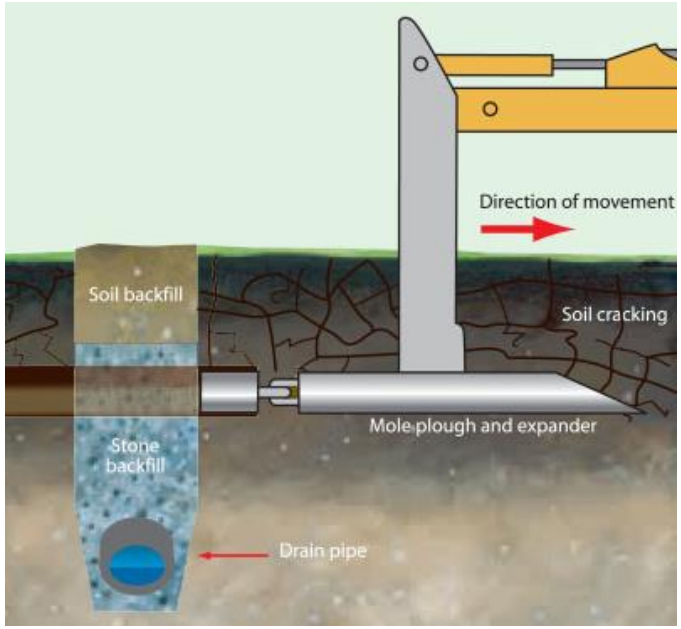


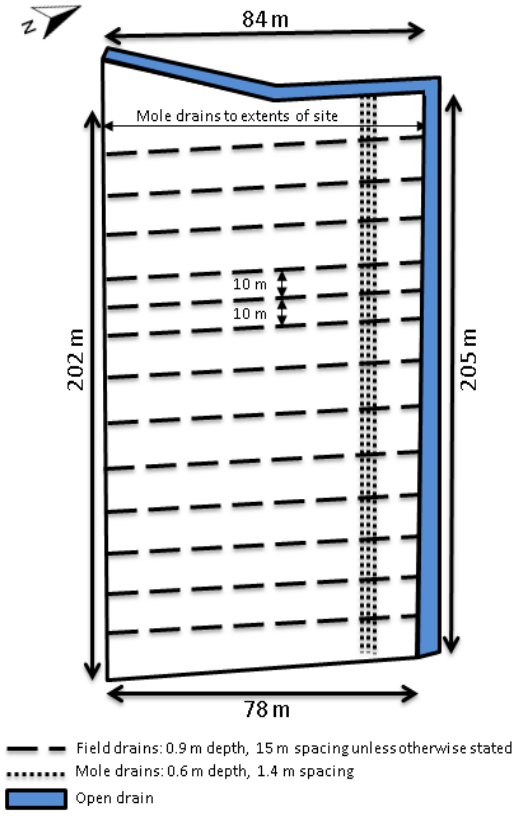
Costs	Total/ha
Drain installation @ €45/hr (55 hrs)	€2,476
Drainage pipe @ €0.70/m (429 m)	€300
Drainage stone @ €11.10/t (141 t)	€1,562
Drainage cost	€4,338

Doonbeg: Shallow drainage system

Problem Diagnosis

Soil Test pits



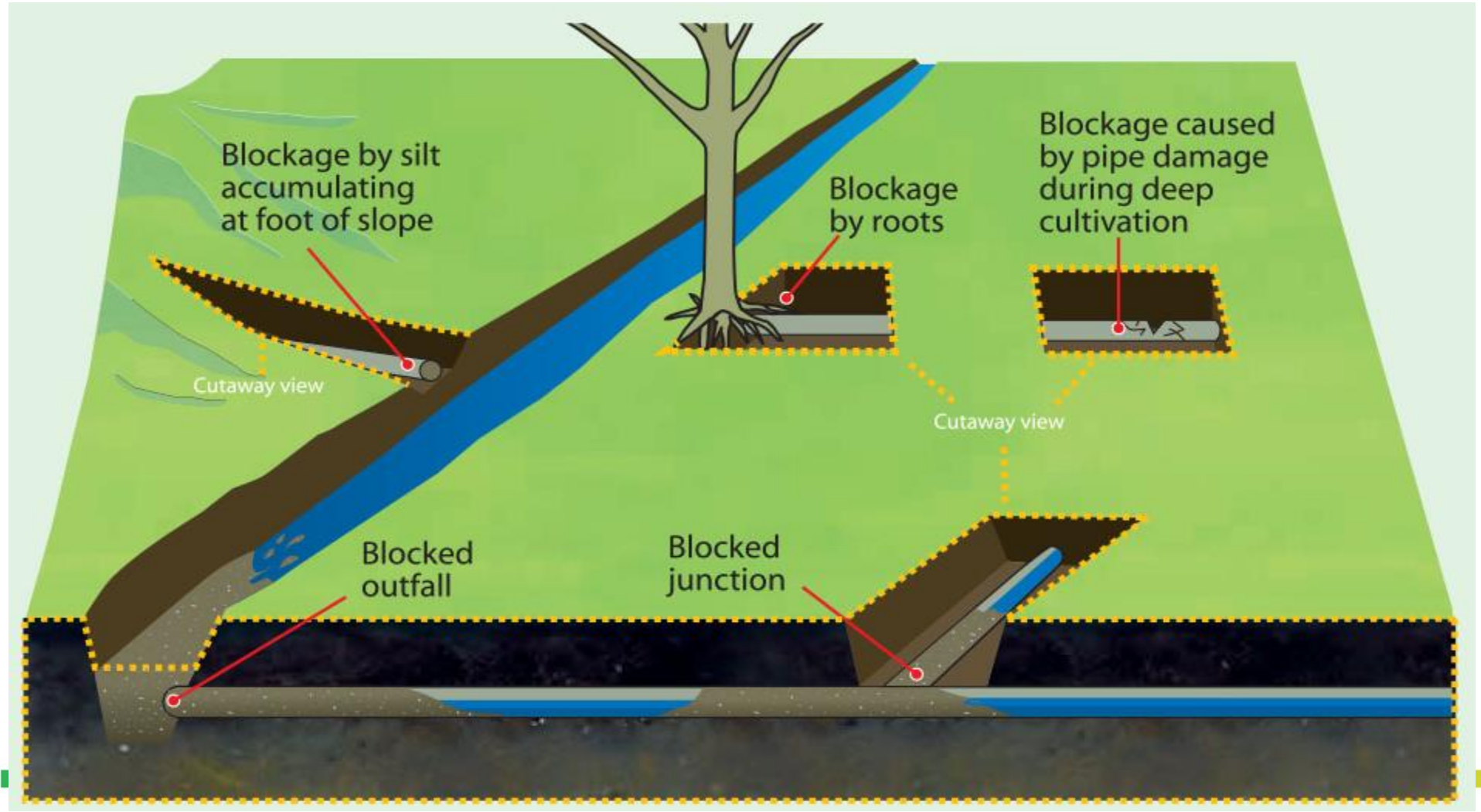


- Aim to crack the soil
- Dependent on:
  - Soil texture (clay >40%, sand <20%)
  - Weather conditions during installation
- Used in tandem with collector drains

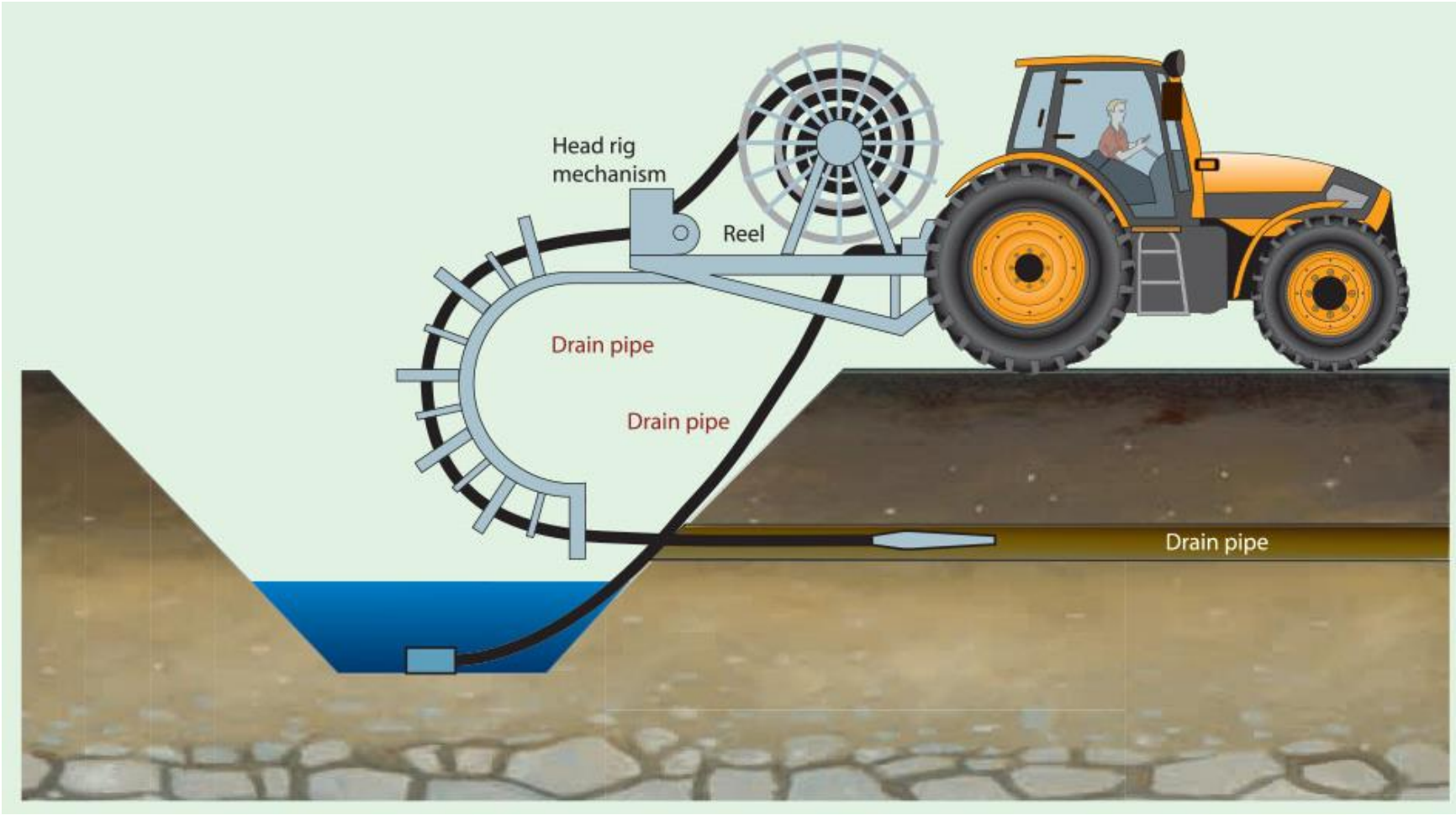
Doonbeg: Shallow drainage work and costs

Costs	Total/ha
Drain installation @ €40/hr (66 hrs)	€2,639
Drainage pipe @ €0.80/m (688 m)	€550
Drainage stone @ €13.48/t (197 t)	€2,650
Mole installation	€100
Drainage cost	€5,939

Maintenance



Maintenance



Approximate costs

Drainage System	Spacing(m)	Depth (m)	Cost/m (€)	Cost/Acre (€)	Cost/hectare (€)
Piped Drainage System					
Conventional System (Costly and ineffective)	8	0.8 - 1.5	5-7	2500-3500	**6200-8600**
Groundwater Drainage	15 - 50	1.0 - 2.5	8-11	1500-2500	**3700-6200**
Shallow Drainage System					
Mole Drainage	1 - 1.5	0.45 - 0.6	-	50	**125**
Gravel Mole Drainage	1.5 - 2.5	0.35 - 0.5	-	600	**1480**
Collector Drains	20	0.75	5-7	1000-1400	**2500-3500**
Collector Drains	40	0.75	5-7	500-700	**1200-1700**

EIA Legislation

Land drainage works on lands used for agriculture is covered by the EIA (Agriculture) Regulations and is controlled by DAFM. Such drainage works include the following:

- Installing open drains
- Installing field drains (not open) such as field drains using plastic pipe with drainage stone or field drains with drainage stone only or mole drains (no pipe or drainage stone) or gravel filled mole drains (no pipe but filled with gravel)
- Opening of a short distance of watercourse

EIA Legislation

- Screening by DAFM is required where drainage work exceeds 15ha

- **For the purposes of the Regulations the area will be considered to be the area of works (drains plus immediate vicinity) rather than the area of the field.**

- The thresholds will be the areas of works undertaken in any one
  year or the sum of such areas over a five year period, beginning
  on the 8th September 2011.

- http://www.agriculture.gov.ie

References

- Teagasc Land Drainage guidebook

- Teagasc Manual on Drainage and soil management
- http://www.teagasc.ie/publications/view_publication.aspx?PublicationID=3075

Thank you for your attention

Teagasc
Agriculture and Food Development Authority

The Irish Agriculture and Food Development Authority