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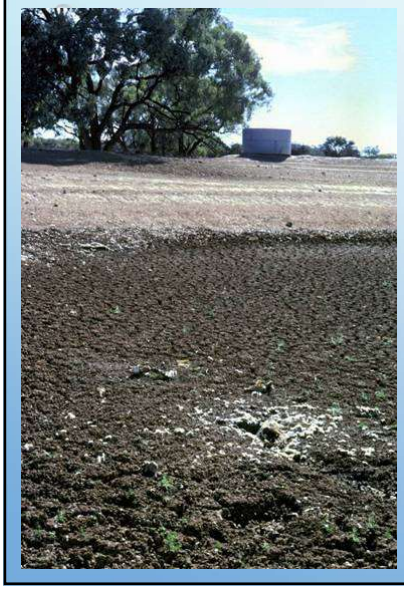
South East LLS

Farm Water Course

Designing and installing a system

February 2020

DESIGNING A SYSTEM

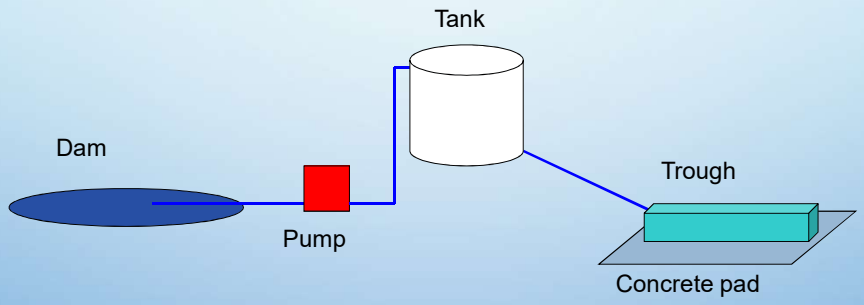


- Determine demand for water from all sources
- Determine volume of water available or determine tank, dam sizes required
- Select pump(s)
- Determine the most suitable diameter of pipe – consider water requirements, distances, heights, pressures
- Protect troughs

WATER RETICULATION

- Improves quality and efficiency
- Should originate from most reliable supply
- Avoids stock losses from bogging
- More efficient feed utilisation
  - Better to have water closest to feed

BASIC RETICULATION SYSTEM



RETICULATION DESIGN

- Design depends on application, topography, location
- Seek professional advice for design and construction
- System needs to deliver maximum daily demand – check flow rates
- Tanks should be large enough to supply the maximum daily demand, plus a few days
- Locate tanks on a level site – but **don't** cut and fill

RETICULATION DESIGN – PEAK DEMAND

- Rule of thumb: system should deliver within 4 hours
- Livestock water together, usually morning or evening, creating **peak demand** period
- Divide total daily water use for mob by 240 minutes (4 hours)

Peak flow requirement (L/min) = (no. stock x daily requirement) ÷ 240

RECOMMENDED INFLOW AND TROUGH CAPACITY

(Farm Water AgGuide Table 21, p.96)

Stock type	Inflow (L/min/head)	Volume (L/head)
Cattle	2.5	5
Sheep	0.25	1
Horses	1.8	5

Round trough holds ~1500 L
5m Long trough holds ~750 L

ACTIVITY – PEAK FLOW RATE

What peak flow rate will be required?

- Bob plans to contain his sheep in summer
- He has 500 cattle and 1800 sheep

Peak flow requirement (L/min) = no. of stock x daily requirement ÷ 240

ACTIVITY – PEAK FLOW RATE

What peak flow rate will be required?

- Bob has 500 cattle and 1800 sheep

Peak flow requirement = no. of stock x daily requirement ÷ 240

$$= \frac{(500 \times 2.5) + (1800 \times 0.25)}{240}$$

= 7.1 L/min

PUMPS

- Pump suitability depends on:
  - pumping volumes
  - pumping duty
  - water source & water quality
  - available power

PUMP DUTY

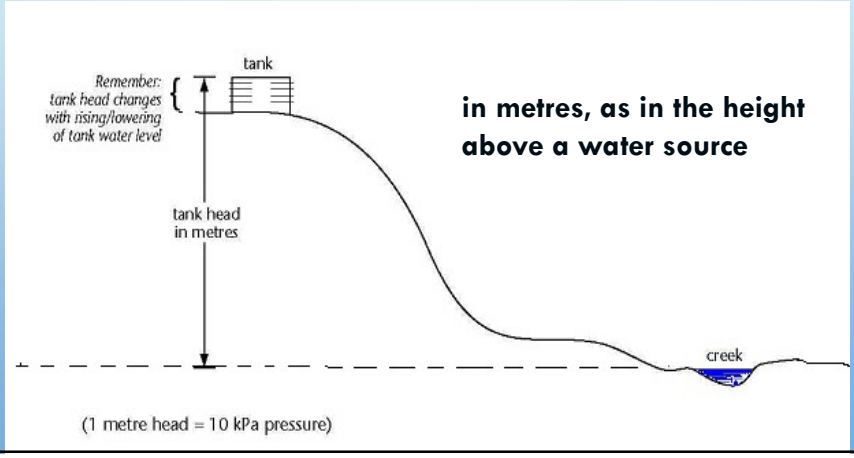
- The term "pump duty" outlines the operating conditions of a pump to do a certain job

- Pump duty has two components:
  - **the head or pressure**
    - Metres of head
    - kPa or psi
  - **the flow rate or discharge**
    - litres per second (L/s)
    - litres per minute (L/m)
    - kilolitres per hour (kL/hr)
    - Etc.

Head or Pressure

(FW Ag Guide ch.5)

- potential energy available to move water from one point to another
- described in two ways:

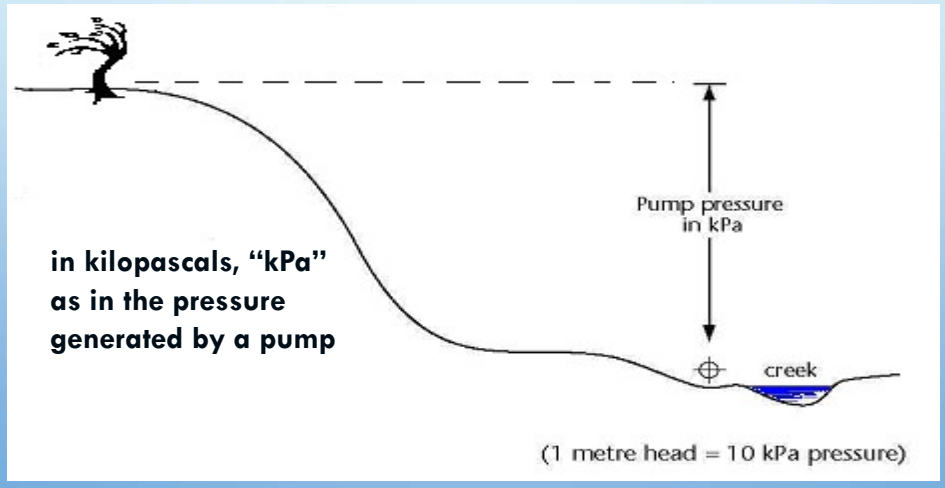


in metres, as in the height above a water source

Head or Pressure

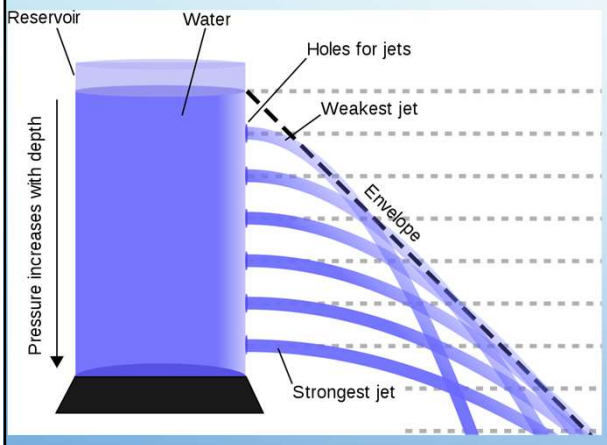
(FW Ag Guide ch.5)

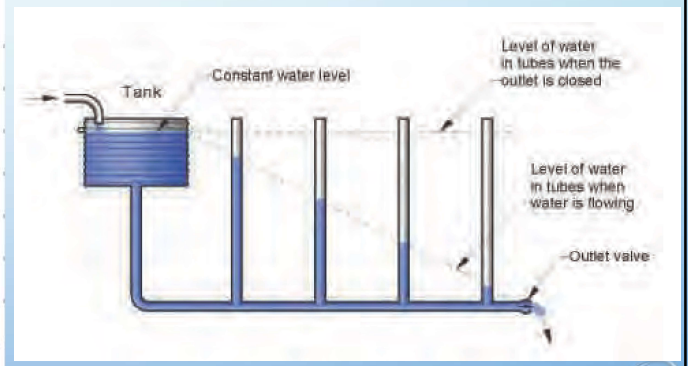
or



in kilopascals, "kPa"
as in the pressure
generated by a pump

PRESSURE





PUMP DUTY

- **Pump Duty is:**
  - **Total Head** in metres or kPa

and

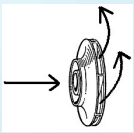
  - **Flow rate** litres per second (L/s), etc.

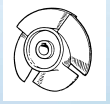
- **Obtain a pump for <u>your</u> duty**
  - Not the one in the shed
  - Not the neighbour's old pump
  - Not the one on sale at the pump shop
  - ALL OF THESE ARE FALSE ECONOMY!!

TYPES OF PUMPS

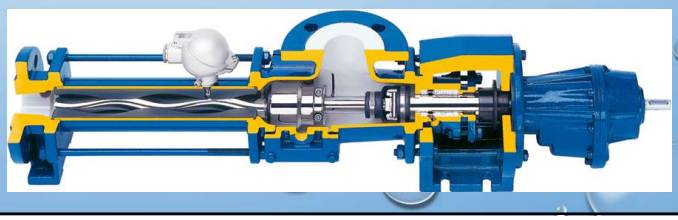
(AgGuide ch.6)

- Hydrodynamic (centrifugal) pumps:
  - radial flow pumps – high head, low flow
  - mixed flow pumps – medium head, high flow
  - turbine pumps – low head, very high flow



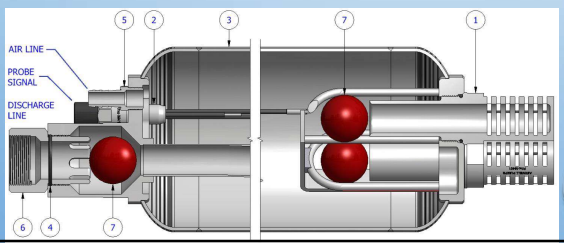


- positive displacement pumps – very high head, low flow:
  - piston pumps
  - helical rotor pumps
  - diaphragm pumps



TYPES OF PUMPS

- Air Lift pumps:
  - No moving parts – moves water by compressed air
  - Low head, low flow
  - Air is injected in the lower part of the pipe
  - The air has lower density than the liquid so rises quickly
  - Water is taken in the rising air flow
  - Efficiency 35% to 55%



PUMP SET UP

(AgGuide ch. 10)

- For long, reliable service, pumps must be set up properly:
  - Secure footing
  - Properly aligned
  - Pipes properly fitted
  - Not too high above water level (NPSHR) (guide: less than 5m)
  - Minimum pipe bends
  - Constantly rising pipe especially suction
  - Large diameter suction pipe
  - Open and close valves slowly

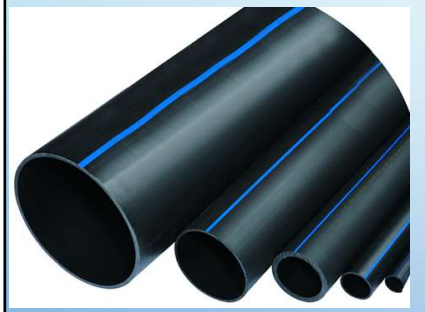
POWER SUPPLY OPTIONS

(AgGuide ch. 8)

- Electric motor – easy to control, efficient, cheap, reliable
  - Mains power – expensive if not close to site
  - Solar power – only available in sunlight, now quite cheap, need inverter, battery maybe necessary, large arrays needed for high volumes
- Petrol or diesel motors – portable, easy to vary speed, good where mains power unreliable, more expensive
- Wind power – generators, windmills
  - Only good in windy locations
  - Windmills slightly expensive to buy but cheap to maintain

PIPES

(AgGuide ch.9, Appendix 2)



- Simplest case: determine main pipe diameter for only one water source and outlet
- This may be all that is needed – consider stock as one mob drinking from one trough
- For multiple troughs, pipes to individual troughs can be smaller – but must be big enough to meet stock demand

PIPES

(AgGuide ch.9, Appendix 2)

- Friction loss adds to the Total Head
- Smaller diameter increases friction loss – maybe to excess – design for largest economic size
- Longer pipe increases friction loss – design for shortest route
- Choose pipe diameter, length, pressure rating that suits your job
- Also choose fittings that suit your pipe and have the correct pressure rating

TANKS

(Farm Water AgGuide p.89-90)

Made from:

- Concrete – strong, heavy, expensive, keep water cool, lasts
- Plastic – light, cheap, easy to repair, gradually deteriorates
- Gal steel – light, mid-price, lasts long with good quality water, needs space under to avoid corrosion
- Poly-lined steel – light, cheap, lower quality water okay

TANKS

(Farm Water AgGuide p.89-90)

- A roof helps maintain water quality, reduces sunlight and algae growth, minimises evaporation
- Where possible, locate on high ground for gravity feed to troughs
- Should have capacity to guarantee several days supply in case of failure of pump or pipeline. Rules of thumb:
  - Mains electric motor – 3 days supply
  - Solar electric motor – 5 days supply
  - Engine driven – 5 days supply
  - Windmill – 10 days supply

TROUGHS

(Farm Water AgGuide p.93-100, 106)

- 1m of trough = 30 cows or 130 sheep
- 1 trough can service 2 yards/paddocks
- Locate as centrally as possible to encourage even grazing
- Stock should range max 3 km flat ground, 800 m rough country

TROUGHS

Mobile troughs are an option

- only few required
- no scarring around supply points
- provides livestock 'cue' to move
- flushed each time it is moved

PLASTIC V CONCRETE TROUGHS

- Solid and heavy – hard for stock to shift or break
- Concrete troughs can suffer from acidic water – erodes concrete from inside of the trough
- Leads to cracks, concrete cancer, leaks
- Might expose ends of reinforcing mesh and injure animals
- Concrete keeps water cooler
- Lime can leach out of concrete into the water – reduces acidity of water

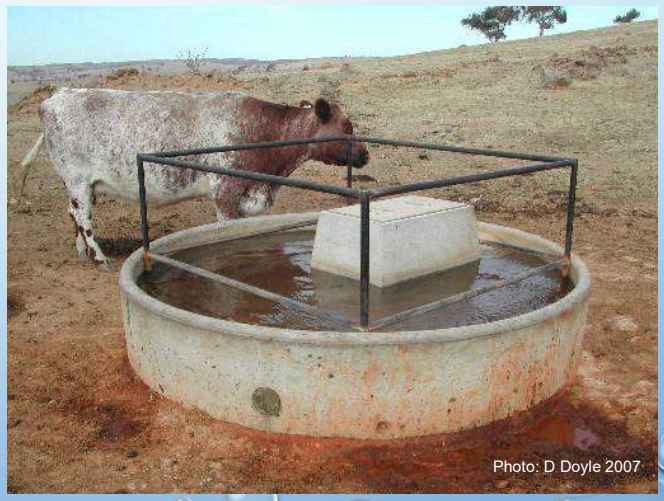
- Plastic troughs lighter, easier to work with
- Rainwater is naturally acidic – in plastic tanks with copper plumbing, copper might leach into the water – health implications
- Susceptible to damage by fire

TROUGH INSTALLATION
(Ag Guide p.99)

- Site on firm, well drained ground
- Lay concrete, gravel pad or rubber matting to prevent erosion
- Avoid gateways
- Strong float valve cover
- Need a drain plug
- Clean regularly
- Protect pipework

TROUGH GUARDS
(Ag Guide p.94)

- Prevent stock or feral animals getting trapped in troughs
- Keep troughs cleaner
- Minimise trough damage



WHAT IS WRONG IN THESE PICTURES?

DESIGNING A SYSTEM

Worked examples – Farm Water AgGuide ch.13 & 14