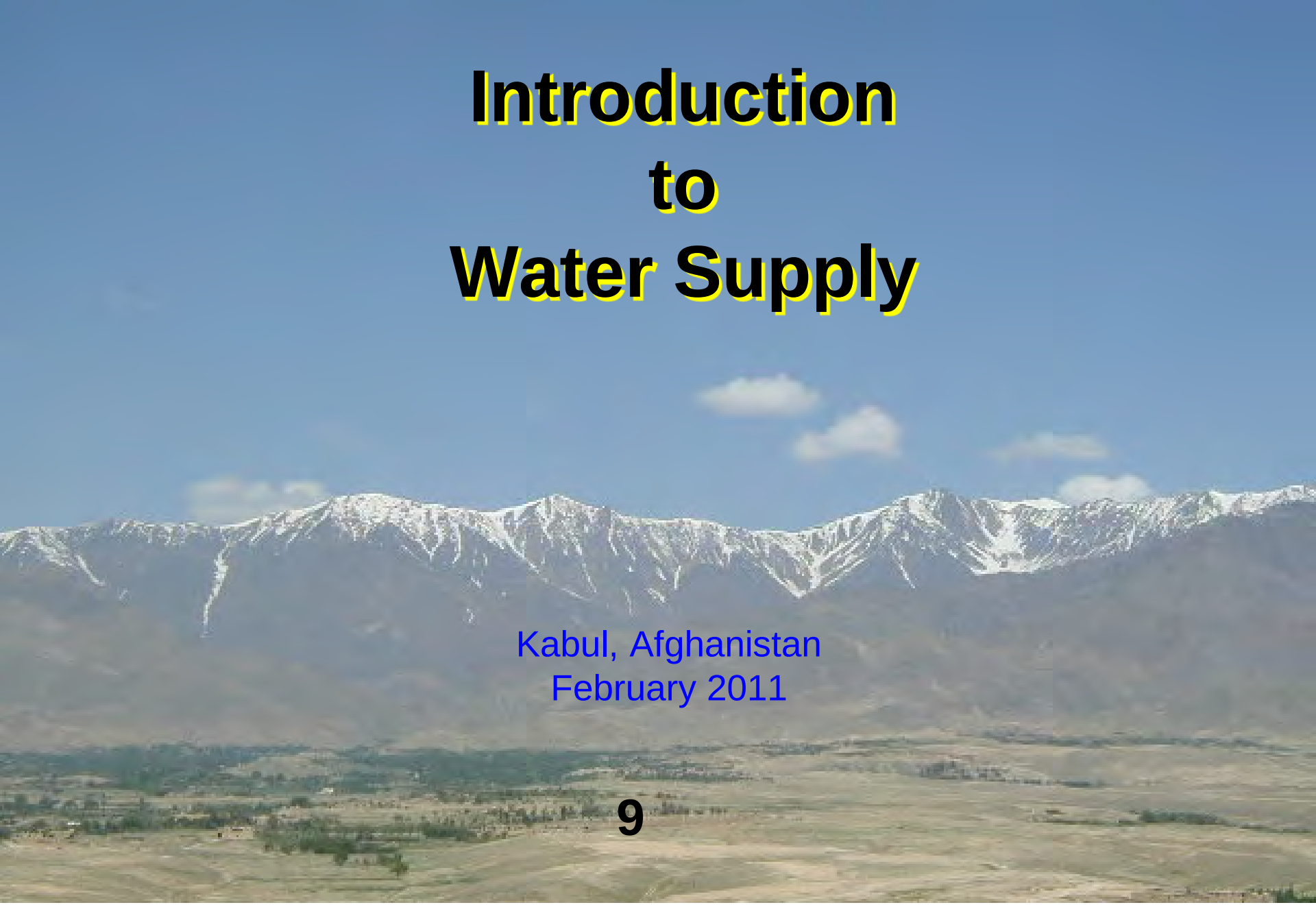
Introduction to Water Supply



Kabul, Afghanistan
February 2011

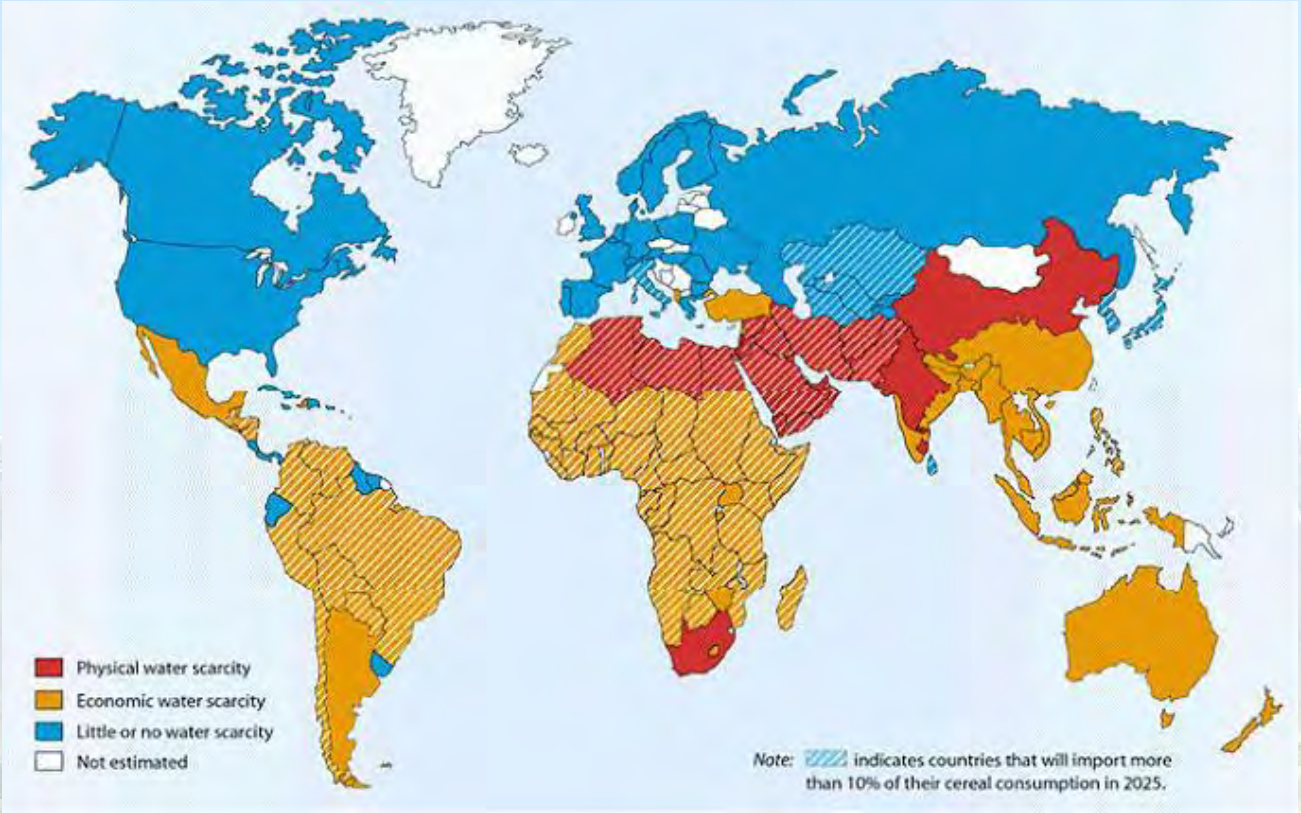
9

This watershed rehabilitation and restoration training was prepared by the U.S. Department of Agriculture (USDA) team of Jon Fripp (Civil Engineer – USDA/NRCS), Melvin Westbrook (Director USDA-NRCS/IPD), Otto Gonzalez (International Agricultural Development Specialist - USDA Foreign Agricultural Service), Clark Fleege, (Nursery Manager, USDA Forest Service, and George Hernandez (Forester - USDA Forest Service), in consultation with Lief Christenson, (USA CJTF101 Water Resources Coordinator, Afghanistan). Contact Jon Fripp at jon.fripp@ftw.usda.gov or Otto Gonzalez at Otto.Gonzalez@fas.usda.gov for more information on this workshop.

Module Topics:

- Purpose
- Techniques
- Issues

Water Supply: **A safe and reliable water supply is important in every zone.**



40% of worlds population live in areas suffering water shortages By 2025, UNEP predicts 2/3rds of world population will be living in conditions of water stress

But we need to remember that it is in the collection zone where the water is collected for the rest of the watershed

So if there is not enough water or it is of bad quality, it may because there is a problem in the watershed above.

For example: a problem could be a lot of soil erosion caused by lack of vegetation due to poor grazing management.

There can be other causes as well that we have discussed in the class

Water Supply: Purpose

- **Human Use: A safe and consistent quantity is needed.**
- **Animal Use: A large volume is needed in many locations.**
- **Irrigation: A even larger quantity is needed. More water is needed in dry times. Filtration may be necessary for drip irrigation.**
- **Other purposes?**

The identified purpose:

Indicates goal for the water source

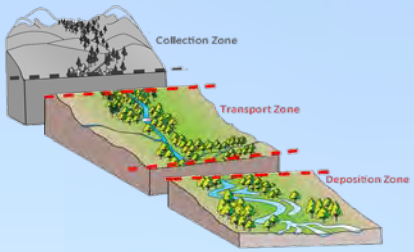
Indicates the quantity and quality needed

Water Supply: Techniques

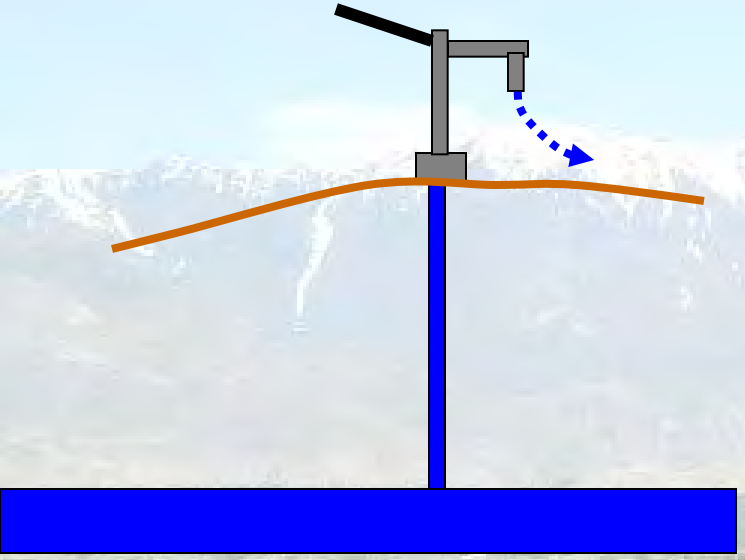
- Pumps and Wells
- Ponds
- Stream Diversions
- Rain Harvesters and Cisterns
- Spring Development
- Ram Pumps
- Others?

Photo from John Moore

Pumps and Wells



- For human use, irrigation and animal needs.
- Pumps and wells draw water from the ground.
- They are mainly done in the transport and deposition zones.



They can be reliable

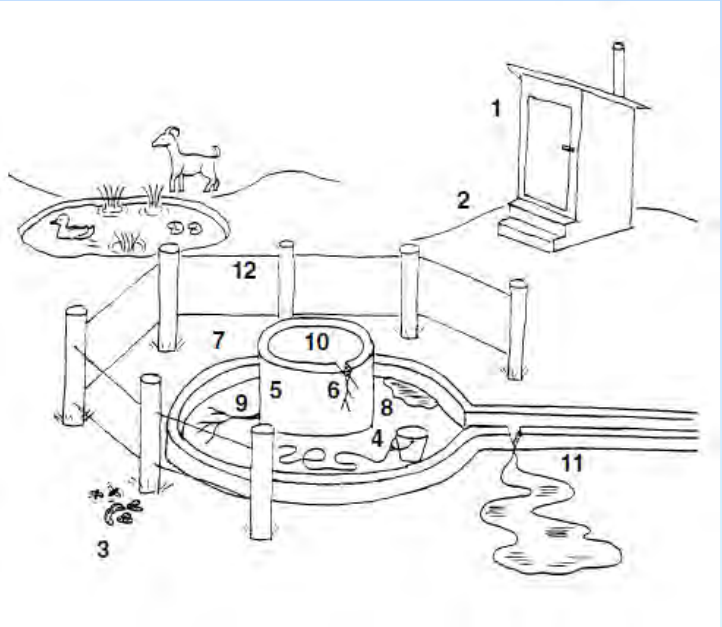
They can pump from cleaner water that is underground

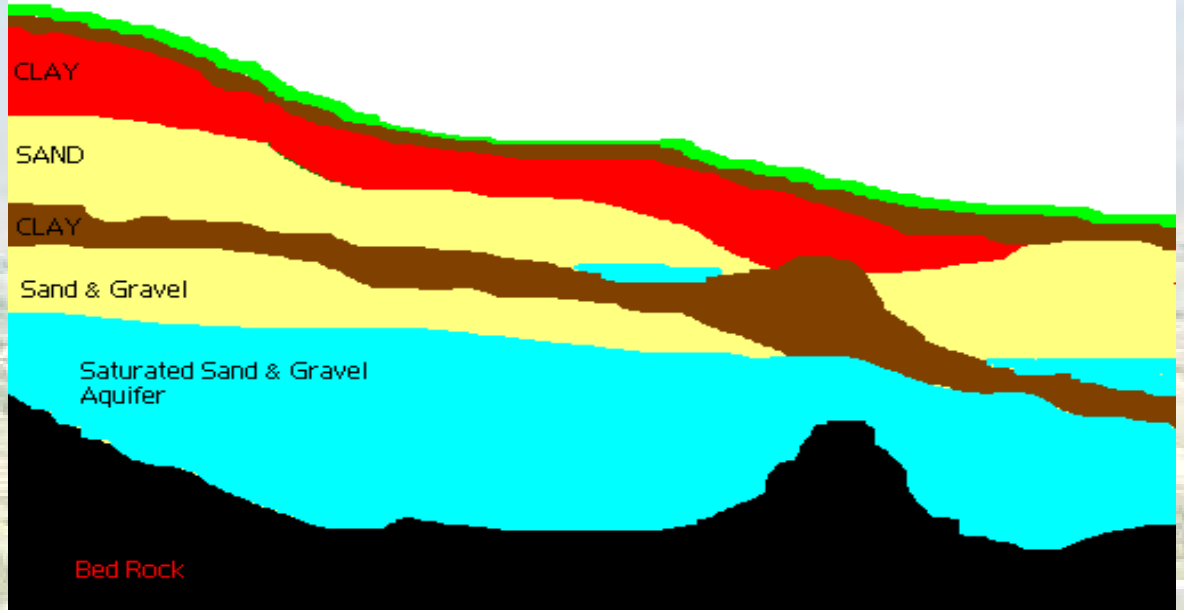
BUT – a bad well (salt, dry, etc) is worse than no well at all!

Where is the water?

Good and bad locations

- Latrines or outhouses
- Waste disposal areas
- Existing open wells
- Dry wells
- Areas subject to flooding
- Faults
- Road
- Areas of known contamination
- Convenient, public location, owner?





What are the resources

How are you going to get to where the water is?

- What equipment is available
- Time available
- Trained personnel

Digging the hole

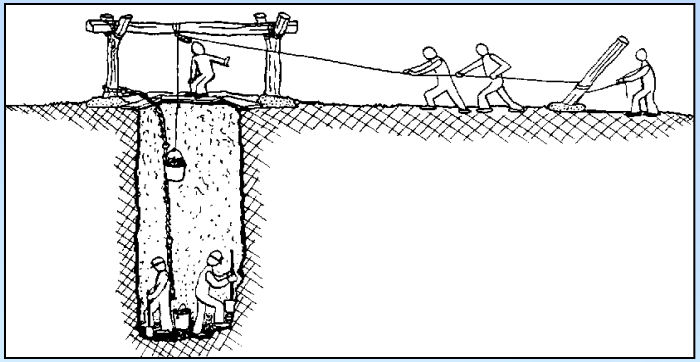
Hand dug: cheap but dangerous. Limited depth of water.

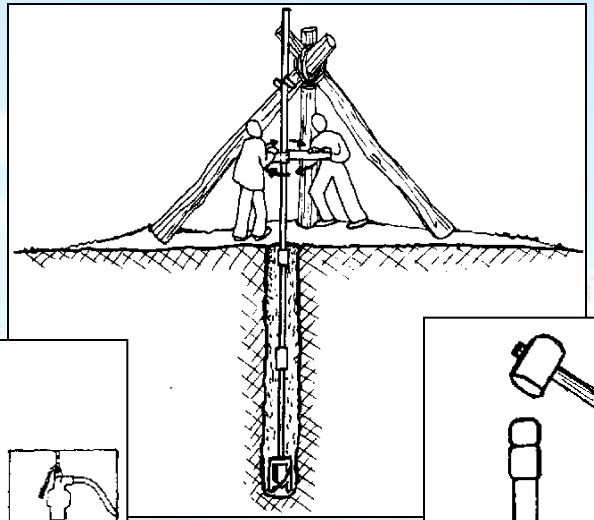
Jetted: Fast but needs specialized tools. Limited depth

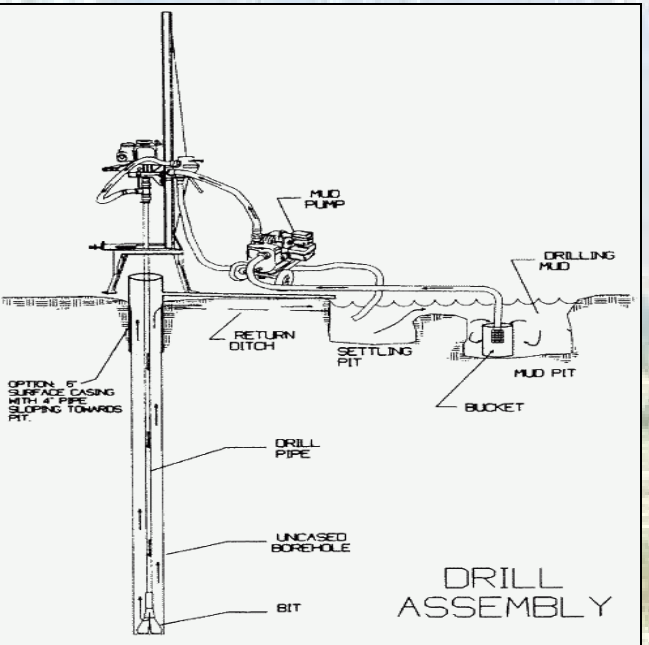
Hand Auger: labor intensive bur cheap, specialized tools. Material issues.

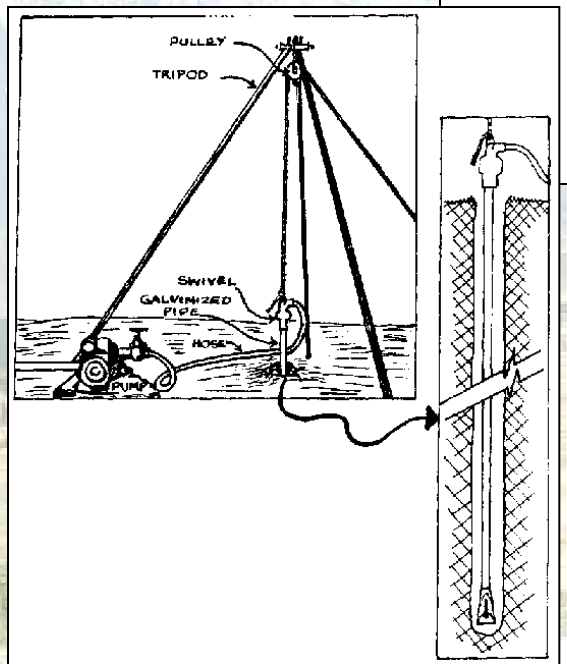
Driven (hand percussion): Simple but very limited depth

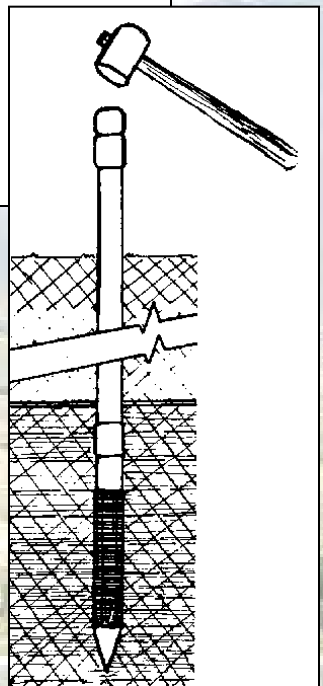
Rotary Mud: Can go very deep but specialized equipment and training needed











Wells

Test water for contamination if water is to be used for human consumption

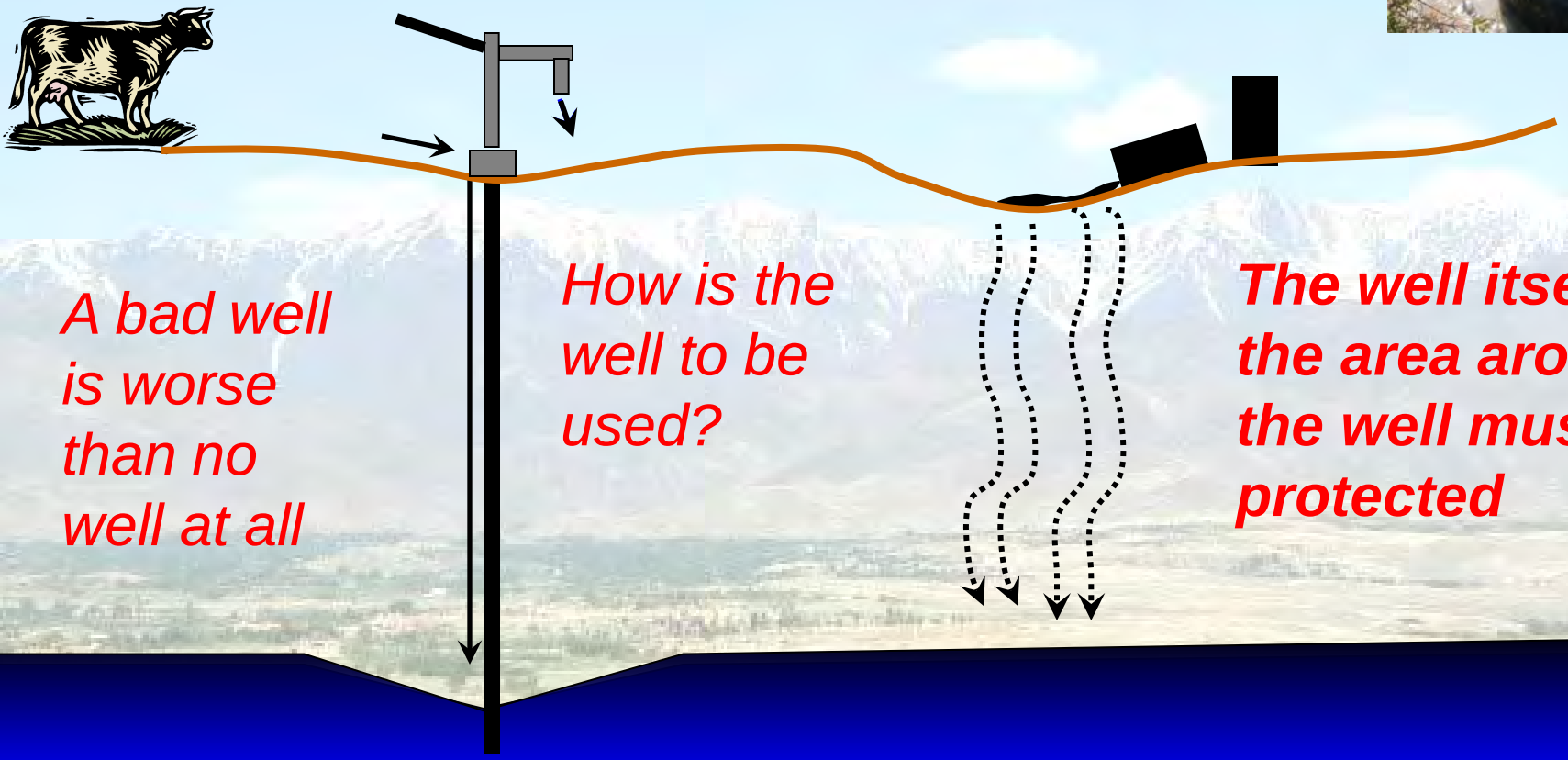
- **Shock chlorinate after installation (250ppm)**
- **Test after installation and run thru of shock *(if bad – seal it!)***
- **Test periodically (good practice for any source!)**
- **Test if reports of sickness**
- **Test after storms and during drought**

Wells

May be reliable but they may not go deep enough to get to clean water

Even deep wells can become contaminated

Protect the well head *(well security!)*



A bad well is worse than no well at all

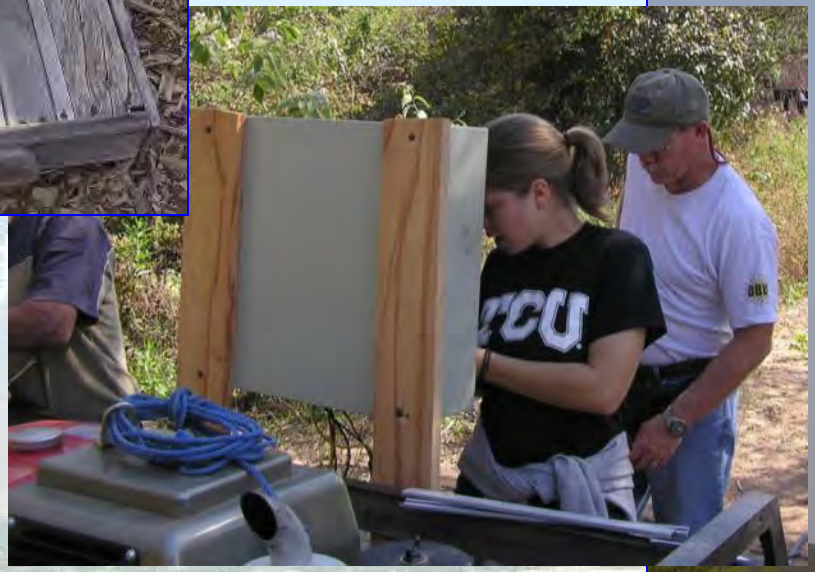
How is the well to be used?

The well itself and the area around the well must be protected

Pumps

How is the water going to get to the surface?

Is the pump sustainable?



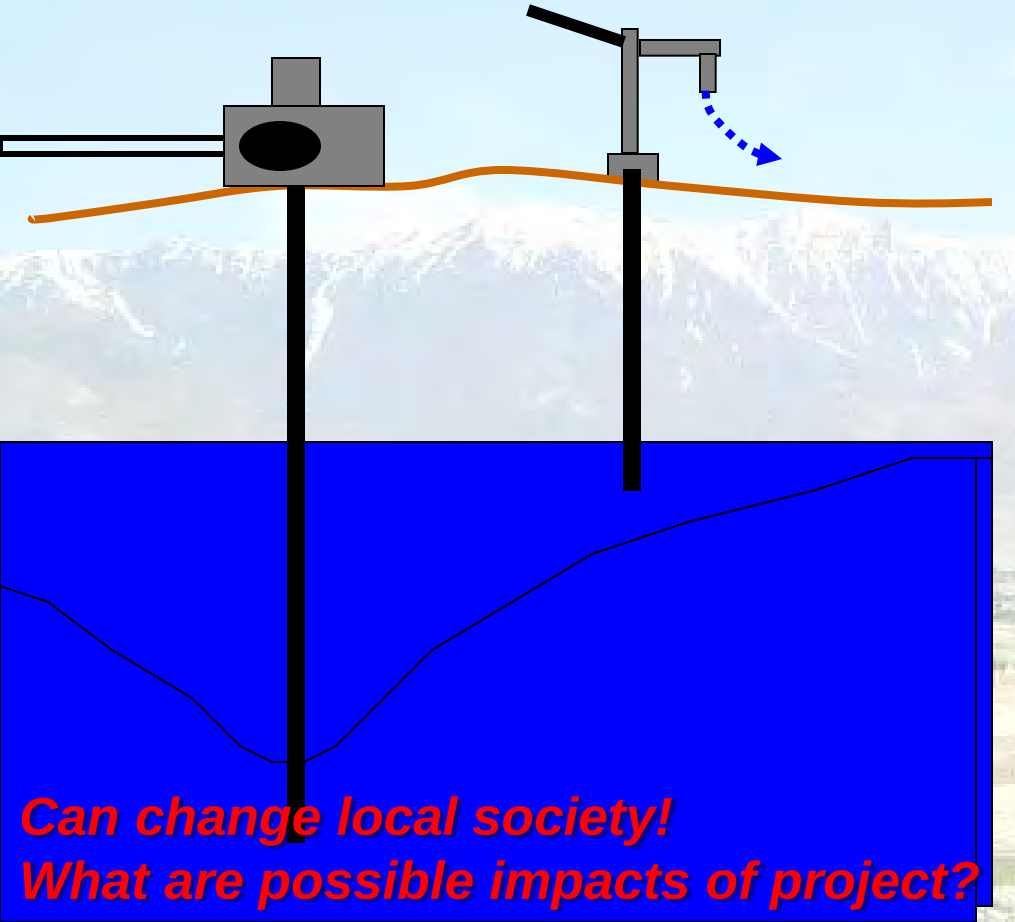
- Hand pumps
- Powered pumps
- Windmill pumps
- others

Pumps

Installation of a large pump can supply water more reliably.

But

Withdrawal by large pumps can impact nearby shallow wells



Can change local society!

What are possible impacts of project?

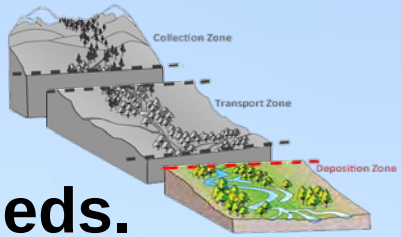
How much can be withdrawn?

- **Analysis and monitoring of well output and water table levels**
- **Empirical (what has worked)**

Examples:

- 40 acres – can only remove enough water for 4 head of cattle
- Limited to pump only enough water a year to irrigate to 24” total depth
- Pumping can continue until shallow well depth drops below a defined level

Ponds

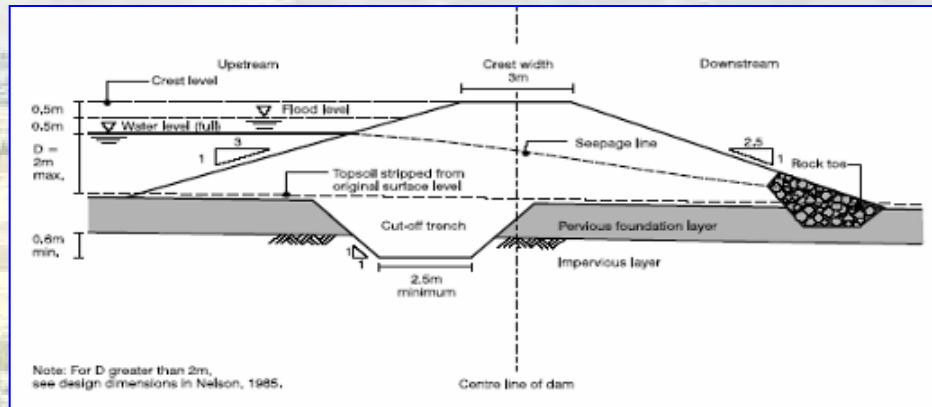


- For fish, human use, irrigation and animal needs.
- Ponds catch the water from a small watershed.
- They are the deposition zone in a small watershed.

•Ponds can store a lot of water.

Ponds

- Can be made by digging a large hole.
  - This is called a “dug-out” or “pit” pond
  - This type may not be able to enough water for the use goal.
- Ponds can also be made by building a small dam.
  - If a small dam is used, it must be designed properly.
  - Leaks in a dam must be controlled
  - Consideration must be given to the performance of a dam during large storms.
  - An engineer may be required to design a large pond.



Ponds

- Most all ponds require rain to fill.
- Need a control for the outlet.
- The bottom of the pond needs enough clay so that all of the water does not soak into the ground.
- If the pond is to be used to produce fish, it must be deep enough to assure that it does not become dry.

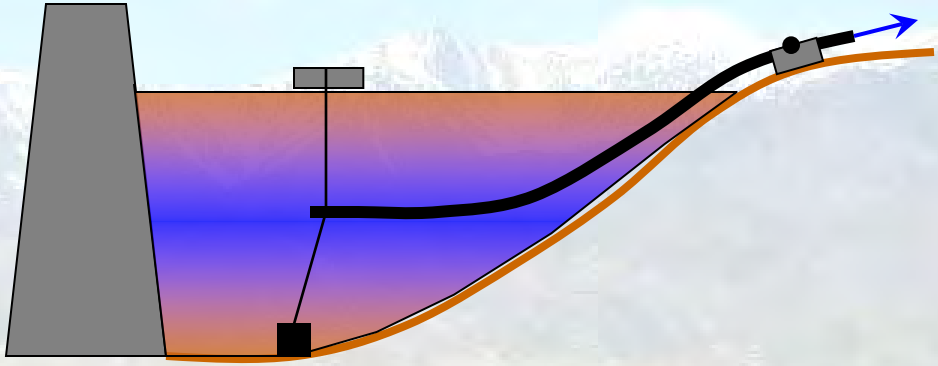
Ponds

- Since a pond is in the deposition zone, the water quality is affected by what happens in its collection and transport zone.
- To keep the water clean, manage and rehabilitate the collection and transport zone.
- Loss of vegetation and soil erosion in the collection and deposition zones can contaminate the water in the pond

- Can use a riparian buffer (wetland vegetation) to filter the water as it flows into the pond.
- Still need filtration and disinfection

Ponds

- **It may be best to draw drinking water from the middle to upper half of the pond water.**
- **Additional treatment may still be necessary if the water is going to be used for humans.**



This topic will be discussed in more detail later in the workshop

Rain Harvesters and Cisterns

- **Rain Harvesters and Cisterns are used mainly for human needs but can also be used for animals.**
- **They collect rainfall from a roof or hard surface and store it for use.**
- **These can be used in any zone.**

This topic will be discussed in more detail later in the workshop

- **Simple technique**
- **Rain is clean**
- **But the roof may be dirty and can contaminate the rain water**

More later on this topic

Spring Development

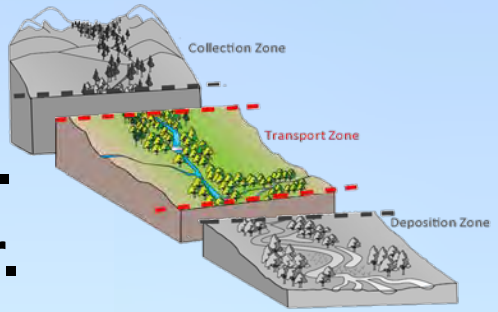
- Used to collect water from the ground.
- Typically in the collection zone
- Can be done in any zone.
- The area must be protected from contamination.

Spring Development

- **Water can be used for humans and for livestock.**
- **Can also be used for irrigation but might not produce enough water.**

This topic will be discussed in more detail later in the workshop

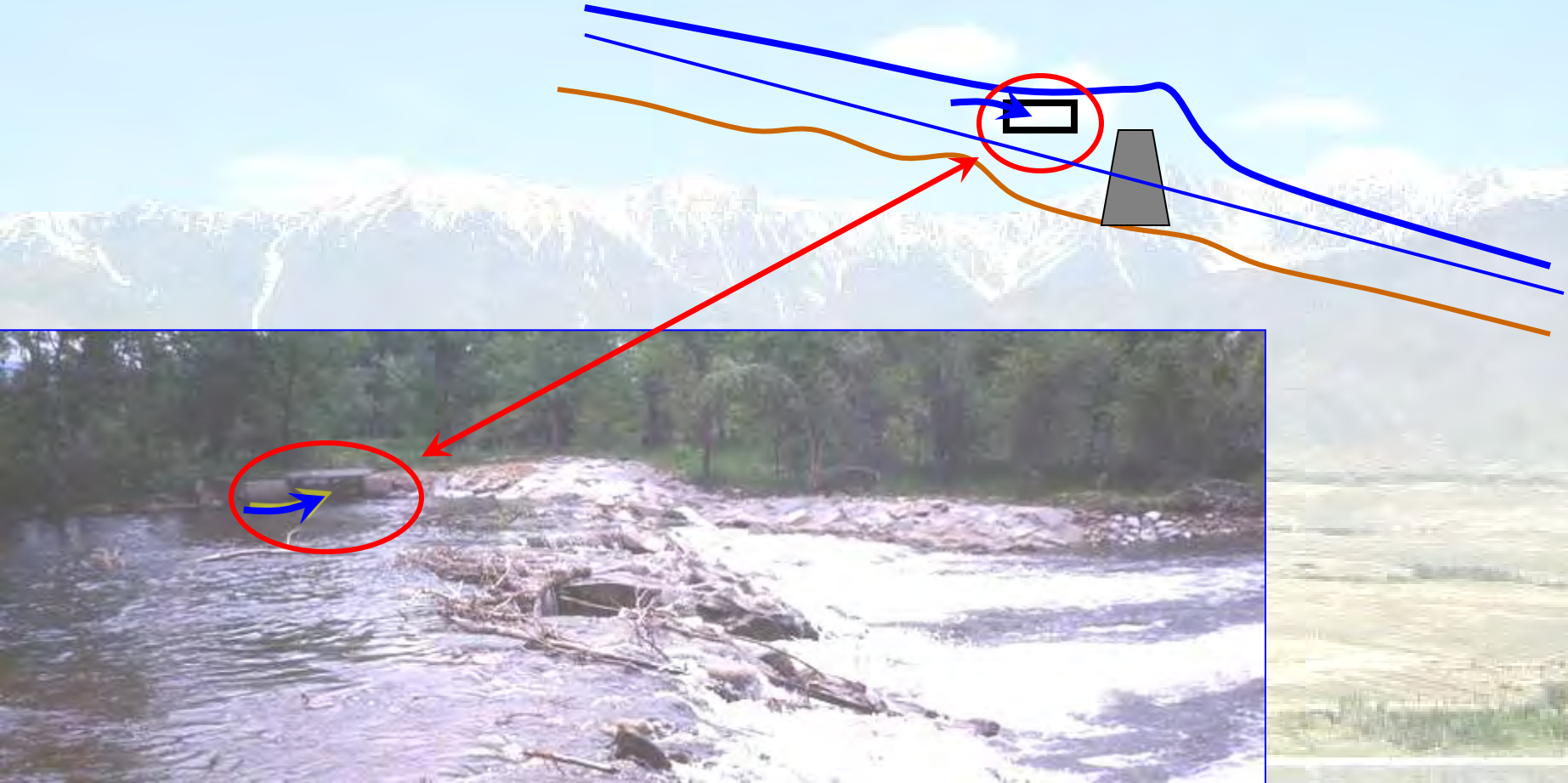
Diversions



- For human use, irrigation and animal needs.
- Diversions take water from a stream or river.
- Diversions are used in the transport zone.

Diversions

- Can be simple or complicated.
- Recall check dam design and issues
- They can supply a lot of water.
- All diversions raise the water level so it can flow into a water supply channel.



Diversions

- **Once the water is in the water supply channel, a control structure is necessary.**
- **Without a control structure, too much water may be diverted and the people below the structure can be impacted.**
- **Simple gates can be used.**

Diversions

- **It is best to line the water supply channel to prevent loss of water.**

Diversions

- **Different techniques to line diversion ditches**
  - **Concrete**
  - **Soil Cement**
  - **Clay**
  - **Brick**
  - **etc**

Loss for unlined ditches is about 60%

Loss for lined ditches is about 20%

Water that is lost to infiltration may be recovered in wells or by other vegetation but it may not be used as intended

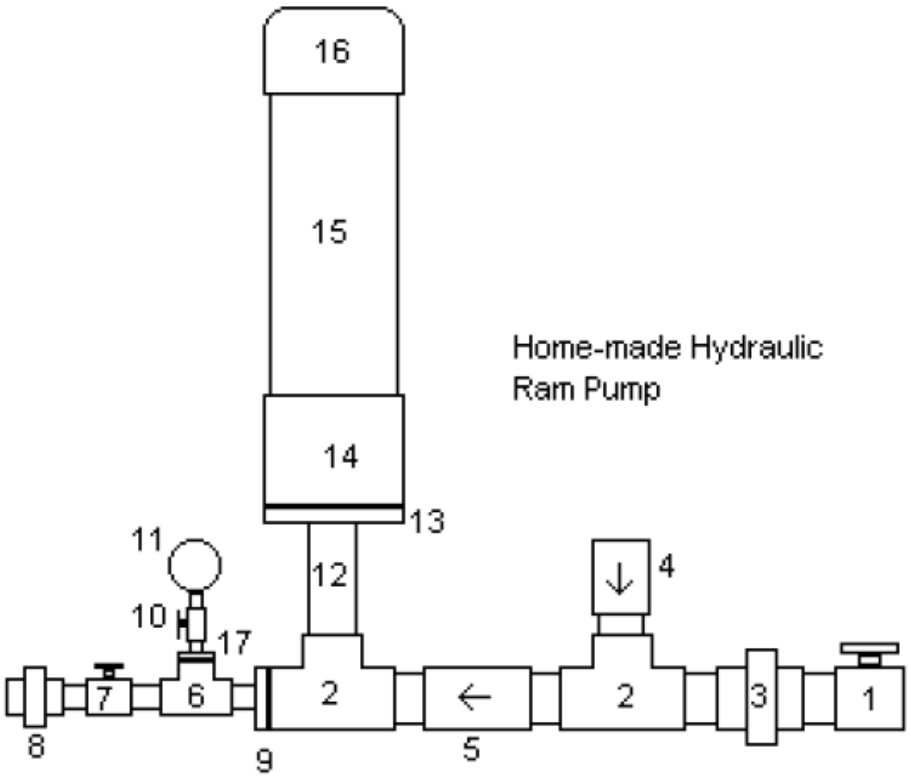
Diversions

- Care should also be taken to prevent contaminated water from getting into the diversion channel.
- A pipe may be useful to prevent contamination.

Photos from Dennis Reep

Hydraulic Ram Water Pumps

(water hammer pump)



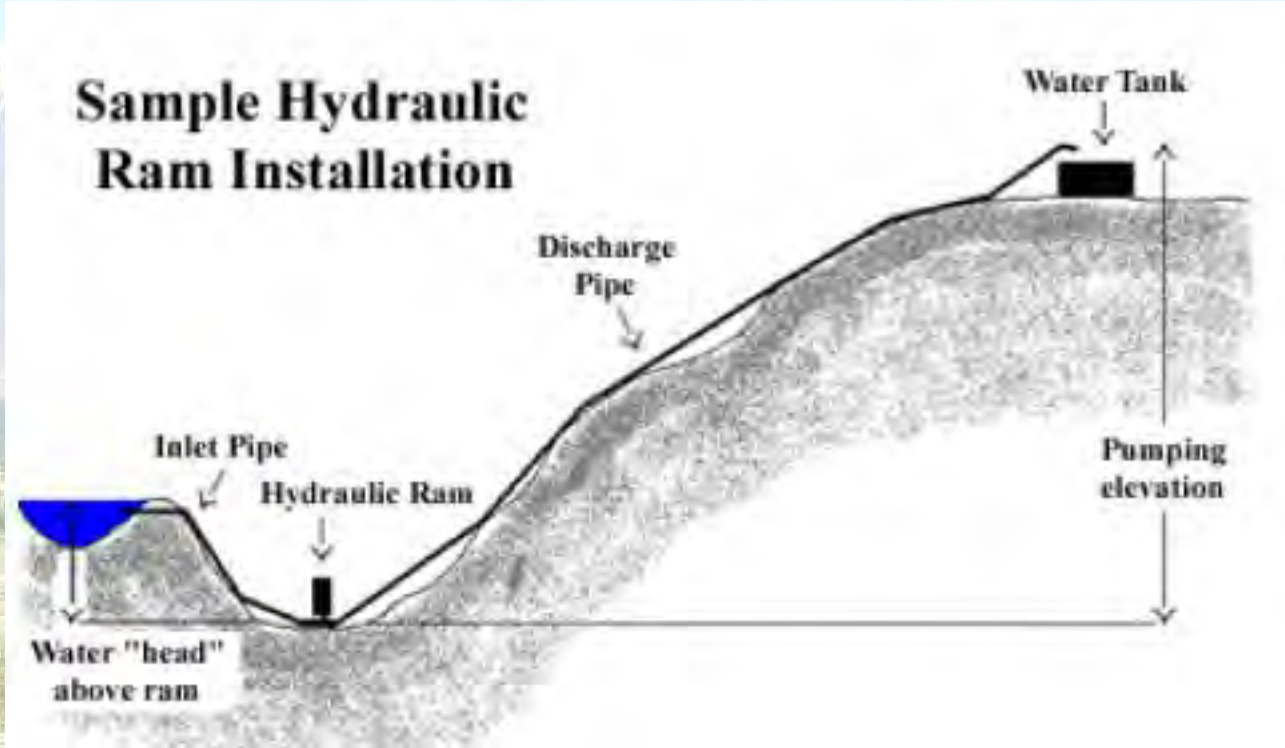
Self powered
Runs on Water/Gravity
Need no external power
Pollution Free

Typical Applications of Ram Pumps

- Village water supply
- Lift irrigation water from streams to raised channels
- Livestock water
- Pump storage for water use during dry periods

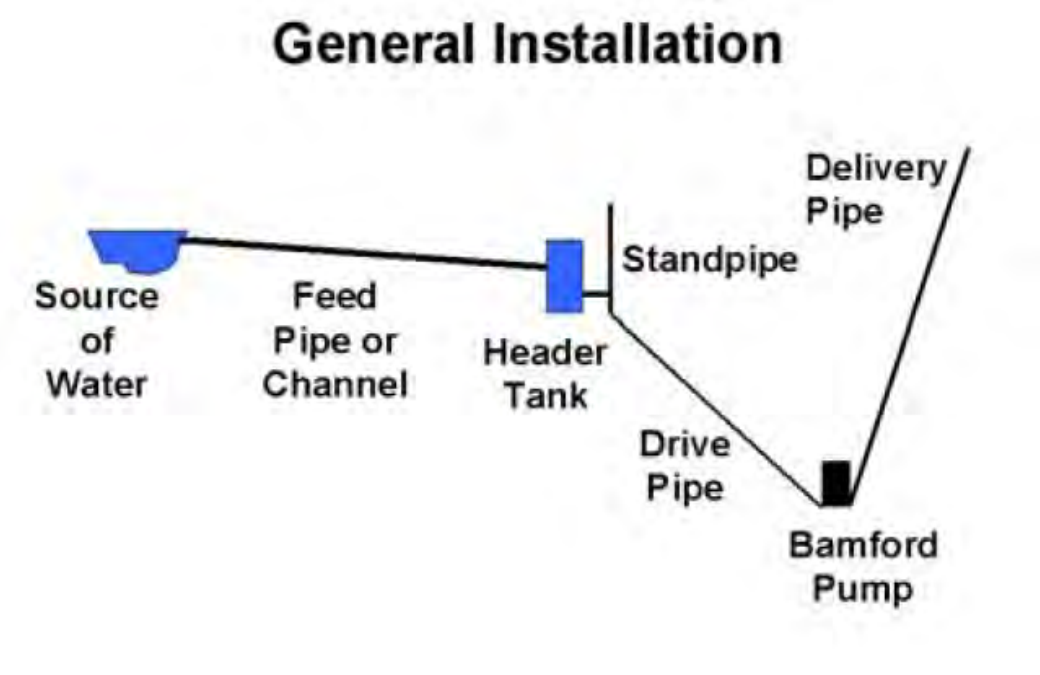
<u>In general:</u>

A ram pump can lift 10% of the received volume to a height that is 10x the receiving head



Different Types of Ram Pumps

- Minimum inlet flow of 8 liters per minute
- Drive head of 1.5 m can provide delivery head of 50 m
- Drive head of 2 m can provide a delivery head of 100 m
- 1000 liters per day delivery head of 20 m from a drive head of 2 m with an inlet flow of 15 liters per minute

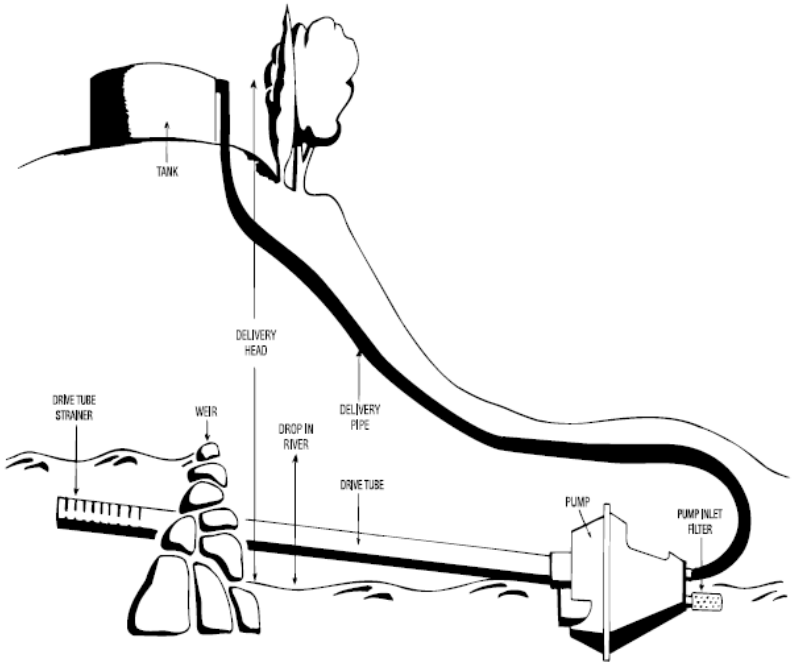


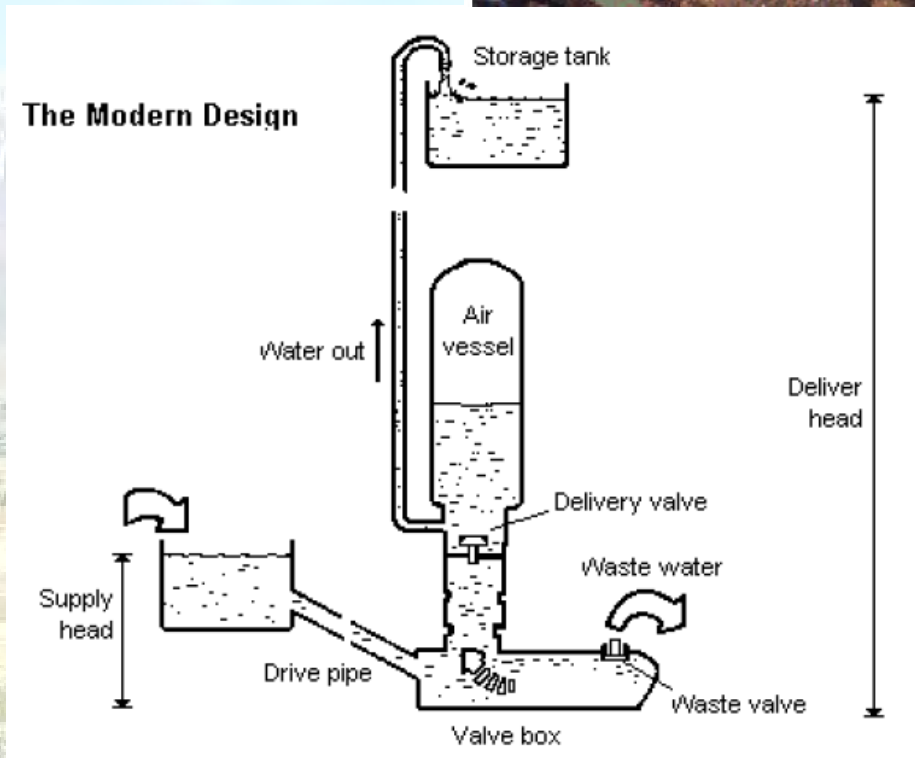
From specs of Bamford Hi-Ram Pump

The Bamford "Hi-Ram Pump ®"
Australian Patent No 741896

Maintenance of Ram Pumps

- Delivery pipes leak or get chewed by wild animals
- Reservoirs fill with sediment
- Impulse valves plug and wear
- Check valves & seals wear
- Accumulators and other metal components rust
- Vandalism





Test Time

- ***What is wrong in this picture of a pump?***

It does not appear that the area around the well is protected

Test Time

- ***What issues can you see with this well?***

Hint: This is a 115 ft deep hand dug well

Safety Issues
Contamination Issues

Test Time

- ***What is wrong in this picture of the side of a pond?***

Hint: what is growing here?

No riparian vegetation or wetland plants to filter the water that is flowing into the pond.

Test Time

- ***How could this water supply channel from a stream diversion be improved to reduce loss of water***

The diversion channel could be lined.

Example Calculation

- Given 15 pair of cattle
- Assume: Average use 20 gallons/day/pair
- Will a 5 gpm pump run 1.5 hours per day be sufficient?

Note: cows water once in morning and once in evening. We usually calculate for a 6 hr fill time maximum

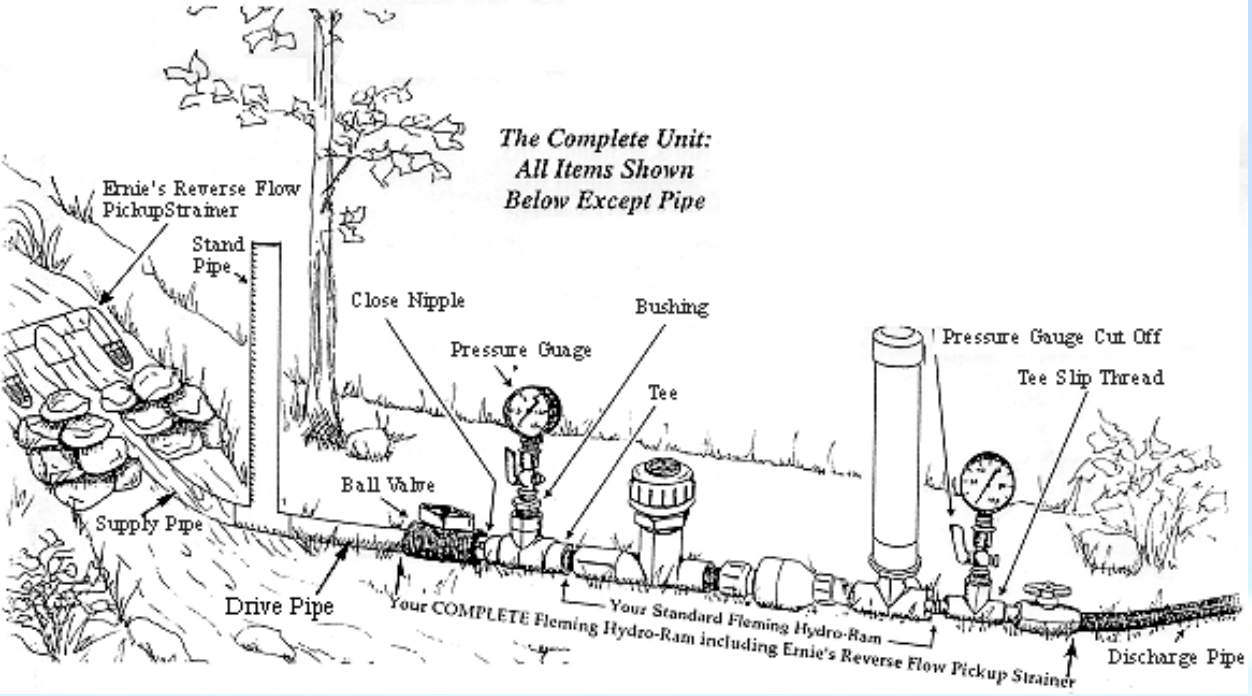
1. What is needed for cows:15 pair x 20 gallons/day/pair = 300 gallons per day
2. What is can be provided from the pump: 5 gpm x 1.5 hr x 60 min/hr = 450 gallons

…so the 5 gpm pump is sufficient

<u>Bonus Question 1:</u> How much land needed? (assume 25 acres per pair required)
25 x 15 =375 acres

<u>Bonus Question 2:</u> How many pairs of sheep (ewes with lambs) can be watered with this pump (assume 3 gallons per day per pair required)
5 x 1.5 x 60 / 3 = 150

1 gal = 3.78 liter
1 acre = 0.4 hectare



The End

Don’t wait until you are thirsty to dig the well. - *Chinese Proverb*