Spring-shed Development

What are "Springs"

- Points where water emerges out "*naturally*" from a rock or rock materials
- Natural points of "*Discharge*"
- Categorised as "*Groundwater*" or "*Underground water*"

TYPES OF SPRINGS

1. Depression Spring

Depression spring is a type of spring which formed at topographic lows. It formed when water table reaches the surface due to topographic undulations. A local flow system is created and a spring is formed at the local Discharge zone.

2. Contact Spring

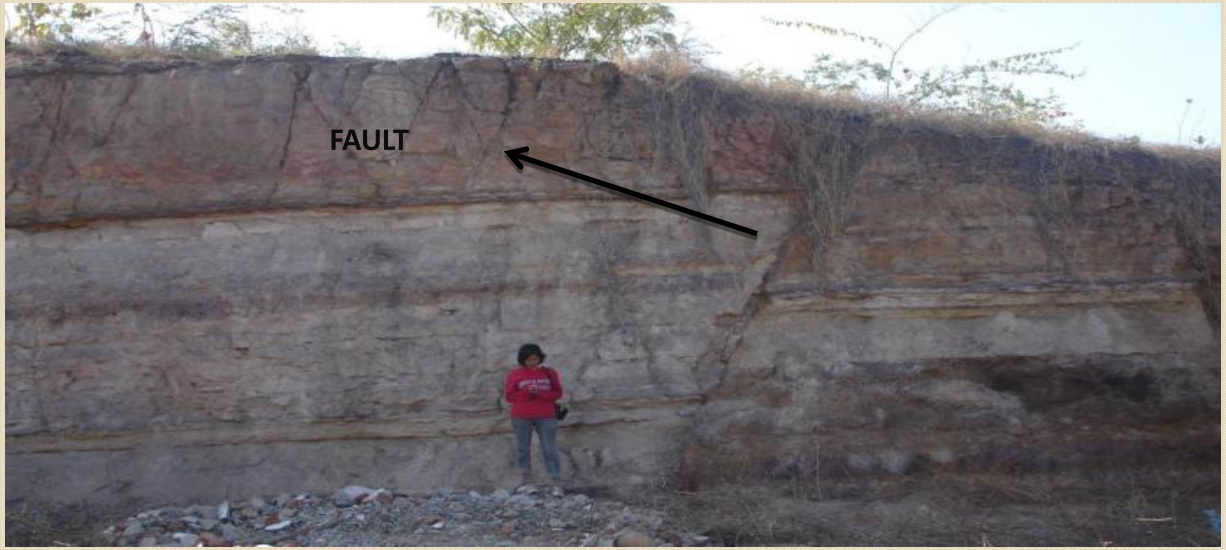
Contact spring is a type of spring which formed at places where relatively permeable rocks overlie rocks of low permeability. A lithological contact is usually marked by a line of springs. Such springs are usually associated with perched aquifers in mountains

3. Fracture spring

- *Fracture spring is a type of spring which occurs due to existence of jointed or permeable fracture zones in low permeability rocks. The movement of groundwater in this type of spring is mainly through fractures that may tap shallow as well as deep aquifers. Springs are formed where these fractures intersect the land surface.*

4. Fault Spring

- *Fault spring is a type of spring that occurs through faulting which give rise to conditions favorable for spring formation as groundwater under hydrostatic pressure (such as in confined aquifers). An impermeable rock unit may be brought in contact with an unconfined aquifer due to faulting.*



5. Karst Spring

- *Springs which are found in limestone belt region are known as karst spring. Spring in limestone terrains can be interconnected to topographic depressions caused by sink holes – depressions in the ground surface cause due to the dissolving of limestone below. Large quantities of water move through the cavities, channels, conduits and other openings developed in limestone*

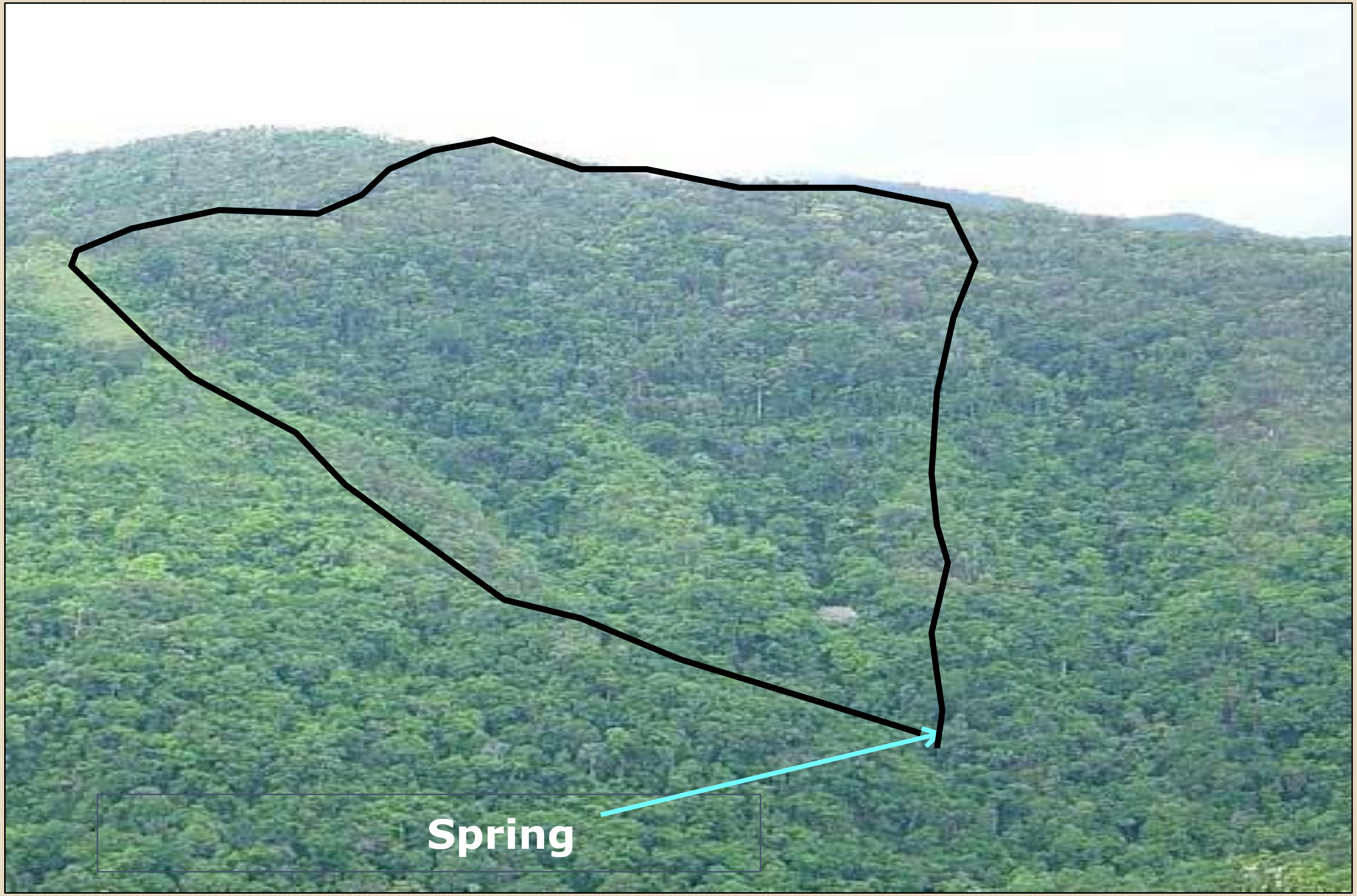
Springshed

An area within a ground or surface water basin that contributes to the spring flow.

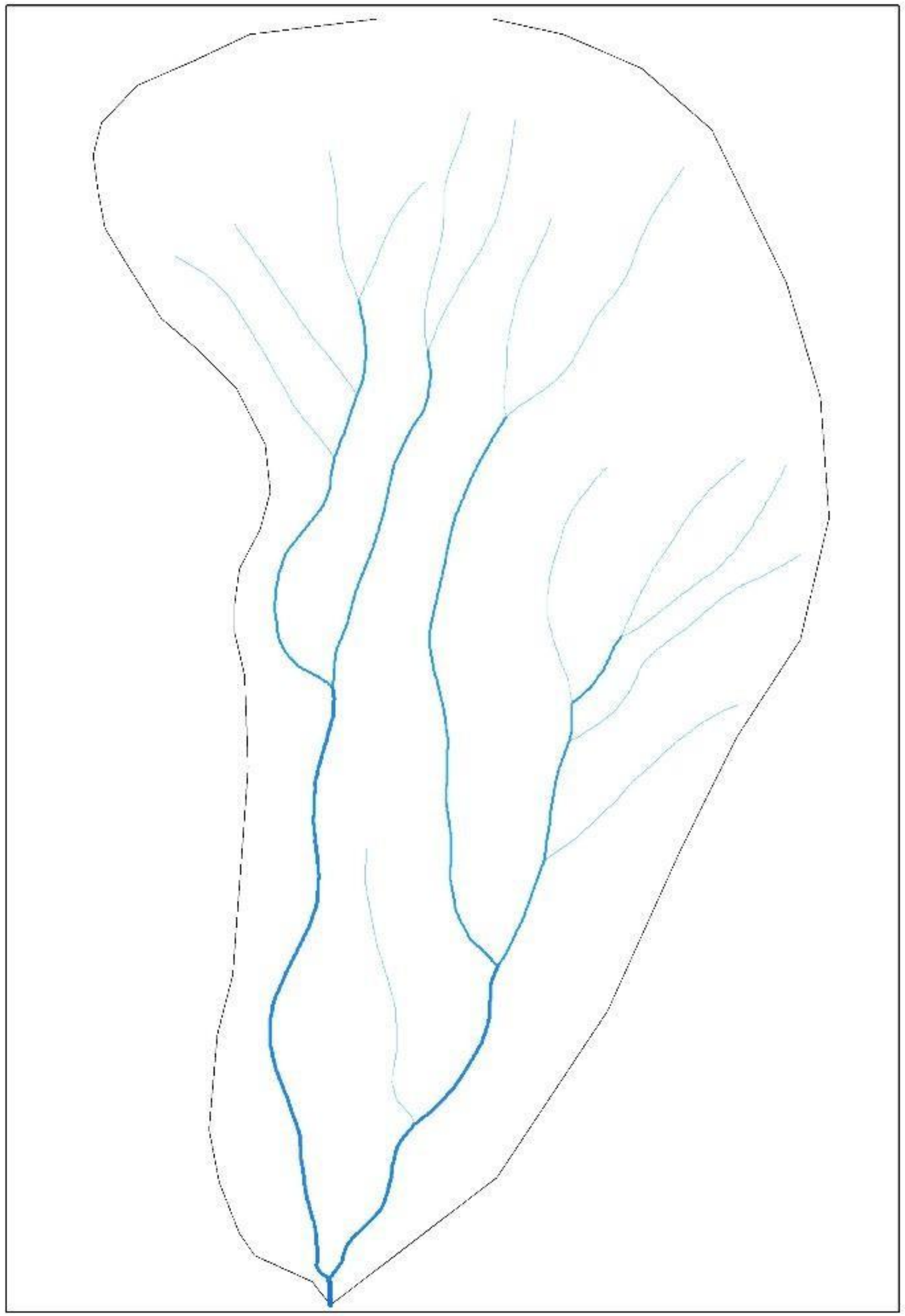
Objective:

To Revive springs that has dried up both in quantity and quality through spring-shed development works.

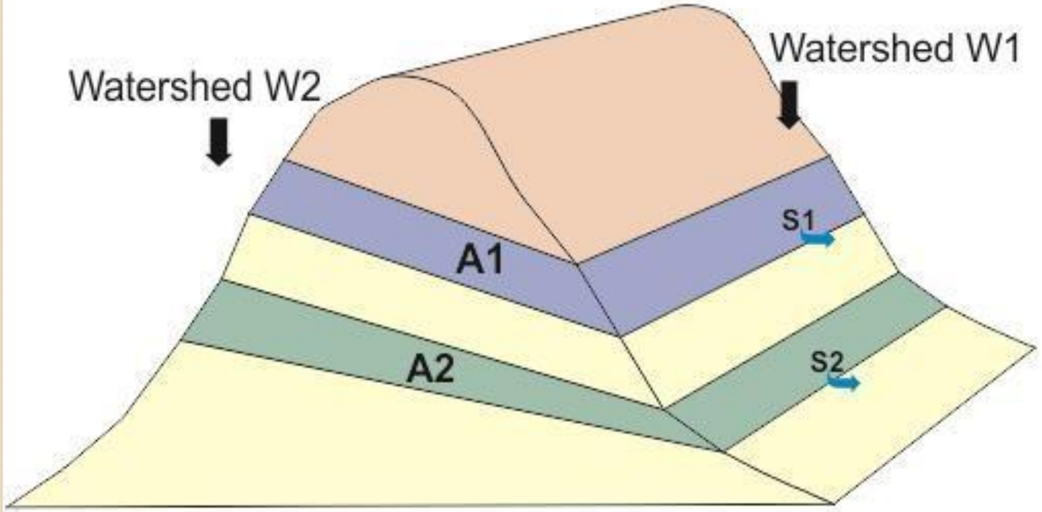
A SPRING IN A WATERSHED: CLASSICAL HYDROLOGY



A WATERSHED MAP



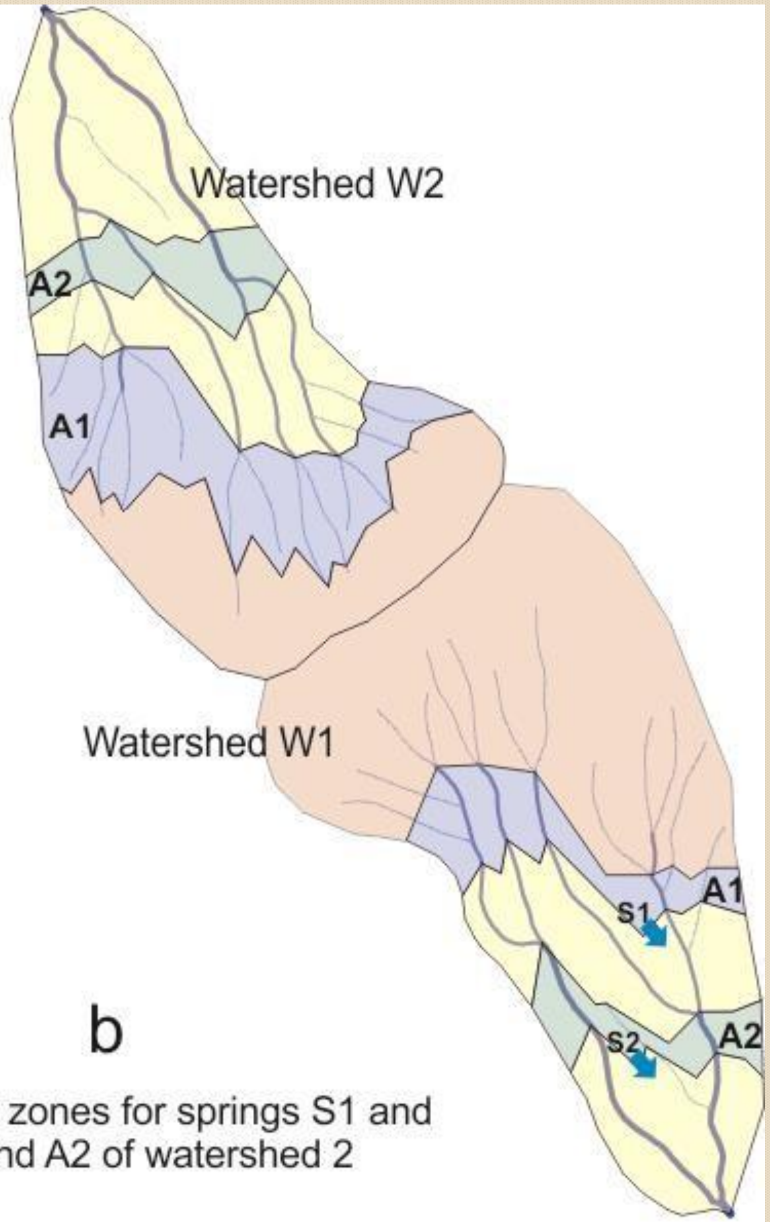
Mapping aquifers in the mountains…



a

A1 and A2 are two layers forming two distinct aquifers.

S1 and S2 are two springs emerging from the two aquifers A1 and A2 respectively.



b

The recharge zones for springs S1 and S2 lie in A1 and A2 of watershed 2 respectively.

METHODOLOGY IN SPRINGSHED WORK

Protocol for reviving springs in the Hindu Kush Himalaya: A Practitioner's Manual

(Jointly developed by ACWADAM and ICIMOD)

STEPS	SUB-STEPS
1. Comprehensive mapping of springs and springsheds	1.: Background information of identified area 2.: Reconnaissance survey through transect walk 1.3: Spring mapping and data collection 1.4: Delineation of springsheds
2. Setting up a data monitoring system	1.: Data Collection (*Why, Who, Where, What, How)* 2.: Data Storage and Management 3.: Data Analysis (Software development, app development) — Hydrograph/basic software 4.: Data sharing with community
3. Understanding Current Social and Governance systems of Spring	1.: Analysis of existing systems of management/institutional aspects of springs 2.: Tools - Questionnaire survey, Focused Group Discussions (FGDs), Key informant interviews (KIIs), and Communication and Dialogue with community and public policy makers
4A. Hydrogeological mapping	4A.1: Getting hold of a geological map of the area 4A.2: Transect walk observations on the geology - Measurements (Latitude, Longitude, Elevation, Spring Location, Geological observations and measurements: Dip and Strike, Lithology, Structural features of rocks) 4A.3: Use of Google Map for creating a Base Map (Through Google Earth/Toposheet)
4B. Creating a conceptual hydrogeological layout of springshed	4B.1: Create a geological map on the basis of transect walk (Excel converter Google map) 4B.2: Cross-sectional layout
4C. Classification of spring types, identifying mountain aquifer and recharge area	4C.1: Spring types 4C.2: Aquifer types 4C.3: Delineation of recharge area
5. Developing springshed management protocols	1.: Hydrogeological inventory for springsheds 2.: Negotiable and non-negotiable land use and land cover change 5.3: Institutional and governance mechanism 4.: Conservation and intervention (also include externalities), measures of recharge and discharge area (sanitation issues, chemical fertilizer utilization, mining, fecal contamination and other issues) 5.: Operation and maintenance guidelines (develop manual of Operation and Maintenance guideline)
6. Measuring hydrological and other impacts of spring revival activities	1. : Impact study 2. : Continuous monitoring

A DOWN-TO-EARTH APPROACH TO SPRINGSHED MANAGEMENT

- Training / Capacity building
- Field Facilitation
- Hand-holding
- Action-Research
- Convergence
- Policy advocacy

Geological Characteristic of Rocks !

Springshed development works

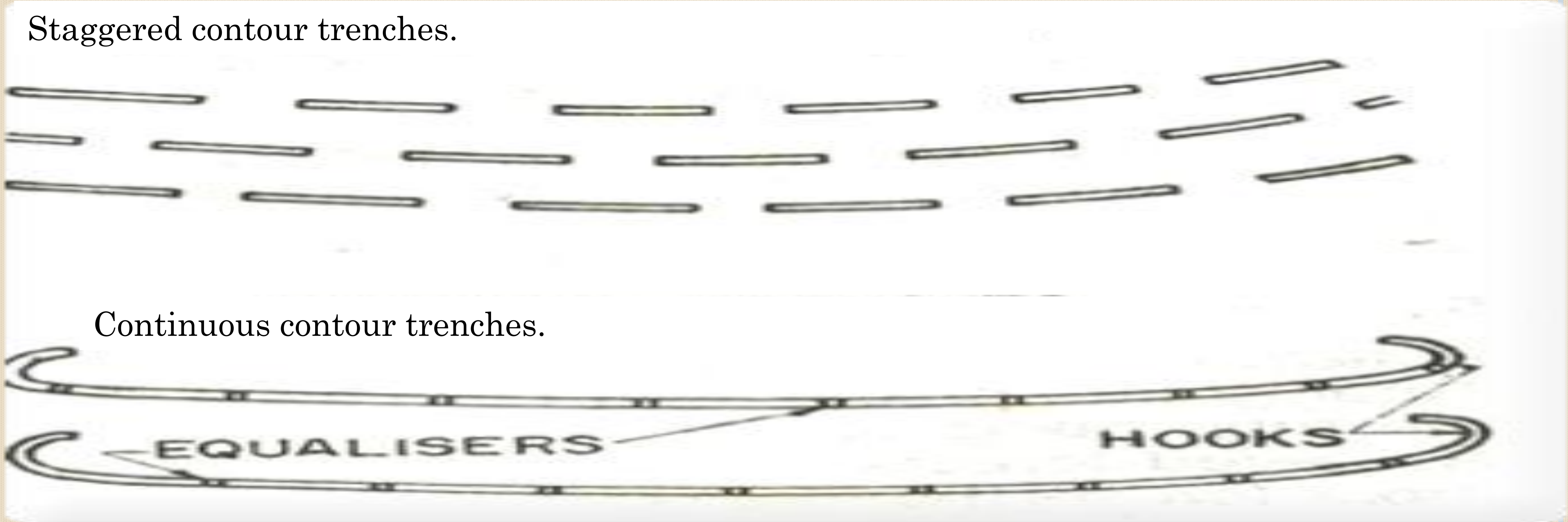
- Recharge Pits or Trenches(Contour Trenches)
- Dug Out Ponds,
- Check Dams,
- Impounded Ponds,
- Contour Bunds and
- Afforestation with fruit or forest trees
- Spring Chamber/ spring box

Contour Trenches

- Contour Trenches across the slope along contours retain water and sediments transported by water down-slope generally constructed with light equipment.
- **Objective:** Contour trenches are used to break up the slope length, to slow runoff and allow infiltration, and to trap sediments.

TYPES OF TRENCHES:

- Continuous contour trenches.
- Staggered contour trenches.

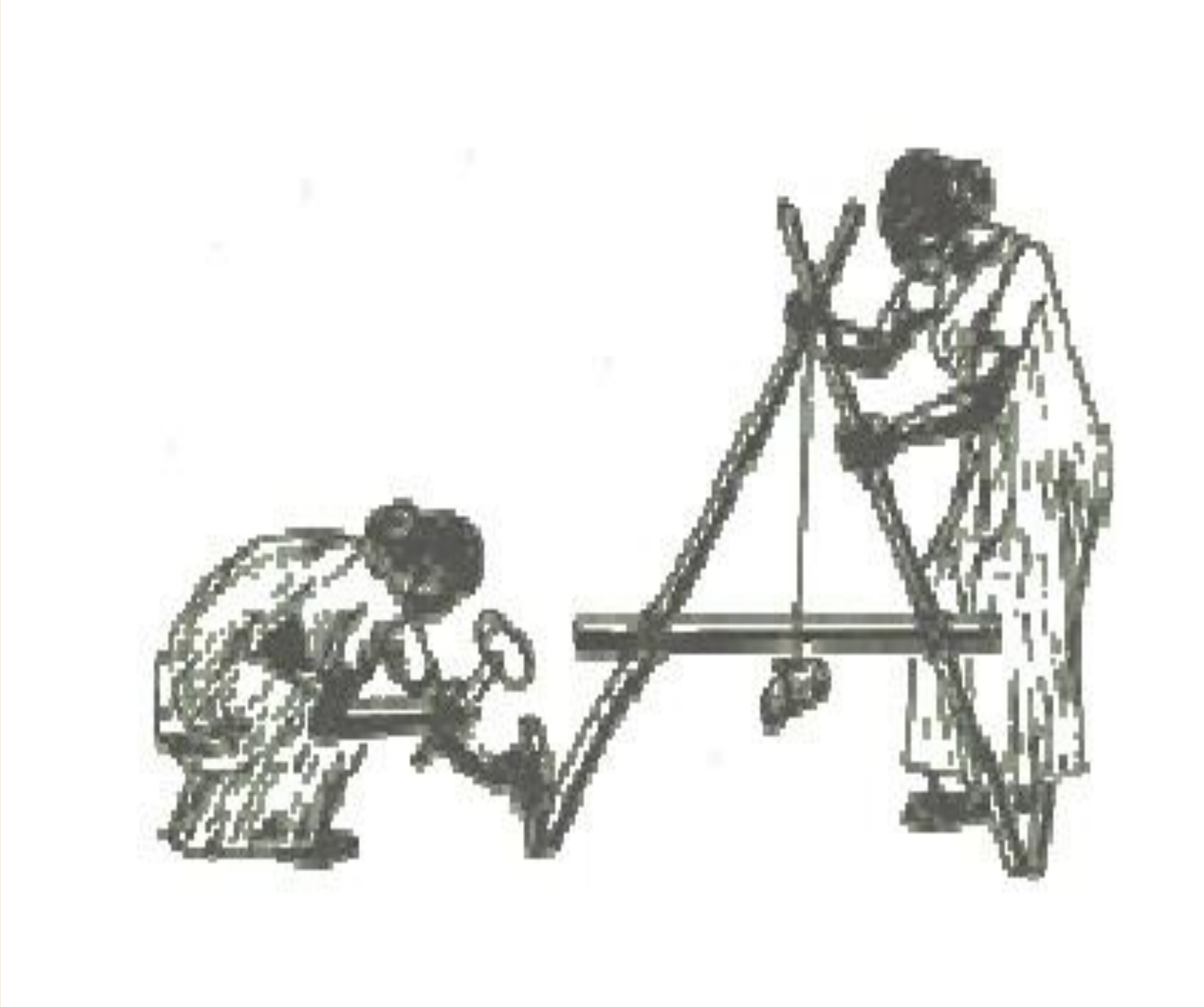


WHERE?

- Continuos Contour Trenches(CCT) are made in areas where there is no Agriculture for eg in hilltops or in forest areas.
- Staggered Contour Trenches(SCT) are made in agriculture areas or mid slopes of hills.
- **Spacings:** 3m to 6m on steeper slope and 8m to 15m on gentle slope lands
- **Size:** For CCT the length is as per site but width is 30-45 cm and depth also between 30-45 cm
- **Size:** For SCT the length is 1.2-1.5m;width is 30-45cm and depth 30-45cm
- **Cost:** For Continuos Contour Trench it is Rs.70/-per running metre.
- **Cost :** For Staggered Contour Trench it is Rs.100/-Per Trench.

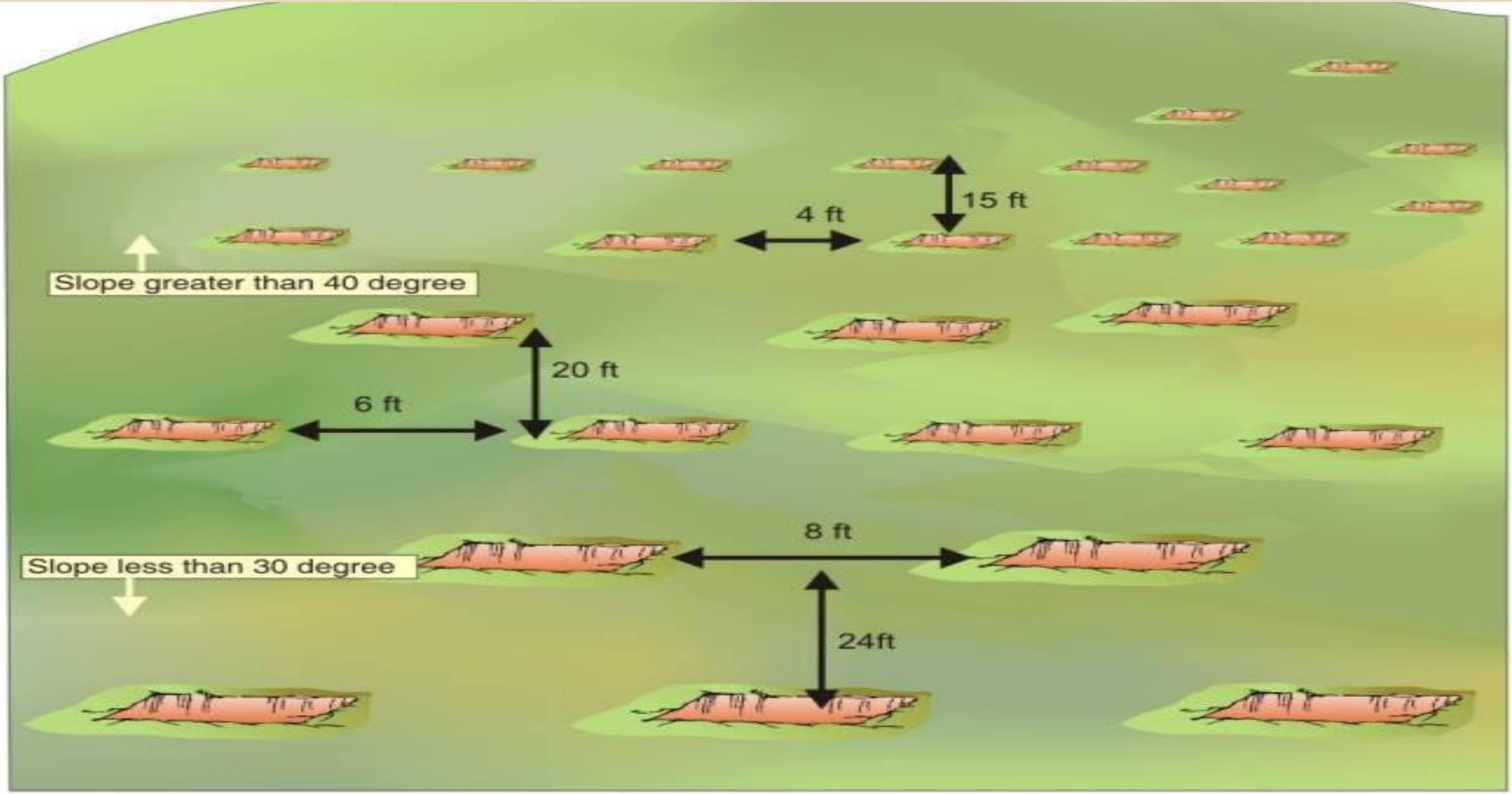
The A-Frame for alignment of points of equal elevations on the ground

- Hold one pole firmly on the ground.
- Move the other pole until both poles are on the ground with the string touching the level mark.
- Place a stick into the soil by each pole.
- Move the A-frame along, by turning it around (pivoting), keeping pole 1 in exactly the same into the ground by pole 2.
- Carry on in this way, pivoting the A-Frame across the field.






Continuous Contour Trenches



Staggered Contour trenches

Staggered Contour trenches

Dugout or Excavated Pond

WHY?

It is for used for trapping and storing rain water for recharging the ground water.

WHERE?

It is constructed in the upper catchment of the watershed, along the nala or shallow gully.

The site for the pond should be where there is a depression.

HOW?

By digging and the loose earth as embankment around the pond area

Dugout or Excavated Pond

SHAPE?

It can be Square, Rectangular or Circular depending upon the site conditions

SIZE ?

It ranges from 5mx5mx1.2m to 10mx10mx1.2m for Square shaped pond

It ranges from 10mx5mx1.2m to 20mx10mx1.2m for Rectangular shaped pond

COSTS ?

Rate Per Cubic metre is Rs. **108/-**

Check Dams

WHY ?

- To slow down the flow of rain water along nalas or natural drainage lines and facilitate infiltration and silts traps.

WHERE?

- They are made across natural drainage line or nala

HOW?

By using timber or bamboo pole or loose boulders and in case the slope is more by Gabion(G.I Wire mesh and stones)

Check Dams

SHAPES

- Trapezoidal shape is generally recommended but rectangular shape are also preferred

SIZE?

- Normally for Trapezoidal shape, it is 0.5 to 1.0 m top width;1.5 to 2.0m bottom width and 1.0 to 1.5 m depth/height

COSTS?

Timber/Bamboo pole Checks @ Rs.1200/-per Rm

Loose Boulders Checks @ Rs.1900/-per Cu.m

Gabion Checks @ Rs.3850/- per cu.m

Gabion Check Dam

This is a dam made of stones and bounded by galvanised iron sausage wire nets across a gully line.

Objective: To collect or slow down the velocity of run-off water.

Suitability : Gabion Check Dams are commonly used in high slope areas.

Procedure:

- A foundation base is excavated to facilitate positioning of the Sausage wire
- A rectangular wire mesh of 8-10 gauge is laid and packed with boulders weighing not less than 25 kg and tied over to prevent movement of stones


3:34

Loose Boulder Check Dam

This is a small barrier constructed of rock, gravel bags, sandbags, fibre rolls, or reusable products, placed across a constructed swale or drainage ditch or nala.

Objective: To reduce the slope of the channel, thereby reducing the velocity of flowing water, allowing sediment to settle and provide groundwater recharge.

Suitability: Loose Boulders Check Dams are commonly used in mild slope areas.

Procedure:

- A foundation base is excavated to facilitate positioning of the Stones
- A rectangular/Trapezoidal shaped structure is laid and packed with boulders weighing not less than 25 kg.

Loose Boulder Check Dam

Bunds

This techniques is used in agriculture lands to collect surface run-off, increase water infiltration and prevent soil erosion.

Objective: By building bunds along the contour lines, water runoff is slowed down, which leads to increased water infiltration and enhanced soil moisture.

Types of Bunds:

- **Peripheral Bund**
- **Earthen Contour Bund**
- **Loose Boulder Bund**

Cost of bunds:

Peripheral bunds	= Rs 110 per running meter.
Earthen contour Bunds	= Rs. 120 per running meter
Loose Boulder Bund	= Rs. 740 per running meter

Peripheral Bund

- Bunds constructed along field boundaries without reference to contour.
- **Objective:** They serve as fences, and give protection from water and wind erosion in low rainfall areas. They are not suitable in heavy rainfall areas but can be reinforced by vegetative coverage.
- **Suitability:** In gentle sloping lands only
- **Size:** Top width is 0.6m;Bottom width is 1.6m and height is 1.0m
- **Shape:** Trapezoidal

Earthen Contour Bund

- Earthen embankments across the slope of the land, following the contour as closely as possible.
- **Objective:** acts as barriers to the flow of water, thus reducing the amount and velocity of the runoff and helps in moisture conservation
- **Suitability:** In gentle sloping lands only
- **Spacings:**12m to 15m between two contour line
- **Alignment :** Using A-framed level
- **Size:** Top width is 0.6m;Bottom width is 1.6m and height is 1.0m
- **Shape:** Trapezoidal

Loose Boulder Bund

- Loose Boulder Bunds across the slope of the land, following the contour as closely as possible.
- **Objective:** acts as barriers to the flow of water, thus reducing the amount and velocity of the runoff and helps in moisture conservation
- **Suitability:** In steep sloping lands only
- **Spacings:**3m to 5m between two contour lines
- **Alignment:** Using A-framed level
- **Size:** Top width is 0.6m;Bottom width is 1.6m and height is 1.0m
- **Shape:** Trapezoidal

Loose Boulder Bund

IMPOUNDED PONDS

A raised structure built of impervious material usually with earth, clay, cement concrete, etc to make an embankment dam to impound water.

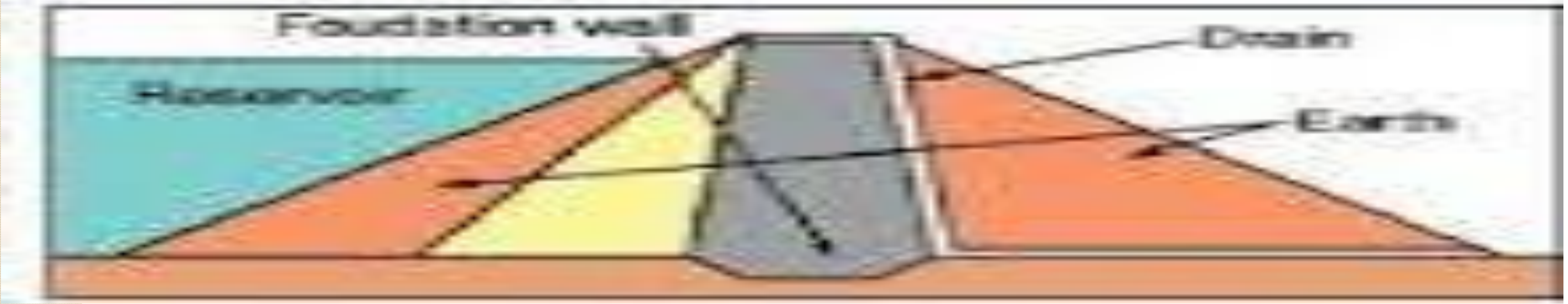
Objective: To store water

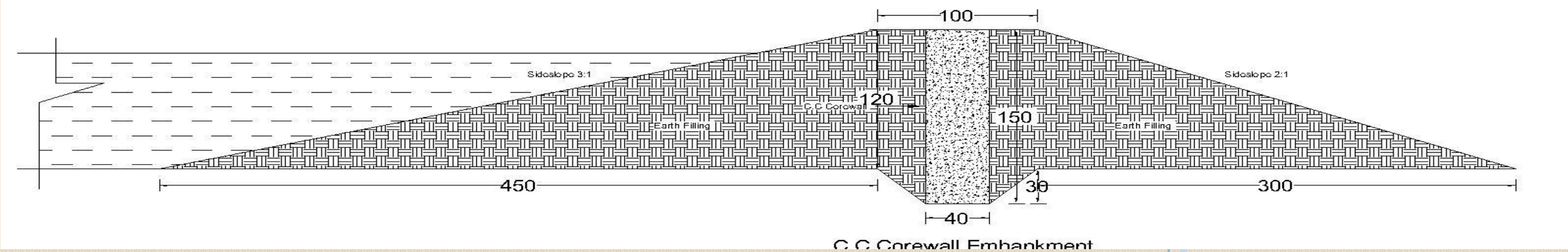
Where: In natural depression areas

How: By making an Embankment made of earth or a combination of clay and stones; a combination of earth and cement concrete etc

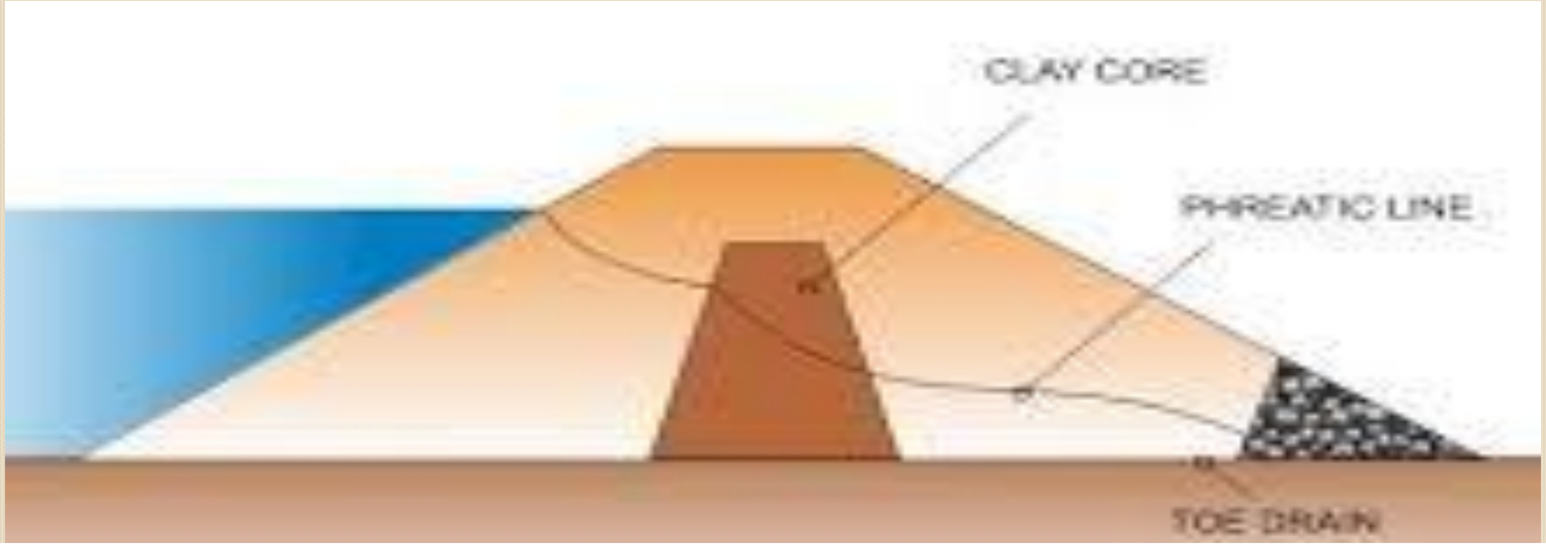
Procedure:

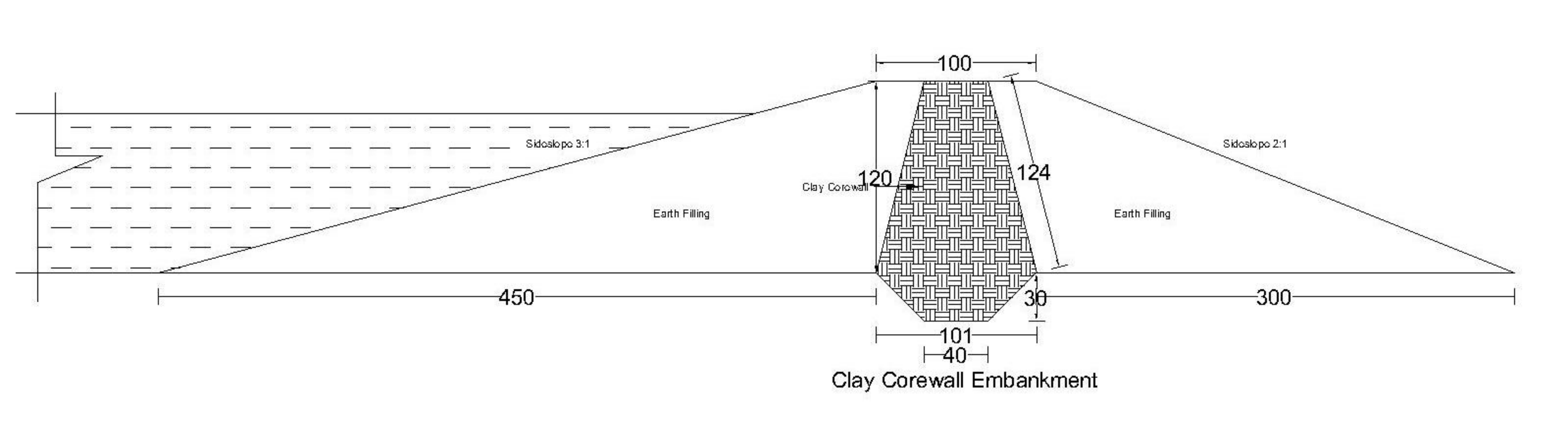
- Earthwork is excavated as per site measurement
- Shuttering for the structure is done before casting.
- Plain cement concrete with coarse aggregate is provided in required thickness and depth of wall
- Earth is filled in between the faces of impervious wall
- **Cost:** As per Estimates



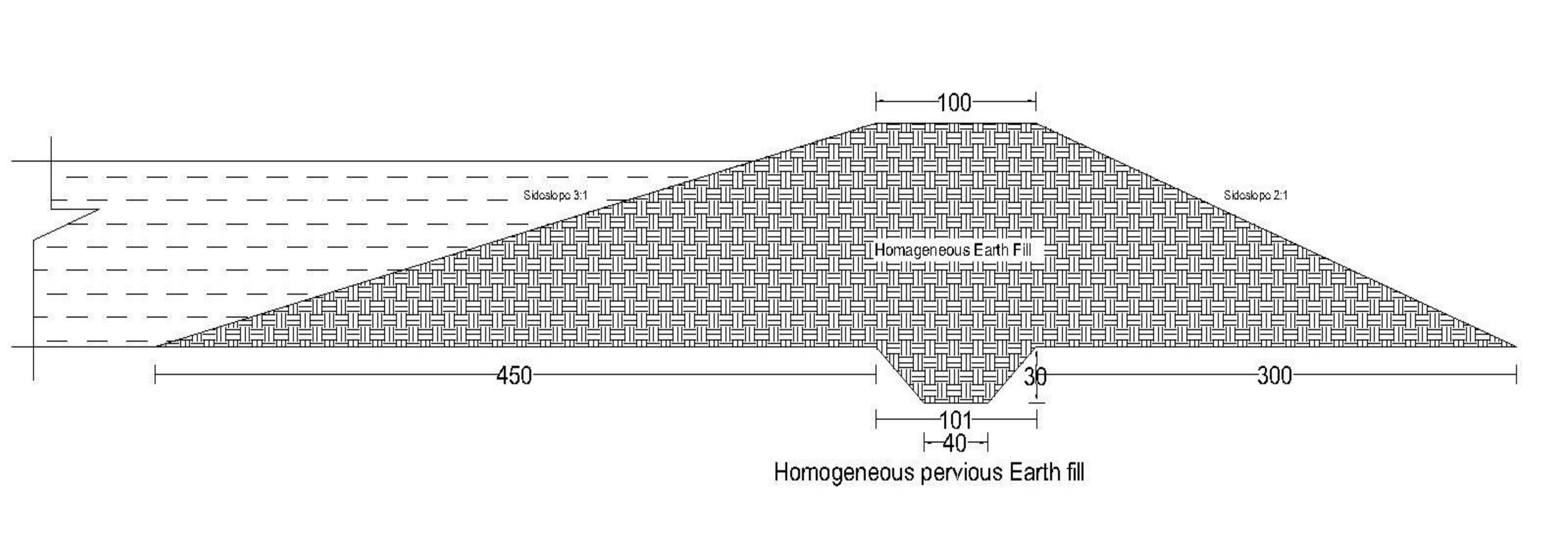


Impounded Pond by Earth and Cement Core Wall

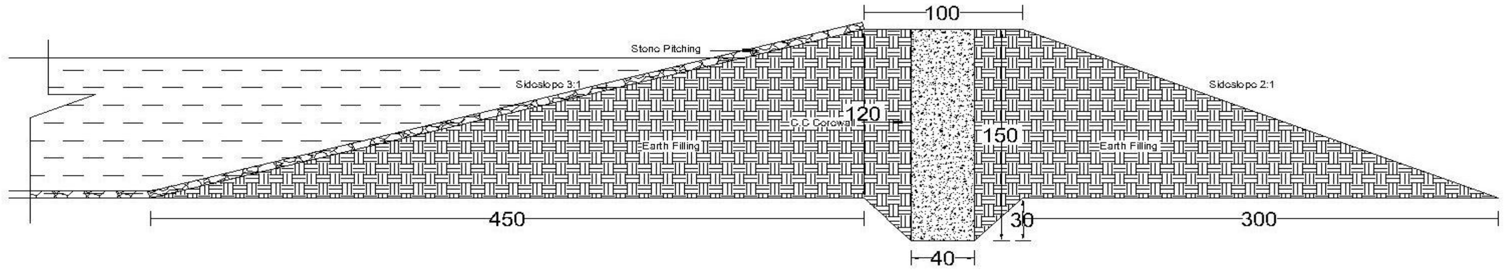




Impounded Ponds by Earth and Clay core Wall



Impounded Ponds by Homogeneous Earth

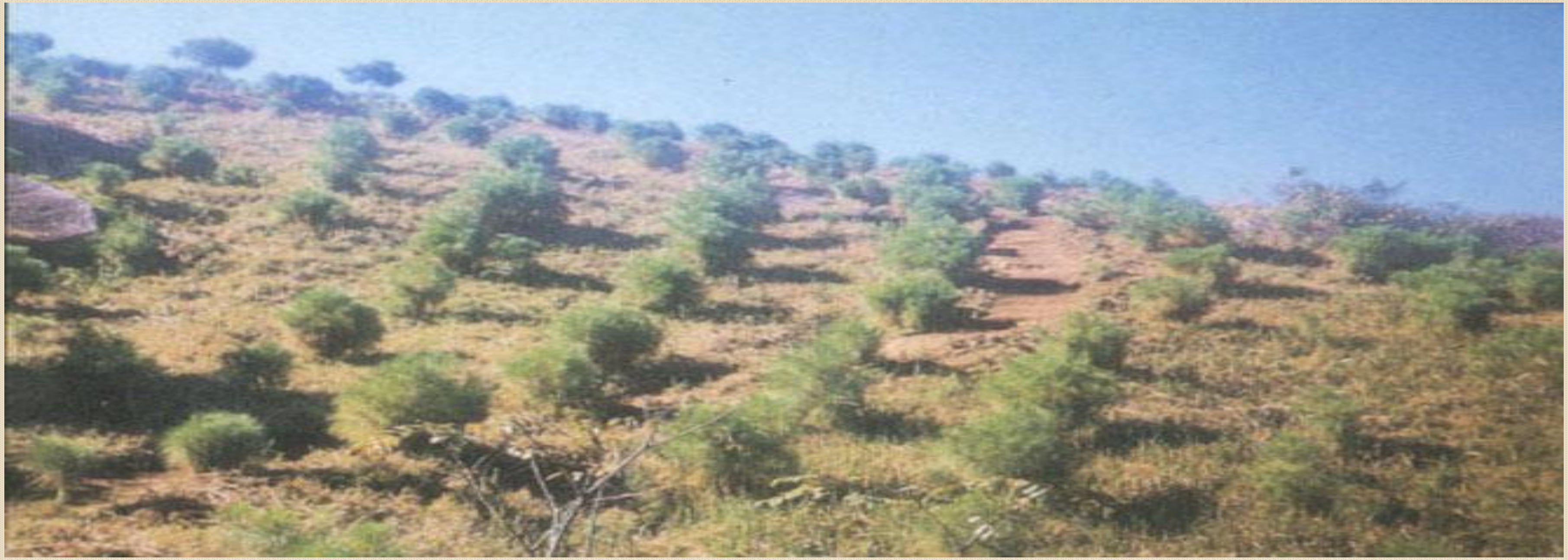


C.C Corewall with Lining

Impounded Ponds by C.C lined facewall

Afforestation

- Process of planting trees, or sowing seeds, in a barren land devoid of any trees to create a forest.
- **Objective:** To provide cover to the ground thereby helps in water retention of the soil and underground water recharge.
- **Where to Plant:** In all catchment areas of springs and streams
- **What to plant:** Local indigenous fruit/tree species that are good for water conservation
- **How to plant:** By collecting seedlings from nearby Village Reserve Forests or by procuring from local Nursery
- **When to plant**: Mid May to Mid August
- **Spacings:** From 2.5mx2.5m to 3mx4m depending upon the type of tree species



Spring Chamber/Spring Box

- A spring box is a structure engineered to allow groundwater to be obtained from a natural spring.
- **Purpose:** To protect the spring water from contamination, normally by surface runoff or contact with human and animals. The area surrounding the spring box should be fenced off in order to reduce the risk of contamination from animal faeces. An overflow pipe should be installed into the spring box, and it should also have a well fitting lid.

Springs Discharge measurement:
Case 1: Spring flowing out from an outlet:

- Take a vessel of Known Volume
- Record the time taken to fill the vessel
- Discharge = Volume / Time (record in Litres/min

Case 2: Spring oozing from the ground and collects in a pool of water:

- Using a stick, measure the level of water and make a marking.
- Take a vessel of Known Volume, draw water from the pool/pond and record the time.
- Record the time taken for the water to rise to the initial level marked.
- Discharge = Volume Emptied/ Time (record in litres/min)




Water Quality Testing using water tracers: Parameters to be measured are temperature, pH, TDS, EC, salinity, etc.

- Dip the tracer into the water covering about 2 inches of the tracer and then switch on the tracer.
- The pH value and temperature will appear on the screen.
- Record the temperature value first and then wait till the pH value is stable and then record it.
- Press the menu button to change to another parameter, Electrical conductivity (EC), wait till the value is stable and then record it.
- Press the menu button to change to another parameter, Total Dissolve Solids (TDS), wait till the value is stable and then record it.
- Press the menu button to change to another parameter, Salinity, wait till the value is stable and then record it.

Thank you