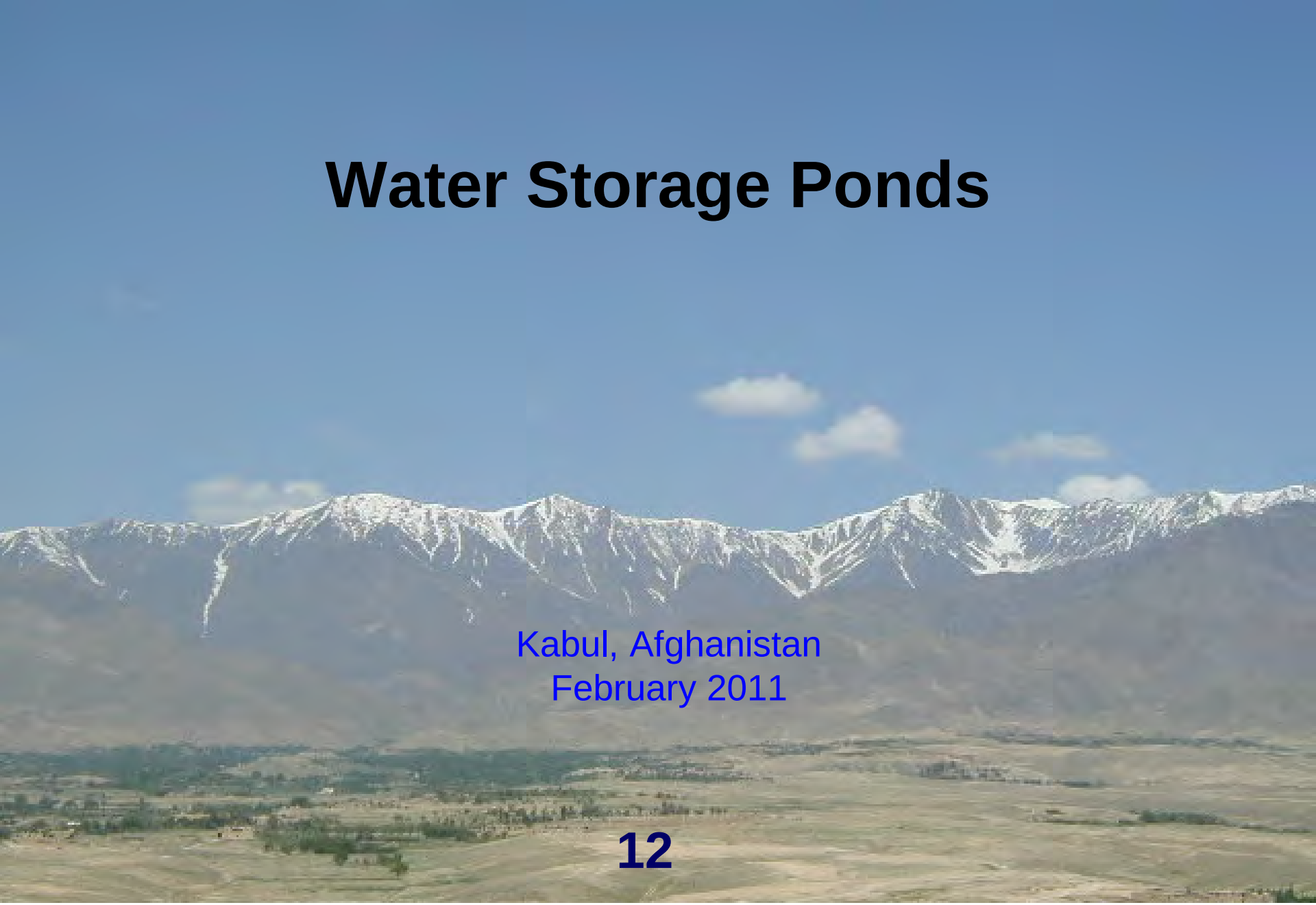
Water Storage Ponds



Kabul, Afghanistan
February 2011

12

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), Rich Weber (Civil Engineer – USDA/NRCS) 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 of Ponds
- Types of Ponds
- Pond Design Issues
- Field Exercise

Purpose of Ponds

- Provide Source of Drinking Water for Livestock
  - Improves Grazing Distribution
  - Increases Health of Grass
  - Increases Animal Production
  - Grass Health Increases
    - Infiltration of Rainfall and Snowmelt
    - Soil Health
  - Grass Health Decreases
    - Erosion and Sediment Depostion
    - Downstream Peak Discharges in Streams

Three Types of Ponds

- Embankment Ponds
- Pit Ponds – Surface Runoff
- Pit Ponds – Groundwater Source

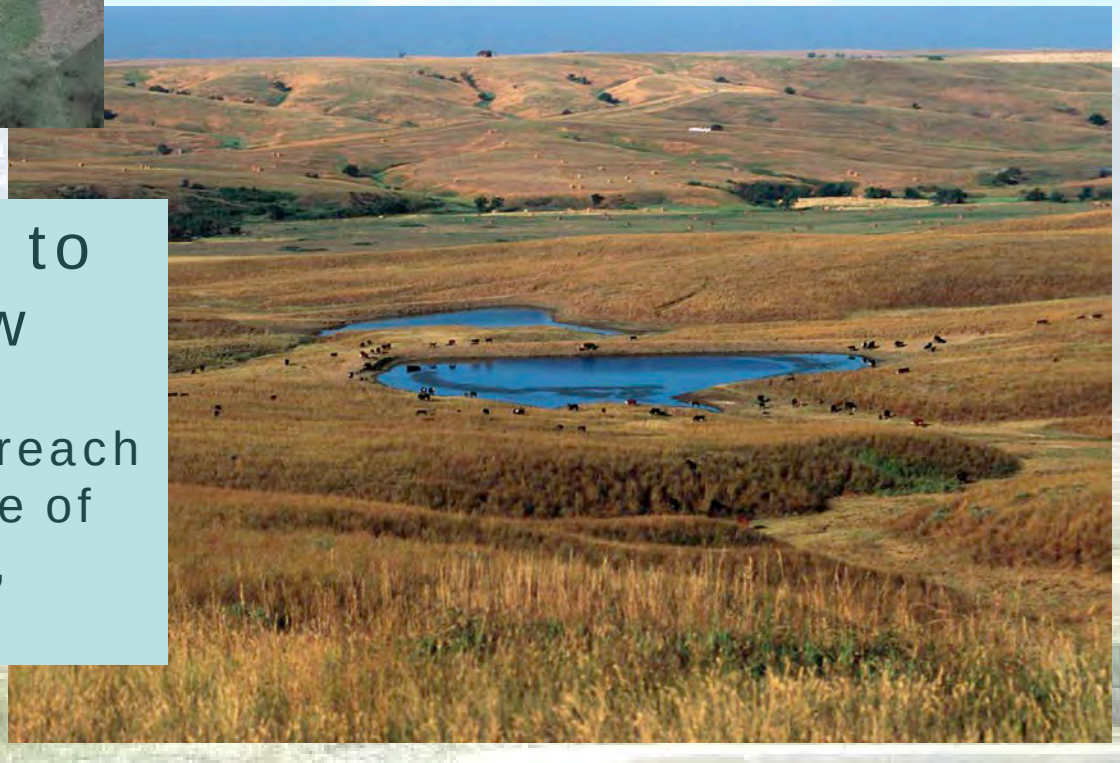
Pit Ponds

- Pond is Excavated
- Excavation is Placed as “Spoil”

- Water Comes From –
  - Surface Runoff
  - Bottom of Pond is Below Groundwater Table

Embankment Ponds

Installed on Streams to Capture Surface Flow



Installed on Streams to Capture Surface Flow

- Subject to Failure
- Risk Downstream Due to Breach
- Design Requires Knowledge of Watershed Hydrology, Soils, Drainage Area, etc.

Considerations:

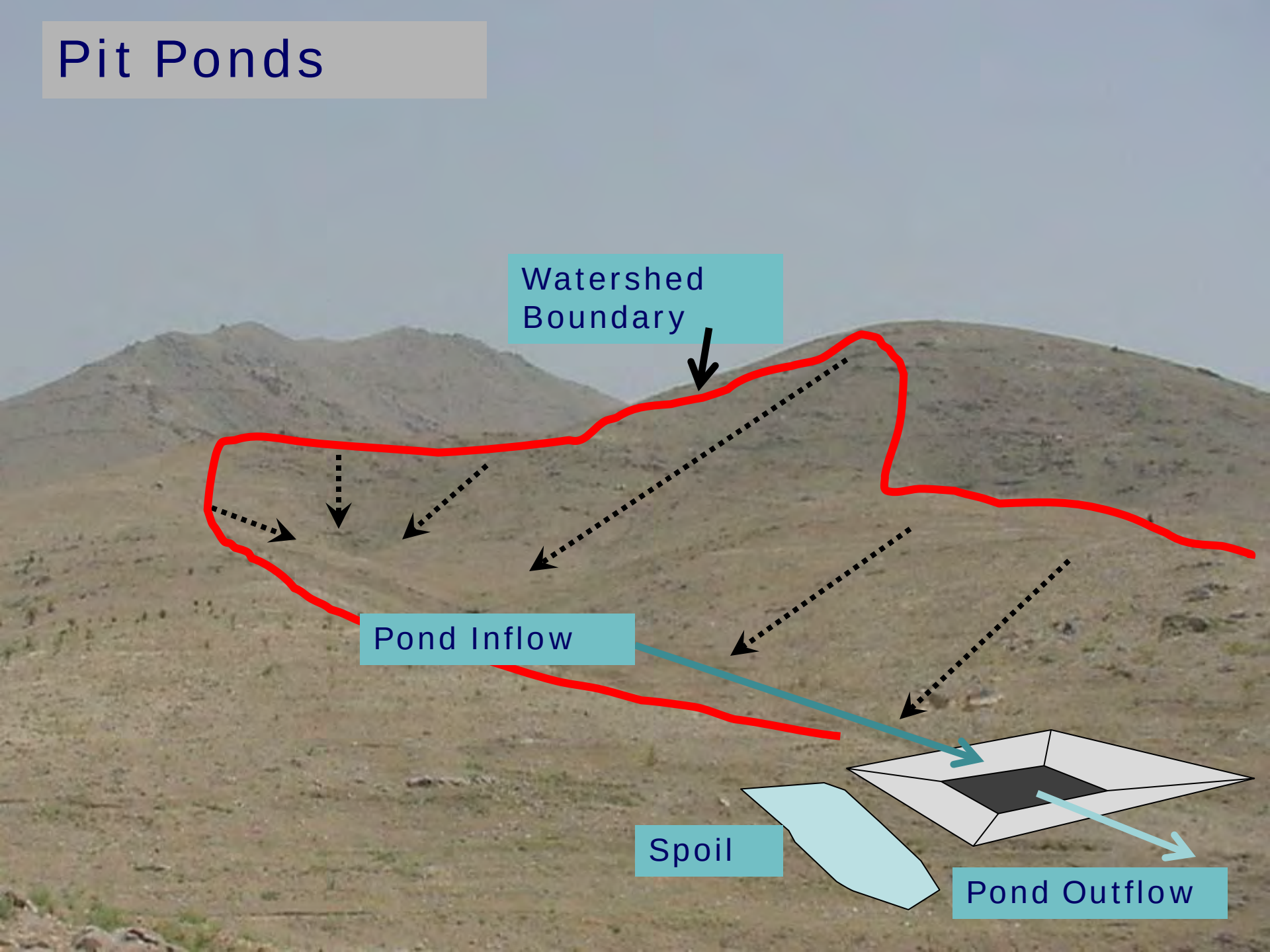
- Embankment Ponds are Complex
- Embankment Ponds Require Maintenance
- Embankment Ponds can Fail

- Pit Ponds are Simple
- Pit Ponds Only Fail by Silting up
- Pit Ponds Cannot Create a Downstream Hazard

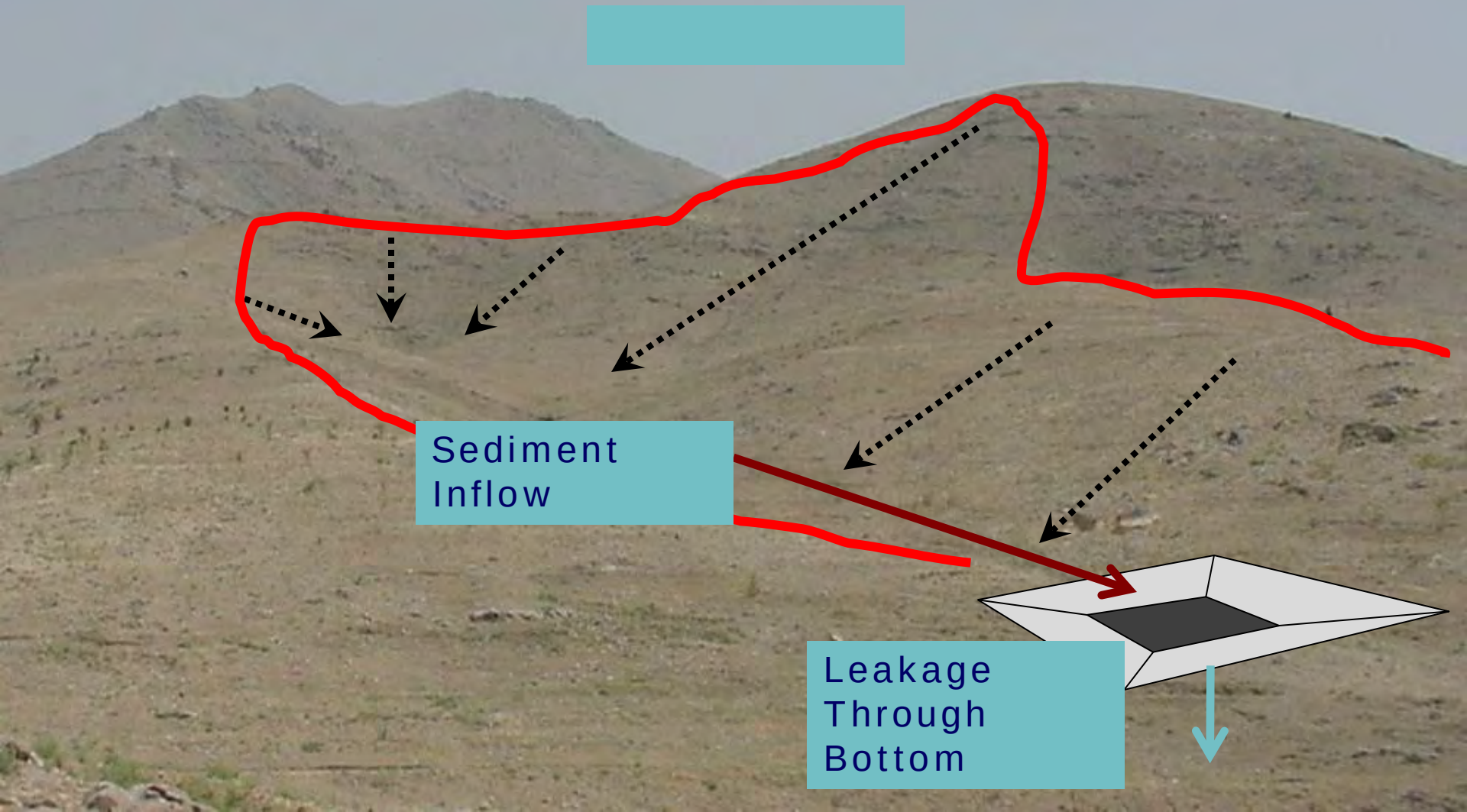
- ALL Ponds are for supplying LIVESTOCK water
- Should not be relied to supply safe drinking Water for human consumption

Pit Ponds

Pit Ponds

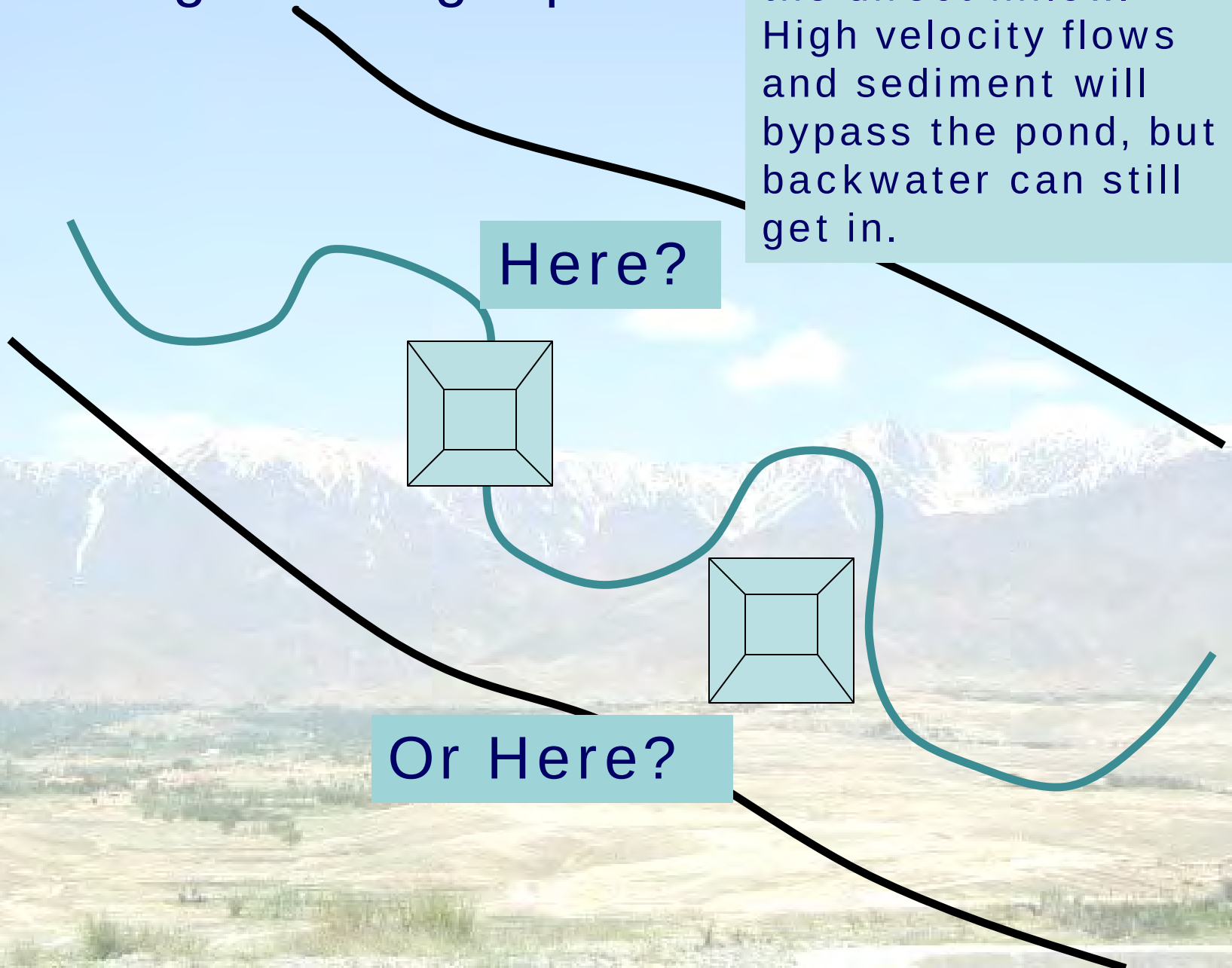


What Can Possibly Go Wrong With This?



Avoiding “Silting Up”

Site pond adjacent to the direct inflow. High velocity flows and sediment will bypass the pond, but backwater can still get in.



Preventing Leakage

Soil Investigation

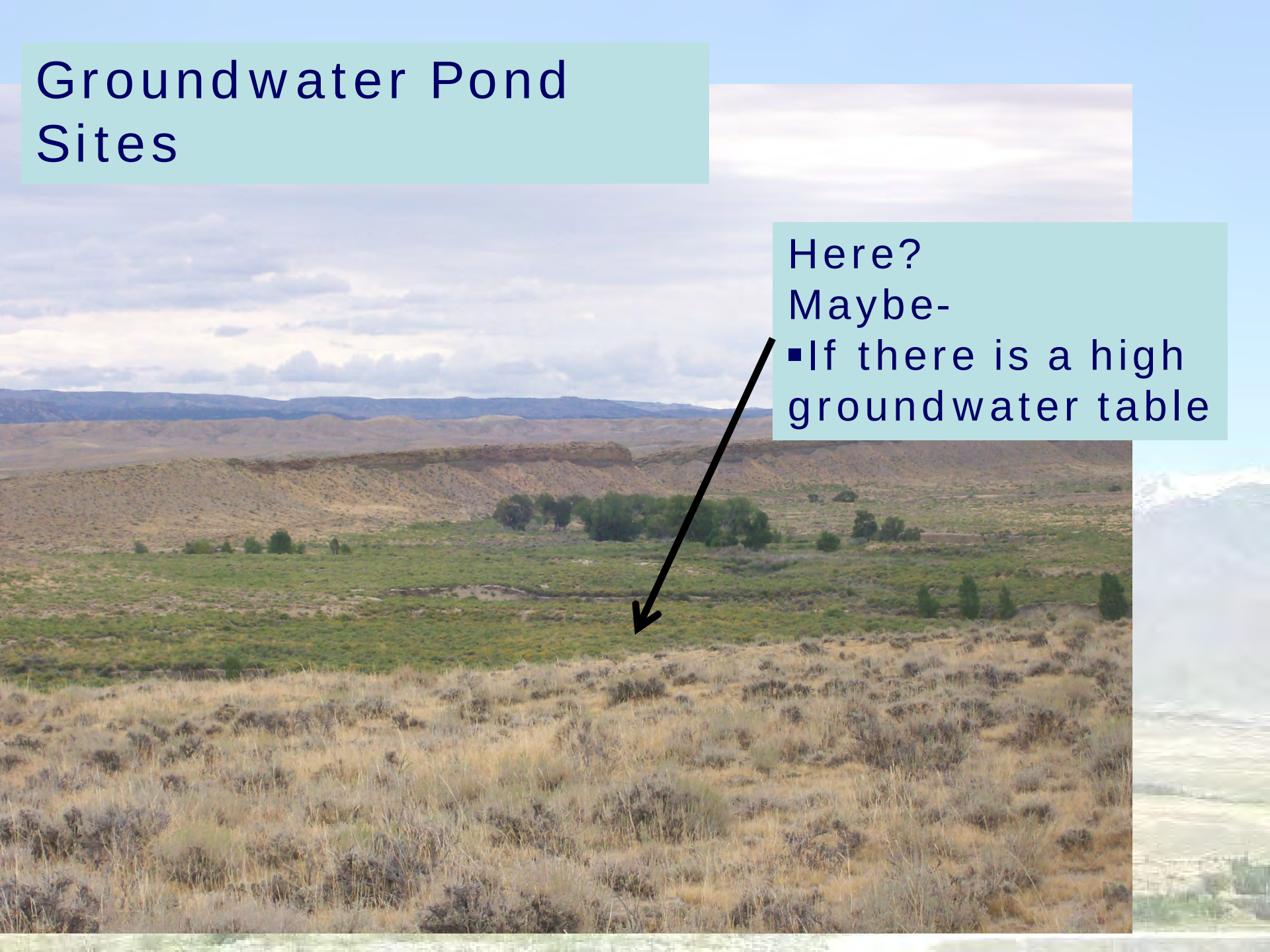
- Clays will hold water
- Sands and Gravels Will Leak

Groundwater Ponds

- Leakage is not an issue
- We want groundwater to “leak” in
- Look for Floodplain Sites in the Transition Zone
- Look for wet sites on the Collection Zone
- Look for High Groundwater Table
- Usually Associated with Sandy, Gravelly Soils
- Site Pond Well Away From Direct Stream Flow

Groundwater Pond Sites

Groundwater Pond Sites



Here?
Maybe-

- If there is a high groundwater table

Groundwater Pond Sites

Why put a pond here?

Pit Pond Sites

Soil Types

Surface Runoff Pond
- Clays and Silts

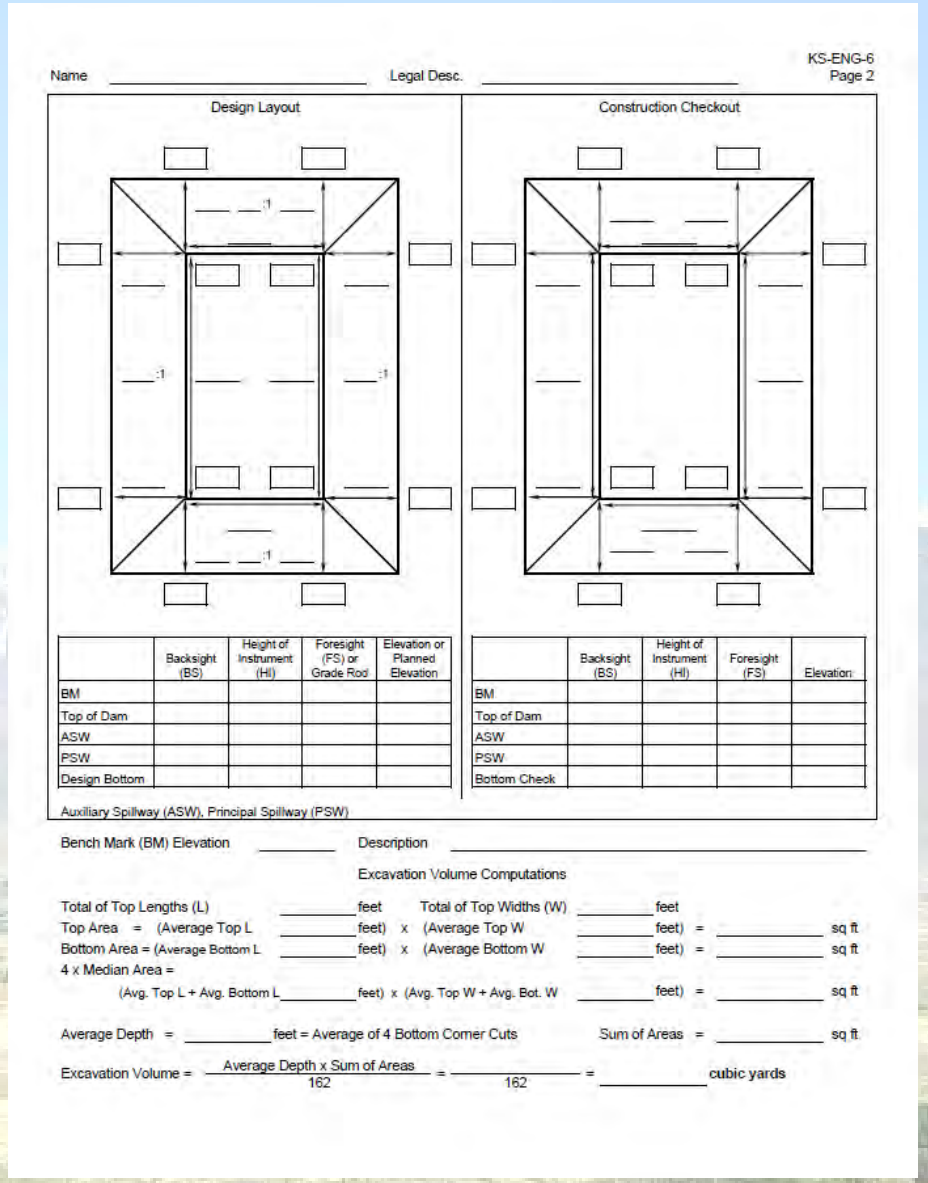
Groundwater Pond
- Sands and Gravels

Pit Pond Design, Layout, and Construction

Handy forms are available

We need to make decisions about –

- How long
- How wide
- How deep
- How much earth to move



KS-ENG-6
Page 2

Name _____ Legal Desc. _____

Design Layout

	Backsight (BS)	Height of Instrument (HI)	Foresight (FS) or Grade Rod	Elevation or Planned Elevation
BM				
Top of Dam				
ASW				
PSW				
Design Bottom				

Construction Checkout

	Backsight (BS)	Height of Instrument (HI)	Foresight (FS)	Elevation
BM				
Top of Dam				
ASW				
PSW				
Bottom Check				

Auxiliary Spillway (ASW), Principal Spillway (PSW)

Bench Mark (BM) Elevation _____ Description _____

Excavation Volume Computations

Total of Top Lengths (L) _____ feet Total of Top Widths (W) _____ feet

Top Area = (Average Top L _____ feet) x (Average Top W _____ feet) = _____ sq ft

Bottom Area = (Average Bottom L _____ feet) x (Average Bottom W _____ feet) = _____ sq ft

4 x Median Area =

(Avg. Top L + Avg. Bottom L _____ feet) x (Avg. Top W + Avg. Bot. W _____ feet) = _____ sq ft

Average Depth = _____ feet = Average of 4 Bottom Corner Cuts Sum of Areas = _____ sq ft

$$\text{Excavation Volume} = \frac{\text{Average Depth} \times \text{Sum of Areas}}{162} = \frac{\qquad}{162} = \text{\_\_\_\_\_ cubic yards}$$

Fillable Form first page

USDA
NRCS

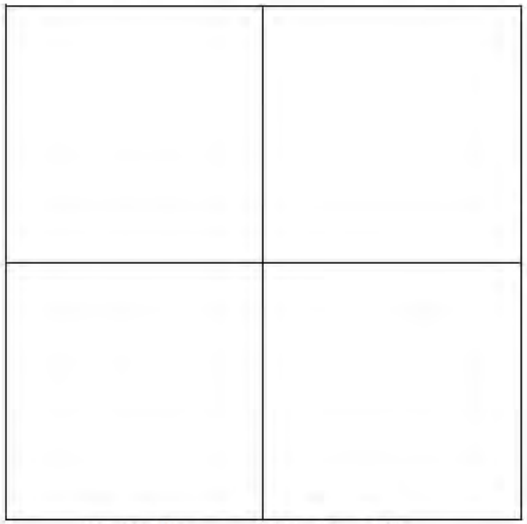
Pond - 378 (Excavated Pond or Pit)

KS-ENG-6
Rev. 6/05

Name	Ali Momeni	Ident. No.	
Legal Desc.	Afghanistan	County	

Layout by	PFC Bailey	Date	5/1/11
Designed by	PFC Bailey	Date	5/1/11
Checked by	PFC Bailey	Date	5/2/11
Approved by	Sgt Snorkel	Date	5/15/11
Checkout by	Sgt Snorkel	Date	5/20/11
Audited by	Lt. Fuzz	Date	5/25/11

Before any investigation or construction activity, the excavator is responsible for calling Kansas One-Call at 800-344-7233 (800-DIG-SAFE).



Location Map Scale 1" = 100'

Test Hole Notes

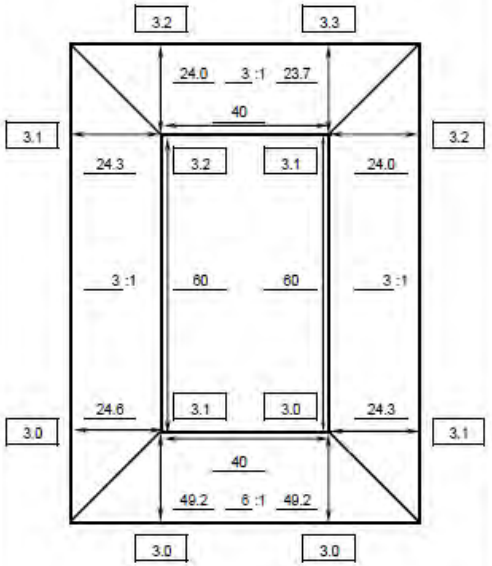
Excavation Yardage Eligible for Practice Payment 1,951 cubic yards

Remarks

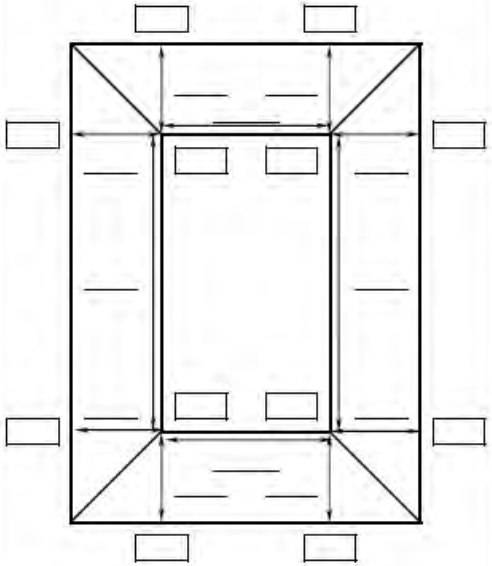
Fillable Form second page

Name Ali Momeni Legal Desc. Afghanistan

Design Layout



Construction Checkout



	Backsight (BS)	Height of Instrument (HI)	Foresight (FS) or Grade Rod	Elevation or Planned Elevation
BM	3.2	103.2		100.0
Top of Dam				
ASW				
PSW				
Design Bottom			11.2	92.0

	Backsight (BS)	Height of Instrument (HI)	Foresight (FS)	Elevation
BM				100.0
Top of Dam				
ASW				
PSW				
Bottom Check				

Auxiliary Spillway (ASW), Principal Spillway (PSW)

Bench Mark (BM) Elevation 100.0 Description Pit pond adjacent to ephemeral stream channel

Excavation Volume Computations

Total of Top Lengths (L) 266.1 feet Total of Top Widths (W) 177.2 feet

Top Area = (Average Top L 133.05 feet) x (Average Top W 88.6 feet) = 11,788 sq ft

Bottom Area = (Average Bottom L 60.0 feet) x (Average Bottom W 40.0 feet) = 2,400 sq ft

4 x Median Area =

(Avg. Top L + Avg. Bottom L 193.1 feet) x (Avg. Top W + Avg. Bot. W 128.6 feet) = 24,826 sq ft

Average Depth = 8.1 feet = Average of 4 Bottom Corner Cuts Sum of Areas = 39,014 sq ft

$$\text{Excavation Volume} = \frac{\text{Average Depth} \times \text{Sum of Areas}}{162} = \frac{316{,}017}{162} = 1{,}951 \text{ cubic yards}$$

Toe Staking

Toe Stake Pit Pond

Sta.	B.S.	H.I.	F.S.	Elev.
B.M.	3.2	103.2		100.0
Pond Bottom			11.2	92
Right Toe			2.8	
Right Toe			3.3	
Left Toe			4.1	
Left Toe			4.0	
End Toe			2.7	
End Toe			2.6	
Ramp Toe			4.3	
Ramp Toe			4.4	

Toe Distances are from bottom flags at corners

Date: 5/1/2011
Weather: Hot, Dusty

Survey Party: Spc Bailey, MSgt. Snorkel

Painted Boulder NW of Pond

Planned Bottom Elevation

C 8.4 @ 25.4 (3:1)

C 7.9 @ 23.7 (3:1)

C 7.1 @ 21.3 (3:1)

C 7.2 @ 21.6 (3:1)

C 8.5 @ 25.5 (3:1)

C 8.6 @ 25.8 (3:1)

C 6.9 @ 41.4 (6:1)

C 6.8 @ 20.4 (6:1)

Considerations

- Depth – A practical limit is 8 feet
- Shape – They don't have to be square, but you can stake out and measure a square one easier
- Size – Site limitations may dictate size more than the volume of water needed
- Construction – Local hand labor. Need to get local estimates for cubic yards per day per laboror
- Slopes – 6:1 for watering access slopes for cattle, 3:1 on remainder of slopes.

Field Exercise