Training on

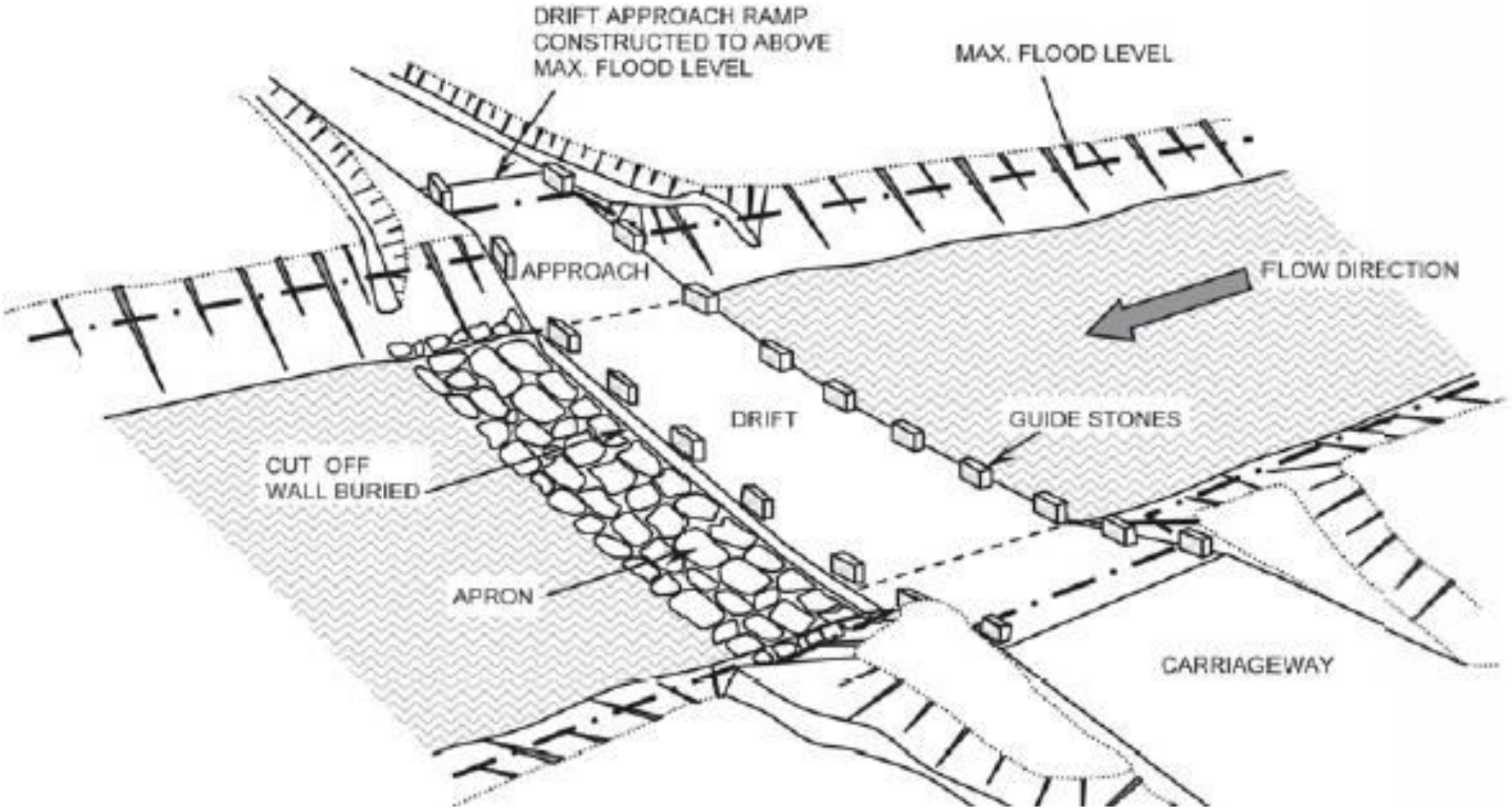
Roads for Water and Resilience

WATER HARVESTING FROM SEASONAL RIVER CROSSINGS

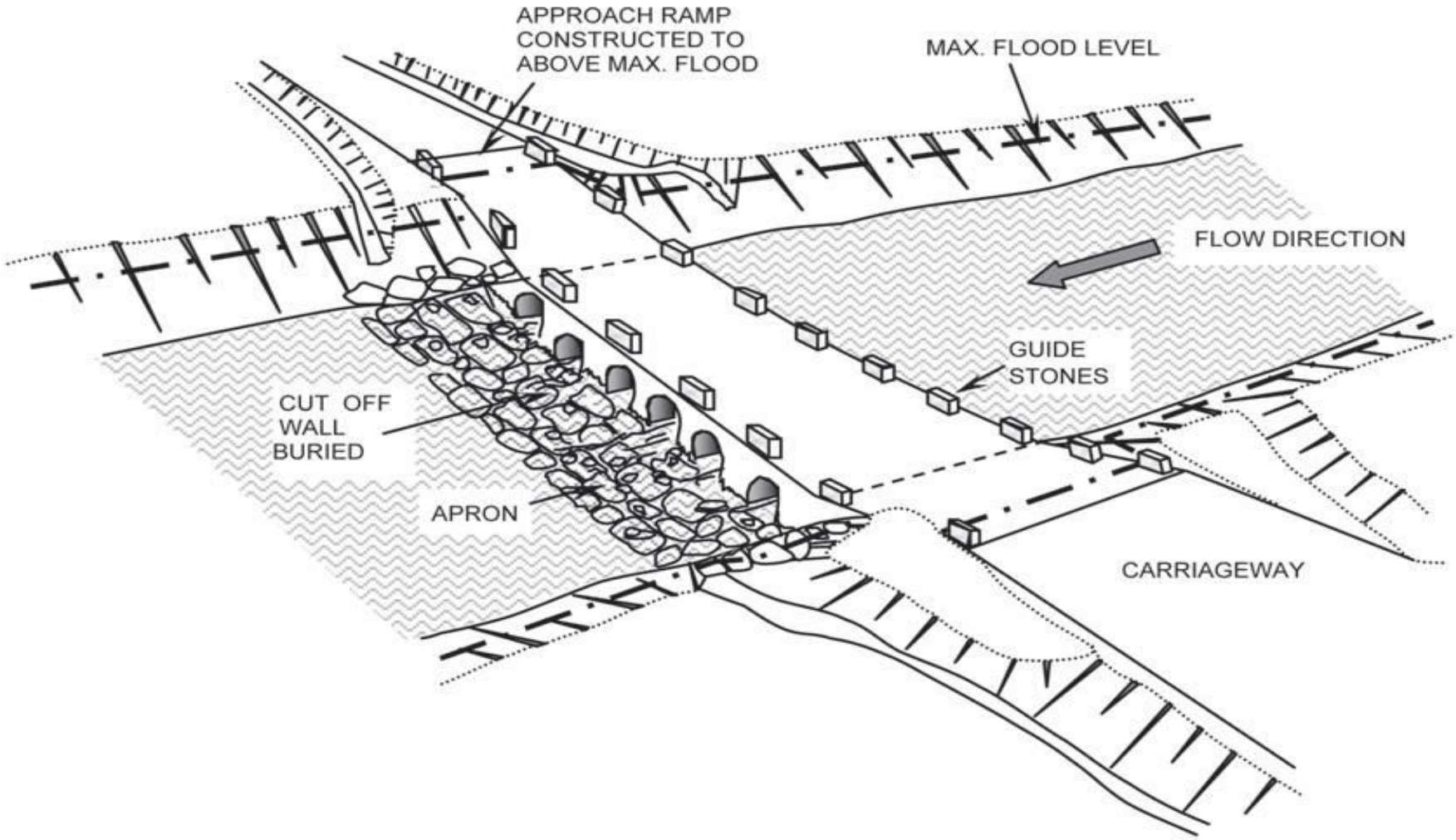
Water harvesting from seasonal river crossings

- Traditional road – seasonal river crossings
- Common problems
- Sand dams
- Combining sand dams and road river crossings
- Siting and design rules
- Benefits and opportunities

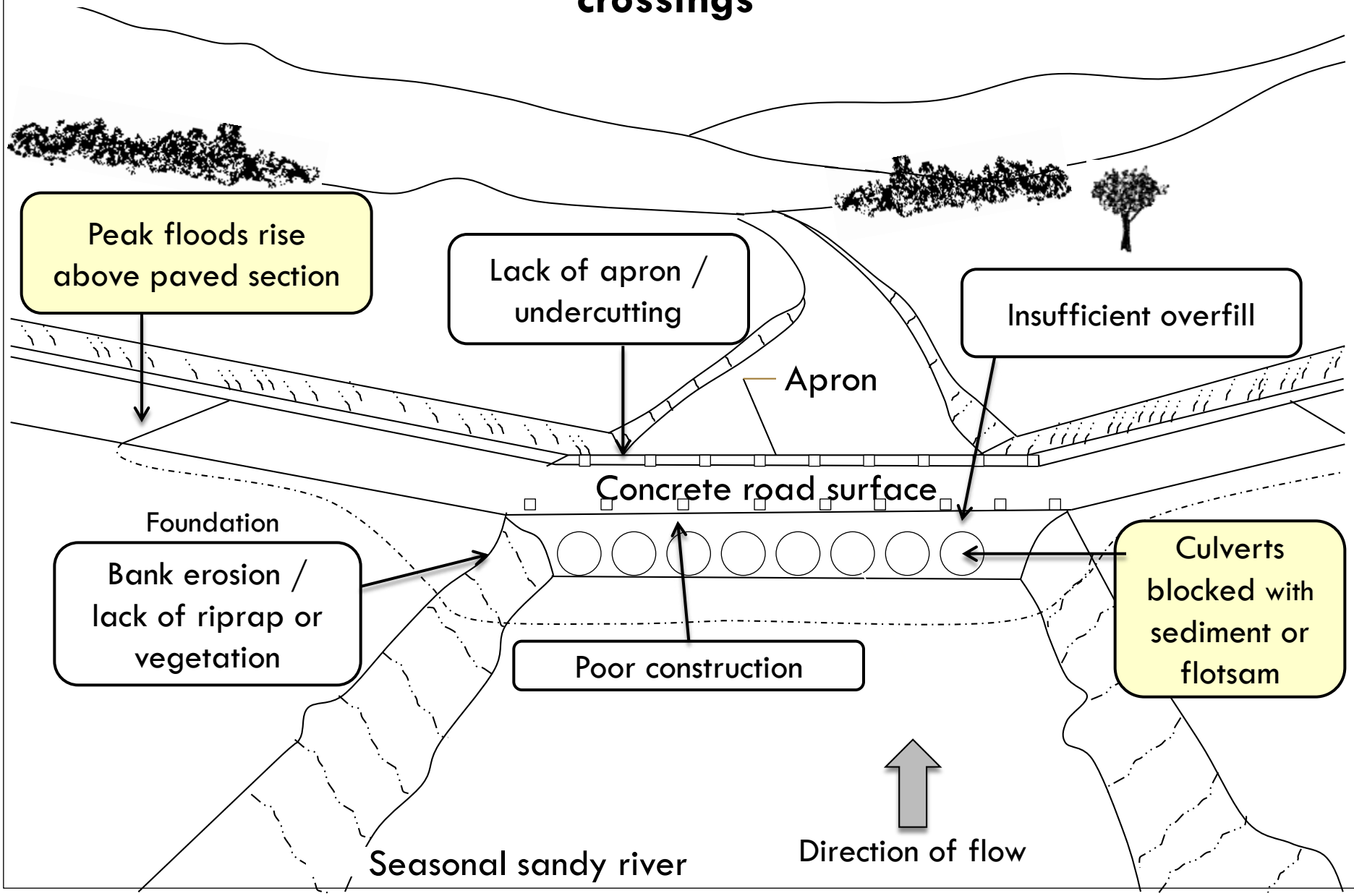
Traditional drift

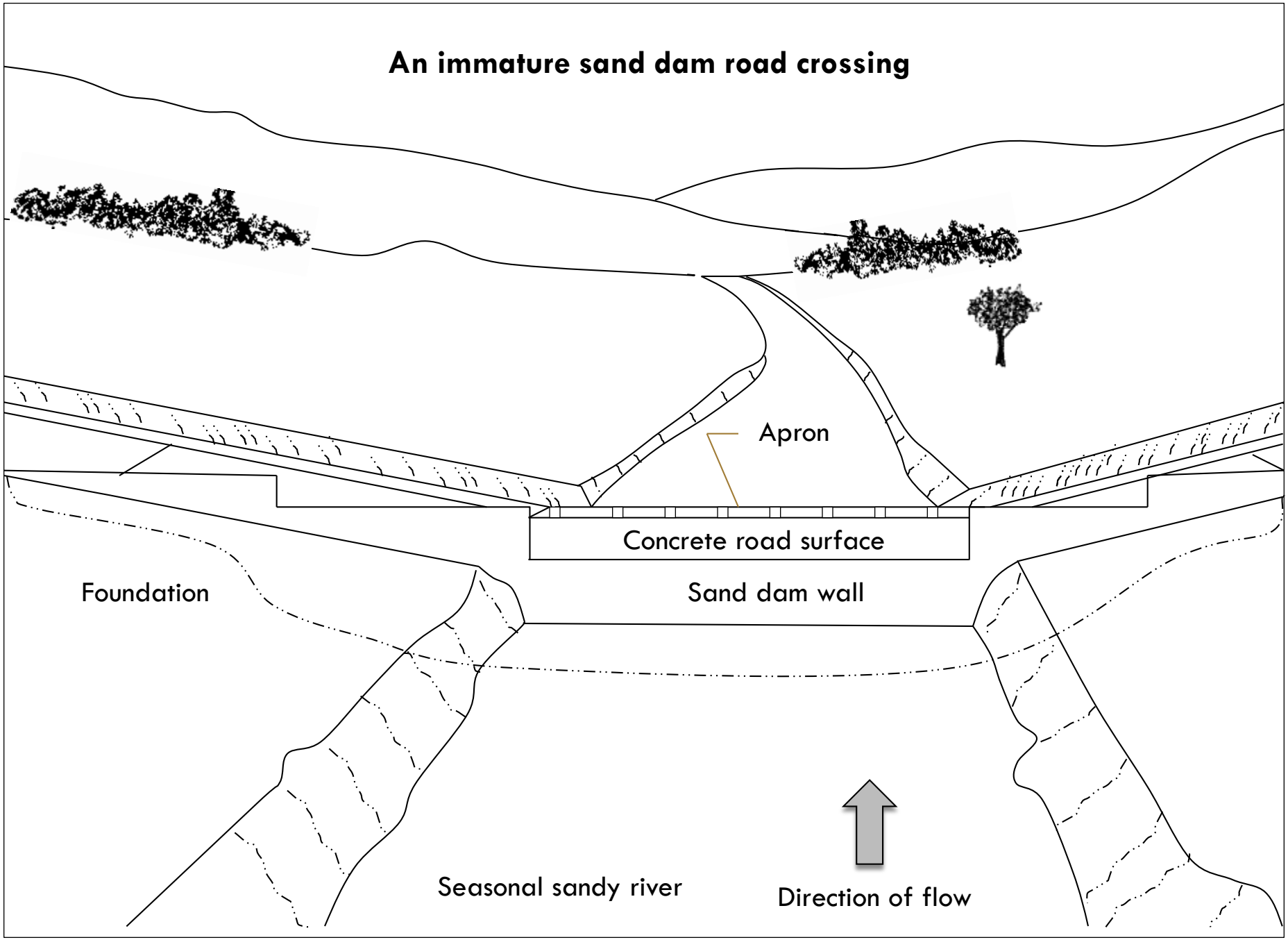


Vented causeway or culvert



Common causes of damage and failure to seasonal river crossings




An immature sand dam road crossing
Apron
Concrete road surface
Foundation
Sand dam wall
Seasonal sandy river
Direction of flow

Makueni, Kenya

Spillway 3m above riverbed

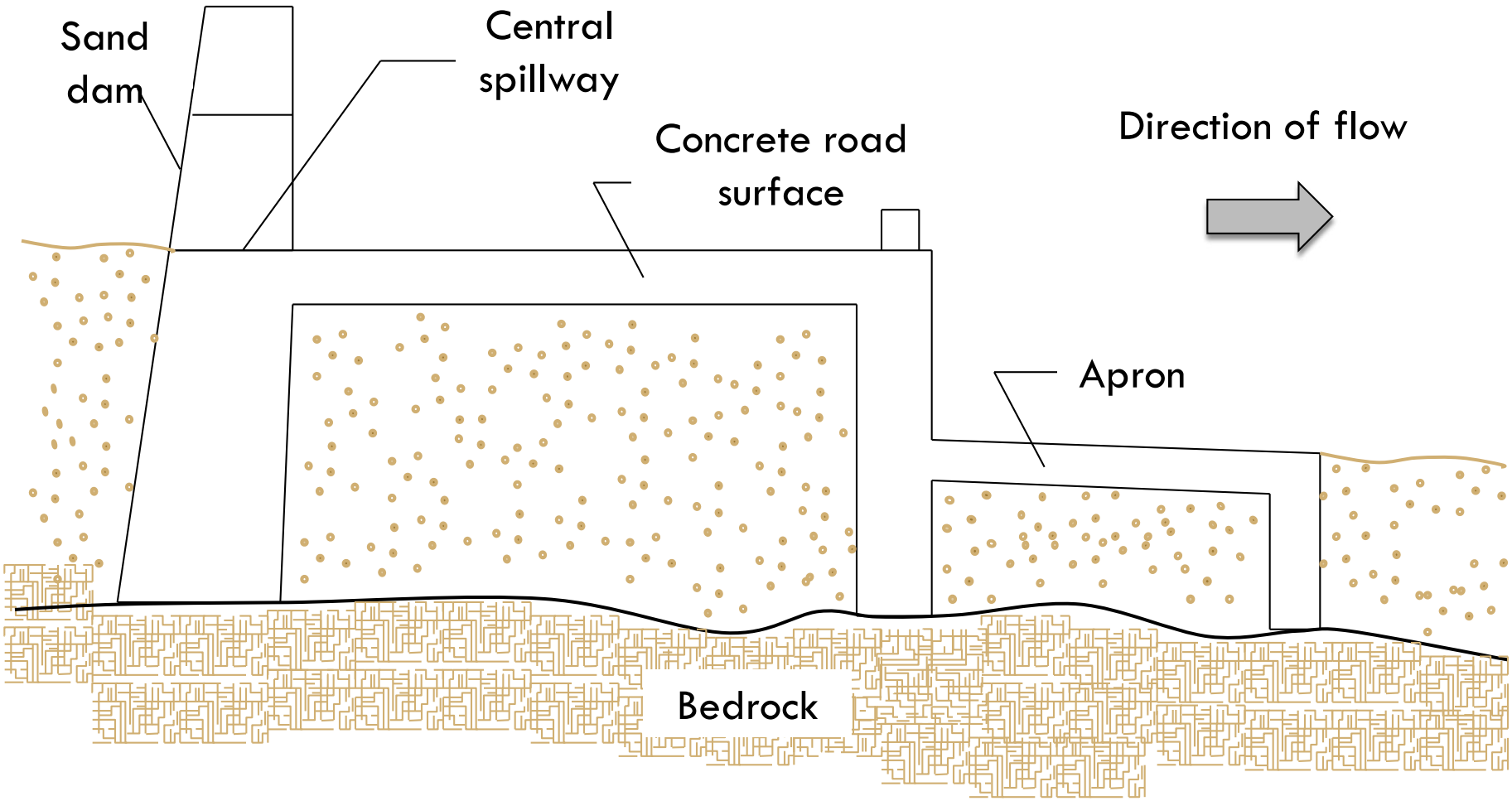
Makueni, Kenya

Makueni, Kenya

Mozambique

Ethiopia

Cross-section of sand dam road crossing



Benefits of sand dams in SE Kenya

Indicator	With dam	Without dam
Months of primary water source depletion	-2.5	+0.2
Change in distance to primary water source	-2016 m	+23 m
Change in water use	3.44 x more	0.96 x less
Daily time saved on fetching water	100 minutes	-7 minutes
Newly irrigated land	+0.18 Ha	-0.01 Ha
New fruit trees	13	5
Change in income (€/year)	+270	-380
Malnutrition	decreased	increased

Source: Aerts et al

Benefits of water harvesting road crossings

- Low maintenance/repair costs
- Keeps water where it is needed
- Impact increases as they mature
- Raises water table and base flow
- Reduces flood risk including to bridges
- Water protected from contamination, water-vector disease and evaporation
- Opportunities to share vital data and knowledge between road and water professions
- Opportunities for cost sharing and collaboration

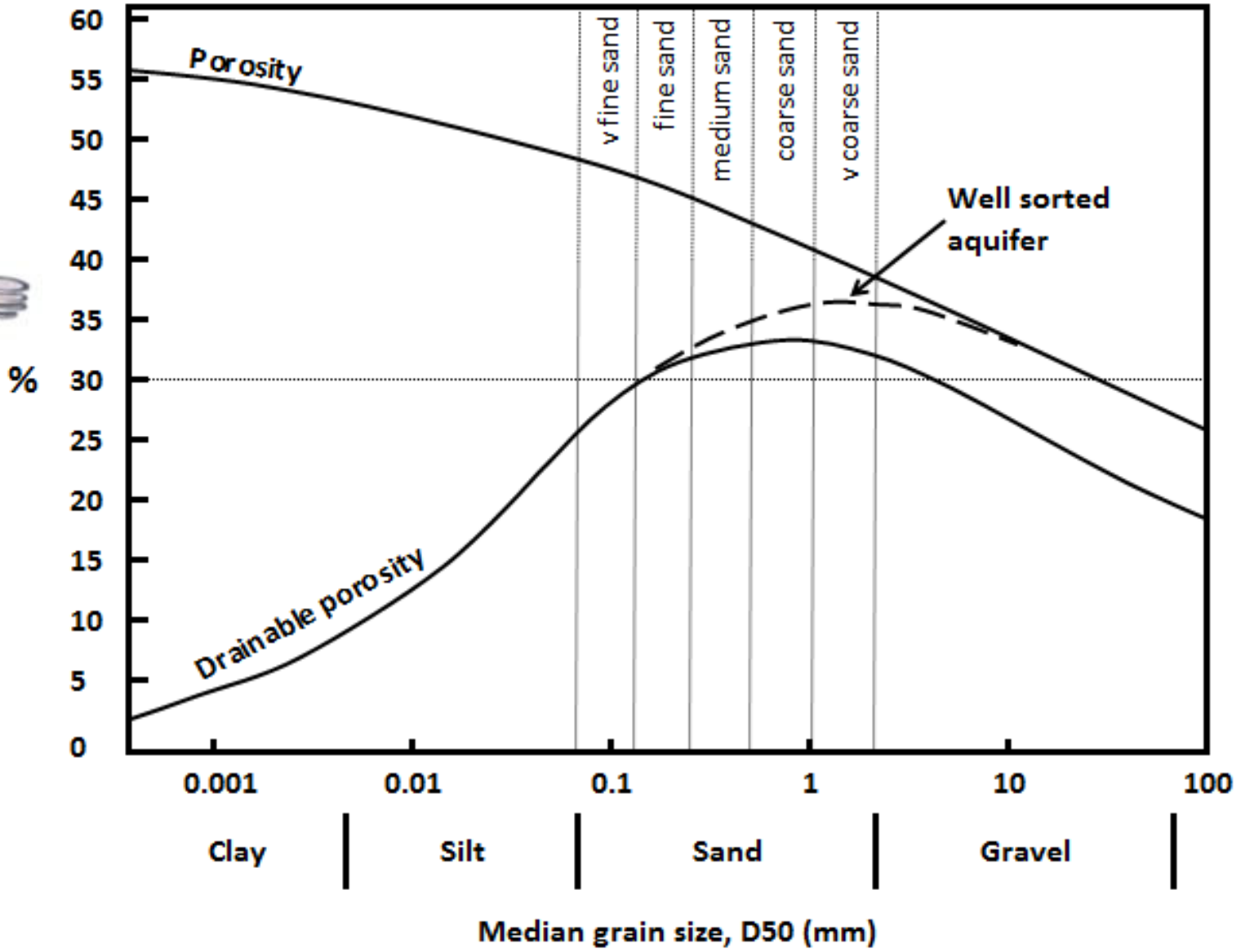
Where are sand dams (and water harvesting raised drifts) suited

4 conditions for a suitable site

- Ephemeral / seasonal river >>> dryland climates
- Impermeable or low permeability riverbed >>>

  presence of scoop holes
- Sufficient, sandy sediment
- Suitable, impermeable, accessible foundation

Sufficient sandy sediment



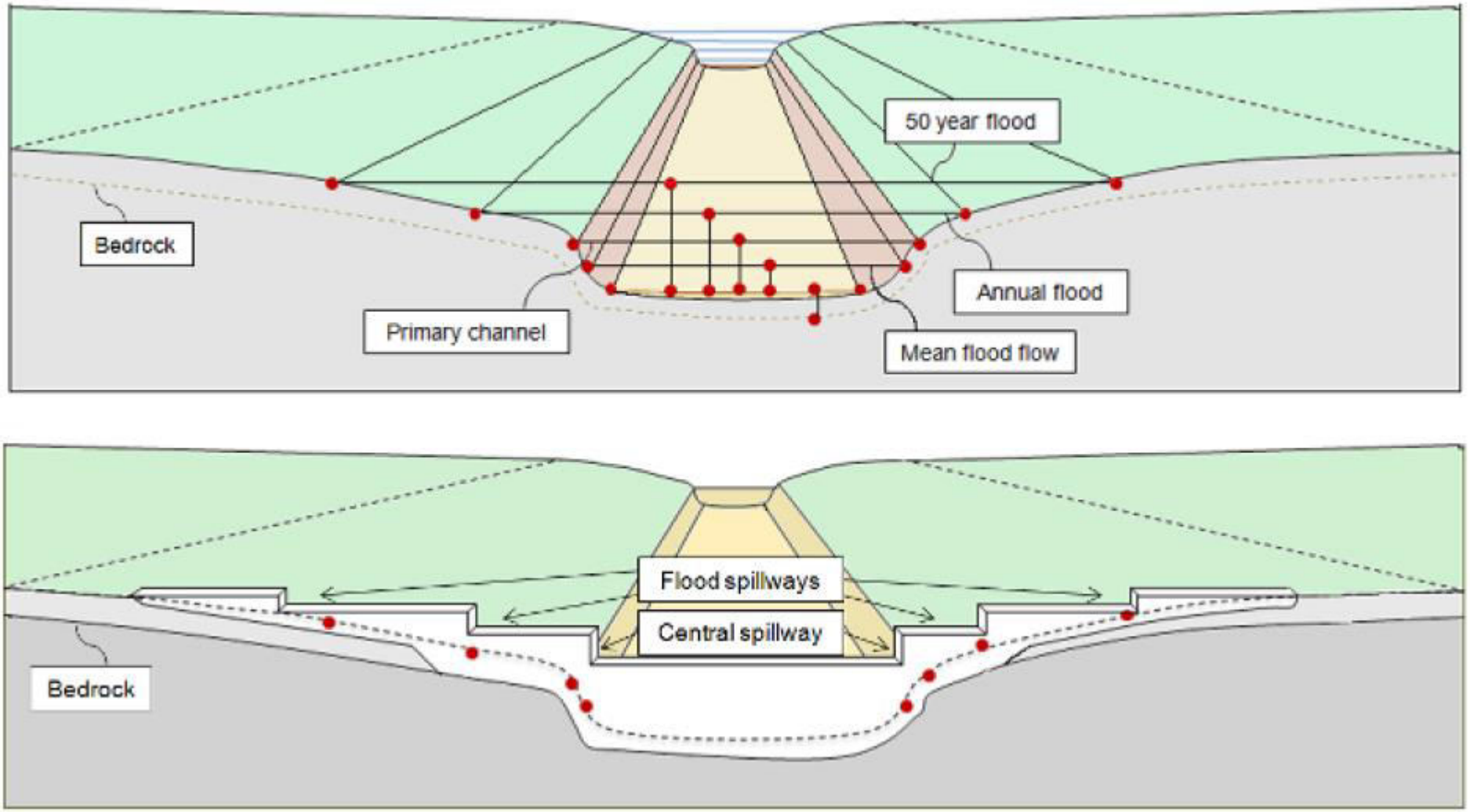
3 design rules

- Impermeable foundation 2m wider than annual flood width
- The river must continue on its original course. Use stepped spillway with x-section > flood x-section
- The spillway height must not cause siltation >>> fill with sand in 2-3 years

If the spillway is too small, drifts, culverts and sand dams will fail

Spillway x-section > design flood x section

Spillway widths and X sections correspond to flood widths and X sections



Reading river: estimating design flood using local knowledge and observation

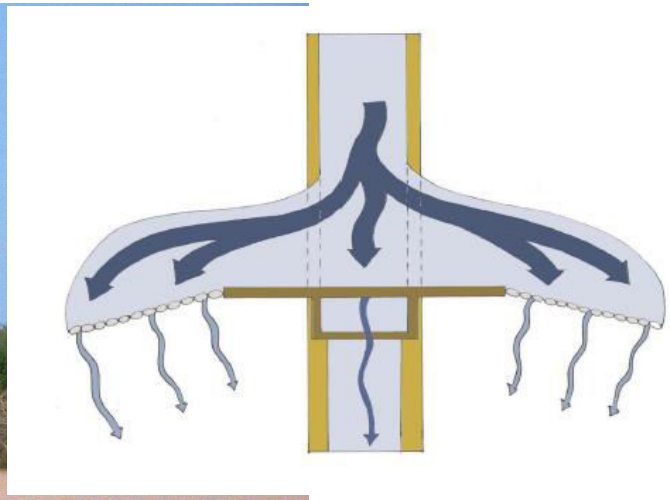
Protection of river banks

Napier and other grasses provide fodder for animals

Avoid raised drifts / sand dams on small catchments

Small catchments with shallow channels have limited flood flows and sediment transport >>> risk of siltation

Niger: Flood water spreading weir = road



‘Kolhapur Type Weirs’, India

Potential of embedded sensors

- New open source solar powered dataloggers with plug and play sensors >>> affordable data collection ($100-200/unit)
- Rationale formula: Q = CIA
- C = Catchment coefficient: factor of slope, soil/infiltration rates, vegetation/land use
- Flood flow depth >>> Q discharge (known)
- I = Intensity of rainfall (known)
- A = Catchment area (known), S, slope (known)
- Therefore real data on catchment coefficient.

Potential of embedded sensors

- Rainfall and flood levels >>> accurate flood modelling and better design standards
- Better road drainage design and reduced costs
- Better mapping water harvesting potential
- Better flood management and climate proofing
- Better local understanding of climate change

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