VETIVER SYSTEM

Application under Kuwaiti Environment

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Unique Attributes of Vetiver Grass Suitable for Arid Environment

- **High level of tolerance to drought and flood, due to its extremely extensive, deep and penetrating roots system**
- **High level of tolerance to cold (-14oC) and heat (55oC)**
- **High level of tolerance to extremely adverse growing conditions: high soil Acidity, Salinity Sodicity and Alkalinity**
- **High level of tolerance to heavy metal toxicities.**
- **High level of tolerance to fire, animal grazing and heavy traffic.**
- **Very quick recovery after the adverse conditions improved.**

Therefore, Vetiver Grass is an ideal Pioneer Plant, which establishes on the adverse environment first and then other plants follow.

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POTENTIAL APPLICATIONS IN KUWAIT

Treating effluent by Land Irrigation

Sewage effluent and other wastewater by:

- **Overhead sprinkler system**
- **Surface irrigation**
  - **Flood**
  - **Furrow irrigation**

Overhead sprinkler system

Overhead sprinkler system


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Flood irrigation system

Excellent growth, over 2m in 12 months

Effectiveness of vetiver planting on quality of effluent seepage

Analytes	Nutrient levels		
	Inlet	Mean levels in monitoring bores	
		20m down slope from inlet	50m down slope from inlet
pH	8.0	6.5	6.3
EC (uS/cm)	2200	1500	1600
Total Kjel. N (mg/L)	170	11.0	10.0
Total N (mg/L)	170	17.5	10.6
Total P (mg/L)	32	3.4	1.5

Results of MEDLI Simulation

Effluent Volume for Sustainable Disposal

Plants	Effluent volume for irrigation (ML/day)	Effluent volume for irrigation (ML/year)
Vetiver	1.24	452
Kikuyu	0.8	292
Improvement of vetiver over Kikuyu grass		55%

POTENTIAL APPLICATIONS IN KUWAIT

Treating effluent in storage ponds and wetlands

Sewage effluent and other wastewater by:

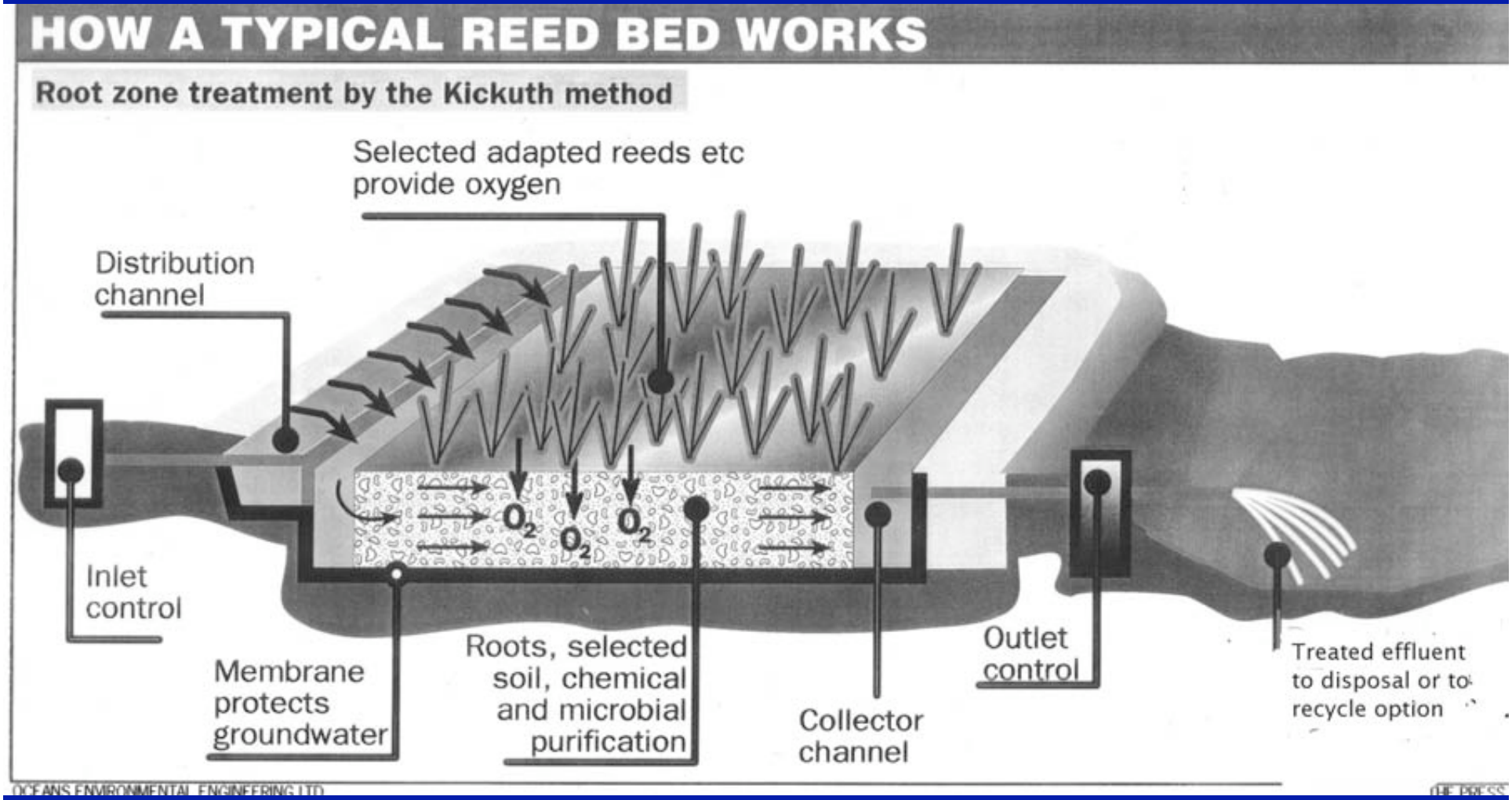
- **Wetlands**
- **Soil based reed bed**
- **Flow through system**

Deep Wetland: Planting on the shallow semi-flooded edges of the wetland

Shallow Ponded Wetland: Hydroponics pontoons or floats

Semi Wetland: Wet and dry flood irrigation cycle

Soil Based Reed Beds (SBRB)



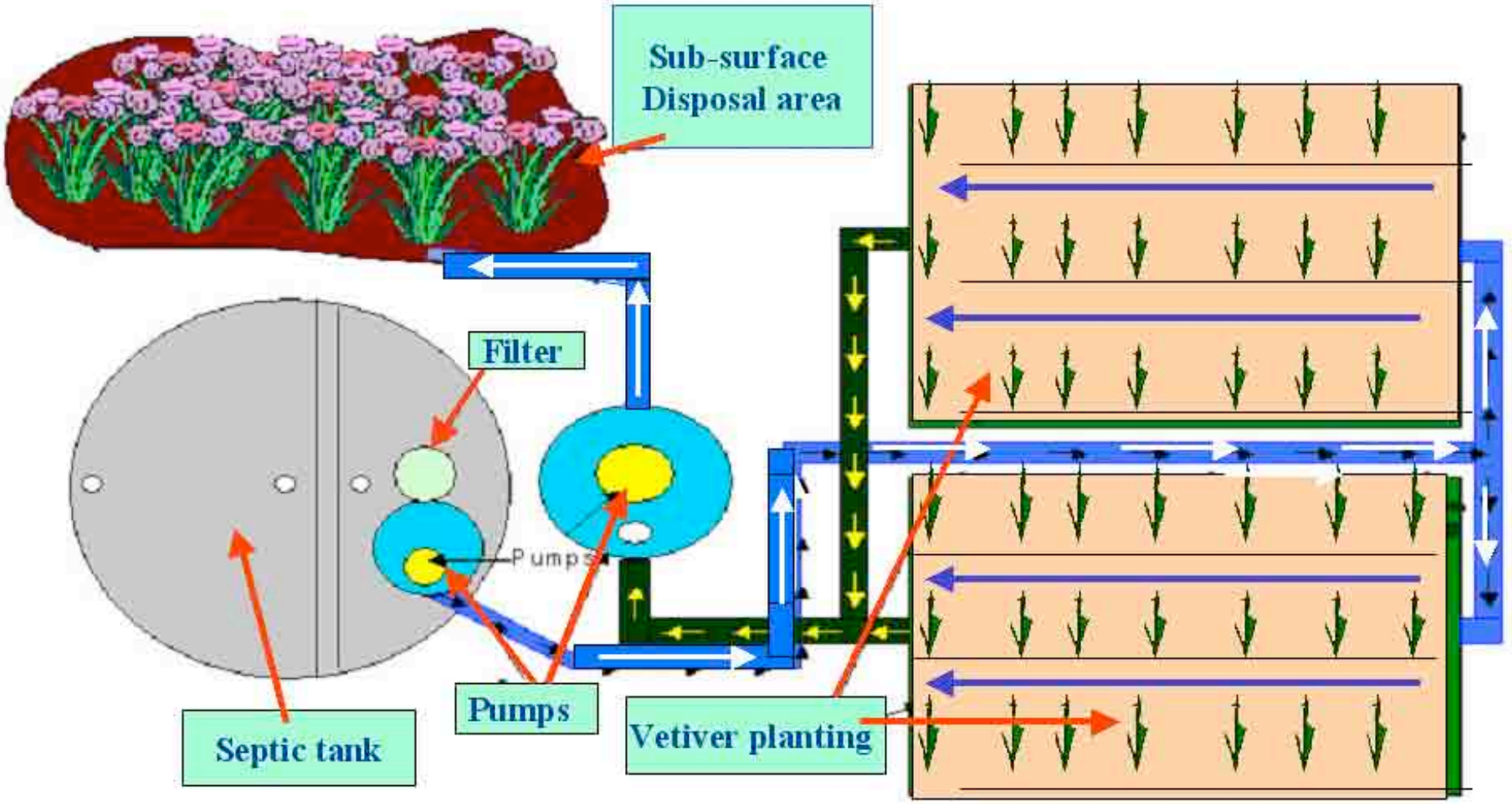
Soil Based Reed Bed demonstration trial in Australia

Soil Based Reed Bed adapted to small scale household in Australia .

Incorporated into the garden on the left and growth 6 months after planting

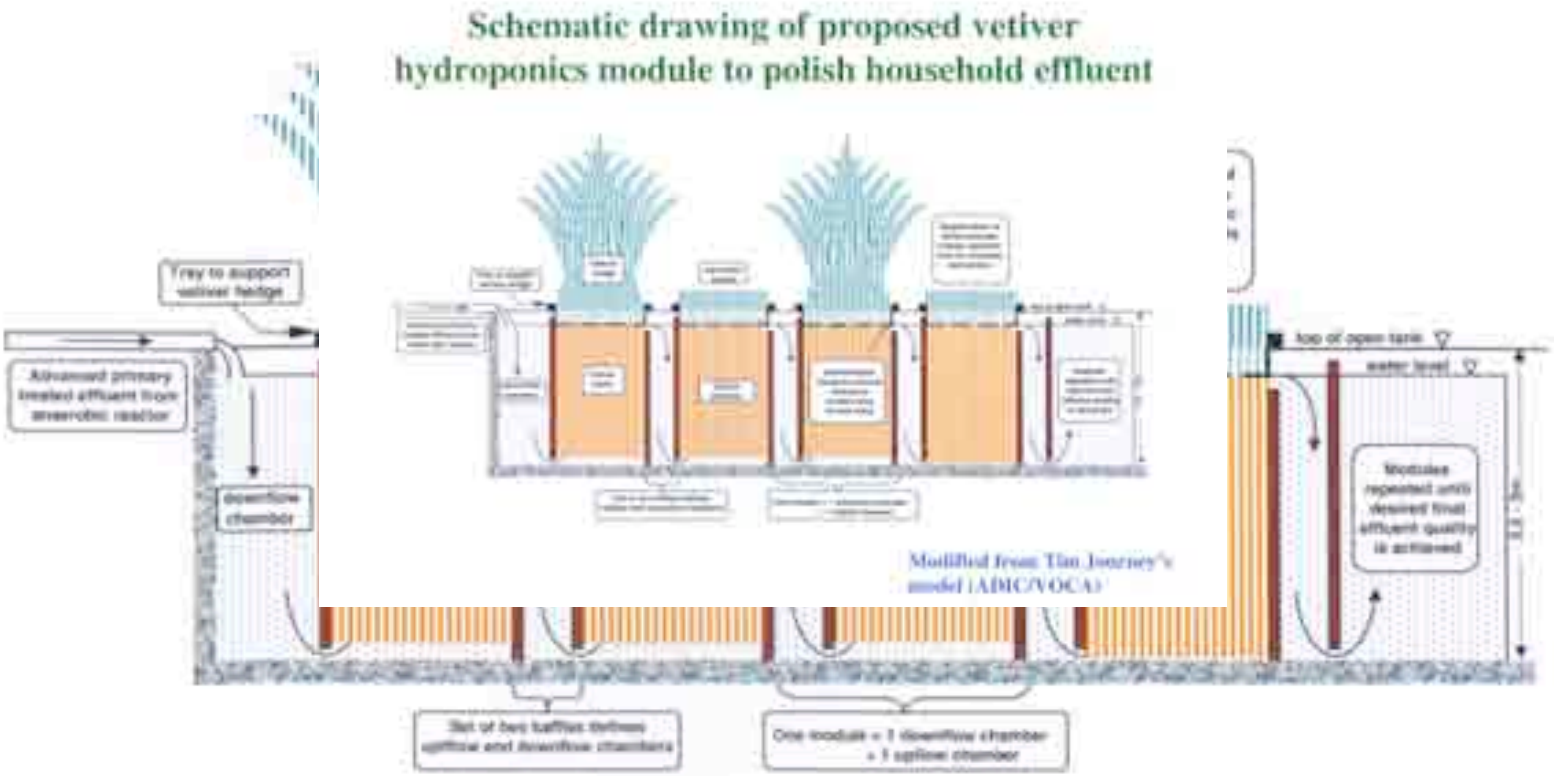
Domestic Scale for Single Household

Diagrammatic layout of a domestic disposal system



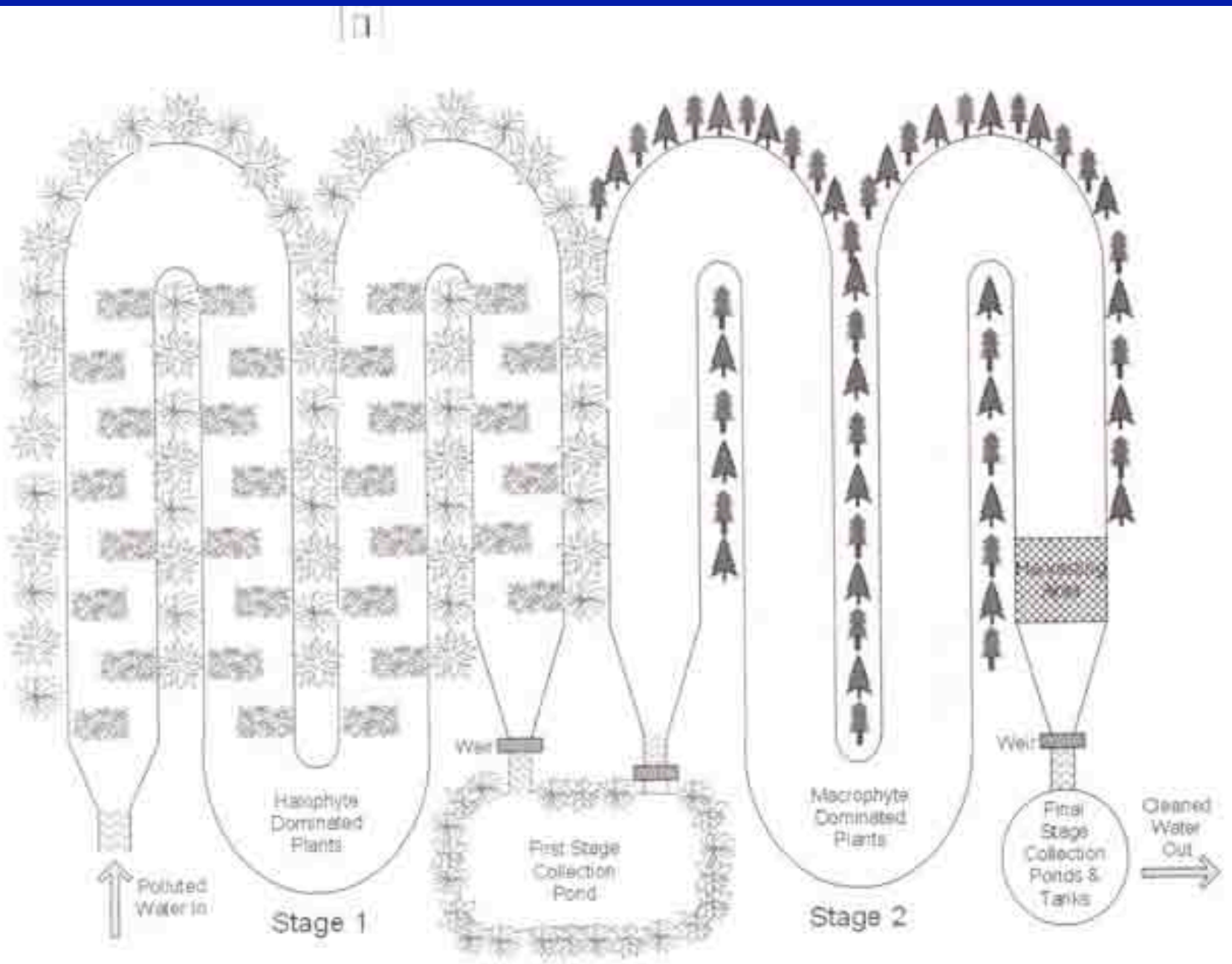
Small Business Scale such as motels, shops which are not connected to the city sewer system

Schematic drawing of proposed vetiver hydroponics module to polish household effluent



Modified from Tim Journey's model (ADIC/VOCA)

Industrial Scale



POTENTIAL APPLICATIONS IN KUWAIT

Stabilisation of infrastructure with primary treated effluent

Unstable slopes of sand and sandy loam can be effectively stabilised by VS with drip irrigation of effluent or semi saline water.

Coastal dunes stabilised with VS in Viet Nam, six months after planting

Coastal dunes stabilised with VS in Viet Nam, one year after planting

POTENTIAL APPLICATIONS IN KUWAIT

Desert rehabilitation and cropping with underground water

Research in Israel has demonstrated that semi saline water can be used to produce very high quality tomato for fresh fruit and canning.

Similarly, saline effluent can also be used instead of underground water.

Result Summary

- A research effort spread over a 10 years period in the Negev desert has turned tomatoes from a relatively "salt sensitive" crop into a "salt tolerant" crop.

- Using the information gained in this study it is possible now to grow processing tomatoes with 6.2 dS/m (4,000ppm TDS) water with no reduction in revenue

- A separate study demonstrated that salinity significantly improves the taste of table tomatoes . The "desert sweet"brand created to market saline water tomatoes significantly increased income from these tomatoes as compared with fresh water irrigated tomatoes

Effect of Salinity on Fruit Dry Matter Yield

- **Salinity significantly increases the dry matter content of tomato fruit**
- **Dry matter is expressed as TSS=Brix**
- **Canning factories decided to give bonuses for higher brix contents**
- **As a result the gross revenue from saline water irrigated tomatoes was the same as for fresh water tomatoes even though fresh yields were slightly reduced by salinity**

POTENTIAL APPLICATIONS IN KUWAIT

Desert Rehabilitation by Water Harvesting

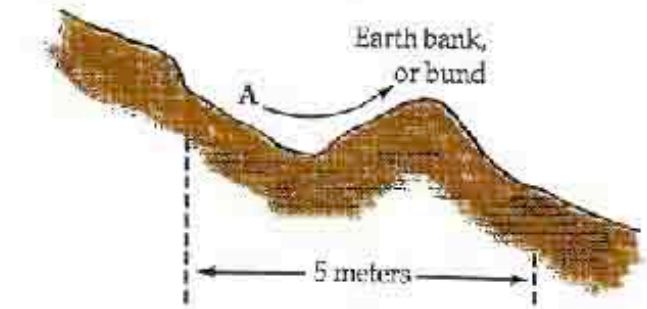
There are two main ways that vetiver can improve the rehabilitation of degraded arid lands:

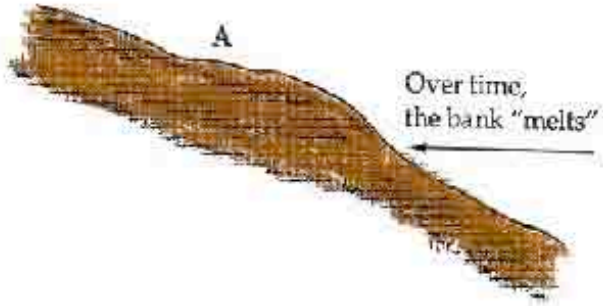
- ***Vetiver hedgerows on undisturbed land***
- ***Land shaping by:***
  - ***Shallow ponding or artificial Wadis***
  - ***Soil pitting***

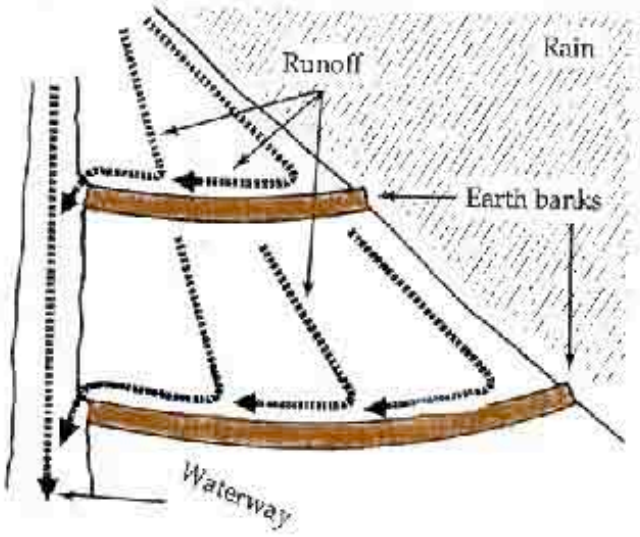
Desert Rehabilitation by Water Harvesting by Vetiver Hedgerows on Undisturbed Land

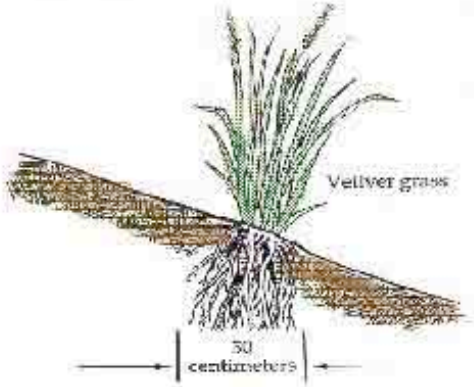
There are five main ways that VS can improve the rehabilitation under Kuwaiti environment:

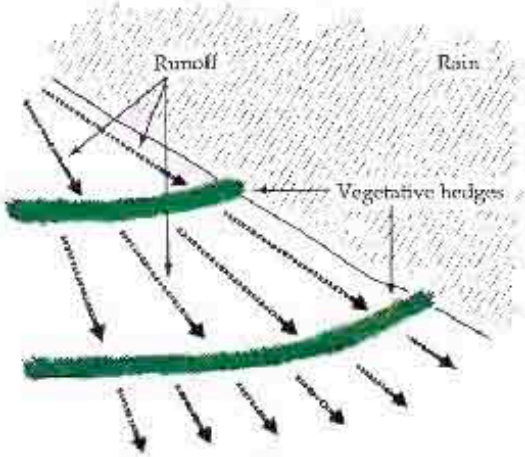
- ***Spreading and improving infiltration of run-off water***
- ***Diverting and concentrating water***
- ***Trapping sediment***
- ***Providing shade***
- ***Protection soil from wind erosion and plants from sand blasting and sand drift***











Reducing flow velocity, spreading runoff water, trapping sediment

Contour hedgerows reduce flow velocity, spread runoff water, trapping sediment and stop erosion

Vetiver planted to provide shades for tree less grassland in Australia

Vetiveria nigritana in Mali, Westl Africa (PC: C Juliard)

Remove trapped sediment

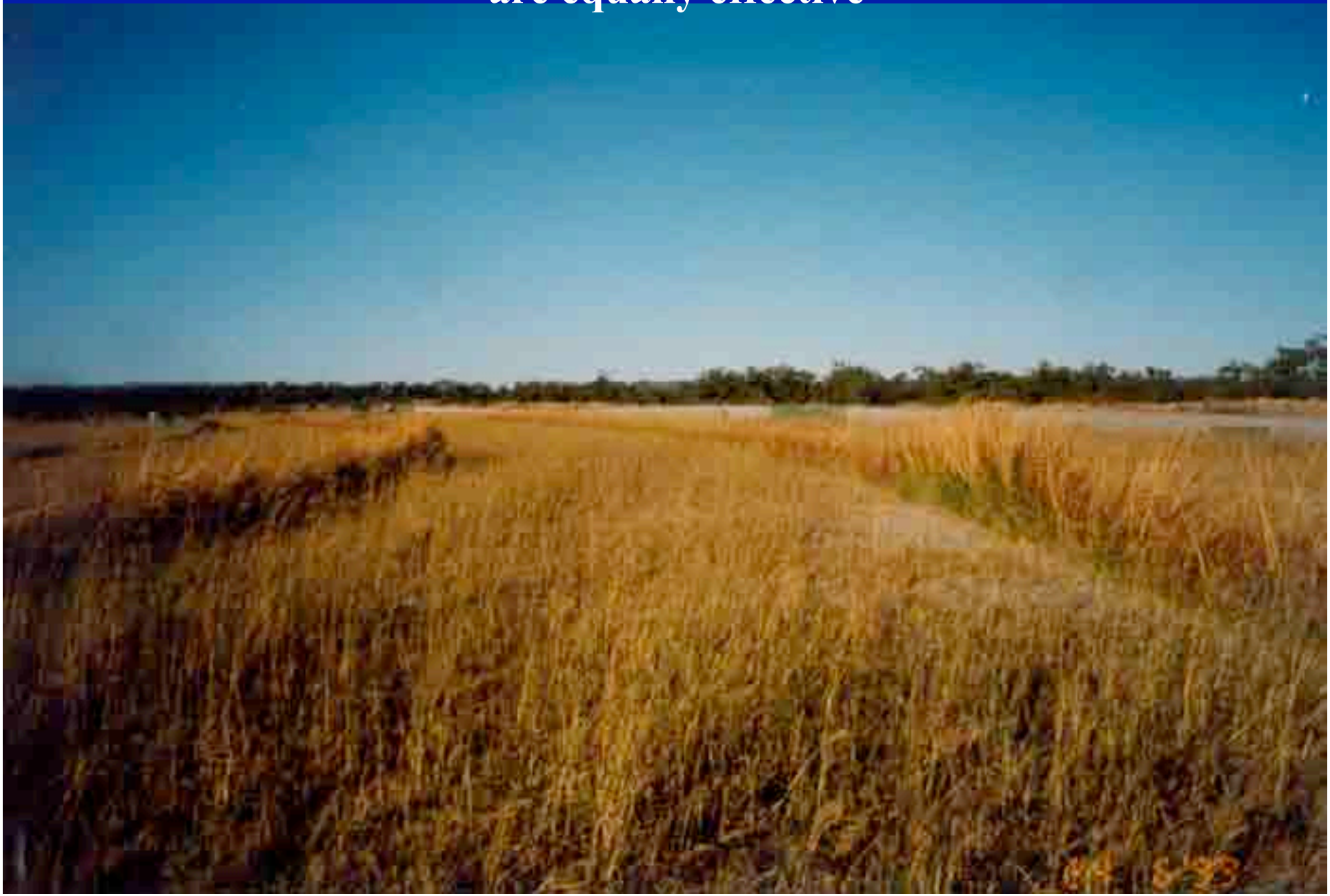
A typical dust storm on a new gold mine tailings dam in northern Australia

The best way to control these sand storm is an effective ground cover. But windbreaks has to be established first to protect the emerging seedlings

An expensive artificial wind break but it is vulnerable to strong wind gusts

Vetiver hedges can also be used to protect the young plants and

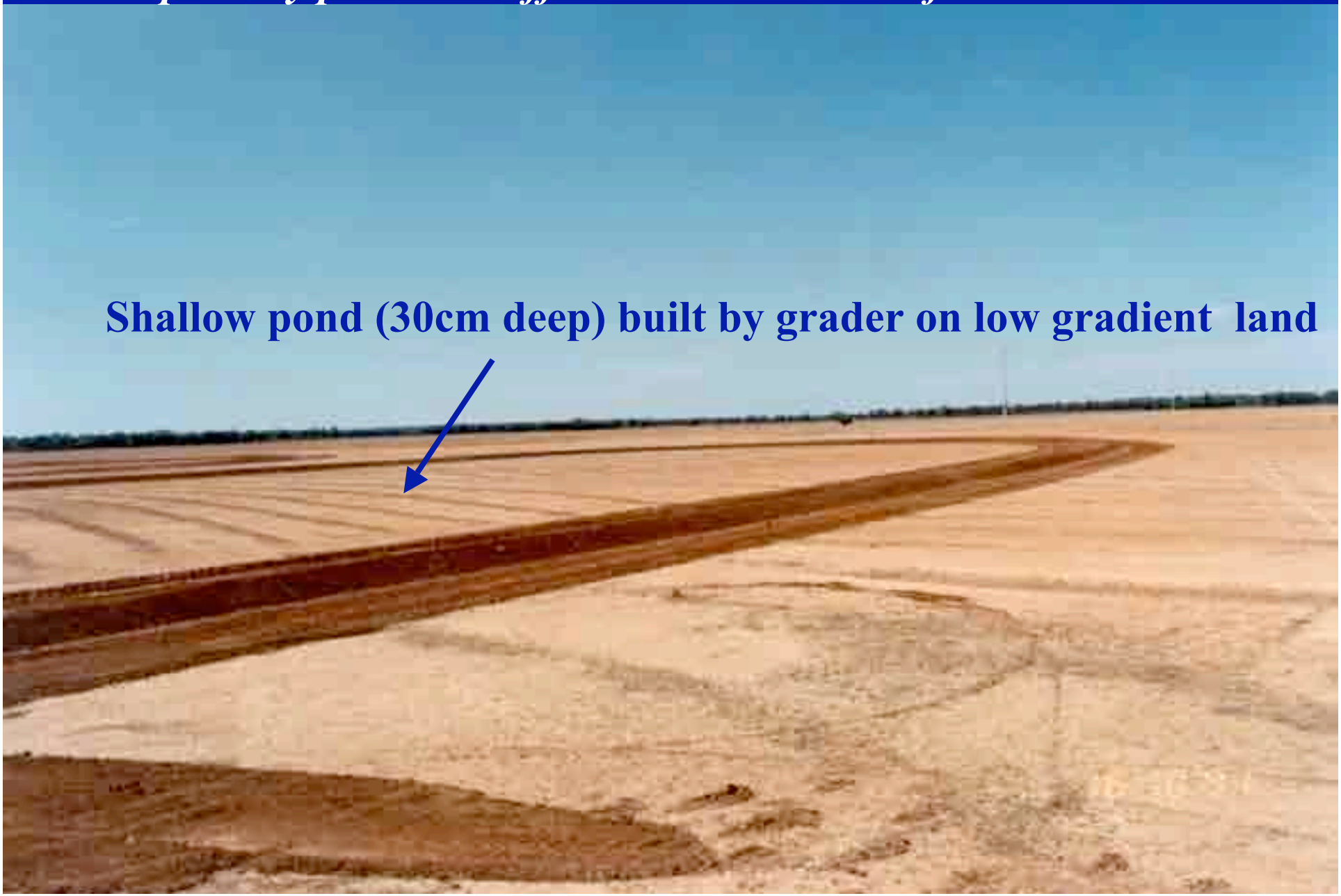
Vetiver hedges can also be used to protect the young plants and are equally effective



Desert Rehabilitation by Water Harvesting by Land shaping

- ***Shallow ponding or artificial Wadis***
- ***Soil pitting***

***Shallow ponding*: On flat land , low retaining structures built to collect and temporarily pond run-off water in arid land of Central Australia**



Water collected after rain

Native grass and vetiver established a year later

Native vegetation and vetiver established 3 years later

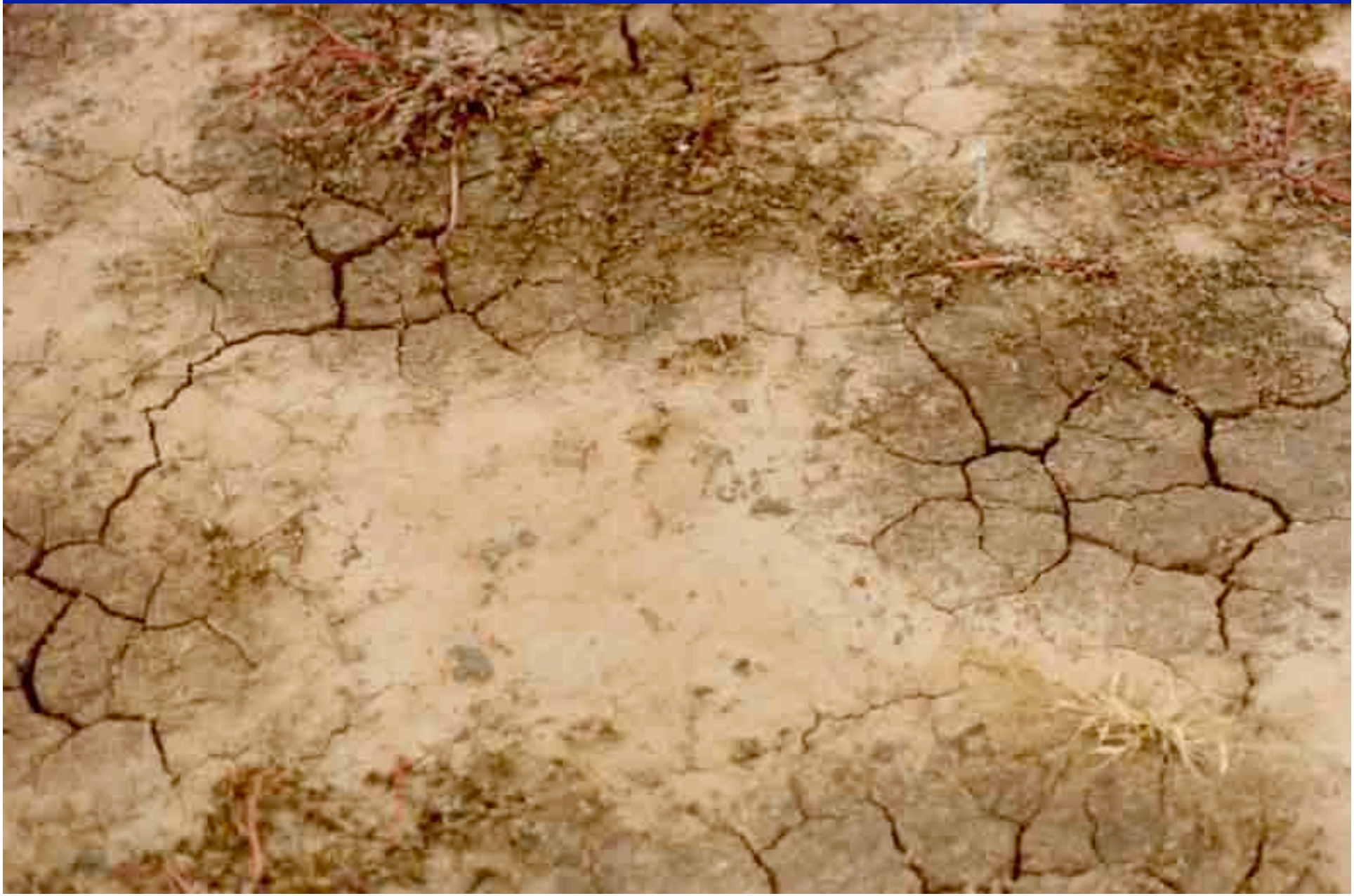
***Soil pitting*: Constructing temporary pits on flat land in arid land of Central Australia**

Soil pitter or locally know as " Crocodile"

Soil pits created after one run by the crocodile

Soil pits collected water after rain

When the water dried up, the previously crusted and sealed soil surface cracked open, letting more water in and also trapped seeds



Native grass established at the end of the rain season

POTENTIAL APPLICATIONS IN KUWAIT

Using semi saline water from oil wells for desert rehabilitation

Oil drilling in Saudi and Israeli deserts often produces semi saline water, which gas to be disposed off.

If similar process is occurring in Kuwait then this water can be used to revegetate areas around oil well, to control wind erosion, reduce sand storms and also provide feed for animal.

Similar technology as mentioned before could be developed and adopted for the rehabilitation of war-affected desert dunes near the oil wells.

Vetiver grass is ideally suited for this application due to it high level of tolerance to salinity, sodicity and alkalinity.


Thank You