

VETIVER PHYTOREMEDIATION TECHNOLOGY FOR TREATMENT OF POLLUTED WATER AND CONTAMINATED LAND



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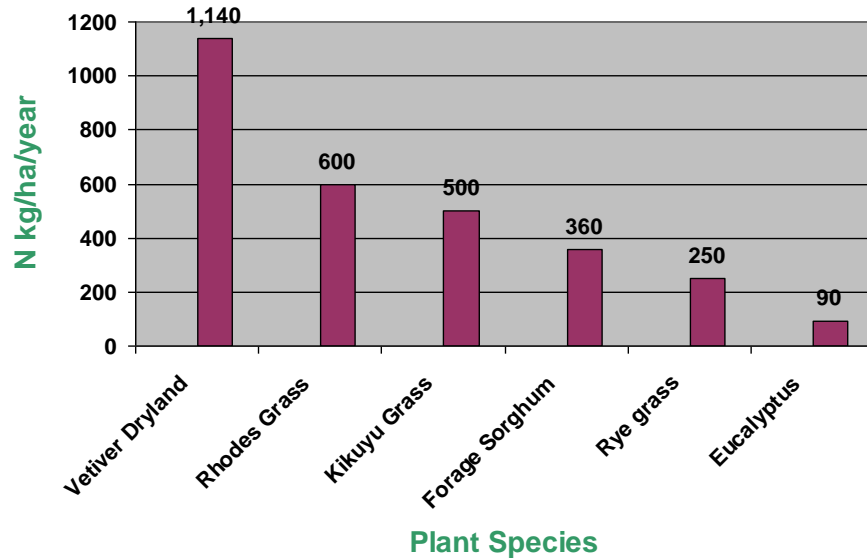
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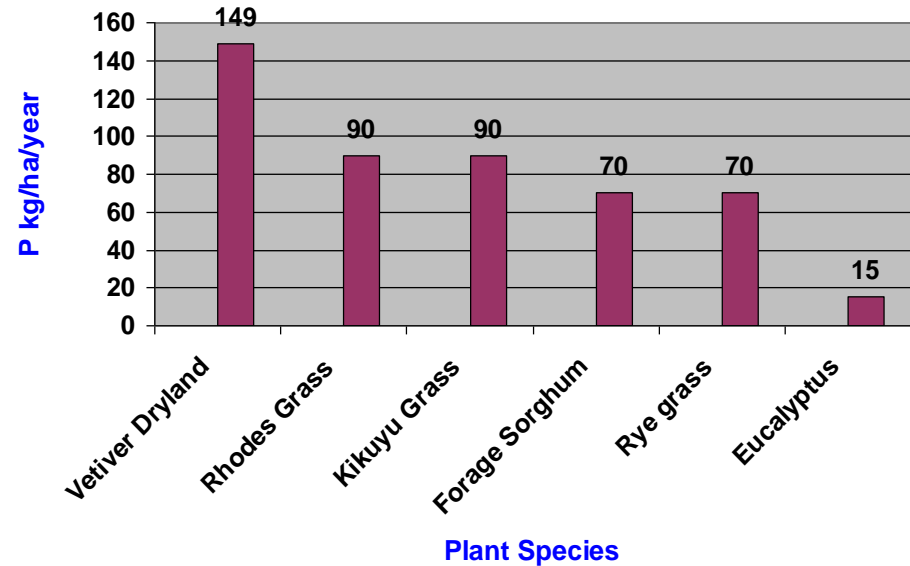
Special Characteristics Suitable for Treatment of Polluted Water and Contaminated Land

- **Very high capacity for N and P uptake under Dry land, Wetland or Hydroponics conditions**
- **Highly tolerant to extreme levels of nutrients**
- **Very fast growth with very high water consumption under wet conditions**
- **Biomass up to 132t/ha**
- **Tolerant high levels of herbicides and pesticides**
- **Highly tolerant to heavy metal toxicities**

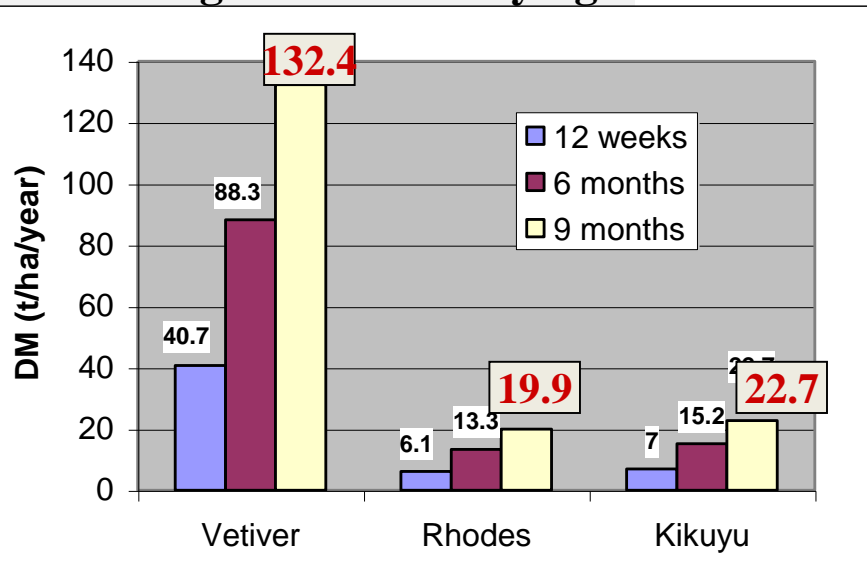
NITROGEN UPTAKE



PHOSPHORUS UPTAKE



Comparative yield between vetiver, Rhodes grass and Kikuyu grass



Plant species	Nitrogen (kg/ha/year)	Phosphorus (kg/ha/year)
Vetiver hydroponic	13,688	1,026
Vetiver pot trials	2,040	153
Vetiver field trial	1,142	149
Rhodes grass	600	90
Kikuyu	500	90
Green Panic	430	70
Forage sorghum	360	70
Bermuda grass	280	30-35
Eucalypts trees	90	15
Rye grass	200-280	60-80
Wheat (6)	23-208	3-27

TREATMENT OF POLLUTED WATER

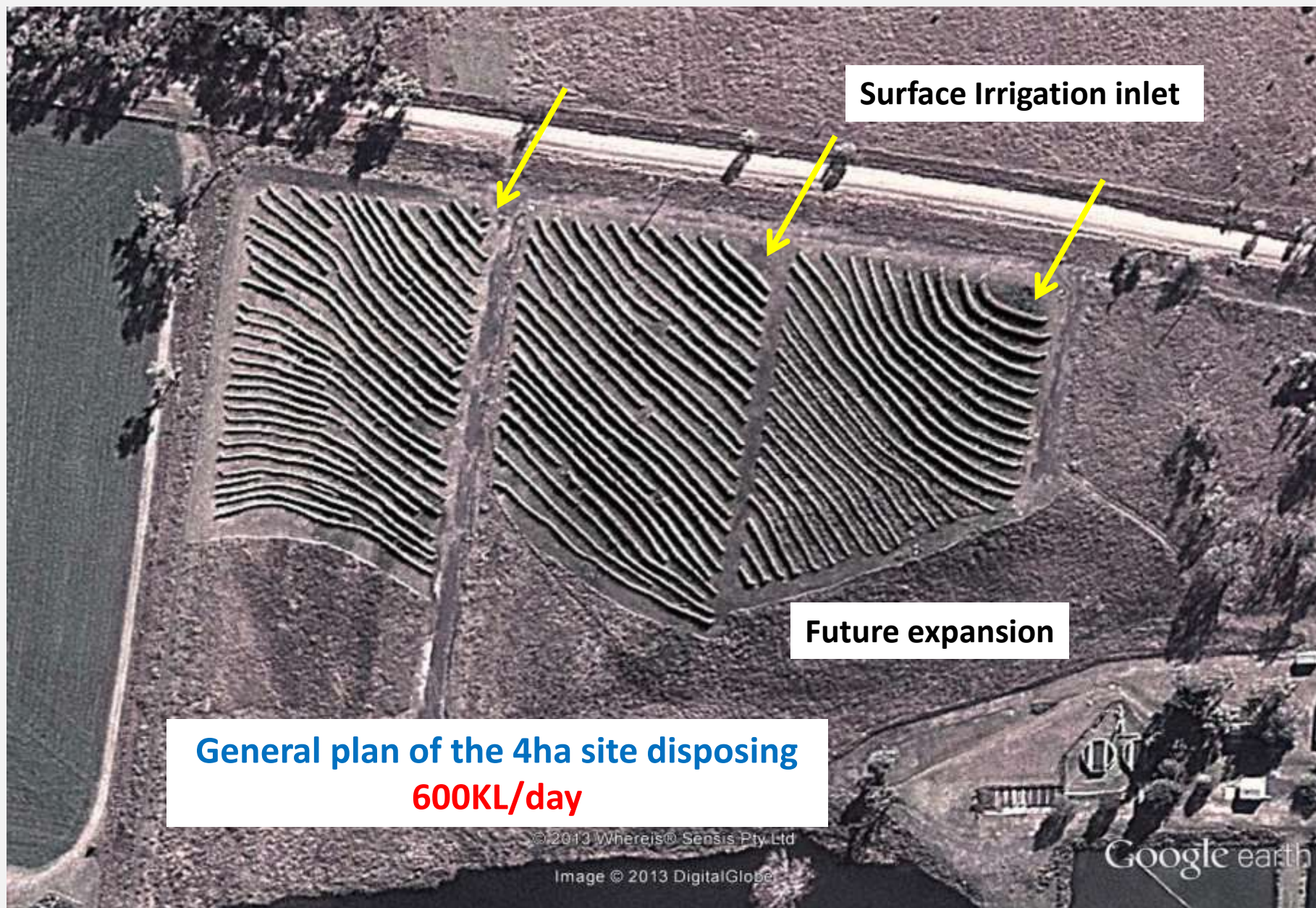
SEWAGE EFFLUENT: Disposal of municipal domestic sewage effluent by Ephemeral Wetland treatment in Australia



Effluent quality before and after the vetiver treatment

Tests * (license requirements)	Effluent Input	Effluent Output
PH (6.5 to 8.5)8*	7.3 to 8.0	7.6 to 9.2
Dissolved Oxygen (2.0 minimum) *	0 to 2 mg/l	8.1 to 9.2 mg/l
5 Day BOD (20 - 40 mg/l max) *	130 to 300 mg/l	7 to 11 mg/l
Suspended Solids (30 - 60 mg/l max) *	200 to 500 mg/l	11 to 16 mg/l
Total Nitrogen (6.0 mg/l max) *	30 to 80 mg/l	4.1 to 5.7 mg/l
Total Phosphorous (3.0 mg/l max) *	10 to 20 mg/l	1.4 to 3.3 mg/l

Disposal of municipal domestic sewage effluent by land irrigation in Australia





Six month old

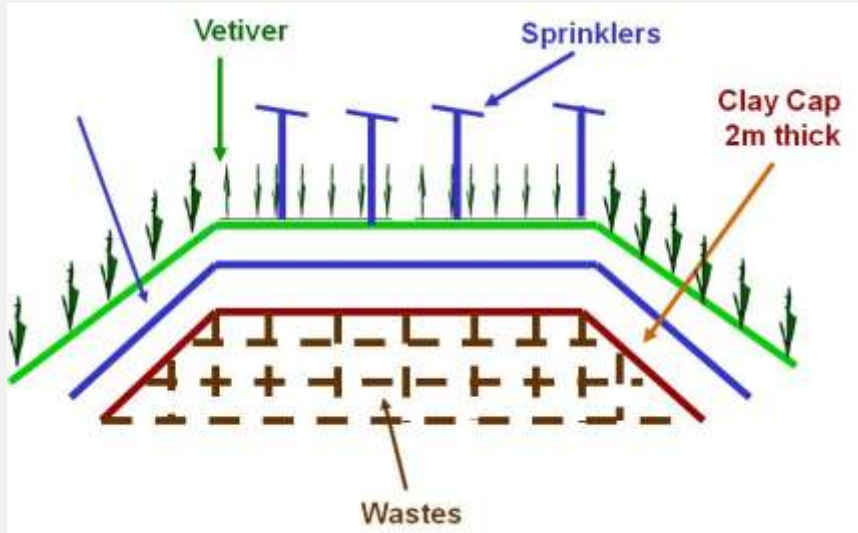
**This planting has
totally disposed
500-600KL/day**

12 month old



LANDFILL LEACHATE: Disposal of municipal landfill leachate in Australia

Spray irrigation on landfill mound: the diagrammatic cross section of the mound (top left), vetiver irrigated every day with leachate after planting (top right), two (bottom left) and twelve (bottom right) months after planting.



Vetiver growth was over 3m in the second summer

Growing in highly saline and polluted leachate pool



Fresh leachate pool



Twelve months after planting, the 3.5ha site disposing 4 ML/month



Disposal of landfill leachate seepage, Australia

This leachate runoff is highly contaminated with Cr, Cd, Cu, Pb and Zn



Three months after planting, good growth, no adverse effects



Planting Vetiver on seepage



Within a year vetiver has completely stopped the leachate seepage

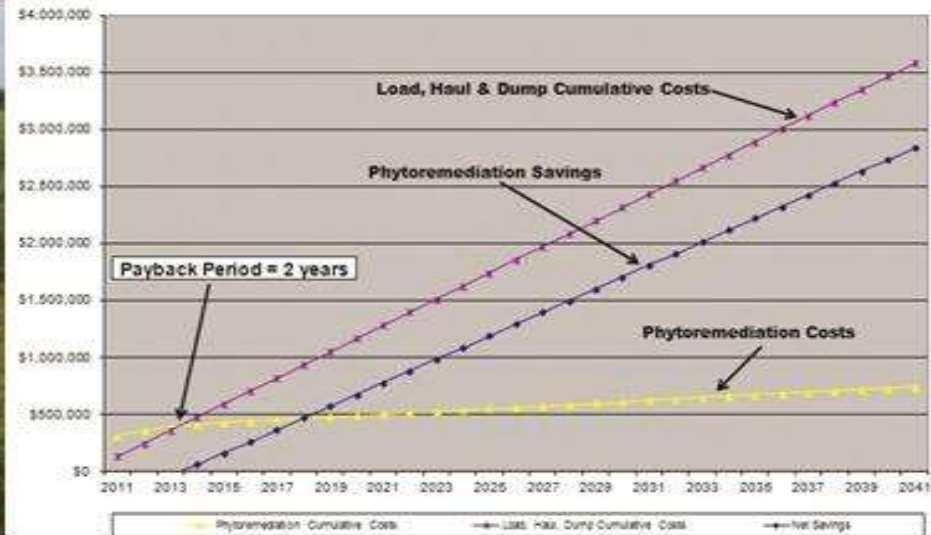


Disposal of industrial landfill leachate in Mexico

Early stage of vetiver establishment at Leon (left) and Poza Rica (right).



Disposal of industrial landfill leachate in USA



Disposal of landfill leachate in China

The dam 75m high and 100m long was built to retain garbage, vetiver was planted to stabilize the wall and to reduce seeping leachate. Previous attempts with other plant species have failed because of the toxic nature of the leachate.



INDUSTRIAL WASTEWATER : Disposal of industrial wastewater in Australia

Food processing factory effluent disposal by land irrigation. **The 22.5 ha site disposing 48ML/month**



TREATMENT OF PIG FARM EFFLUENT



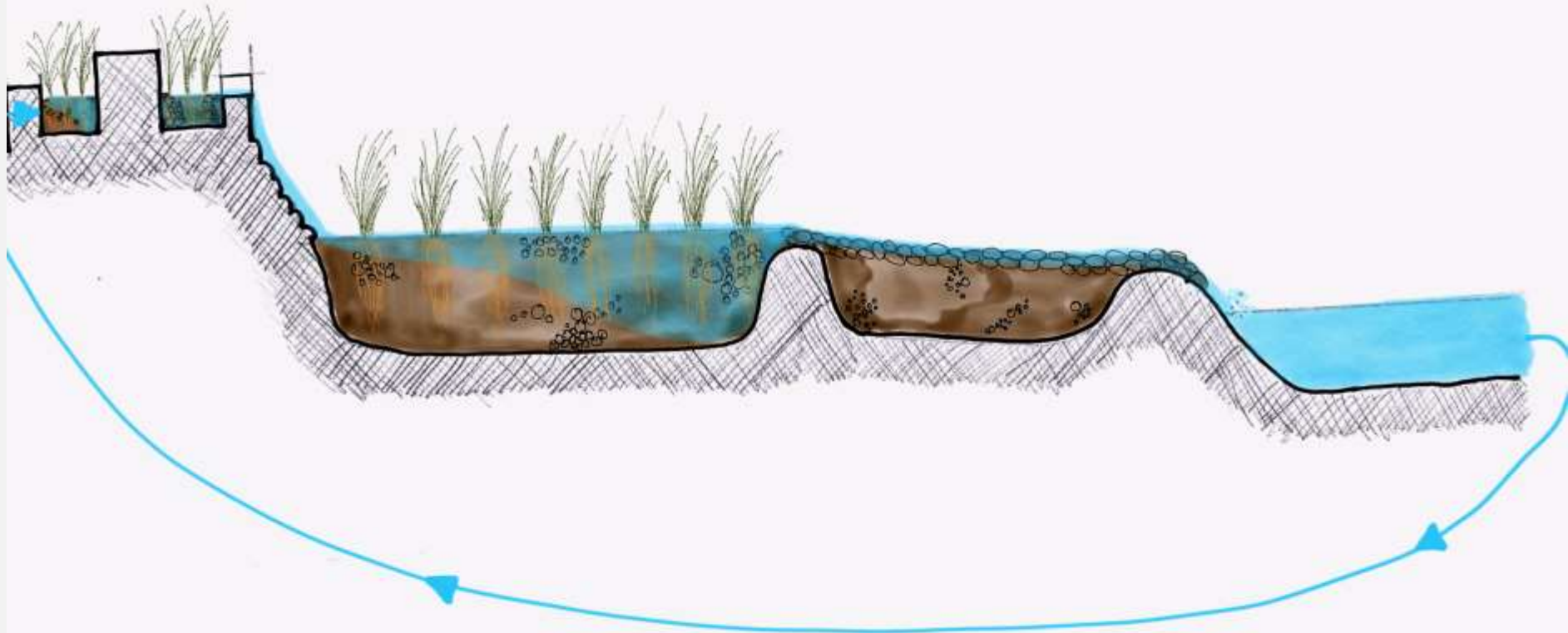
China



Vietnam



TREATMENT OF POLLUTED WATER AT PARQUE CEMENTARIO DE MALAGA (PARCEMASA)



Effectiveness of Vetiver in removing nutrient in polluted water at parque cementario de malaga



Flow direction



Top section (Input)

Middle section

End section



Flow direction



TREATMENT OF CONTAMINATED LAND

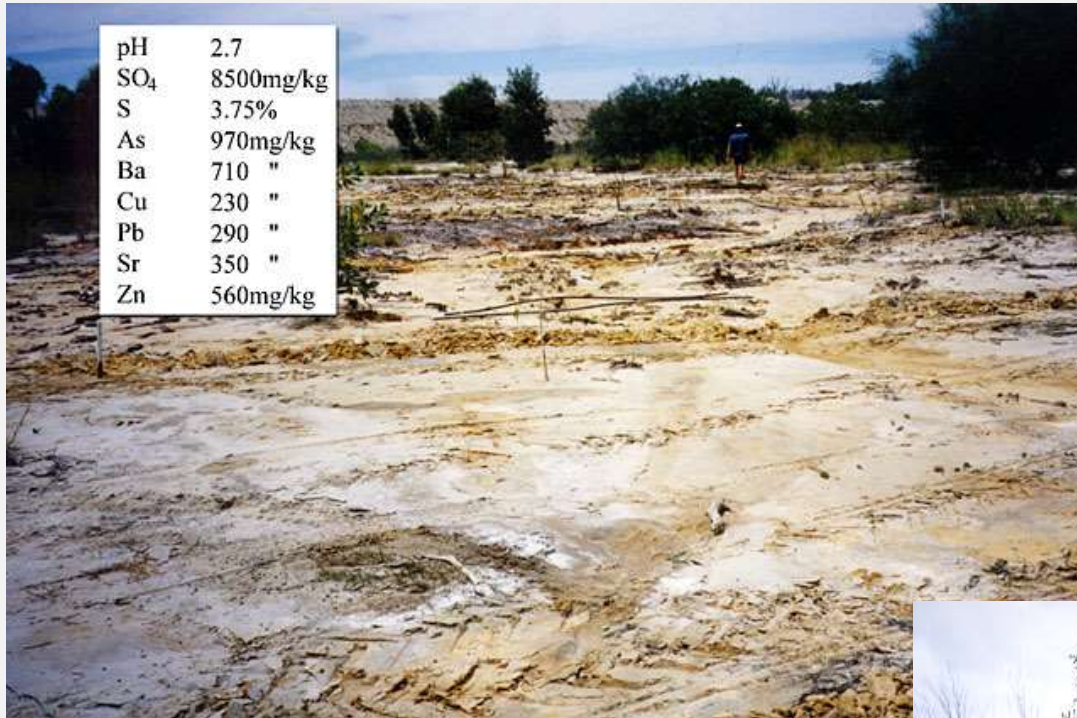
MINE REHABILITATION

Bentonite mine waste dump in Australia

This Bentonite mine tailings dump is barren with an extremely erodible surface which has low water infiltration and high runoff rates.



Old gold tailings dump



Kidston mine old gold tailings: An extremely acidic (pH 2.7, sulfate 8 500mg/kg) gold mine tailings in north Queensland

Good establishment and growth with lime and fertiliser application on this site

