

**The Use of Vetiver Grass System for Erosion Control and Slope
Stabilization along the Yadana Gas Pipeline Right of Way
The Yadana Gas Pipeline Project
The Petroleum Authority of Thailand**

Supporting images and diagrams to text

**Photographs illustrating the role of vetiver grass in stabilizing steep slope
In high risk area of the Yadana Gas Pipeline Project**

KP 46 + 600

KP 3 + 750



November 1997



June 1997



December 1997



October 1997



October 1999

On a steep terrain where vetiver grass is planted and rocks are arranged alongside



October 1999

After construction and reinstatement, Herringbone berms were built for preventing soil erosion and deflecting surface water off. Vetiver grass and perennial trees were planted along the side slope

**Photographs illustrating the role of vetiver grass in stabilizing steep slope
In high risk area of the Yadana Gas Pipeline Project**

At KP 19 + 800



March 1998

At KP 12 + 800



March 1998



January 1999



January 1999



October 1999

Cable Crane, a construction technique, was used woven bamboo in steep slope mountain area. After pipeline installation, the area was reinstated in the ladder pattern upon which vetiver grass was planted and legume and other grass seeds were sowed.



October 1999

Planting vetiver grass and applied the fence to stabilize the soil.

**Photographs illustrating the role of vetiver grass in stabilizing steep slope
In high risk area of the Yadana Gas Pipeline Project**



← KP 7 +
758



KP 12 +
280 →

After the pipeline installation and completely back-filled, the construction area was reinstated in the ladder-pattern upon which vetiver grass was planted and legume seeds were sowed in order to prevent soil erosion. Photo taken Oct. 99.



KP 12 + 800: Photo taken in July 1998 (left) and in October 1999 (right)
Herring-bone berms were built for preventing and deflecting surface water off. Vetiver grass was planted along side slope and saplings of perennial trees were planted at 3 m from pipeline center.



KP 45 + 230: Photo taken in June 1998 (left) and in October 1999 (right).
Vetiver grass planted and legume seeds sowed along the side slope to prevent soil erosion.

**Photographs illustrating the role of vetiver grass in stabilizing steep slope
in high risk area of the Yadana Gas Pipeline Project**



**PK 14 + 078: Photo taken in March 1998 (left) and January 1998 (right) After back-filling
reinstatement and arranging rocks along the stream**



**KP 12 + 080: Photo taken on June 1997 (left) and October 1999 (right)
On a steep terrain where vetiver grass and legumes were planted.
Saplings of perennial trees were also planted at a distance of 3 m from pipe center line.**



**KP 12 + 280: Photo taken on July 1997 (left) and November 1999 (right).
On a steep terrain where Ladder berms were built and vetiver grass was planted to prevent erosion.**

Fig. 1.1 : Flow chart of Vetiver Grass combined with re-vegetation agronomic erosion control and construction methodology

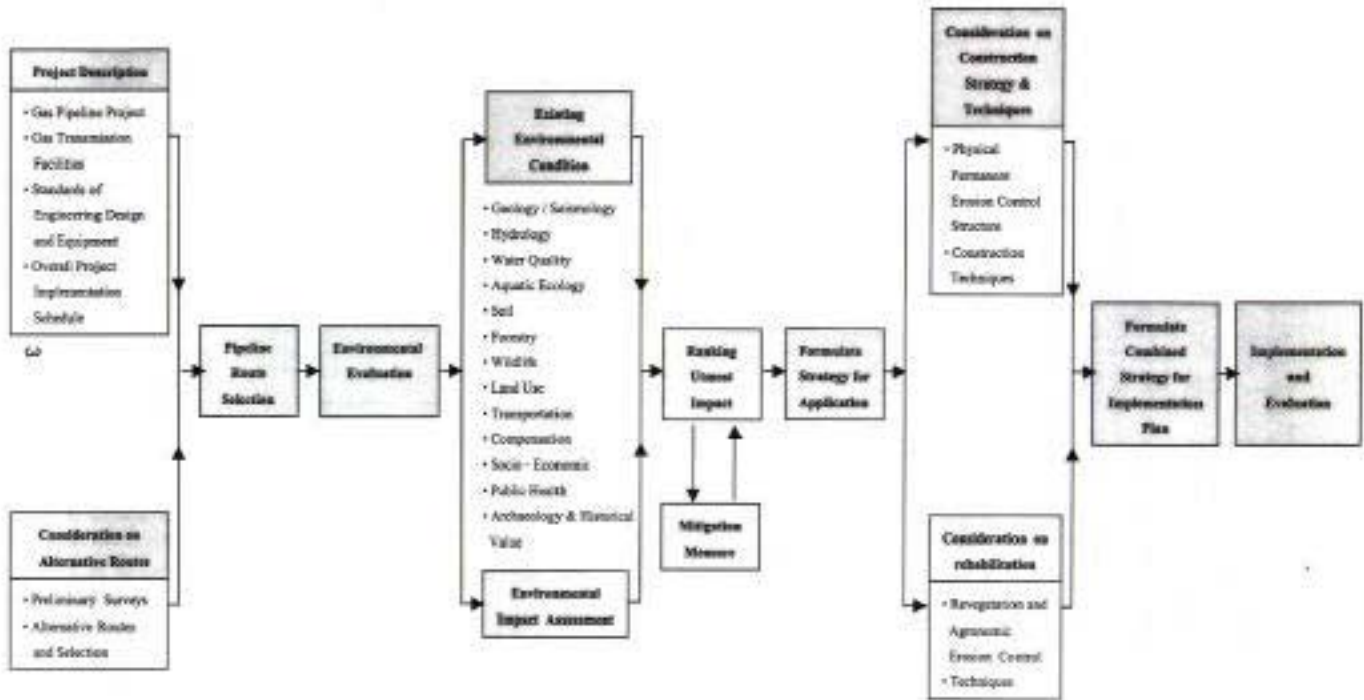


Fig. 3.2 : Alternative routes of Yadana Gas Pipeline for the 50 km strip to be passed through the forest

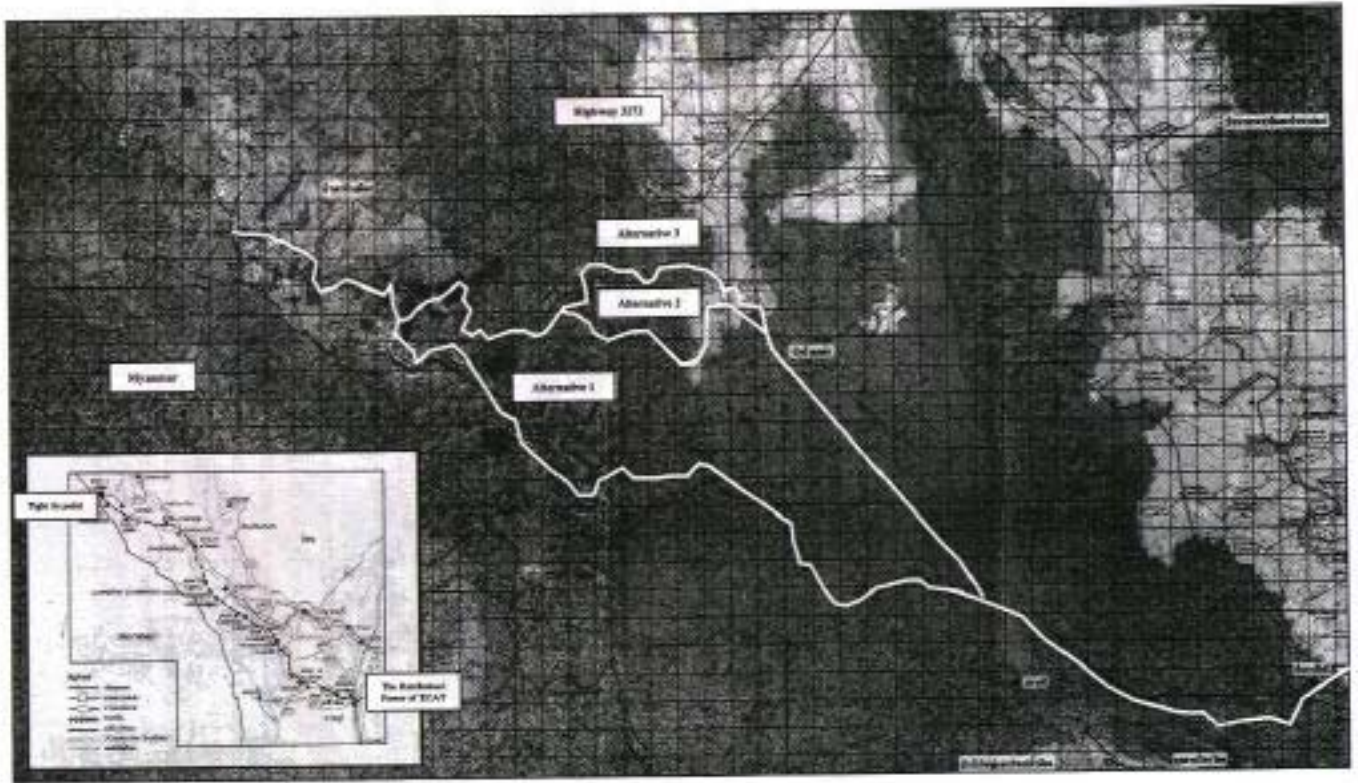
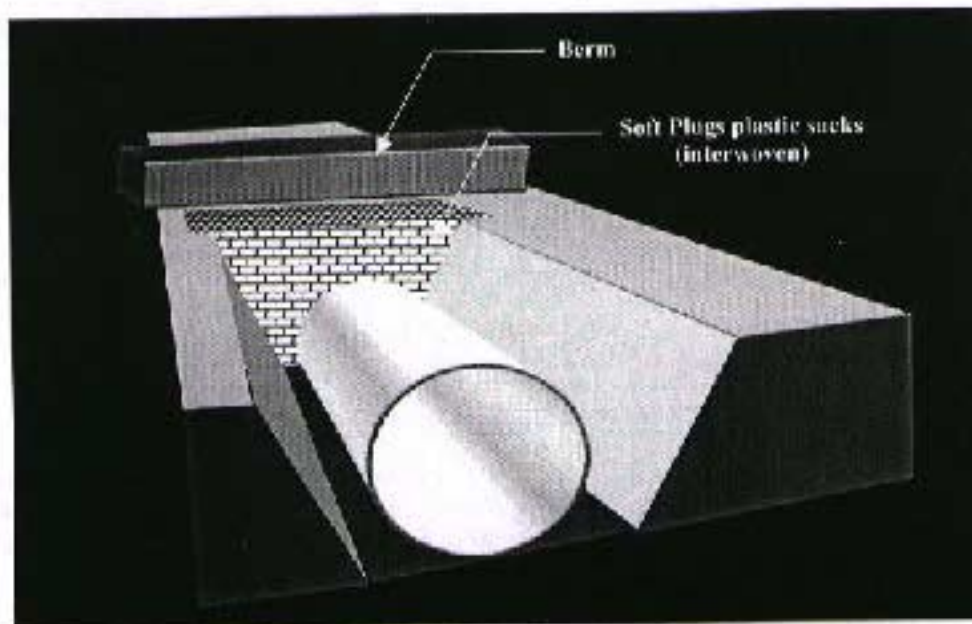
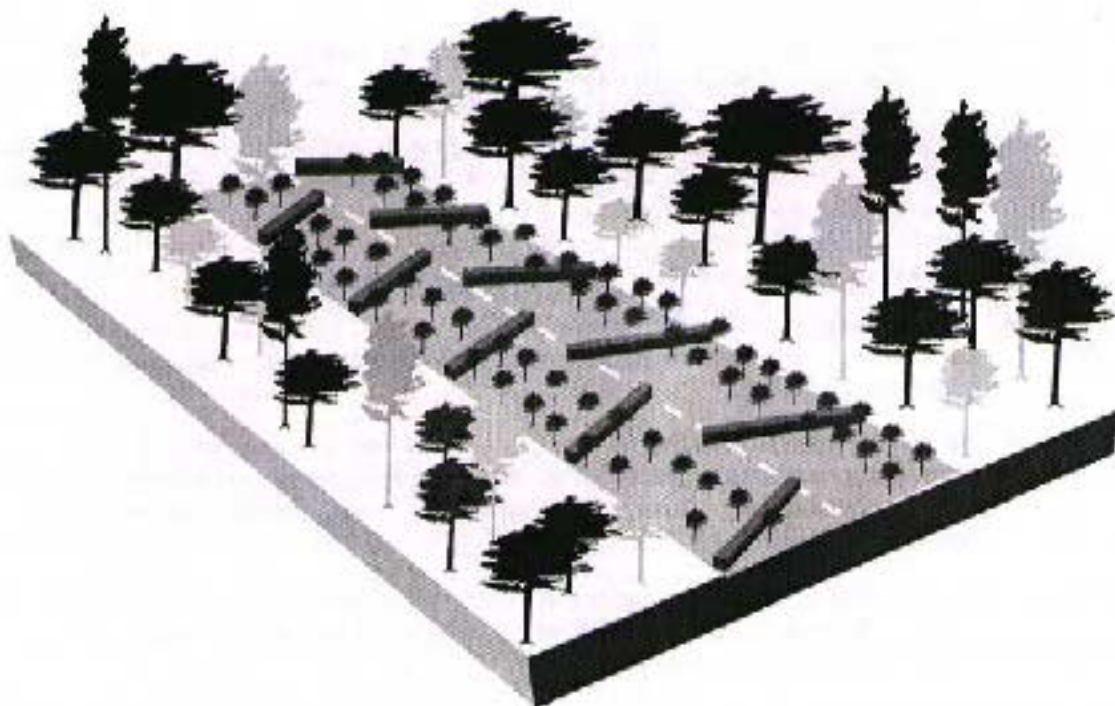


Fig. 6.1 : Soft Plugs with Berms



- Soft Plug forms an impermeable barrier, which can prevent mudslides or wash out of the back-fill material



- Berms are a form of surface drainage-control device to deflect surface water off the 20 m R/W
- Plant perennial trees at distance of 3 m from Pipeline center.

Fig. 9.1 : Vetiver grass combined with re-vegetation, agronomic erosion control methodology and construction engineering methodology is a key to erosion control success in the Yadana Gas Pipeline Project

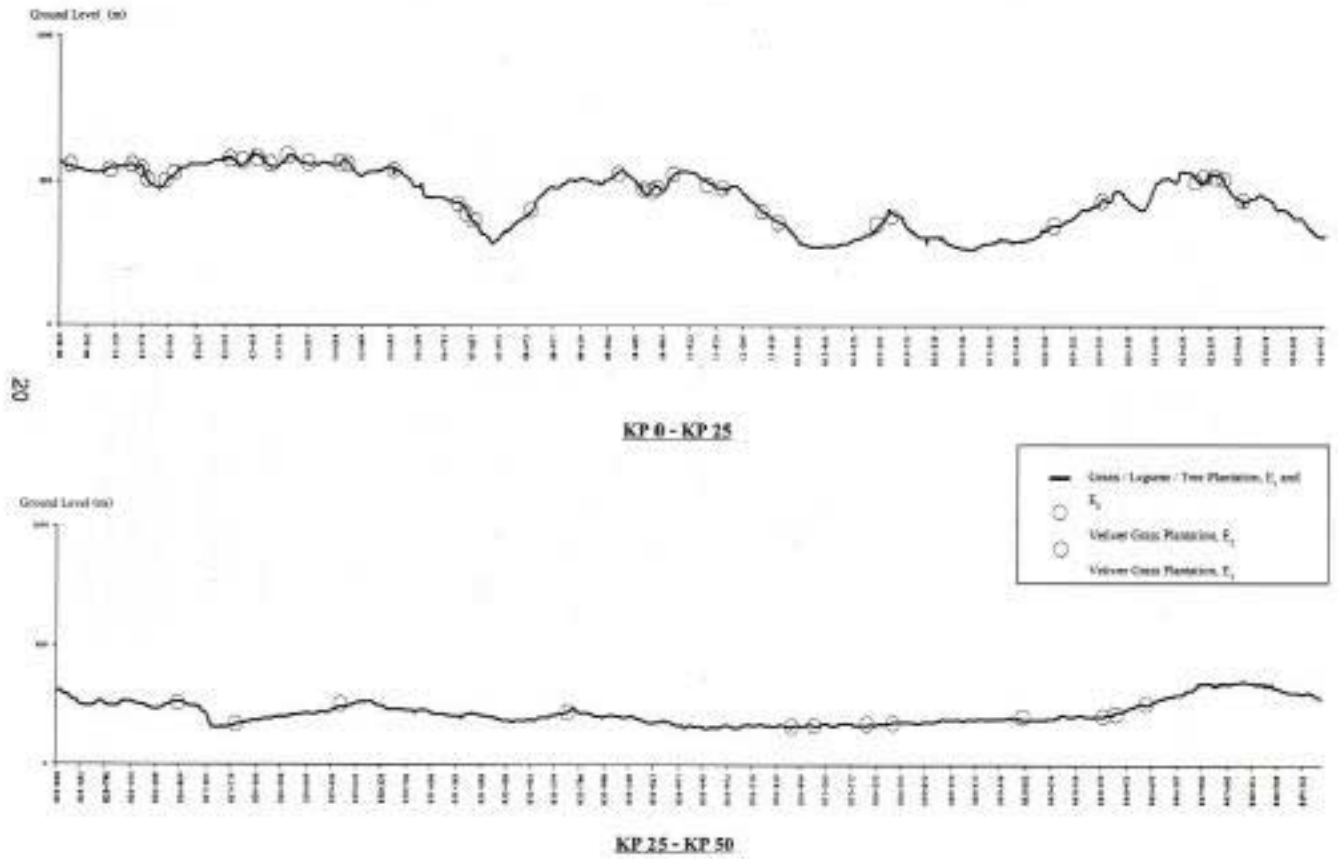
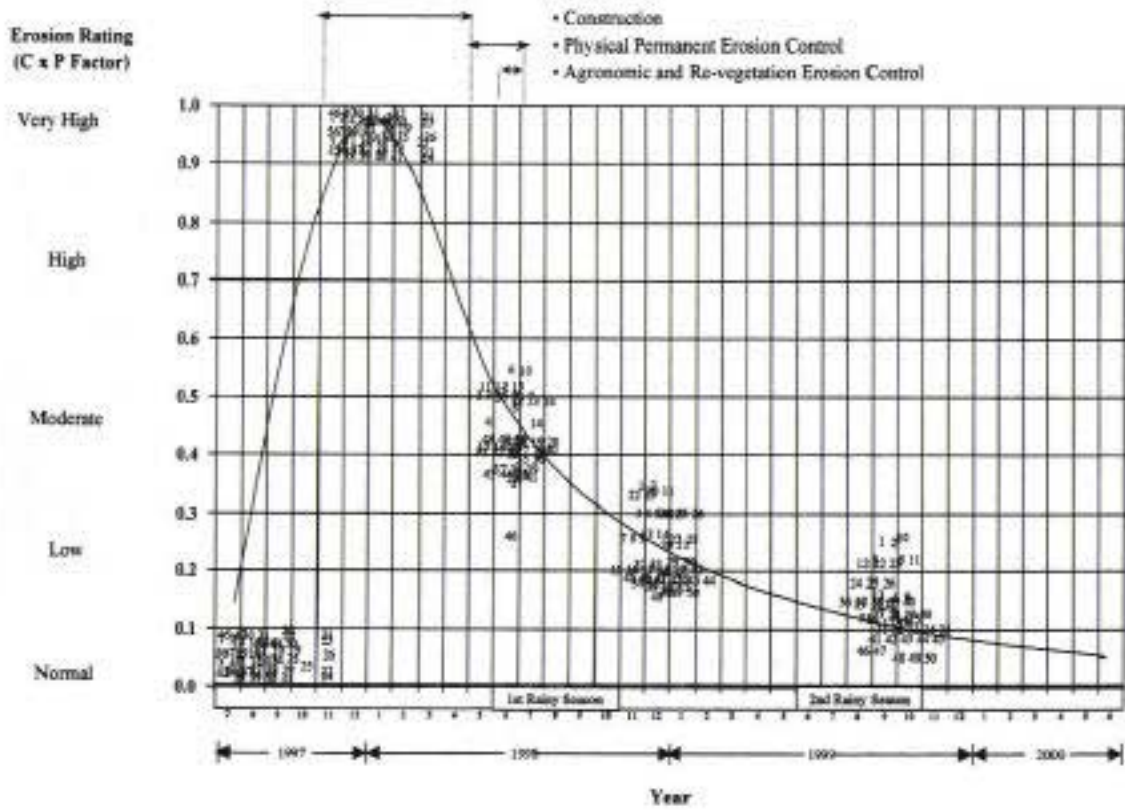


Fig. 10.1 : Rehabilitation performance i.e. multiplication results of the C and P Factor for each KP, from KP 1 to KP 50, is plotted against time.



**Photographs of the physical permanent erosion control structure
with agronomic and re-vegetation erosion control of the
Yadana Gas Pipeline Project of the Petroleum Authority of Thailand**



KP 46 + 300: December 1997



KP 46 + 300: July 1998



KP 46 + 300: January 1999



KP 45 + 300: October 1998



KP 46 : December 1997



KP 46 : January 1998