

VETIVER SYSTEMS APPLICATIONS
Highway Slope Protection along Kiunga – Tabubil Highway
PAPUA NEW GUINEA



EAGLE VETIVER SYSTEMS LIMITED
Green Solution for Sustainable Development

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Our Problem

- Roadside slope failures, often the result of monsoon rainfall events; block roads, damage pavement and pose numerous safety hazards.
- While there is no single method to repair and stabilize all slopes, several methods have proven effective, including improving drainage, changing the geometry of the slope and reinforcing the soil with pilings which have been proven to be costly for OTML.
- As evident, most of the road sections along the road corridor have been experiencing ongoing landslide problems affecting OTML business operations.
- The instability issues were result of ongoing erosional issues due to high rainfall activities and heavy road usage by vehicle freighters (Convoys).

Our Solution

- Roads and Civil Engineering Departments major cost concerns is the conventional method of stabilizing these failed sections.
- One of its long-term cost cutting, road improvement and maintenance strategy is to minimize damages to the Environment through the use of innovative green construction method (bioengineering) which is less damaging to the Environment.
- The strategy is intended to use Vetiver System Technology (bioengineering) to mitigate the failed sections and also to protect the sections that has the potential to fail over time.
- These provides for the right of every road user to a safer road with minimal disruptions to OTML's business operations.

Vetiver grass technology for erosion control and stabilization of highway slopes was a specific technique we used and we had some degree of difficulty and or challenges in establishing them on our highway slopes and they were:

- Low nutrient of planting soil,
- Peat soil
- Steeper slopes compare with farmlands.
- In some areas the local weeds growth were vigorous and overshadowed after 1 – 2 years of planting, which would then lead to the unsustainability of vetiver system. In order to achieve maximum benefit and sustainability of the vetiver system, we introduced a upkeep and maintenance program where local communities are engaged on a quarterly basis to weed the area.

The project area is located on the Kiunga – Tabubil – Mine Highway in the Western Province, where approximately 900k+ vetiver slips were planted on 15 highway slopes, with initial trial in 2018 in order to reaffirm and verify the Vetiver Grass Technology for erosion control and stabilization of highways slopes.

BIO-ENGINEERING SITES

Vetiver Grass Planting Map

Mine Pit



3. KM147.3

.38ha



4. Oakwood Camp

.21ha



5. RCE Yard

.1500ha



6. KM115.0

.26ha



7. KM99.3

2.3ha



2. KM99.0

1.5ha



10. KM107.5

.1105ha



8. OK Menga

2.19ha



1. KM98.2

1.8ha



9. KM147.2

Google Earth

Image © 2022 Maxar Technologies



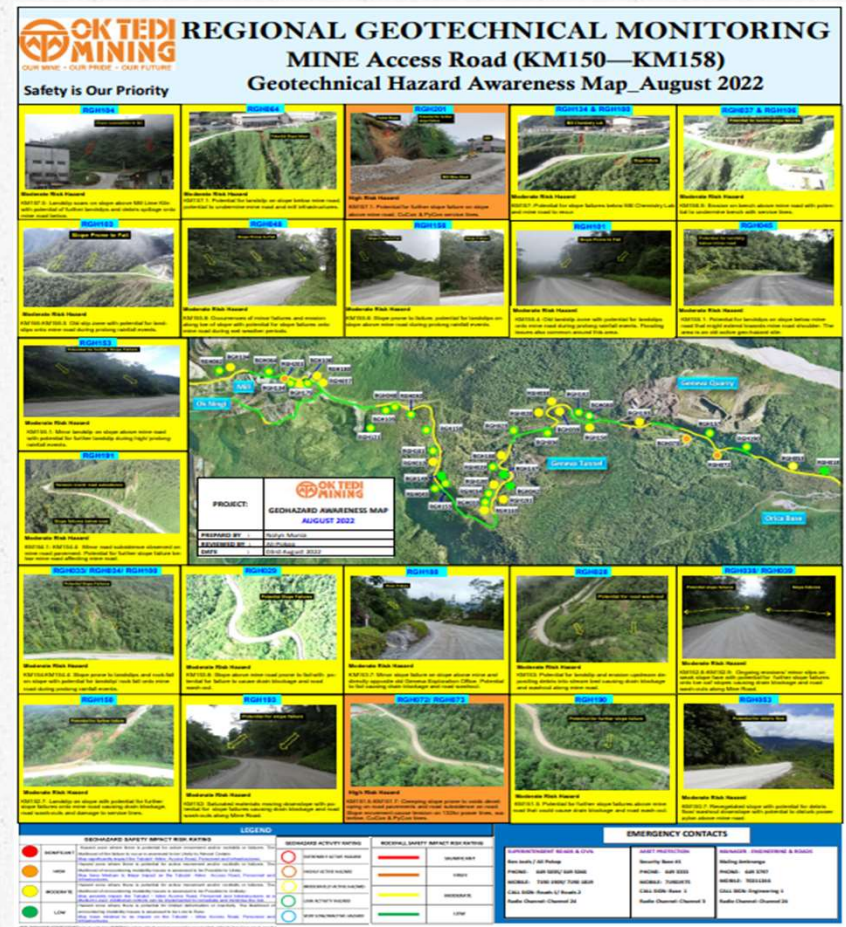
TO KIUNGA

The **Kiunga-Tabubil Highway** is:

- An all-weather gravel road that runs from the river port town of Kiunga through Tabubil to the Ok Tedi Mine (OTML) site.
- The road is around 158 kilometres (98 miles) long.
- The "highway" was built in the early 1980s.
- It is maintained by OTML, who are the greatest beneficiaries of the road.
- The highway, for the most part, runs parallel with the Ok Tedi River, which is an incredibly fast moving and volatile river since it is a high-volume waterway resting on a sand bank.
- Parts of the highway are often consumed by the river.
- The cost of maintaining this road is in excess of USD1.5 million a year.

METHOD: Geotechnical Hazard Assessments

- The Geotechnical hazard slopes along the road corridors identified are reported in the monthly Geotechnical hazard report and are plotted onto the geotechnical hazard awareness map for public consumption, as shown.
- These geotechnical hazard sites are reported under their respective Road Maintenance sections.
- These sites mentioned are randomly inspected as they pose immediate threat to the safety of the road users due to the ongoing instability and erosional issues due to high rainfall activities and heavy road usage.



Pilot Trials (2018)

Survey Monitoring

Monitoring is undertaken on a weekly basis and results for the last three months are summarized as shown in **Table** below. Most prisms displayed regressive to transitional style of movement that mostly trends towards the northeast.

Prism ID	Last Survey Date	Movement Direction	# Days Elapsed	Total Elevation Displacement (mm)	Cumulative 2D Displacement (mm)	2D Displacement Rate (mm/day)
KM98.1_01	8-Oct-17	Northeast	90	-18	14	0.16
KM98.1_02	8-Oct-17	Northeast	90	-31	240	2.67
KM98.1_03	8-Oct-17	Northeast	90	-18	175	1.94
KM98.1_04	8-Oct-17	Northeast	90	-30	59	0.66
KM98.1_06	8-Oct-17	Northeast	90	-1653	3437	38.19

Table 5: Survey Monitoring results for KM98.1

*** Prism KM98.1_05 was lost along with the slip debris.*



JAN 2018



FEB 2018



MAR 2018



MAY 2018



NOV 2018

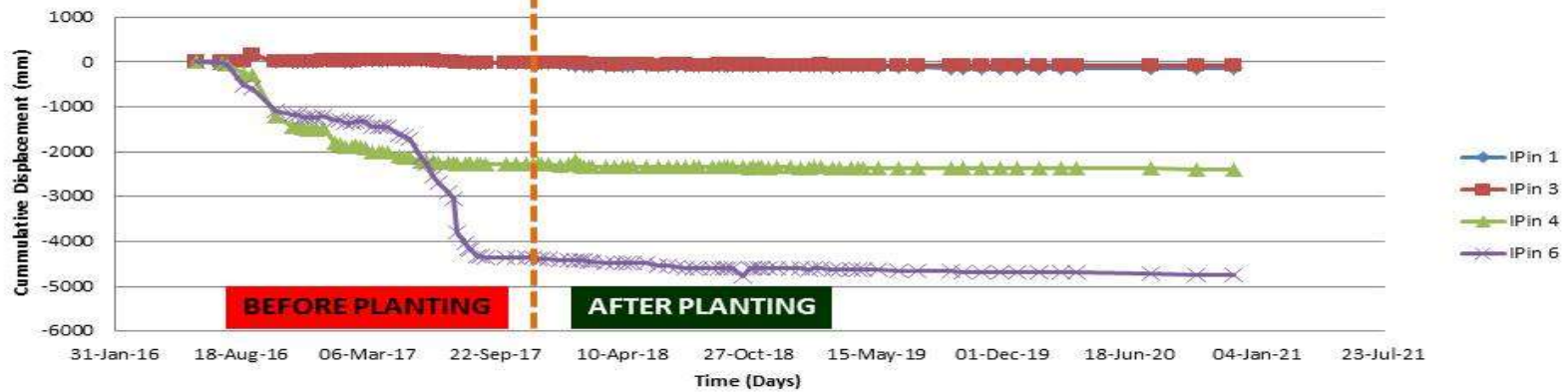


MAY 2021

Results from a slope stability trial using Vetiver in Tabubil has shown significant movement reduction hence improving stability.

The power of the **LIVING SOIL NAIL**.

Cummulative Elevation Trend - Vetiver Grass Trial





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VETIVER SYSTEM TECHNOLOGY

TABUBIL-KIUNGA Access Road (KM98)
Slope Stabilization Trial Using Vetiver Grass



OK TEDI MINING
SECURING OUR FUTURE
Safety is Our Priority

OK TEDI MINING
ROADS & CIVIL ENGINEERING
TOKSAVE
BIO-ENGINEERING TRIAL PLOTS
PURPOSE:
SOIL STABILITY AND EROSION CONTROL
BIO-ENGINEERING PLANT:
VETIVER GRASS
"LUKAUTIM NA EM BAI LUKAUTIM YUPLA"



Bioengineering Project initiative by Ok Tedi Mining Limited—Projects and Engineering Department



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VETIVER SYSTEM TECHNOLOGY

TABUBIL-KIUNGA HIGHWAY (KM99)
Slope Stabilization Trial Using Vetiver Grass



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SECURING OUR FUTURE
Safety is Our Priority



Bioengineering Project initiative by Ok Tedi Mining Limited—Projects and Engineering Department

SITE NURSERY



We had a nursery established on site to provide us quality planting materials for our on going project. This was important for the success of the project.



SUCCESS SITE

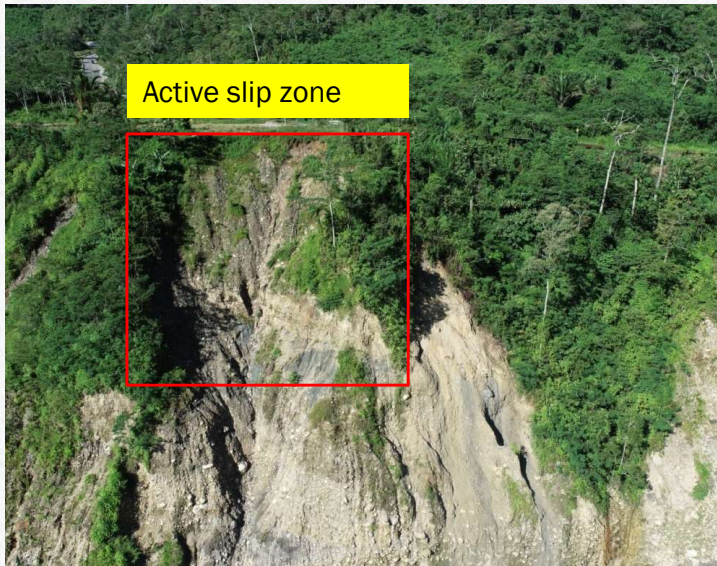


KM147 Significant Erosion & Slumping

These slope face immediately below the mine road has been subjected to progressive toe erosion by the Ok Tedi River navigating its way downstream. The slope comprises of soft to firm mudstone unit at the base and is overlain by unconsolidated limestone rubble from the historic Hindenburg landslide.

Remediation Works





Active slip zone



Strips planted along critical area

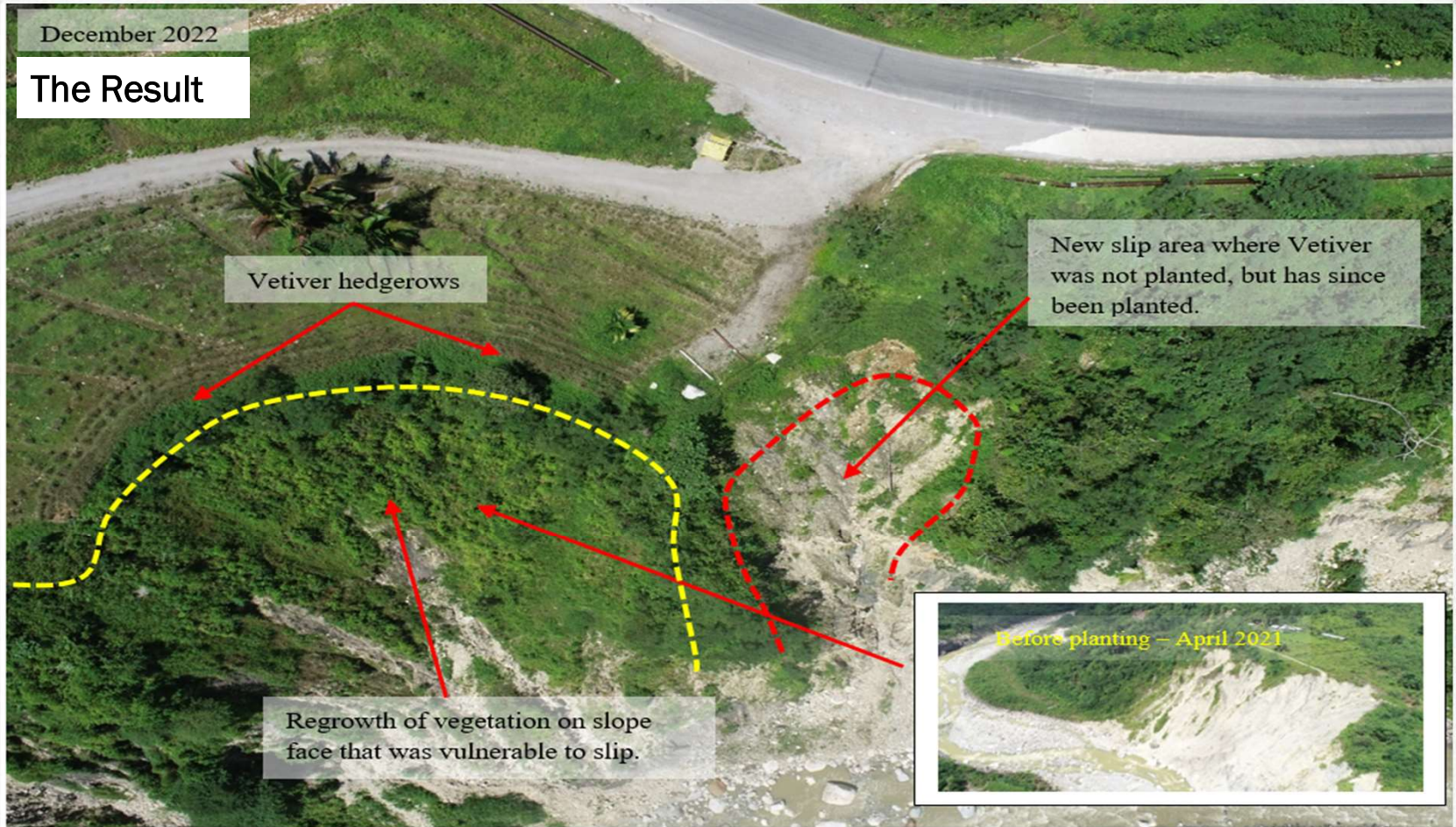
Bare rooted slips



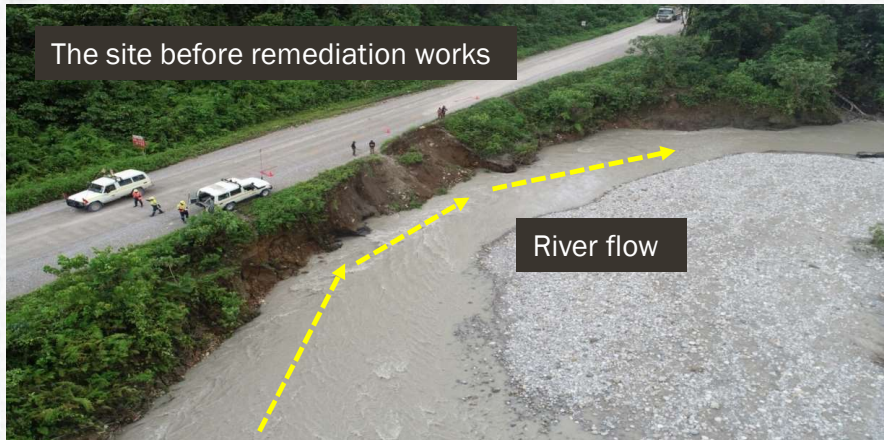


December 2022

The Result







The site before remediation works

River flow



New planting (1 month)



New planting (4 months)



Bioengineering (Vetiver)

Hard Engineering





Summary

- o Bioengineering (VS) method of managing Roads Geo-hazard risk have been very effective since 2018.
- o Fifteen (15) geo-hazard sites were remediated using Vetiver Grass (Bioengineering) and is ongoing.
- o The company has now incorporated VS into its yearly road maintenance plan going forward.



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Thank You

Think Green Think Vetiver