CASE STUDY

NANKA RECENT LANDSLIDE PROJECT

Phase 1

NOVEMBER 2011 - OCTOBER 2016

Location
Nanka, Anambra State, Nigeria

Client
The Presidency, Ecological Fund Office, Abuja

Project
Large-scale erosion gully

Lead designers
Sani Mustapha and Partners
Project background

In 2011 Rhino Construction Limited purchased the nationally advertised tender as part of a sealed bidding process. The procurement process was monitored by the Federal Ministry of Environment. 16 applications were submitted from competing construction companies.

14 companies submitted tenders for the project in June 2011. The procurement process was conducted under a sealed bid procedure which culminated in the public bid opening in July 2011. This preceded a further evaluation period, prior to the award of the final construction contract.

In November 2011, the contract was awarded to Rhino Construction Limited by the Presidency, Ecological Fund Office in Abuja. Sani Mustapha and Partners were the appointed project designers to whom Rhino Construction would liaise throughout the various stages of construction.

During November and December 2011, Rhino Construction initiated a number of pre-construction site surveys and then moved on to the site in January 2012, in order to commence works.

Nanka Recent Landslide Erosion Project: mid-term construction, photographed in September 2012, showing landslides caused by seasonal storm water. Geologically, the area comprises friable, erodible and sandy soils which are further subject to the effects of extreme erosion caused by storm water run-off. The lack of proper drainage infrastructure would be addressed during the initial phase of groundworks and site preparation.
Project brief

Phase 1 of the project is intended to provide gully base stabilisation through a combination of both hard and soft engineering solutions. This comprising of two mass gravity gabions walls with mattress toe protection coupled with extensive embankment planting on the slopes.

Phase 2 is currently in planning to provide additional stability to Nanka and Oko embankments which will complete the scheme.

The main challenges

- Local geology: friable, erodible and sandy soils which are further subject to the effects of extreme erosion caused by storm water run-off.
- Extremes of the local climate: here it is typically equatorial with six months of seasonal heavy rains.
- Training the local workforce: to assemble and install the large retaining walls to specification.
- Access for heavy machinery: break in to the gully through the Nanka side perimeter and create access to allow for the delivery of materials on site.
- Working with heavy machinery: to excavate site and prepare wall foundations, excavating drainage channels, with a build programme that would span three seasonal rains.

The construction programme

<table>
<thead>
<tr>
<th>Groundworks</th>
<th>Woven wire mesh mattresses and gabion baskets</th>
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<tbody>
<tr>
<td>- Excavate drainage channels (for perimeter storm drains).</td>
<td>- Installation of mattresses for ground stabilisation.</td>
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<tr>
<td></td>
<td>5m × 2m × 300mm woven mesh mattresses.</td>
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<td>280 number supplied by Enviromesh UK.</td>
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<tr>
<td>- Prepare ground, and install 3.9 km of reinforced concrete perimeter storm drains with stilling ponds.</td>
<td>- Installation of two stepped-face gabion retaining walls, 270 metres in length.</td>
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<td></td>
<td>2m × 1m × 1m woven mesh baskets.</td>
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<td></td>
<td>4,000 number supplied by Enviromesh UK.</td>
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<td>- Cut and fill gully storm water damage.</td>
<td>- Substantial quantities of plastic coated lacing wire to join the gabions and mattresses together to form one monolithic structure. Needle punched non-woven geotextile membrane to the rear of the walls and to their foundations.</td>
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<tr>
<td>- Shaping of the main embankments and groundworks preparation.</td>
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<tr>
<td>- Excavate site and prepare wall foundations.</td>
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<tr>
<td>- Install geotextile membranes.</td>
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<td>- Rehabilitation of a 3.9 km long asphalted community road.</td>
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<td></td>
<td>Remedial works</td>
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<td></td>
<td>- Cut and fill and remove 240,000 cubic metres of landslide embankment material.</td>
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<td>- Comprehensive programme of planting (fast-growing grasses, bamboo and cashew) to help reinstate landscaping to the embankments.</td>
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A community-wide initiative
Prior to starting construction, Rhino Construction was keen to foster a good working relationship with the local community. By providing both training and employment to the local workforce, this ‘local partnership’ approach contributed in a very positive sense to the success of the project as a whole.

Geography, geology and climate
Anambra State is situated in the south eastern belt, equidistant from Abuja (the capital), Lagos (the commercial capital) and Port Harcourt — in the oil-rich area of the Niger Delta. The climate here is typically equatorial with six months of seasonal heavy rains.

As a result of the climatic influences and local geological conditions (fragile, erodible and sandy soils which are further subject to the effects of extreme erosion caused by storm water run-off and poor infrastructure planning), the area at Nanka has suffered; both in terms of the effects on the local community and housing, as well as through the inevitable land loss and the resultant drop in agricultural output.

Preliminary works
Our first challenge was to establish a clear plan for dealing with the heavy rain and the resultant storm water run-off. This involved a number of surveys and follow-up groundworks in the installation of the area’s perimeter drainage channel systems.

Storm water gully preparation: The site shown here during a survey to determine alignment and levels. The photo shows excavation and the first stages in blinding the drainage gullies (a total of 3.9 km of gullies would be constructed in total). These gullies were built to help manage and channel storm water run-off away from the main construction zone into a local creek.
Storm water drainage infrastructure
Construction of the drainage infrastructure would need to consider the existing site topography, as well as providing an effective means to manage storm water and surface water run-off. The drains were designed and installed at the start of the project to carry heavy flood waters away from the main Nanka gully into the creek downstream. By improving communications with the rehabilitation of 3.9 km of local roadways, together with the associated drainage improvements, agricultural land would be once again freed-up to become productive. This would have the knock-on effect of providing reemployment for the local workforce at the end of the project.

The concrete reinforcement steelwork prior to concrete pour, shown here during the early stages of the works.

During the latter stages of gully construction, the completed and partly back-filled rectangular RFC drains. Remedial works included provision of asphalted community roads, fast-growing grasses and vegetation in order to reinstate areas affected by the site works.

The local Nanka construction team prior to initial training.
The Nanka gully landslide erosion scheme

Work in the main gully started in January 2012 and the initial, formidable challenge, was to break in to the gully through the Nanka side perimeter and create access for heavy machinery and trucks to the base of the gully.

This was completed within three months with work proper starting on shaping the gully’s embankments and preparing the wall foundations, from June 2012 onwards.

- Install hexagonal woven, wire mesh gabion mattresses for ground stabilisation/foundations.
  Individual mattress dimensions: 5m × 2m × 300mm
  280 no. mattresses supplied by Enviromesh UK

- Install two, four-metre high stepped face gabion retaining walls, 270 metres in length (each wall).
  Individual basket dimensions: 2m × 1m × 1m
  4,000 no. baskets supplied by Enviromesh UK

Ongoing challenges

Severe flooding occurred at the commencement of the seasonal rains in May 2012 as a result of a collapse of an existing storm water drain on the Oko side perimeter which created major landslides affecting the work in progress. An additional 240,000 cubic metres of landslide was cleared from the gully base, which inevitably delayed the build programme to the start of the following dry season.

As the project progressed, additional protection work was undertaken in the form of a lateral retaining wall installation at end of the two main structures. The scale of the project is evident to the far tree line.
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**Gabion wall installation**

Two parallel walls were constructed along the gully, each of which was 270 metres long by four metres high.

The ‘mass gravity’ walls were designed by the consultants and founded on a hexagonal woven wire mesh mattress apron. The courses of hexagonal woven wire mesh gabion baskets comprised a stepped face, with a geotextile membrane sited both behind and below the structure to prevent future erosion of the sub-soils through the walls.

Working in the gully is subject to climate extremes of high humidity and temperature. The day-to-day welfare and safety of the workers was critical — and keeping them hydrated was a major priority in order to maintain productivity.

Typically, 200 cubic metres of gabions and mattresses were assembled, installed, jointed and filled with a granite 6G graded stone each day.

Physical installation of the walls commenced February 2016 and were completed by September 2016.

**Gabion mesh wall installation**: The build project in the Nanka gully at mid-term with the local workforce constructing the second gabion wall. High temperatures and humidity in this region required constant vigilance in monitoring the workers and keeping them properly hydrated.
CASE STUDY: NANKA EROSION SCHEME, PHASE 1

Three-dimensional rendering showing the location of the finished gabion retaining wall structure. The four-metre high walls were constructed to prevent further erosion of the gully and comprised four courses of gabion mesh baskets, four metres wide at the base tapering to one metre wide at the top. Each wall, 270 metres long is founded on 5.0m × 2.0m × 0.3m gabion mesh mattresses at the foot and backed with a geotextile membrane.

### SPECIFICATIONS

- **GABION MESH BASKETS**
  - 4,000 no.
  - DOUBLE-TWIST
  - HEXAGONAL WOVEN MESH
  - 80 mm × 100 mm
  - PVC COATED GREY

- **GABION MESH MATTRESSES**
  - 280 no.
  - DOUBLE-TWIST
  - HEXAGONAL WOVEN MESH
  - 60 mm × 80 mm
  - PVC COATED GREY

- **GEOTEXTILE MEMBRANE**
  - 200 g/m²
Material specifications
Both the gabion mesh baskets and mattresses supplied by our UK technical partner, Enviromesh conformed to the following standards:

- BS EN 10223-3:2013 and has BBA certification
- Wire to have an ultimate tensile strength of between 350 to 550N/mm²
- Corrosion resistance: Zinc coated in accordance with BS EN 10244-2:2009 (Class A). Additional extruded organic polymer powder coating of nominal 0.5mm radial thickness

Rockfill
Granite: 6G grade (100mm to 200mm). Sourced from a local quarry in Ishiagu some 80 km away from the site. 16,000 tonnes at 35 tonnes per truck, two loads daily.

Geotextile membranes
Needle-punched, non-woven geotextile provided by our UK technical partners, Enviromesh.

Heavy machinery
Construction equipment included: Excavators, Caterpillar 960 Payloader and all terrain Volvo 35 tonne dumpers.

Above, finished section of gabion mesh wall with dry stacked, hand-faced finish for consistent appearance and aesthetics; 6G graded stone being delivered to site via 35T dumper; mass gravity walls during construction phase with evidence of geotextile membrane in the foreground.
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Above and left
Mid term progress photo showing the fourth and final course of the wall under construction, using (6G) granite stone, with double-twist hexagonal woven mesh gabion baskets. The finished quality of the facing stone having been hand-placed, is evident in the photo, left.

The management and construction team (from left)
Akins Awoyele, Procurement and Logistics Director, Rhino; Scot Kilgrow, Construction Manager Rhino; Neil Holmes, Director, Enviromesh; Trevor Jewitt, Managing Director, Rhino.
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**Location**
Nanka, Anambra State, Nigeria

**Client**
The Presidency, Ecological Fund Office, Abuja, Nigeria

**Lead Designers / Consultant**
Sani Mustapha and Partners

**Executing Agency**
Federal Ministry of Environment, Abuja

**Contractor**
Rhino Maritime Services and Construction Limited, Port Harcourt, Rivers State, Nigeria

**Technical support**

- **Site training**
- **Gabion / mattress products**
- **Geotextile products**

Enviromesh, Etruria, Stoke-on-Trent, Staffordshire, United Kingdom

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