

**Bangli Regional Landfill in Indonesia's Bali province is located about 60km outside of Denpasar, the provincial capital and home to more than 500,000 residents.**

**The region hosts Ngurah Rai International Airport - the main entry point into Bali - and numerous tourist destinations along Bali's popular white sands beaches.**



When the Indonesian central government approved funding for the Bangli landfill project, the Ministry of Public Works put the country on a new path for landfill design: Bangli would become the first landfill in Indonesia to be designed with a modern lining system. It would serve as both a pilot project and the benchmark for future designs throughout the country.

Though the Ministry wanted a geosynthetic containment and **drainage** system in the landfill, the original consultant's design did not demonstrate a full understanding of geosynthetic systems. The plans, which were submitted two years before the installation work was performed, indicated only a basic layout with plumbing. Of note, the geotechnical needs for the project, including a stability analysis, were absent.



When NAUE became the geosynthetic supplier for the project, the company also took on the role of providing the necessary geotechnical and analytical support that would enable proper system performance. The project would serve as a future standard for Indonesia's waste infrastructure, so it was vital to provide a thorough example for designing with and installing geosynthetics.

NAUE proposed some immediate changes. First, the slope angle of the landfill cell was reduced from 70° to 45°. The stability analysis performed by NAUE's engineers revealed that the original design slopes were too ambitious for the site. Not enough stability and safety could be guaranteed given the site's soils and seismic activity in the region.

Second, a soil veneer analysis was performed to identify the best geo-synthetic materials for use in the liner system. The US Environmental Protection Agency (EPA) standard helped provide a strong guide for this site. The standard requires a base-liner system to have a minimum of one clay liner, either compacted clay or a geosynthetic clay liner (GCL) and one impermeable liner HDPE geomembrane. NAUE proposed the use of Bentofix® for the GCL and Carbofol® (1.5mm thick) for the geomembrane.

Third, after calculating loads such as drop energy, heavy equipment working on top of the material and waste, and the additional load from the drainage layer and soil cover, a cushioning layer of Secutex® R804 was proposed.

Over this cushioning and separation layer, a 40cm-thick drainage layer (rounded gravel) was installed. The piping system was installed inside this drainage layer system, and over it was placed a filtration layer that uses Terrafix® R609 geotextile. A 30cm cover-soil layer forms the top of the system.

As a final piece of insurance for the site, an access road that runs between two cells at this difficult-to-design-for site was reinforced with **Secugrid® 40/40 Q1 geogrid**.

From the initial concept to modernize Indonesia's landfill practice to the final installation and construction quality assurance (CQA) measures, a great many aspects of geosynthetic design were showcased. The Bangli Regional Landfill is a welcomed and impressive construction for the country.



Materials:

**Bentofix® NSP4900 32,000 m<sup>2</sup>**

**Carbofol® 406 32,000 m<sup>2</sup>**

**Secutex® R804 29,500 m<sup>2</sup>**

**Terrafix® R609 10,300 m<sup>2</sup>**

**Secugrid® 40/40 Q1 8,600 m<sup>2</sup>**

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