

Use of Geosynthetics in Remediation of Bauxite Residue Disposal Area

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In this highly visible environmental application, geosynthetics were used to achieve dust control, soil reinforcement and erosion protection in the remediation of a former 75 acres (30.3 ha) bauxite residue disposal area located on the island of St. Croix, US Virgin Islands. In 2002, dike failures led to the uncontrolled releases of bauxite residue into a cooling pond, settling basin, and surrounding area (see Photo 1).

Bauxite residue exhibits a very fine-grained nature and is highly susceptible to water and wind erosion. This project involved remediation and closure of the disposal area and an additional 55 acres (22.2 ha) impacted because of the dike failures. The remediation was performed under a negotiated Consent Decree (CD) with the government of the US Virgin Islands and landowner. The Department of Planning and Natural Resources (DPNR) provided regulatory oversight.



Photo 1. BRDA Site Before Remediation

The CD stated that the goals of the remediation were to: stabilize the bauxite residue, assure that capped bauxite residue stayed in place, and provide long-term management and maintenance. To meet those goals, the remedial design included bauxite residue consolidation and regrading the disposal area and in-place capping. In addition, to assure long-term stability the design incorporated 4:1 slopes on the disposal area cap and stormwater controls to manage the 500-year storm event.

The various parties involved with the project had generally consistent objectives and perspectives:

- Project Owner – Schedule and cost control, regulatory compliance, avoid fugitive dust, and long-term stability.
- Engineer – Cost-effective engineering solutions, proper installation, and long-term stability.
- Regulator/DPNR – Meet CD requirements, timely completion to reduce downstream impacts, mitigate potential air quality impacts and be sustainable.

Geosynthetics were used to address several site challenges to achieve project objectives:

- Regrading the original disposal area (relocation of 600,000 cubic yards (458,700 cubic meters) of bauxite residue) exposed 75 acres (30.3 ha) to potential erosion and fugitive dust into adjacent neighborhoods. A 6 ounce (170-gram) non-woven geotextile was placed as the cap was advanced over the disposal area (see Photo 2) to control dust.
- Bauxite residue exhibited very low shear strength in the former cooling pond and in pockets on the disposal area. Geogrid was used to bridge the soft areas and enable placement of cap materials (see Photo 3).
- Design for high intensity storms and routing stormwater plus permitted plant discharges resulted in a 50 foot (15-meter) wide channel with design flows of 10,200 cubic feet per second (289 cubic meters per second). To prevent erosion, turf reinforcement mat was installed (see photo 4).



Photo 2. Dust Control



Photo 3. Geogrid Placement



Photo 4. TRM Installation

Using geosynthetics enabled the project to be completed in a timely manner while minimizing dust, preserving island resources, and maintaining the overall construction schedule (see Photo 5).

The site underwent a “test” one year following construction completion. Hurricane Maria, a Category 5 hurricane, passed 30 miles (48 km) southwest of site on Sept. 19-20, 2017. With sustained winds of over 100 miles per hour (160 kph) gusting to 136 miles per hour (220 kph), it knocked out all rainfall gauges on-island including the on-site weather station. 10.5 inches (26.7 cm) of rainfall was the last recorded total at the airport next to the site on Sept. 19, 2017. The heaviest rain was likely on Sept. 20, 2017 with rain lasting several days. Nearby Puerto Rico experienced rainfall up to 38 inches (96.5 cm)¹. Post-hurricane inspections indicated that the site experienced substantial stormwater. Inspections additionally showed no channel erosion in critical channels protected with TRM and only minor erosion in one area of unprotected channels.



Photo 5. Area A Site Post Remediation

It was evident that the use of geosynthetics were key factors in protecting neighbors from significant dusting events, preserving island resources, maintaining the construction schedule, protecting the site from hurricane damage, and in the overall success of this project.

¹ https://www.nhc.noaa.gov/data/tcr/AL152017_Maria.pdf