ECORESTCLAY LIFE+ Project: Geomorphic restoration of Aurora-CEMEX clay quarry (Tarragona, Spain)
Looking at mining restoration (worldwide)

Bank-berm model is the topography most widely applied worldwide.
Mediterranean climate

Teruel, Spain
Santa Engracia quarry, Guadalajara, Spain
Tropical climate
Sub-Atlantic climate
Topography based on “Bank-berm model with drain structures” favours runoff production and concentration, leading to soil loss and limiting plant colonization at least in climates with energetic rainfalls.
Rill erosion reduces soil moisture content in the slope and accordingly, plants diversity and biomass decrease.

The bank-berm model also produces off-site effects
Expert handle of runoff must be a basic criterion to address restoration design in mining reclamation projects

In environments under energetic precipitations
First practical conclusion: If you don’t add drainage network,

Nature will!!

Valencia, Spain
Expert handle of runoff can be applied along the three steps of mining restoration

√ Revegetation  
√ Soils management  
√ Landforming

... BUT LANDFORMS, TOPOGRAPHY, IS THE KEY ACTION, THE MOST INFLUENTIAL

GEOMORPHIC RESTORATION
How to apply Geomorphic Restoration in practice?
GeoFluv method (based in fluvial geomorphology) asks: What would be a stable, natural landform? And designs and builds that

Natural Regrade software

developed by Nicholas Bugosh, USA
WHAT GEOFLUV – NATURAL REGRADE DESIGNS

A) integrated 3D channel network (1) draining to a local base level (2) with concave profiles (3)

B) cross sectional channel geometry based on bankfull discharge and extreme events (4) Cross section increases downstream as water increases downstream (5)

C) slopes between channels have predominantly concave slope profiles (6)
Initial Aurora restoration was oriented towards conventional model: terraces and pond
GEOMORPHIC RESTORATION DESIGN

with GeoFluv

Stable landforms (hillslopes, streams)

Drainage network integrated in natural catchment
Lack of topsoil
Soil moisture monitoring at Aurora quarry

Different areas
- GeoFluv forms
- Talus (conventional topography)
Soil moisture monitoring at Aurora quarry

Soil moisture was measured with a TDR

Soil samples were also taken to determine each kind of soil transformation equation
Soil moisture content is higher in GeoFluv landforms than in conventional ones.

Soil moisture content (%): average from 18.11.2015 to 29-11.2016

Conventional topography

GeoFluv landforms

Soil moisture content is higher in GeoFluv landforms than in conventional ones.
Soil moisture content has been higher in GeoFluv landforms than in conventional ones.
TO CONCLUDE

GEOMORPHIC RESTORATION IS BASIC TO ACHIEVE A SUCCESSFUL ECOLOGICAL RESTORATION IN QUARRIES

IN AURORA, THE FLUVIAL NETWORK IS ABLE TO EVACUATE DISCHARGE PEAKS AND IT IS INTEGRATED INTO THE NATURAL CATCHMENT

IN AURORA, GEOFLUV LANDFORMS ARE MORE EFFICIENT THAN BANKS SUPPLYING WATER TO PLANTS

GEOMORPHIC RESTORATION ENHANCES LANDSCAPE QUALITY AS WELL AS ENVIRONMENTAL HETEROGENEITY
Geomorphic Restoration has been recognised as Best Available Technique by the EU.

Aurora quarry has contributed to that recognition.

Chapter 4: Techniques to Consider in the Determination of BAT

From the questionnaires
- Schöttelheide (DE) (54)
- Haniel (DE) (59)
- El Machorro kaolin mine, María José kaolin mine (ES)
- **Aurora clay quarry**, Somolinos and Nuria abandoned mines (ES)
- La Plata mine San Juan mine, Navajo mine, McKinley Mine (New Mexico); Log Creek Church abandoned mine lands (Indiana) (US)
Aurora quarry restoration

Winner in the FdA National Awards for Sustainable Development in Quarries and Gravels – April 2018

First prize for the Best Available Techniques

Selected to the European Awards UEPG 2019
Thanks!!

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