Bioengineering Quick Guide

Why Bioengineering?

The Department of Homeland Security (DHS) has always applied bioengineering standards for DHS facilities and projects managed directly administered by DHS, including DHS component agencies such as FEMA. Previously, these bioengineering standards were not consistently applied to grants from DHS or components. Effective March 2015, the DHS Director of Sustainability and Environmental Programs mandated that this bioengineering commitment now extends to DHS grants, including grants administered by DHS component agencies (i.e. FEMA). Prior to March 2015, FEMA wasn't mandated to consider Bio-Engineering techniques for FEMA grant projects.

In reviewing the administrative record, DHS found that past FEMA practices encouraged and incentivized stream bank hardening and stream crossing repair practices that are detrimental to fish and species habitat and that do not take full advantage of hazard mitigation measures that would reduce the potential for future damage and the impacts to fish habitat. DHS is concerned about Federal-assistance applicants pursuing stream bank repair practices that could be harmful to natural resources in order to restore their communities more quickly rather than engaging in the development of more thoughtful stream bank repair projects that could trigger a more extensive NEPA analysis. The new FEMA Directive (108-1) Categorical Exclusion (CATEX) N4 addresses this concern by encouraging bioengineering practices that improve environmental quality and wildlife habitat, and mitigate the impact of future floods.

In order to acknowledge the considerations of hard-surfacing and implement designs that incur less long-term maintenance or replacement of materials in streambank stabilization projects, DHS/FEMA is emphasizing designs that transfer some degree of the maintenance burden from local agencies to naturally regenerative systems. In other words, we are learning from nature and applying what we learn.

Context

The basis for this shift is embodied in DHS *Management Directive 023-01, Rev 01* and *Instruction Manual 023-01-001-01, Rev 01* that serve as the Department's procedure for implementing the National Environmental Policy Act (NEPA). *FEMA's* new environmental planning and historic preservation compliance process is captured in FEMA *Directive 108-1* and *Instruction Manual 108-1-1.*

FEMA Directive 108-1 now requires:

- Any new riprap or other hard bank designs for bank stabilization will require an Environmental Assessment to meet compliance with the National Environmental Policy Act (NEPA)

- Riprap at the inlets/outlets of culverts or in the immediate vicinity of bridge abutments, piers, footings or wing walls (pilings) will continue to be supported without bioengineering solutions. Immediate vicinity will be defined on a case-by-case basis by FEMA EHP staff as it is based on the minimum needed to protect the integrity of the structure. Riprap for bank stabilization greater than 50ft upstream or downstream will trigger an Environmental Assessment.

- The responsibility for the preparation of the EA and the eligible costs will be evaluated on a case-by-case basis in coordination with FEMA and state program staff, FEMA EHP staff, and the applicant.

- Projects that use bioengineering for bank stabilization typically will not require preparation of an Environmental Assessment.

What is Bioengineering?

Bioengineering, simply stated, uses natural systems in place of traditional engineering solutions, such as substituting root structures that reinforce soil for steel or concrete structures that "harden" soil. For example, a bioengineering project would plant indigenous plants that are good soil binders and bank stabilizers, preventing washing out and erosion of alluvial soil. Traditional hard-bank projects such as riprap or concrete channelization may simply speed water flow and cause problems downstream, if they are not undermined and wash away altogether. Bioengineering, as used in this regulatory context (CATEX defined in *DHS Management Directive and Instruction* cited below), is defined as "the use of a combination of biological, mechanical, and ecological concepts to control erosion and stabilize soil through the sole use of vegetation or a combination of vegetation and construction materials." Another similar definition is "the use of living and non-living plant materials in combination with natural and synthetic support materials for slope stabilization, erosion reduction, and vegetative establishment". The common denominator is that methods should emulate natural conditions or processes. Non-Bio-Engineering measures that involved hardening of banks, such as placement of rip-rap and steel sheet piles, are *not* covered by CATEX N4 and would require preparation of an EA or EIS.

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Talking Points

- Bioengineering provides a set of tools to stabilize soil slopes. It can be used as a stand-alone approach or in conjunction with typical "non-living" or "hard" engineering solutions.
- Bioengineering uses the similar concepts as steel reinforced concrete. Roots, plants and timber act as the reinforcing 'steel' in a soil and stone slope.
- Bioengineering techniques and concepts have been used in the United States as far back as the 1920's.
- USDA has been using Bioengineering to stabilize slopes in our national forests since the 1930's.
- Bioengineering projects may be expensive initially, especially for labor, replanting, possible repairs, and monitoring. Long-term, their maintenance costs will be significantly lower because of their resiliency and self-sustaining nature.
- Bioengineering projects usually require less heavy equipment excavation resulting in less cost and less impact to the surrounding area.
- Bioengineering uses locally sources materials generally available within a few miles of the project site. Typical rip-rap and solutions could result in long haul distances which increase project cost.

Reference Materials

Engineering with Nature FEMA
https://www.fema.gov/pdf/about/regions/regionx/Engineering_With_Nature_Web.pdf

Erosion Control Treatment Selection Guide
http://www.idot.illinois.gov/Assets/uploads/files/Transportation-System/Manuals-Guides-&-Handbooks/T2/L034%20Erosion%20Control%20Treatment%20Selection%20Guide.pdf

Low Water Crossings
http://www.fs.fed.us/t-d/php/library_card.php?p_num=0625%201808P

Riparian Restoration
https://www.fs.fed.us/rm/pubs/rmrs_gtr102_2.pdf

Soil Bioengineering Guide
https://www.fs.fed.us/t-d/pubs/pdf/fs683/ch_05.pdf

For more Information

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