BIO-ENGINEERING AND SHORELINE STABILIZATION MITIGATION TECHNIQUES FOR LAKES MANAGED BY DUKE ENERGY LAKE SERVICES

I. Bio-engineering

A. Definition

Bio-engineering is an effective scientific method, using a combination of natural and living materials, to stabilize eroded banks along the shoreline. Bio-engineering techniques vary according to a number of factors, including but not limited to; slope, soil type and wave action. Often a combination of techniques may be utilized to effectively control erosion in areas with varying condition.

B. Benefits

In addition to controlling erosion and the aesthetic value of a more natural shoreline, the use of native plants create additional habitat for wildlife. A permit and written authorization for any shoreline stabilization project is required from Duke Energy Lake Services. By utilizing bio-engineering as the primary stabilization technique, the permit application fee for shoreline stabilization is waived.

C. Native Plant Species

COMMON NAME	SPECIES
SOFT RUSH	JUNCUS EFFUSUS
ARROW ALUM	PETANDRA VIRGINICA
SHALLOW SEDGE	CAREX LURIDA
SILKY DOGWOOD	CORNUS AMOMUM
TUSSOCK SEDGE	CAREX STRICTA
BUTTONBUSH	CEPHALANTHUS OCCIDENTALIS
GRAY DOGWOOD	CORNUS RACEMOSA
YELLOW IRIS	IRIS PSEUDACORUS
VIRGINIA BLUEFLAG	IRIS VIRGINICA
PICKEREL WEED	PONTEDERIA CORDATA
BLACK WILLOW	SALIX NIGRA
SOFT STEM BULRUSH	SCIRPUS VALIDUS
GREEN BULRUSH	SCIRPUS ATROVIRENS
EELGRASS	VALLISNERIA AMERICANA
WOOLGRASS	SCIRPUS CYPERINUS

Note: Other plant species that are not listed may also be acceptable. Plant species that are not native to Duke Energy lakes should not be considered and will not likely be approved.

D. Techniques

Bio-engineering techniques normally include minor grading to allow for the installation of a rip rap toe, rock gabion, Bio-log®, crib wall or similar structure in high energy areas. The structures are then enhanced by the addition of natural/living material. For example.

1. live stakes – branches cut from living material and planted with stems and buds pointed upward. Initially they offer little to no soil reinforcement but do so after the first growing season once a root system becomes established. Often used with other techniques and conducted during the dormant season.

2. live fascine – branched bundled and secured together and placed in a very shallow trench along the toe of the eroded bank or in the bank face. They are usually installed in conjunction with geotextile fabrics above a rip rap or gabion toe.

3. brush mattress – includes both live stakes and live fascines. Provides protection of the shoreline upon installation and can be used in layers beginning just above a rip rap or gabion toe.

4. plant plugs – plantings with intact root stock. Placed directly into the bank face with the soil compacted around the root stock.

E. Follow up activities

Riparian Zone Management Information: Duke Energy will design and publish an informational piece that will provide property owners with a range of information about bio-engineering techniques, material sources, information sources and the value of riparian zone. This will be the final project in the Riparian Zone Management Initiative and will serve as a compilation of the on-going efforts through the year 2000.

II. Mitigation

A. General Guidance

Mitigation proposals should provide realistic but substantial allowances for reducing and relieving the impact of the proposed shoreline stabilization technique proposed. In general, mitigation activities should enhance the wildlife habitat in the immediate area of the stabilization activity and may consist of but are not limited to; enhancing fish cover under an approved pier or similar structure, maintaining a natural vegetative buffer along the entire shoreline of the lot, placing or maintaining secured cover and perching habitat (e.g. root wads, stumps, fallen trees, etc.) along portions of the shoreline.

B. Review Timeframe

Applicants for proposed shoreline stabilization activities identified in the Shoreline Stabilization Technique Selection Criteria (Attachment 1) that require wildlife agency review and/or mitigation must send their applications to the district game and fisheries biologist of the applicable NC/SC agency for a minimum 30-day review and comment period. In the absence of any finding of significant adverse impacts on fish and wildlife resources during this 30-day review period, the applicant will be allowed to proceed without further notice to send their completed application to Duke Energy Lake Services for approval. If there are findings of significant impact and those impacts are not adequately mitigated, then the applicant will not be allowed to proceed with the proposed stabilization activity. Applicants should make every effort to comply directly with resource agency recommendations.

C. Agency Review

Lake	(NC) James, Rhodhiss, Lookout Shoals, Norman, Mtn. Island, Wylie (NC)	(SC) Wylie (SC)	(SC) Fishing Creek, Great Falls/Rocky Crk., Wateree, Keowee, Jocassee, Gaston Shoals, 99-Islands
Agency Contact	Mr. Chris Goudreau NC Wildlife Resources Commission Rt. 6, Box 685 Marion, NC 28752-9229	Mr. Dick Christie SC Department of Natural Resources PO Box 4496 Rock Hill, SC 29732	Mr. Roh Ahle SC Department of Natural Resources PO Box 167 Columbia, SC 29202

*Applicants should fill out the Duke Energy Shoreline Stabilization Application form completely, attach any applicable mitigation proposals and send along with a cover letter to the agency contact.

**Agency correspondence must also be attached before sending the final application to Duke Energy for approval.