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Site Stabilization Information Sources

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This Technical Brief is the fourth in a series that addresses the issues of archeological site stabilization and protection. Each of the previous Technical Briefs in the series has described a potentially useful technique for maintaining the integrity of an archeological deposit. This one is about information exchange, which is part of the goal to foster interaction among governmental agencies, professionals, and the private sector. It is not a comprehensive guide to stabilization information; the several bibliographies that are available for different disciplines are better suited for that purpose. It also is not a substitute for contacting the agencies and professionals who have completed successful stabilization projects for detailed information. Rather, it is meant to provide a ready reference to sources that regularly collect and distribute information relevant to archeological site stabilization. These sources can be useful starting points in stabilization project development as well as important references for comparing the merits of appropriate alternatives. It also should encourage those who are planning projects to seek a wide range of multidisciplinary data, since other professions often are not aware of how important their knowledge and skills can be to preservation of non-renewable archeological resources.

The recognition that archeological sites form a class of non-renewable resources has become a key element of the legislative and regulatory process during the last several decades.[1] In the past, the principal alternative used to mitigate adverse effects on significant archeological resources subject to construction or other kinds of land development has simply been systematic archeological excavation. Recently, however, a direction of resource treatment has been to seek a broader range of mitigation alternatives that are in keeping with statutory mandates, and cultural resources management programs have begun to implement activities that provide long-term solutions and preservation in situ. Management of resources for future generations as well as the present is an objective of those mandates, and preservation through site stabilization is a significant aspect of that process.

This Technical Brief is designed to provide an introduction to the variety of sources of baseline stabilization data that can be used when site stabilization efforts are to be planned and initiated. These data will serve equally well for designing solutions to site loss problems and designing management plans to prevent the beginning of site loss. Since budgeted money for managing archeological resources seldom is adequate to meet all of the needs of any given agency, some degree of innovation must be applied when designing stabilization projects. As a direct consequence, archeologists and land managers who are responsible for archeological resources should have a multidisciplinary information base available for their use. Familiarity with this information will enable the cultural resources manager to communicate with engineers and other stabilization specialists during the design phase of a project.

There should be well developed mutual understanding between the cultural resources manager and stabilization specialists, particularly since the latter will follow traditionally accepted or defined standards. Engineers generally will approach a stabilization project design from the perspective of structural technique applications, and they have a tendency to design strengths into a project that are beyond the archeological needs for adequate site protection. Soil scientists and environmental engineers are likely to emphasize a naturalistic approach, such as revegetation. Also, it is not unusual for decisions to employ site stabilization methods to be made by cultural resources managers who may not have an extensive archeology background. Academic programs leading to an advanced degree in anthropology, within which archeology is a sub-field in the United States, may offer coursework in resource management, but few professional archeologists have had any exposure to the wealth of multidisciplinary expertise available to aid in the design and implementation of site stabilization projects. All of these factors highlight site stabilization as a significant alternative to be considered in archeological preservation activities that is both information-rich and management-oriented.

Projects that are designed specifically to protect an archeological property are nearly identical to those developed for construction and other land development purposes by the U.S. Army Corps of Engineers, the Soil Conservation Service, various transportation agencies, and other land managing agencies on a daily basis. The most import-

Shoreline stabilization test area, Cumberland Island National Seashore—placing shell rake, Cumberland Island, GA. (Photos courtesy Robert M. Thorne.)

Boat used to transport shell for experimental shell rake, Cumberland Island National Seashore, Cumberland Island, GA.

ant and elementary difference is that the cultural resources manager will be trying to protect a specific element *within* a matrix, i.e., evidence of various human activities in the past, and not just the matrix in which these data are found. The variety of demonstrably successful techniques for protecting archeological and non-archeological deposits are the same, however. The cultural resources manager can become familiar with these techniques and should participate fully in the design process. The cultural resources managers may experience some degree of difficulty with the project design process because of the difference in the magnitude of archeological stabilization projects in comparison to most other agency-sponsored stabilization efforts. It is important to understand that most site stabilization projects are down-scaled versions of traditional efforts with one primary difference: the goal is to protect an archeological resource that cannot be replicated.

Finally, cost effectiveness of any site stabilization program must always be a consideration in project design. Even though maximum resource protection must be the primary consideration in a design plan, the most expensive technique is not necessarily the best. If the cultural resources manager can provide alternative approaches to the design specialist, frequently innovative techniques and approaches can be devised. Familiarity with the variety of stabilization techniques available for a given situation will allow the manager to suggest ways to cut both initial and long-term costs. These can include such things as: using recyclable materials that can be acquired at little or no cost; the solicitation of contributed materials and supplies, the value of which may be used as a tax deduction by the contributor; or contributed labor from various agencies and organizations.

A stabilization project is likely to be most successful when a systematic approach is taken. Stabilization project designs should, in addition to providing protection to a resource, attempt to improve wildlife habitat, protect endangered species whenever possible, contribute to the aesthetic quality of the area around the resource, and/or provide some level of public education. A systematic approach may initially appear to make planning more difficult, but the advantages that will accrue from a design based upon sound applications of multidisciplinary methods will more than outweigh initial planning problems.

Sources of Technical Information

Corps of Engineers

The U.S. Army Corps of Engineers operates three major research units, called laboratories or centers, that produce information that can be useful in designing site stabilization projects. While each of these units is oriented toward either a geographic region or specific type of research, the kinds of data that they produce can cross regional boundaries or can be applied to other disciplines. The Waterways Experiment Station (WES) and the Coastal Engineering Research Center (CERC) are located in Vicksburg, MS. The Cold Regions Research and Engineering Laboratory (CRREL) is in Hanover, NH, and the Construction Engineering Research Laboratory (CERL) is in Champaign, IL.

Of the three laboratories, WES is the least specialized in regional coverage and research orientation, and to some extent, its breadth of research coverage is better suited to purposes of this discussion. Pertinent Technical Reports, Contractors Reports, and the *Archeological Sites Protection and Preservation Notebook* provide information that goes beyond waterways research and ranges from data on topics as diverse as vegetation and geosynthetics to cultural resources management and archeological site stabilization. An unannotated index of publications that is updated periodically is available. It is categorized by research unit and further subdivided according to the type of report, i.e., Technical Reports and Contractors Reports. Reports that are no longer available from WES may be obtained from the National Technical Information Service (NTIS). Any WES publication can be obtained through interlibrary loan from the WES techni-

cal library. Recently, WES has incorporated much of its experience in research and applications into a training course that serves to introduce the topic of site stabilization and focusses on protection problems in fluvial and lakeshore settings. In cooperation with the Denver Museum of Natural History, WES produced an introductory videotape that demonstrates a wide range of stabilization projects conducted in several different environments. A booklet is available that describes the range of WES technical assistance services that complement its research and publications programs.

The Coastal Engineering Research Center (CERC) is concerned principally with coastal engineering and stabilization problems, but some of the techniques developed there can be modified for application to inland environments. For example, CERC research on coastal dune stabilization can be applied whenever dune instability is a problem.

Recently, CERC publications have been listed in the same index with WES publications, while publications that predate CERC's relocation to Vicksburg may be obtained from NTIS. A limited number of CERC publications, such as the *Shoreline Protection Manual*, may be purchased from the Government Printing Office. Library access to WES and CERC publications, as well as some of those from CERL and CRREL, will be most readily available at the various Corps District and Division libraries. WES and CERC maintain a library that has an active interlibrary loan program.

Of the three Corps laboratories, WES and CERC research data are likely to be most applicable to the solution of archeological site stabilization problems. This is the case primarily because of the diversity of research interests housed at these two facilities. The research emphases of CRREL and CERL are more restricted in scope, with the former dealing exclusively with the colder regions of the world and the latter conducting primary research on construction related issues. Like the other labs, CRREL and CERL maintain indexes of publications that are available.

Department of Agriculture

In general terms, some of the most difficult pertinent information to identify has been produced by the various bureaus of the Department of Agriculture (USDA). In part, the difficulty arises from the very diversity of programs and research units within USDA, which maintains a national agricultural database at the USDA National

Crosstie erosion barriers, Toltec Mounds Park, AR.

Agricultural Library in Beltsville, MD. This database, AGRICOLA, can be accessioned from most university libraries and searched by author, title, and subject.

The bureau within USDA that is likely to prove most useful in providing information to be used in solving archeological site stabilization problems is the Soil Conservation Service (SCS). Local SCS offices have pamphlets and brochures that deal with solving erosion problems and each office has a copy of a *Technical Guide* that specifies erosion control practices that are applicable to specific States. The brochures and pamphlets can be excellent guides in selecting species of plants that can be used in protecting and maintaining archeological sites. When used in combination with the *Technical Guide*, an appropriate stabilization plan can be developed.

When more detailed information or specific site problem assistance is necessary and a revegetation approach is anticipated, the SCS Plant Materials Centers can be especially helpful. The SCS maintains 26 of these Centers that are established on a regional basis to develop erosion control vegetation suited for each Center's research universe.

These Centers develop and test appropriate species, and once developed, turn the propagation and sale of materials over to the private sector. A national database that lists plant materials nurseries is headquartered in Fort Collins, CO. Access to this database is through one of the Plant Materials Centers. Listings are organized by region, soil type, genus and species. Contacts with the Plant Materials Centers can be made through the SCS Regional Plant Materials Specialists, whose telephone numbers are given in the Appendix.

Information on the properties of soil as a material is available from the USDA Soil Sedimentation Laboratory in Oxford, MS. This unit's research emphasis, and consequently the potential for site stabilization applications, is integrative and multidisciplinary. An index of publications is available from the Librarian and can be obtained by calling (601) 232-2900. Some of these publications are technical beyond the needs of cultural resources managers, but others are useful particularly in developing case histories of erosion and filling processes.

Placing filter cloth on Hurricane Mound in preparation for placing riprap, Sardis Lake, MS.

National Clearinghouse for Archaeological Site Stabilization

The National Clearinghouse for Archaeological Site Stabilization at the University of Mississippi maintains a partially annotated bibliography whose entries are directly applicable to the solution of site stabilization and protection problems. The bibliography is divided into four sections: (1) Philosophy; (2) Technical Support; (3) Management Recommendations; and (4) Practical Applications. While the entries in the Clearinghouse bibliography have been drawn from a variety of sources, it is clearly evident that Corps of Engineers publications are central to the listing. This is in part a reflection of the way that the bibliography has been developed, but more significantly, it is an indication of the level of useful information available from the various Corps of Engineers research units. As a note of caution: no single entry in the bibliography is likely to provide sufficient background data to serve as the sole support for the design of a particular stabilization/protection scheme. Rather, data from several sources will need to be combined, and in many instances re-interpreted, to properly support project design.

The Clearinghouse conducts a variety of technical assistance activities related to development of archeological site stabilization programs. These have included systematic analyses of the current status of stabilization methodology, analyses of statutory and regulatory bases for stabilization as a preservation alternative, evaluations of preservation technology transfer, initiatives for training development, and design and testing in experimental stabilization projects. Many of these activities, especially training, have been completed in cooperation with governmental agencies, private utilities, and other organizations. The operational problems in conducting stablization projects, especially as they relate to mid-level administrative structures of organizations, have been analyzed also. The principal result of this work has been improved understanding of cost-benefit data. These data are critical not only to establish an informed basis for selecting appropriate stabilization technologies for projects, but just as important, to specify cost efficient monitoring and maintainance procedures compatible with the ways agencies conduct their daily business.

Other Information Sources

Once the mechanisms that are operating to destroy an archeological resource have been identified, other sources of technical support become reliable beyond those listed above. Some are regional in scope, but the

Rolled hay bales used for lakeshore protection/stabilization, Kentucky Dam Reservation, KY.

obtainable information can be creatively applied to fit a variety of environments and situations. Again, the objective of this Technical Brief is not to be a comprehensive guide to stabilization information, so the following short discussion of information sources is meant to illustrate potential sources that may be useful in the next stages of site stabilization project development.

The Tennessee Valley Authority (TVA) has, for a number of years, addressed the problems of site stabilization project design, implementation, and monitoring in different environments and under a variety of conditions. This has been accomplished as part of a research and demonstration program. One of the areas in which TVA has worked is strip mine reclamation. Techniques have been developed for stabilizing soils that were rendered unsuited for natural revegetation. To reach those goals, standard stabilization techniques have been altered to meet special needs. Similar information is available from the U.S. Bureau of Mines. TVA has sought to share the results of its site stabilization program through both publication of technical information and offering hands-on, problem-solving training courses.

The Federal Highway Administration has developed and maintains a set of standards that are applicable to highway right-of-way stability. These same techniques can be applied to solving archeological problems. Similarly, state-level Departments of Transportation or Highway Departments also maintain standards that may be useful.

Trade journals such as *Grounds Maintenance* and *Nursery Manager* are excellent sources of general information on site vegetation improvement and care. New products, including geosynthetics, and vegetation techniques are frequently detailed in publications of this type. Generally, each publication will include a list of companies that are suppliers for various geotextiles and other synthetic stabilizers. Most also include a classified advertisement section where suppliers of various products and revegetation materials are listed.

Finally, the various college and university departments in the academic studies of soils, geology, and engineering can provide important information once the parameters of a site stabilization project have been established and more specific questions need to be answered. They may be particularly important sources for regionally oriented information because their faculties often conduct research locally.

Conclusion

Clearly, archeological site stabilization is an important part of several organizations' programs and a significant preservation alternative. It should be clear also that in this Technical Brief the programs discussed mainly provide a starting point for sources of information or technical assistance, particularly because they represent systematic efforts to develop stabilization in a variety of contexts. There are numerous other sources of information from organizations that have conducted site stabilization projects. Frequently there is no substitute for identifying, through the information sources described above, for instance, and consulting with those contacts who have already implemented stabilization projects that appear to be similar to new ones being planned. Those individuals are able to clarify the importance of the environmental parameters that were evaluated, the implications of selecting certain preservation technologies, and, most significant, the results of monitoring and maintainance over time.

Information exchange will continue to be a fundamental goal of archeological site stabilization programs. The results of stabilization projects should be accessible, if only as manuscript correspondence generated for intra-agency purposes, and published whenever possible. The records of stabilization projects should be preserved for the long-term similarly to archeological excavation records. Such efforts will insure that professionals in archeological resources management can develop the most effective stabilization projects, and that in the future, when the time is right for archeological study, these significant sites are still accessible to contribute to our understanding of the cultural past.

Endnote

1. Among these are the Antiquities Act (P.L. 59-209), the National Historic Preservation Act (P.L. 89-665, as amended), the National Environmental Policy Act (P.L. 90-190), the Archeological and Historic Preservation Act (P.L. 93-291), and the Archaeological Resources Protection Act (P.L. 96-95, as amended). Regulations include "Protection of Historic Properties" (36 CFR Part 800, especially Section 14), "Secretary of the Interior's Standards for Historic Preservation Projects" (36 CFR Part 68), "Secretary of the Interior's Standards for Archeology and Historic Preservation" (48 FR 44716-44742, especially 44737-44738), "Protection of Archaeological Resources: Uniform Regulations" (18 CFR Part 1312, 32 CFR Part 229, 36 CFR Part 296, and 43 CFR Part 7), and U.S. Army Corps of Engineers Regulation ER1130-2-438, "Project Construction and Operation, Historic Preservation Program."

Selected References

Step 10 in the modeled approach to stabilization plan development (Thorne 1988:24) calls for identification of the range of potential solutions to resource loss problems based upon the minimal criteria of applicable preservation technologies. The bibliographical entries and annotations that follow are included here to demonstrate how available published data can be utilized to support the development of a stabilization plan. These examples can help in that identification effort. Data from these same references can ultimately be used to select the stabilization technique that will best solve a particular problem.

Keywords that are useful in Clearinghouse bibliographic searches follow each entry in all capital letters.

Thorne, Robert M.
1988 *Guidelines for the Organization of Archeological Site Stabilization Projects: A Modeled Approach*. Technical Report EL-88-8, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

This set of guidelines is designed to identify means for evaluating archeological site preservation technical options and to define a model for evaluating and selecting the proper options to be employed in specific situations.

In the absence of anything prior, these guidelines were based on interviews with Federal and State archeologists who had direct personal experience on specific site preservation situations. The guidelines were tested at a prehistoric mound site on Huffine Island, TN, and those efforts are presented as a case study in site preservation.

STABILIZATION, MODEL, GUIDELINES, TEST CASE, FILTER FABRIC

Gilbert, Susan
1989 America Washing Away. *Science Digest*, 94(8):31.

This article, written in layman's terms, discusses beach erosion relative to the destructive effects of wave action aggravated by rising sea levels and intensive coastal development. Diagrams show how waves move sand to form dunes and how destruction of beaches and barrier islands occurs because of the construction of groins, seawalls, and jetties. Dams constructed on the upper reaches of rivers prevent sand from reaching beaches, making them narrower and less able to absorb the energy of waves. The best solution for beach protection so far is to pile on new sand; however, imported sand erodes more quickly for two reasons. The equilibrium of the beach with the seafloor is destroyed since the beach is steeper and absorbs a heavier blow from each wave. Normal beach sand is almost always coarser than other sands and does not wash as fast as finer grained sand. The study of beach and dune ecosystems shows that salt-tolerant beach grasses indicate the inland movement of the high-water line. Using this information, construction is moved away from beaches to allow them to move and change naturally.

BEACH EROSION, WAVE ACTION

Keown, M.P., N.R. Oswalt, B.B. Perry, and B.A. Dardeau, Jr.
1977 *Literature Survey and Preliminary Evaluation of Streambank Protection Methods*. Technical Report H-77-9. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

This literature survey emphasizes known streambank protection methods. Mechanisms contributing to streambank erosion are identified, and the effectiveness of various methods are evaluated. Appendix B lists commercial concerns that market streambank protection products. A selected bibliography is included.

EROSION, STABILIZATION METHODS, BIBLIOGRAPHY

Whitlow, Thomas H., and Richard W. Harris
1979 *Flood Tolerance in Plants: A State-of-the-Art Review*. Technical Report E-79-2, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Both basic aspects of flood tolerance and applied aspects of establishing vegetation are discussed. Tables arranged by the common and scientific names of plants are included. This information would be useful in planning shoreline stabilization/revegetation efforts. Available from NTIS.

FLOOD TOLERANCE, PLANTS, RESERVOIRS, VEGETATION

Henderson, J. E., and F.D. Shields, Jr.
1984 *Environmental Features for Streambank Protection Projects*. Technical Report E-84-11, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

This report provides guidance for incorporating environmental considerations into streambank protection projects. The stability of the streambanks of a channel is related to both site-specific and basin-wide stream reach factors. Streambank erosion or failure is a natural fluvial process that is often accelerated by changes in geotechnical or hydraulic factors and especially human activities such

as reservoir construction and landuse changes. Streambank protection projects stabilize a streambank, preventing or stopping erosion. Such stabilization results in a range of environmental changes.

A review of available information on environmental features relevant to streambank protection projects was performed. Environmental features are those planning, design, construction, and maintenance procedures or practices that minimize adverse environmental impacts or enhance terrestrial and aquatic habitats and the aesthetic quality of land and water associated with streambank protection projects. Such features include structural and nonstructural designs; construction procedures that are environmentally compatible; maintenance procedures; and institutional, planning and management approaches for streambank protection projects.

Each feature is discussed in terms of concept, the purpose or appropriate use of the feature, environmental considerations, limitations to use of the feature, performance history, and cost.

STREAMBANK PROTECTION, VEGETATION, BANK STABILIZATION STRUCTURES

Allen, Hollis H., and C.V. Klimas
1986 *Reservoir Shoreline Revegetation Guidelines*. Technical Report E-86-13, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

The results of revegetation efforts at three lakeshore study sites are synthesized in this report. Pertinent revegetation concepts also are reviewed. A set of revegetation guidelines for shorelines having fluctuating water levels is presented. Emphasis is placed on reduced costs, proper planning, procurement of plant materials, appropriate planting times and methods, and special planting techniques.

EROSION, VEGETATION, SHORELINE, STABILIZATION

Schiechtl, Hugo
1980 *Bioengineering for Land Reclamation and Conservation*. The University of Alberta Press: Edmonton, Alberta, Canada.

This book illustrates how the products of scientific and technical research can be integrated with natural materials to realize effective and economic means of stabilizing, protecting, and actually improving the condition of the environment. It is a specific aid in improving cooperation between the civil engineer and bioengineer.

The author begins with a description of the technical preparation, usually done by civil engineers, and shows in succeeding chapters how bioengineering is integrated into these various protection methods to further enhance and protect earthworks and waterways. The criteria for the selection of various plant materials used in bioengineering are fully discussed, as is how, why and where they should be used. A section on the cost of bioengineering is included. The appendices contain a listing of suitable plants, commercially available, for a wide range of environments.

STABILIZATION, NATURAL MATERIALS, PLANTS, STABILIZATION STRUCTURES

Andropogon Associates, Ltd.
1989 *Earthworks Landscape Management Manual; Section 1*. Prepared for the Mid-Atlantic Regional Office, National Park Service, Philadelphia, PA.

This manual's primary focus is on development of management strategies and interpretive guidelines that resolve current conflicts between the requirements for preservation and the impacts of interpretation and visitor use at earthwork sites. The manual is intended to serve as a guide for all earthworks in the NPS system and for application to similar environments within the NPS system and requiring only limited additional study. A major observation noted during the review of the sites evaluated for the preparation of the manual was that earthwork sites stabilized by healthy, native plant communities are in the best condition, while some current management practices have contributed directly to the degradation of the resource. The manual is divided into two major sections. The first section is a review and evaluation of current management practices and an assessment of present vegetative cover types. Recommendations are made for an overall management program aimed at integrating preservation and interpretation objectives. The second section begins with procedures for evaluating and monitoring a site with respect to the proposed guidelines. Since many of the management techniques focus on native plant communities, the management of which is unfamiliar to many park employees, workshops at various levels of NPS employees were held. Actual hands-on instruction sessions were used as a means of both teaching park employees how to use the soil bioengineering techniques and to begin restabilization and revegetation on damaged ground surfaces which need immediate attention. Critical to the soil bioengineering techniques is the need to prioritize problem areas to include both short- and long-term management practices.

MANAGEMENT STABILIZATION, EVALUATION, SOIL BIOENGINEERING, NPS

Copies of the Stabilization Bibliography, from which the above selected references are taken, are available on request, either as hard copies or on 5.25-inch diskettes on the WordPerfect 5.1 word processing program. Requests should be addressed to: Dr. Robert M. Thorne, National Clearinghouse for Archaeological Site Stabilization, Center for Archaeological Research, University, MS 38677; telephone: (601) 232-7129.

APPENDIX

Selected Information Sources

US Army Corps of Engineers Research Units

Librarian
USAE Waterways Experiment Station
3909 Halls Ferry Road
Vicksburg, MS 39180-6199
telephone: (601) 634-3111

Librarian
USAE Coastal Engineering Research Center
3909 Halls Ferry Road
Vicksburg, MS 39180-6199
telephone: (601) 634-3111

Librarian
USAE Cold Regions Research and Engineering Laboratory
72 Lyme Road
Hanover, NH 03755-1290
telephone: (603) 646-4100

Librarian
USAE Construction Engineering Research Laboratory
P.O. Box 4005
Champaign, IL 61820-1305
telephone: (217) 352-6511

USDA Soil Conservation Service

Plant Materials Centers: Information on the nationwide program is available from the National Plant Materials Specialist. Regional information and contacts for the 26 plant materials centers are available from the respective Technical Centers listed below:

SCS National Plant Materials Specialist
Room 6150-S
Department of Agriculture
P.O. Box 2890
Washington, DC 20013
telephone: (202) 447-5667

Regional Plant Materials Specialist
Midwest Technical Center
Lincoln, NE
telephone: (402) 437-5355

Regional Plant Materials Specialist
Northeast Technical Center
Chester, PA
telephone: (215) 499-3918

Regional Plant Materials Specialist
South Technical Center
Fort Worth, TX
telephone: (817) 334-5282

Regional Plant Materials Specialist
West Technical Center
Portland, OR
telephone: (503) 326-2826

Tennessee Valley Authority

Reclamation Program
TVA
Natural Resources Program
Norris, TN 37415
telephone: (615) 632-1750

Cultural Resources Program
TVA
Natural Resources Building, 2C
Norris, TN 37828
telephone: (615) 632-1583

Soil Sedimentation Laboratory

Librarian
Reclamation Program
Soil Sedimentation Laboratory
P.O. Box 1157
Oxford, MS 38655
telephone: (601) 232-2900

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