WRP Technical Note WG-RS-3.2
January 1999

Geotextile Tube Structures: Example Contract Specifications

PURPOSE: This technical note provides an example set of contract specifications for the construction of sediment-filled geotextile tube structures. While the example presented here can be used as a guide by U.S. Army Engineer (USAE) District Contracting Officers preparing their own contract specifications, it is not intended as a substitute for knowledge regarding appropriate applications for geotextile tube structures; these applications are discussed in Davis and Landin (1997, 1998).

BACKGROUND: Geotextile tubes are polypropylene or polyester tubes, typically 100–1,000 ft (30–300 m) long and 8 to 45 ft (2.4–14 m) in circumference (Figure 1). These tubes can be filled with sand and used as semipermanent, nearshore, low-crested breakwaters that protect wetlands from erosion and as containment dikes for dredged material that can be used to create wetlands. Geotextile tubes are positioned empty and then filled by inserting a dredge discharge pipe into ports on the tops of tubes. A typical geotextile tube would sit on top of a scour apron held in place by anchor tubes (Figure 2).

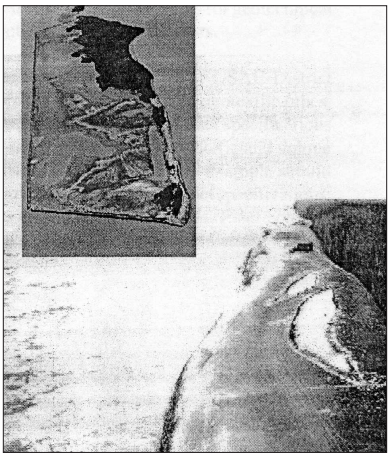

Figure 1. Geotextile tube deployed in field, with *S. alterniflora* to right and open water to left; inset shows dredged material island with geotextile tubes

Many USAE Districts are investigating the use of geotextile tubes as structures in coastal and estuarine projects and several Districts have already constructed such projects. Based on experience with existing projects, some USAE Districts have developed contract specifications for geotechnical tube projects in an effort to limit reliance on the judgement of dredging contractors.

The example contract specifications provided in this technical note may assist USAE District Contracting Officers who are preparing contract specifications for projects using geotextile tubes. Portions of the specifications presented in the example are derived from real contract specifications used by the Galveston and Baltimore Districts. But, because every project has specific and unique requirements, the example presented here should not be used "as is." Instead, the example should be considered a guide that highlights various issues that should be covered by contract specifications. The example also suggests the level of detail required to ensure desirable results. Final contract specifications should be reviewed by District legal staff. Text boxes with explanatory notes accompany subsections of the example contract specifications.

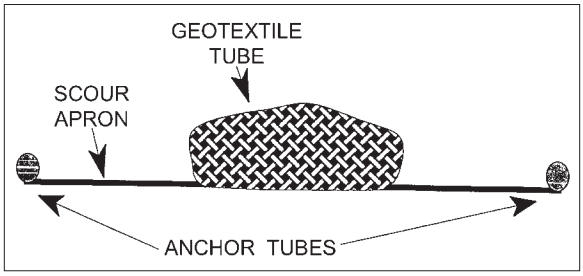

Figure 2. End view of a typical geotextile tube with scour apron and anchor tubes

EXAMPLE CONTRACT SPECIFICATIONS

PROJECT TITLE
SECTION ####[1]
GEOTEXTILE TUBE STRUCTURES

1. SCOPE: The work covered by this section includes: a) provision of all plant, labor, equipment, and materials; and b) performance of all operations in connection with the construction of the geotextile tube structures between Stations *xxx*[2] and *yyy* (as shown in the attached drawings) using sandy dredged material.

2. APPLICABLE PUBLICATIONS: The publications listed in Table 1 form a part of these contract specifications to the extent that they are referenced. The publications are referenced by basic designation only.

Comments: The American Society for Testing and Materials (ASTM) has developed standards that are useful in a geotextile tube project. Those ASTM standards that are referred to in the text of the actual contract specifications should be included in the "APPLICABLE PUBLICATIONS" subsection. For the purposes of this example, 14 potentially relevant references have been listed.

[1] Throughout this example, "####" refers to section numbers of the contract. Because the example presented here only represents the contract specifications for geotechnical tubes, and not the entire contract, the "####" notation is necessary. In an actual contract, this notation would be replaced with numbers referring to relevant sections of the contract.
[2] Abstract station numbers are used in this example; the example does not include drawings.

Table 1. American Society for Testing and Materials (ASTM) Publications

ASTM Designator	Year	Title
ASTM D 422	1990	Test Methods for Particle Size Analysis of Soils
ASTM D 3786	1987	Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method
ASTM D 4354	1989	Sampling of Geosynthetics for Testing
ASTM D 4355	1992	Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
ASTM D 4491	1992	Water Permeability of Geotextiles by Permittivity
ASTM D 4533	1991	Trapezoid Tearing Strength of Geotextiles
ASTM D 4595	1986	Tensile Properties of Geotextiles by the Wide-Width Strip Method
ASTM D 4632	1991	Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	1987	Determining the Apparent Opening Size of a Geotextile
ASTM D 4759	1988; R 1992	Determining the Specification Performance of Geosynthetics
ASTM D 4833	1988	Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4873	1988	Identification, Storage, and Handling of Geotextiles
ASTM D 4884	1990	Seam Strength of Sewn Geotextiles
ASTM D 5321	1992	Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method

3. SUBMITTALS: Government approval is required for submittals with a "GA" designation. Submittals designated "FIO" are for information only. The following shall be submitted in accordance with section ####, CONTRACTOR SUBMITTAL PROCEDURES.

Comments: The SUBMITTALS subsection lists items that the Contractor must submit to the USAE District Contracting Officer. The first two sentences distinguish between submittals that require approval and those that do not. In this example, all submittals require approval.

SD-01 Data GA

Submit geotextile tube manufacturer's catalog cuts, brochures, specifications, and product data for approval.

Comments: The Contractor is usually given the opportunity to select a manufacturer or supplier provided that the fabric and tube fabrication meet the specifications set forth in the contract. Therefore, the Contractor should submit pertinent information from the manufacturer or supplier for approval.

SD-08 Statements GA

Submit a Plan of Construction describing the sequence of operations for the construction of the geotextile tube structures. The plan should conform to the general guidelines presented in these contract specifications but should also include additional information. The plan shall address the approach and techniques required for a) fabrication of the geotextile tubes, scour aprons, and anchor tubes, b) construction site preparation, c) placement of the scour apron and anchor tubes, d) geotextile tube deployment and filling, and e) monitoring and analysis of parameters such as characteristics of the material to be dredged, pipeline pressure, and hydraulic-fill characteristics. Equipment to be used for geotextile tube placement and filling shall be specified.

Comments: Criteria for the Plan of Construction may be added or removed as needed from this subsection to suit individual project requirements.

SD-09 Reports GA

Submit the results of gradation testing (in accordance with ASTM D 422) on the sand used to fill the geotextile tubes.

Comments: Samples of the sand used to fill tubes should be collected and analyzed to be sure they meet the contract specifications. The sediment should also be sampled after it is placed in tubes.

SD-14 Samples GA

Submit clearly identified samples of geotextile fabric to be used for the geotextile tubes, scour aprons, anchor tubes, and all other geotextiles required for construction of the geotextile tube structures. Each sample should have dimensions of 1 ft × 1 ft (0.09m^2).

Comments: The size of the sample required depends on the needs for testing. A 1-ft^2 (0.09-m^2) piece of fabric may be sufficient, as suggested in the example. However, some projects have required samples as large as 15 ft (4.6 m) by 5 ft (1.52 m).

4. DELIVERY, STORAGE, AND HANDLING:

4.1 General. Geotextiles for tubes shall be delivered only after the Contracting Officer has received and approved the required submittals. Geotextiles shall be labeled, shipped, stored, and handled in accordance with ASTM D 4873 and as specified herein. Each segment of geotextile tube shall be wrapped in an opaque and waterproof layer of plastic during shipment and storage. The plastic wrapping shall be placed around the geotextile in the manufacturing facility and shall not be removed until deployment. Each packaged segment of geotextile tube shall be labeled with the manufacturer's name, geotextile type, lot number, roll number, and roll dimensions (length,

Comments: The DELIVERY, STORAGE, AND HANDLING subsection specifies steps taken to prevent damage to tubes during the construction process. This subsection also calls for labeling, which can be very important when a variety of tubes are used in a project.

width, and gross weight). Appropriate handling equipment and techniques, as recommended by the manufacturer and as mentioned in the submittals and approved by the Contracting Officer, shall be used. Geotextile or plastic wrapping damaged as a result of delivery, storage, or handling shall be repaired or replaced, as directed by the Contracting Officer, at no additional cost to the Government.

4.2 Handling. Geotextiles shall not be handled with hooks, tongs, or other sharp instruments. Geotextiles shall not be dragged along the ground. Any surface upon which the geotextile may rest or from which it may be deployed shall be smooth and free of burrs or protrusions that could snag and tear the fabric.

Comments: Although geotextile fabric has an extremely high tensile strength, it can be easily torn, punctured, and abraded. Contract specifications in the "Handling" subsection may prevent unnecessary damage from inappropriate handling.

4.3 Storage. Geotextile tubes shall be a) stored in areas where water cannot accumulate, b) elevated off the ground, and c) protected from conditions that will affect the properties or performance of the geotextile. Geotextiles shall not be exposed to temperatures in excess of those recommended by the manufacturer or 140°F (60°C), whichever is less. Outdoor storage shall not be for periods that exceed the manufacturer's recommendations or 2 months, whichever is less. Geotextiles shall not be exposed to direct sunlight prior to deployment for more than 14 days.

Comments: Contract specifications for storage may prevent unnecessary damage from inappropriate storage. Some types of damage resulting from inappropriate storage could have long-term consequences for project success, but may not be immediately apparent. For example, extended exposure to sunlight (ultraviolet radiation) will accelerate degradation of geotextile fabrics. The manufacturer or supplier should be consulted for additional information regarding proper storage.

5. MATERIALS:

5.1 General Requirements. The geotextile for the tubes and the scour apron shall be a woven monofilament or multifilament pervious sheet of polymeric yarn. Fibers used in the manufacture of the geotextile fabric shall consist of long-chain synthetic polymers composed of at least 85 percent by weight polyolefins, polyesters, or polyamides. Stabilizers and/or

Comments: The description of fabric given in the FABRICS subsection should be as specific as possible to ensure that fabric selected is of sufficient quality. The properties noted in Table 2 are the properties used to define the fabric. The geotextile test values in Table 2 must be determined for each project. Experts in geotextile tube design and construction, including manufacturing representatives and fabric suppliers, should be consulted to obtain appropriate values for a given application. Fabric samples submitted under the SUBMITTALS subsection can be used to test physical properties of fabric, providing independent confirmation of manufacturer's product information.

inhibitors shall be added to the base polymer if necessary to make the filaments resistant to deterioration by ultraviolet light and heat exposure. Reclaimed or recycled fibers or polymer shall not be added to the formulation. Geotextiles shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other (including the filaments or yarns at the edges of the fabric). The geotextile physical properties shall equal or exceed the minimum average roll test values listed in Table 2, as determined by the standard test methods listed in Table 2. Acceptance of geotextile shall be in accordance with ASTM D 4759. Strength values shown in Table 2 are for the weaker principal direction.

Table 2. Geotextile Physical Properties[1]

Property	Test Method	Test Value
Apparent opening size (U.S. sieve)	ASTM D 4751	40-100
Permittivity, sec-1	ASTM D 4491	0.2
Puncture, lb	ASTM D 4833	350
Burst strength, psi	ASTM D 3786	1,200
Trapezoidal tear, lb	ASTM D 4533	800 warp 800 fill
Ultraviolet degradation (percent strength retained at 500 hr)	ASTM D 4355	80%
Wide width tensile strength, strength minimum, lb in.	ASTM D 4595	1000 warp 1000 fill
Wide width elongation	ASTM D 4595	15% warp 15% fill
Factory seam strength, lb in.	ASTM D 4884	500

[1] Test values are from the Poplar Island Habitat Restoration Project in Maryland and may not be applicable elsewhere.

5.2 Fabrication. Geotextile tubes shall be fabricated by sewing together standard sheets of high-strength, woven geotextile material to form a tubular shape. The tube shall have a circumference of 30 ft (9.1 m). The tubes may vary in length from a minimum of 150 ft (45.7 m) to a maximum of 350 ft (106.7 m). Tube filling ports shall be spaced at intervals not exceeding 25 ft (7.6 m) along the crest of the tube. Each fill port shall consist of a geotextile sleeve having a length of at least 5 ft (1.5 m) and a circumference slightly greater than that of the dredge discharge pipe. In addition, a pressure relief port, consisting of a 5-ft- (1.5-m-) long geotextile sleeve, shall be located not more than 5 ft (1.5 m) from each end of each tube. The port sleeves shall be fabricated of the same

Comments: The "Fabrication" subsection should clearly describe the process for fabrication of the geotextile tubes as well as associated scour aprons, anchor tubes, and any other features of the tube design. The description is best obtained from experienced geotextile tube manufacturer representatives and engineering design consultants. This subsection should provide as much detail as necessary to ensure that the tubes are manufactured properly. The description should at least include the dimensions of the tubes, the design of the seams (e.g., simple overlap, folded overlap), the design and spacing of the filling sleeves or ports, other features such as port tie-offs, pressure-relief ports, and the dimensions of the scour apron and anchor tubes.

geotextile as the tubes and shall have a "drawstring" closure system to assure a secure closure after the completion of filling. Loops or straps shall be incorporated along the sides of the tube every 20 ft (6.1 m) to facilitate deployment and anchoring. The loops or straps shall have the same tensile strength as the tube geotextile. All seams shall be overlapped and folded. All seams shall be completed at the factory.

Tubes shall have a scour apron with a width of 40 ft (12.2 m) fabricated from the same geotextile material as the tube. The scour apron shall include a 6-ft (1.8-m) circumference anchor tube located along the leading edge of the apron with filling ports as recommended by the manufacturer. The scour apron shall be deployed and the anchor tube shall be filled prior to the filling of the larger geotextile tube.

5.3 Tests, Inspections, and Verifications for Geotextiles. Geotextiles and factory seams shall meet the requirements specified in Table 2. Conformance testing shall be performed on random samples in accordance with quality control practices approved by the Contracting Officer.

Comments: The "Tests, Inspections, and Verifications for Geotextiles" subsection reiterates requirements for testing of fabrics.

5.4 Fill Materials. Material for filling geotextile tubes will consist of silty fine sand dredged from the designated borrow site shown on the drawings. Logs from subsurface investigations of the borrow site and laboratory testing results are presented in Appendix B of these specifications. Suitable material for filling tubes will contain not more than 15 percent fines (percent by weight passing the No. 200 sieve) to minimize subsidence of tubes after filling. Some materials in the borrow area may not be suitable for use in tubes without removal of some of the fines; in this event, the Contractor shall locate alternative suitable sand borrow materials or shall process the borrow materials to reduce the fines content to the specified level. If excessive fines are observed during the filling process, the Contractor will divert all of the flow to an appropriate hydraulic fill area in the dredged material placement site until more suitable borrow material can be located.

Comments: Compatibility of fill material and geotextile fabric is central to project success. The "Fill Materials" subsection specifies the source and nature of fill material and instructs the Contractor to monitor fill materials to be sure that specifications are continually met. It is possible that a source of sand identified by pre-work investigations may turn out to contain a substantially different grain size distribution once the Contractor begins dredging. This subsection might identify a recourse to be used in the event that the material identified in pre-work investigations is found to be unsuitable during construction.

5.5 Testing of Fill Materials. Gradation testing of hydraulic fill materials shall be conducted in accordance with ASTM D 422. One gradation test shall be performed for each tube filled, immediately after completion of filling. The sample of fill material should be taken near the center of each tube and should be representative of material throughout the tube. The sample should be obtained from a filling port and as a core taken through the vertical extent of material in the tube. The fabric should not be punctured. Results of gradation testing shall be provided to the Contracting Officer within 2 days after the sample is taken. If visual inspection of the fill materials or tube suggests that the percentage of fines may exceed the requirements presented herein, additional testing may be directed by the Contracting Officer and replacement of the tube may be required, at the discretion of the Contracting Officer and at no additional cost to the Government.

Comments: The "Testing of Fill Materials" subsection provides instructions regarding sampling of material within filled or partly filled geotextile tubes. This subsection specifies how the gradation analyses should be done and when results are required. In some cases, results may only be required as part of the construction documentation, but in other cases, test results may be required before continuing construction.

6. INSTALLATION: Within 30 days after notice to proceed, the Contractor shall submit the Plan of Construction called for under the SUBMITTALS subsection of these specifications. The plan shall incorporate the requirements of these specifications with respect to tube (and associated components such as scour apron and anchor tubes) geometry, orientation, fabrics, fabrication, deployment, anchoring, and filling procedures. Fabrication details or installation techniques that differ from those outlined in these specifications may be documented in the Plan of Construction and submitted for consideration by the Contracting Officer. However, rejection of alternative methods suggested by the Contractor shall not constitute a basis for claim against the Government.

The geotextile tubes shall be hydraulically filled with the sandy material as per these specifications and will subsequently form a retaining structure behind which dredged material will be placed. The tubes will also provide erosion protection from waves. As noted in the "Fabrication" section of these specifications, each tube shall be between 150 ft (45.7 m) and 350 ft (106.7 m) long, and have a circumference of 30 ft (9.1 m). Past experience suggests that tubes that are about 300 ft (91.5 m) long are best. Longer tubes may be harder to control during the filling process while shorter tubes require more labor spent in deploying the tubes (because more tubes are required). Tube-length variations may be required to satisfactorily achieve the orientation requirement for the structure. Typical sections of the proposed geotextile tube structure are shown in the drawings. The Contractor may deviate from the details of the typical sections if the deviation is identified in the Plan of Construction and approved by the Contracting Officer.

a) The geotextile fabric shall be protected during installation from binding, clogging, penetrations, tears, or other damage. Damaged geotextile fabric shall be repaired or replaced. The Contracting Officer, or his designated representative, shall visually inspect geotextile materials, prior to installation, for damage and imperfections. Defective materials shall be marked and repaired using methods recommended by the manufacturer and approved by the

Contracting Officer. Geotextiles which cannot be satisfactorily repaired shall be replaced at no additional cost to the Government.

b) The Contractor shall have onsite a representative of the geotextile tube manufacturer to provide assurance of proper deployment and filling procedures. The representative will be present as needed during the construction of the geotextile tube structure.

c) Each tube shall have a scour apron as specified herein and shown on the drawings. The scour apron shall be deployed prior to deployment of associated geotextile tubes. The length of each section of scour apron used by the Contractor shall be identified in the Plan of Construction and approved by the Contracting Officer. The Contractor shall ensure that adjacent lengths of scour apron overlap one another by 20 ft (6.1 m) and that the location of overlap between each length of scour apron is more than 25 ft (7.6 m) from the joint between adjacent geotextile tubes placed on top of the scour apron. The scour apron shall be fully extended and the anchor tubes filled to hold the apron in place while the geotextile tubes are placed on top.

Comments: The "Installation" subsection describes the Plan of Construction, which clearly identifies installation techniques. Experts in geotextile tube design and construction and manufacturing representatives or fabric suppliers should be consulted regarding questions about the Plan of Construction. If the "Installation" subsection suggests a specific technique, the rationale behind the suggestion should be included; then if the Contractor chooses to submit an alternative approach to construction, the full scope of desired outcomes can be considered. Contractors may want to submit alternative plans because of their access (or possibly lack of access) to certain types of equipment or for other reasons. Items that would be described in the "Installation" subsection include: the means of deploying the geotextile tubes, how they will be held in place during filling, the filling technique and desired equipment (pipes, deflectors, valves, pressure gauges, etc.), where they should be placed, the final dimensions of the tubes, the elevations of various parts of the tubes, techniques for butting the end of one tube against another, requirements regarding bed preparation (fill or excavation), ways to take care of the fabric during deployment, how to replace or repair defective or damaged tubes, identification of allowable tolerances on height, elevation, and alignment, recourses in the event that tolerances are exceeded, recourses in the event that poor quality fill material is encountered during construction, and identification of requirements and qualifications for inspectors such as material manufacturer representatives or engineering consultants. It may be instructive to reference drawings to help describe the installation specifications.

d) After filling, each tube is expected to achieve an average height of 5 ft (1.5m) with a variation of ± 0.5 ft (0.15 m) and an average width of about 13 ft (4 m). The crest of each tube shall be placed at +2.0 ft mllw with an allowable variation of ± 0.5 ft (0.15 m). In some locations it may be necessary to remove some foundation material to assure that the top of the tube does not exceed the specified final elevation. In other locations sandy material may be used to

raise the bed elevation prior to placement of the scour aprons. If such a sand base is used, it shall extend a minimum of 20 ft (6.1 m) from the center line of the tube (i.e., a total minimum width of 40 ft (12.2 m)). In some locations, removal and replacement of low-strength foundation materials will be required on the basis of geotechnical investigations required by section ####, "Geotechnical Investigations." Foundation materials shall be replaced in accordance with the requirements of section ####, "Unsuitable Foundation Material Excavation," prior to construction of the geotextile tube structure covered by this section of the specifications. In all cases, the foundation for the placement of the geotextile scour apron and tubes shall be smooth and free of protrusions that could damage the geotextile.

e) Each tube shall be placed along a straight line with an allowable lateral deviation of no more than 2 ft (0.6 m) to either side. No portion of a tube shall be filled until the entire tube segment has been fully anchored to the foundation along the correct alignment.

f) As shown on the drawings, the ends of each tube shall be tightly butted together. This shall be accomplished by laying out two successive tubes at once and overlapping the ends of the tubes by at least 10 ft (3 m). The overlying tube shall be filled first before the underlying tube is filled. In this way, the overlying tube pins the end of the adjacent tube beneath it.

g) After completing the deployment and anchoring of the geotextile tube, filling with sand from the borrow area shall be accomplished in accordance with the approved Plan of Construction. All fill ports shall be left open during initial stages of filling and shall be closed as filling is completed at each port location. The discharge line of the dredge shall be fitted with a "Y-valve" to allow control of the rate of filling. The Y-valve system must be fitted with an internal mechanism such as a gate, butterfly valve, ball valve, or pinch valve to allow the Contractor to regulate the discharge into the geotextile tube. The discharge pipe shall be fitted with a baffle diffuser to achieve uniform filling of the tube. Any excess discharge shall be directed toward the appropriate hydraulic fill zone behind the geotextile tube structure. The discharge pipe leading to the geotextile tube shall be fitted with a pressure gauge to monitor filling pressures. Any damaged geotextile tube resulting from the Contractor's failure to control filling rates and pressures shall be repaired or replaced at no additional cost to the Government.

h) Failure to achieve the specified crest elevations or subsidence of material within tubes that results in unacceptably low crest elevations prior to acceptance by the Contracting Officer shall be corrected by supplemental filling or replacement. Under no circumstances shall a replacement tube be accepted when placed on top of the original tube because the top tube cannot be considered stable. With the Contracting Officer's approval, a replacement tube may be placed parallel to and on the leeward side of the original tube. The supplemental filling or replacement shall be done at no additional cost to the Government.

7. PLANT AND EQUIPMENT: The plant and equipment used for the work required shall be determined by the Contractor, identified in the Plan of Construction, and shall be approved by the Contracting Officer.

Comments: The "Plant and Equipment" subsection of this example provides the contractor with freedom to suggest equipment. Some contract specifications may be written with more specific equipment requirements.

8. QUALITY CONTROL: The Contractor shall establish and maintain quality control as required in "Contractor Quality Control" of section ####.

Comments: Both the "Quality Control" and "Measurement and Payment" subsections refer to sections of the contract not included as part of this example. Most USAE Districts have standard wording for contracts in regard to these issues.

9. MEASUREMENT AND PAYMENT: Measurement and payment shall be in accordance with section ####.

10. FINAL EXAMINATION AND ACCEPTANCE. The geotextile tube structure, located between Stations *xxx* and *yyy*, shall be surveyed for acceptance not sooner than 6 months after completion of the geotextile tubes. Any subsidence of the top elevation of the geotextile tubes below the planned elevation shall be corrected by supplemental filling or replacement of the tubes that are below the specified elevation at no additional cost to the Government. After the completion of final surveys for acceptance, the completed reach shall be examined for acceptance by the Contracting Officer. Use of any portion of the completed reach for construction activities will not be allowed without prior approval by the Contracting Officer. Any damage to the accepted reach caused by construction activity shall be repaired by the Contractor at no additional cost to the Government.

Comments: Experience has shown that the full impact of subsidence on geotextile tube height may not become apparent for as long as six months after filling. The "Final Examination and Acceptance" subsection recognizes the need for a stabilization period before acceptance.

POINTS OF CONTACT: For additional information, contact Mr. Jack E. Davis (601-634-3006, *davisj@ex1.wes.army.mil*), or Dr. Bill Streever (601-634-2942, *streevw@ex1.wes.army.mil*). This technical note should be cited as follows:

> Davis, J. E., and Streever, B. (1999). "Geotextile tube structures: Example contract specifications." *WRP Technical Notes Collection* (TN WRP WG-RS-3.2). U.S. Army Engineer Research and Development Center, Vicksburg, MS. *www.wes.army.mil/el/wrp*

REFERENCES

Davis, J.E. and Landin, M.C. (1997). "Proceedings of the national workshop on geotextile tube applications," Technical Report WRP-RE-17, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Davis, J.E. and Landin, M.C. (1998). "Geotextile tube structures for wetlands restoration and protection," WRP Technical Notes Collection (TN WRP-HS-RS-3.2), U.S. Army Engineer Research and Development Center, Vicksburg, MS.