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USACE / NAVFAC / AFCEC **UFGS-02 54 19.16 (February 2025)**

Preparing Activity: USACE **Superseding**
UFGS-02 54 19.16 (February 2021)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2025
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BIOREMEDIATION OF SOILS USING WINDROW COMPOSTING

02/25

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SECTION 02 54 19.16

BIOREMEDIATION OF SOILS USING WINDROW COMPOSTING
02/25

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NOTE: This guide specification covers the requirements for reduction of the concentrations of organic contaminants in soils by bioremediation using windrow composting.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
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PART 1 GENERAL

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NOTE: This guide specification was developed based on the use of composting to treat explosives-contaminated soil. According to Composting guidance from Federal Remediation Technologies Roundtable (FRTR), composting also applies to treat soils and sediments contaminated with petroleum hydrocarbons and aerobically biodegradable organic compounds such as nonhalogenated volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs). Composting effectiveness is varied for halogenated VOCs, SVOCs, and pesticides and is not effective for more highly

chlorinated compounds (such as polychlorinated biphenyls (PCBs)). This Specification presumes that the project team has confirmed composting is generally a feasible remedy for the site before the specs and contract are prepared.

Please also note that "Contracting Officer" mentioned throughout this document is intended to be an umbrella term for anyone, including the Contracting Officer, designated by the Contracting Officer.

An edited version of this Section may be used to solicit a request for proposal (RFP). Use of an RFP approach may prevent the contract from being awarded to a Contractor that is not technically qualified.

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1.1 MEASUREMENT AND PAYMENT

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NOTE: Edit this paragraph based on whether the Contract will use a single job price or unit prices. If Section 01 20 00 PRICE AND PAYMENT PROCEDURES is in the project, move these paragraphs to that Section for editing. The project team should involve their Contracting Office to determine the best way to create a payment schedule/milestone for their Contract or Task Order.

If the project includes Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIALS, coordinate measurement and payment methods and contaminated material handling and stockpiling between this Section and Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIALS.

If the quantities of contaminated soils are well defined, payment may be based upon a single job price structure. When the amount of contaminated material is inadequately defined or uncertain, a data gap investigation is generally advised before any windrow composting activity begins. When specifying a unit price structure for treatment, separate items should be provided in the Contract Price Schedule to cover any other work required. Other work items include, but are not limited to: preparation of submittals, mobilization and demobilization, site preparation, construction of the treatment pad and run on/runoff controls, water storage facilities, contact water treatment and disposal, sampling and testing, implementing health and safety requirements, and utilities. Inclusion of separate items in the Contract Price Schedule for the above work tasks should result in a lower unit price for treatment.

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1.1.1 Unit Prices

1.1.1.1 Field Demonstration

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NOTE: Prior to planning the field demonstration, bench-scale treatability study testing should be performed to arrive at a suitable recipe of amendments, and to determine if the contaminants of concern are amenable to composting in the site-specific soil matrix. The field demonstration may either be conducted prior to the construction of the full-scale facilities or conducted using the full-scale facilities and equipment. Payment for the field demonstration should be covered by a separate single job price, or on a unit price that is separate from the unit price for full-scale treatment. Because more intensive monitoring is usually required during the field demonstration, and because a demonstration generally has a smaller weight of treated soil over which fixed costs can be distributed, the unit price for the field demonstration will usually be higher than the unit price for full-scale treatment. Analytical Testing for chemical data is not included as a component of the price in this paragraph. The contract price schedule should include separate, unit price items for analytical testing.

If the results of the field demonstration indicate that an extended treatment period (or other special measures) will be required to meet cleanup goals, it may become necessary to modify the bid item that covers treatment pricing for full-scale operations.

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Payment for the field demonstration will be[by the contract unit price schedule for each[cubic meter yard][_____] treated during the field demonstration][a single job price for proper completion of approved tests]. The price must include the cost of labor, materials, equipment usage, utilities, and fuel for: [pre-processing,] [operation, maintenance and process monitoring (not including testing for chemical data),][ancillary waste treatment and disposal,][preparation of Field Demonstration Report,][and][_____]. Costs for procurement and handling of amendments used in the compost must be included in the unit price for treatment.

1.1.1.2 Contaminated Soils Treatment Unit Price

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NOTE: Except for equipment usage costs (e.g., rental), other equipment costs are not included as a component of the unit price for treatment in this paragraph; testing for chemical data is also not included in the unit price. The contract price schedule should include separate, unit price items for testing for chemical data.

If unit price payment will be based on weight, dry

weight should be specified and requirements should be included for moisture content testing so that dry weight can be determined. However, surveys are usually required before and after excavation of contaminated material, so that excavation and backfilling can be paid for on the basis of in-place volume. Thus, it is advantageous to pay for processing and treatment of soils using in-place volume as the pricing unit.

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[Payment for composting treatment of contaminated material will be by the contract unit price schedule for each cubic meter yard of contaminated soil that is treated based on[in-situ volume, or for each measured unit of weight, after separation of oversize material][_____].]

[Payment for composting treatment of contaminated material will be by the contract unit price schedule for each metric ton ton of contaminated soil that is treated. Use a properly calibrated weighing system to accurately measure the gross (bulk) weight of the contaminated material. Convert the measured gross (bulk) weight of the contaminated materials to be treated to dry weight based on the[percent moisture content of representative contaminated material samples. Determine the percent moisture content in accordance with[ASTM D2216][ASTM D4643][ASTM D4959][_____]]. Determine moisture content[daily][for every[500][_____] metric tons tons of contaminated material that is treated][_____].]

[This unit price must include the cost of labor, materials, equipment usage, utilities, and fuel for: [pre-processing,][operation, maintenance and process monitoring (not including testing for chemical data),][ancillary waste treatment and disposal,][preparation of operations reports,][and][_____]. Costs for procurement and handling of amendments used in the compost must be included in the unit price for treatment. After each batch has been treated, the quantity of material that does not meet treatment criteria must be reported and subtracted from the quantity of material comprising the batch, when determining payment for treatment. Payment will not be made for material that does not meet treatment criteria. If additional tests, or additional processing and testing, are necessary to show that material meets treatment criteria, the additional costs must be borne by the Contractor.]

1.1.1.3 Oversize Materials from Contaminated Areas

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NOTE: This paragraph should be deleted if payment for treatment and disposal of oversize materials will be included as part of the price item for treatment of contaminated soil. Payment for disposal of oversize materials may be by weight or volume, depending on the nature of the materials. Oversize materials may include brush, trees, roots, rubble, construction debris, and materials that cannot be composted.

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Payment for [disposal][and treatment] of oversize material separated from contaminated soil will be by the contract unit price schedule for each[kilogram pound][_____]. Soil, free water and other extraneous materials must be separated from oversize materials prior to measuring quantities.

1.1.2 Single Job Prices

[1.1.2.1 Bench-Scale Testing

****
NOTE: Single job pricing for each bench-scale treatability study testing run is recommended for this item. The single job price should include analytical costs to evaluate the treatment effectiveness. However, bidders should be required to provide a unit cost amount for testing for chemical data. This will provide a basis for payment for additional analytical costs, if it is determined that more testing will be required. The following reference should be used to prepare the Bench-Scale Treatabilit Study Test Plan: EPA 540/R-93-519a, Guidance for Conducting Treatability Studies Under CERCLA, Biodegradation Remedy Selection, 1993.
****

Payment for bench-scale treatability study testing will be a single jobprice for proper completion of specified tests. The price must include the cost of labor, materials, equipment usage, utilities, and fuel for:

[a. Preparation of the bench-scale treatability study test plan.

][b. Collecting samples.

][c. Sample shipment.

][d. Pre-processing.

][e. Process monitoring (including testing for chemical data).

][f. Disposal of treated material and waste.

][g. Ancillary waste treatment and disposal.

][h. Preparation of the bench-scale test treatability study report.

][i. [_____].]

]1.1.2.2 Other Work Items

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NOTE: Coordinate this paragraph with Section 01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS. Temporary utility connections are covered in Section 01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS.
****

Payment for other work items not included in the above paragraphs will be included in the payment for the base bid for treatment of the contaminated materials. The other work items include submittals related to mobilization and demobilization, site preparation in the treatment pad, manufacturers' field services, environmental compliance monitoring, health

and safety monitoring and controls, and utilities required for the composting treatment if approved by the Government as necessary for the project.

1.2 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D2216	(2019) Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D4643	(2017) Standard Test Method for Determination of Water Content of Soil and Rock by Microwave Oven Heating
ASTM D4959	(2016) Determination of Water (Moisture) Content of Soil by Direct Heating

BIOCYCLE, JOURNAL OF COMPOSTING AND RECYCLING (BIOCYCLE)

BIOCYCLE	(Nov 1995; 5th Ed 2009) A Standardized Test for Evaluation of Compost Self-Heating; Briton, W.F.Jr, et. al.

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(2018) Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

PLANT AND LIFE SCIENCES PUBLISHING (PALS)

NRAES 54	(1992) On-Farm Composting Handbook

U.S. ARMY (DA)

DA PAM 385-64	(2023) Ammunition and Explosives Safety Standards

U.S. ARMY ENVIRONMENTAL COMMAND (USAEC)

USAEC CETHA-TS-CR-93043	(1993) Windrow Composting Demonstration for Explosives-Contaminated Soils at the Umatilla Depot Activity (NTIS PB95-200119)
USAEC SFIM-AEC-ET-CR-96184	(1996) Cost Report: Windrow Composting to Treat Explosives-Contaminated Soils at Umatilla Army Depot Activity (UMDA) (NTIS AD-A318001)

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 505-B-04-900A	(2005) Intergovernmental Data Quality Task Force - Uniform Federal Policy for Quality Assurance Project Plans: Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs Part 1: UFP-QAPP Manual
EPA SW-846	(Third Edition; Update VII) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods
UFP-QAPP WKSTS	(2012) Intergovernmental Data Quality Task Force - Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP-QAPP Worksheets

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards

[1.3 PRE-CONSTRUCTION MEETING

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NOTE: Delete this paragraph if the requirements are included in Section 01 30 00 ADMINISTRATIVE REQUIREMENTS, Section 01 32 01.00 10 PROJECT SCHEDULE, or other Specification Section.

Appropriate facility personnel should be present at the pre-installation meeting if siting of the treatment facility and other associated work areas will be discussed.
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Arrange and conduct a preconstruction meeting at the jobsite[at least five business days prior to the start of operations on the project][_____]. The preconstruction meeting must follow the written pre-construction meeting agenda submitted [_____] days prior to the meeting. The purpose of this meeting is to review the requirements of this Section and the associated plans. The following individuals must

attend this meeting: [Contractor's project manager,][site foreman,][and Contracting Officer].

Record pre-construction meeting minutes and publish via email within 48 hours to the attendees. Re-publish the meeting minutes within 48 hours via email pending subsequent comments from the attendees.

]1.4 SYSTEM DESCRIPTION

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NOTE: Requirements for a specific method of treatment are provided below. If the use of a process other than windrow composting will be allowed, this paragraph should be revised to indicate that a process, other than described in this section, may be proposed by the Contractor; other composting methods may include static piles, aerated static piles, or in-vessel. The Contractor's approved submittals must demonstrate equivalent capabilities; and that such approval will not relieve the Contractor of responsibility for meeting specified requirements for safety, reliability, and performance.

It is also recommended that copies of USAEC CETHA-TS-CR-93043, and USAEC SFIM-AEC-ET-CR-96184 be made available to prospective Contractors to provide descriptions of the intended treatment process.

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Perform treatment using a safe, reliable method to treat contaminated material conforming to paragraph PERFORMANCE REQUIREMENTS, USAEC CETHA-TS-CR-93043, and USAEC SFIM-AEC-ET-CR-96184.[Requirements for a specific process are provided below. The Contractor may propose an alternative process. Government approval of a Contractor-proposed plan does not relieve the Contractor of responsibility for meeting specified requirements for safety, reliability, and performance.]

1.4.1 Design Requirements

1.4.1.1 Composting Treatment Pad

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NOTE: Siting of the treatment facility should be in accordance with regulatory requirements. The prevailing wind direction and the potential for odor and dust generation should also be taken into consideration. The design of the treatment pad and weather cover should include provisions for control of storm water and contact water, and should take into account the expected wheel loads of and contact with material handling equipment. Besides the windrow mixer, various bladed and/or bucketed equipment may have to be used to establish, dress or maintain, and remove the windrows. Concrete pads are typically more expensive, though less permeable than asphalt pads. Asphalt pads have been used for hazardous waste composting projects. It may also be necessary to construct asphalt pads for the

following areas: soils pre-processing area; and the amendment and soil blending area.

As an alternative to paving, a polyvinyl chloride (PVC) liner may be used to cover the treatment pad area with laying 2 feet of impermeable soil on top. Place a layer of straw before windrows are formed. The straw layer is an indicator where the bottom of the windrow is. Soil pad should be sampled before disposing of offsite in accordance with federal, state, and local regulatory requirements, and 02 81 00 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS. Generally, PVC liner can be disposed at an off-site, non-hazardous waste landfill.

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[Pave the treatment pad and other work area surfaces in accordance with Section [32 12 16.16 ROAD-MIX ASPHALT PAVING.][03 30 00 CAST-IN-PLACE CONCRETE.]][_____]. Design the treatment pad to withstand operation of material handling equipment, and to prevent infiltration of contact water. The slope of the surface of the treatment pad must be not less than [2 percent][_____]. Water collection channels must be incorporated into the paved treatment pad, and the pad must drain, by gravity, to collection sumps. The water collection system and sump must be in accordance with paragraph CONTACT WATER MANAGEMENT SYSTEM AND DESIGN STORM. Sloping, placement of collection channels, and sump must be sufficient to prevent ponding in the treatment pad area.

1.4.1.1.1 Treatment Pad Sizing

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NOTE: The dimensions of the treatment pad should be based on the amount of time required to reach cleanup goals for each batch of compost (including laboratory turn-around time for compliance testing), the amount of time allotted for treatment of the contaminated soil within the contract schedule (i.e., the project duration), the "per-batch amount" of material that will be composted, the bulk density of the compost and soil, windrow dimensions and spacing, and the type of material handling equipment that will be used. A batch is defined as that amount of material, including soil and amendments, for which treatment is initiated at the same time during full-scale operations. After cleanup goals have been met for contaminants of concern, it may be necessary to continue to cure the compost (see paragraph CURING AND STORAGE). The compost may be moved to a separate area for curing. On a previous composting project for explosives, each batch required about 4 weeks on the treatment pad (about 2 weeks treatment time, plus about 2 weeks to receive laboratory data from confirmation samples). Curing was not required on this project.

Formulas for the areas of typical windrow cross sections are provided in NRAES-54. The bulk density of compost will vary depending on what amendments are used and the proportions of soil and amendments

(see paragraph AMENDMENTS). See paragraph WINDROW CONSTRUCTION 3 for information on windrow dimensions. Use of long, narrow treatment pads may allow windrow mixing equipment to process a greater volume of material using a minimal number of turn-arounds. Thus long, narrow treatment pads may result in a more efficient operation than a wider treatment pad. It may be economically advantageous for the Contractor to divide the treatment pad into separate areas, so that mixing equipment does not sit idle: on a portion of the pad, daily mixing of windrows may continue until definitive field analysis indicates that the compost is ready for compliance testing; on the other portion of the pad, the windrows may be allowed to set static while waiting for laboratory data from compliance testing.

****

Locate the treatment pad within the area indicated.[Size the treatment pad to avoid constricting other parts of the composting operations that must be conducted within the designated area available for composting operations.][Size the treatment pad based on the information from, but not limited to, the Remedial Investigation Report, Decision Documents, Bench Scale Treatability Study Test Report, Field Demonstration Report, and Amendment Test Report.]

1.4.1.1.2 Other Work Area Surfaces

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NOTE: The dimensions of the curing and storage area should be based on the amount of time required for curing, the amount of time that cured compost will remain in storage, and the dimensions of curing and storage piles. The volume of treated material will usually be less than the initial volume of the compost (see paragraph DISPOSAL). The compost is usually allowed to cure until after the following has been observed: the high temperature (43 to 65 degrees C 110 to 150 degrees F) stage of the process has been completed; the temperature has fallen back to about 38 degrees C 100 degrees F or less; and the windrows no longer heat-up after turning. The On-Farm Composting Handbook recommends curing for at least one month. Immature, or improperly cured compost may be detrimental to plants.

It may be necessary to require paving in areas designated for handling contaminated material, and operation of heavy equipment (e.g., front-end loaders).

Curing and storage may not be needed for some projects based on the results of bench-scale treatability study testing, field demonstration, or project team's site-specific knowledge. The main text below may need to be modified if curing and storage are not part of the project requirements.

****

The slope of the surface of the areas for curing and storage must be not less than [2 percent][_____]. The surfaces of areas for curing and storage must be well drained and kept free of standing water at all times. Locate the soils pre-processing area, curing and storage area, and the area designated for blending soil and amendments within the area indicated; and construct and pave in accordance with paragraph COMPOSTING TREATMENT PAD.

1.4.1.2 Contact Water Management System and Design Storm

****
NOTE: Windrow composting areas may generate contact water from precipitation if they are uncovered, or from wetting or irrigation to achieve a certain moisture content whether they are covered or uncovered. If in accordance with regulatory requirements, excess contact water may be discharged to national pollutant discharge elimination system (NPDES) storm water discharge outfalls, publicly-owned treatment works (POTW) sewers, facility sewer to onsite treatment systems, or treated and disposed of offsite. If the treatment area is uncovered, the source of data for the design storm should be referenced. Sources for hypothetical storm information in the United States are referenced in Appendix A of Hydrological Analysis of Ungaged Watersheds Using HEC-1, Training Document No. 15, USACE Hydrologic Engineering Center, April 1982; another source is NOAA Atlas 14.
****

Contact water is defined as water that has come into contact with contaminated materials, or other contaminated surfaces. Sources of contact water may include, but are not limited to: water from decontamination of equipment, personnel, and personal protective equipment (PPE); and runoff water from storage, preprocessing and treatment areas. Use a design storm with [24][_____] hour duration and a return interval of [25][_____] years, based on data from [_____]. The collection, conveyance, storage, treatment and disposal system must remove all contact water from the design storm in not more than [24][_____] hours.

1.4.1.2.1 Perimeter Berms

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NOTE: Use of barriers constructed from interlocking concrete blocks may, for some applications, be an acceptable substitute for berms.
****

Construct berms around the perimeter of the following work areas: [treatment,] [storage areas,][and][_____]. Size the perimeter berms to prevent flood water run-on from the [25][_____] year flood, and to contain runoff from the design storm. Maintain a minimum of [0.3][_____] meter [1][_____] foot from the top of the berm to the surface inside of the work area, and from the top of the berm to the surface outside of the work area. Provide at least [3][_____] meters [10][_____] feet of lateral distance between berms and windrows in the treatment pad area to allow passage of equipment for mixing and dressing windrows. Include ramps to permit vehicle access across berms constructed around the [treatment cell

and laydown and storage areas][_____].

1.4.1.2.2 Storage Volume

****

NOTE: Typically, storage and testing of contact water is required prior to discharge. Thus contact water storage facilities should be sized to contain the peak detention volume for the design storm. In order to minimize treatment and disposal costs, it is often desirable to reuse the contact water to irrigate windrows. If this approach is applied, the storage volume must be sufficient to retain the volume of water in storage prior to the design storm, and the volume of water generated by the design storm.

Sources of contact water include: water from decontamination of equipment, personnel, and PPE; and runoff water from storage, preprocessing and treatment areas. If the storage, preprocessing, and treatment areas are adequately covered, then the amount of contact water resulting from precipitation events should be limited.

****

Size contact water storage facilities to contain [30][_____] percent above that required for the design storm, and [the maximum volume that will be held in storage for reuse][_____]. The design storm is defined above.

1.4.1.2.3 Reuse, Treatment, and Disposal

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NOTE: Although it is possible for contact water to accumulate compounds (e.g., acids, bases, or salts) at levels which may inhibit microbial activity, contact water may, typically, be applied to contaminated soil or compost with little or no treatment. Water which has accumulated excessive levels of acids, bases or salts may require treatment and/or offsite disposal.

****

Reuse contact water to the maximum extent in order to minimize the need for new makeup water and to limit the treatment, discharge and offsite disposal of wastewater. Prior to reuse, test contact water in accordance with paragraph CONTACT WATER TESTING and confirm that contact water meets the requirements of paragraph WATER SUPPLY. Prior to disposal, collect and test contact water that cannot be applied to contaminated soil or compost in accordance with paragraph TREATMENT CRITERIA FOR CONTACT WATER. Treat process sludge (resulting from the removal of suspended material in the contact water) to meet the requirements of paragraph [TREATMENT CRITERIA FOR OTHER WASTE][TREATMENT CRITERIA FOR COMPOSTED SOIL][_____].

1.4.1.3 Irrigation Equipment

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NOTE: Water may be added at many different points

in the process: to the raw materials prior to blending; during blending of amendments, before soil has been added; during the initial blending of compost; and during turning of the compost windrows. Mixing equipment may be equipped with spray nozzles for applying water. Timely irrigation of compost is critical during thermophilic stages of composting, when the highest rates of evaporation occur. In arid climates, water usage rates will obviously be higher than in non-arid climates.

****

Provide irrigation equipment capable of delivering at least [2.9][_____] liters of water per cubic meter [1.0][_____] gallons of water per cubic yard of compost per day, and meeting the requirements of paragraph MOISTURE CONTROL.

1.4.1.4 Weather Cover

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NOTE: Although "breathable", water resistant cover material is available, direct contact between the covering material and the compost should be avoided. Clam-shell buildings, metal buildings, pole barns, large tents, or other prefabricated structures may serve as weather covers. The section containing requirements for the weather cover (e.g., Section 13 34 19 METAL BUILDING SYSTEMS), should include the design snow load, maximum wind speed, soil bearing capacity, seismic parameters in accordance with UFC 3-301-01, maximum and minimum ambient air temperatures. The interior of the weather cover should be suitable for a high water-vapor environment. Metal surfaces may be subject to corrosive conditions. If the composting will be conducted inside of an enclosed structure, adequate ventilation must be provided. A rate of 3 to 6 air changes per hour has been recommended for composting facilities. Carbon dioxide is generated and oxygen may become depleted during composting. Ammonia gas is commonly generated as well. If volatile compounds are being remediated in the piles and the piles are in the thermophilic stage, such compounds can be volatilized. It is also possible for methane to be generated, if anaerobic conditions are allowed to develop. Finally, steaming can be extensive enough to block the vision of equipment operators. To ensure that proper and consistent ventilation requirements are specified, this section should be coordinated with other sections; e.g., Section 23 30 00 HVAC AIR DISTRIBUTION, edited accordingly.

****

Use weather covers, or appropriate structures, to prevent precipitation from coming into contact with windrows, and design in accordance with Section [13 34 19 METAL BUILDING SYSTEMS][_____]. Provide covers which allow for free exchange of gasses between the atmosphere and the compost. Size weather covers to allow unimpaired maneuvering of[front-end

loaders,][windrow mixing equipment,][and][_____]; size openings in weather covers to allow for entry and exit of[front-end loaders,][windrow mixing equipment,][and][_____]. Provide ventilation of the composting facility in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

1.4.1.5 Stockpiles

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NOTE: Typical stockpile design requirements are provided in Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL. However, in very arid climates, covers may not be necessary. If composting operations will continue during subfreezing conditions, it may be necessary to ensure that the Contractor has included provisions to prevent a portion of the contaminated soil stockpile from freezing. The stockpile requirements in that section should be edited based on site-specific factors and regulatory requirements.
****

In accordance with Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL, prepare areas that will be used to stockpile[contaminated material,][oversize material,][treated material that has not been fully cured,][treated material that has been fully cured,][and][_____].

1.4.1.6 Amendment Storage Facilities

****
NOTE: Some types of amendments should be kept covered to prevent contact with precipitation. However, in very arid climates covers may not be necessary. Usually, synthetic membranes are used as covers. To ensure that stored material can be removed from stockpiles and blended with other compost ingredients in subfreezing conditions, it may be necessary to store a portion of some materials at above 0 degrees C 32 degrees F.

To prevent undesired infiltration, some types of amendments (e.g., manure) should be stored in containers, or on a paved surface (e.g., asphalt pad) with containment walls. However, if the amendment is delivered directly to a blending vessel, use of storage facilities may not be necessary. See paragraph AMENDMENT STORAGE regarding controls for insects and rodents.
****

Cover the following amendments to prevent contact with precipitation: [_____]. Covers will not be required for [woodchips][_____]. Use frames, or other materials to prevent contact between covers, and the following amendments: [manure,][and][_____]. Design the storage area to withstand operation of material handling equipment, and to minimize infiltration of contact water. The slope of the surface of the storage area must be not less than [2][_____] percent. Water collection channels must be incorporated into the surface of the storage area, and the storage area

must drain, by gravity, to collection sumps. The water collection system and sump must be in accordance with paragraph CONTACT WATER MANAGEMENT SYSTEM AND DESIGN STORM. Sloping, placement of collection channels, and sump must be sufficient to prevent ponding in the storage area.

1.4.1.6.1 Paved Storage Area

Store the following amendments on a paved surface with perimeter berms: [manure,][potato waste (or other vegetable wastes),][and][_____]. Pave the storage area in accordance with Section [32 12 16.16 ROAD-MIX ASPHALT PAVING.][03 30 00 CAST-IN-PLACE CONCRETE.] Provide berms surrounding the paved storage area in accordance with paragraph PERIMETER BERMS.

1.4.1.6.2 Unpaved Storage Area

Store the following amendments on an unpaved surface with containment walls, or stockpile in accordance with paragraph STOCKPILES: [manure,][potato waste (or other vegetable wastes),][and][_____]. Geomembrane liners will not be required for storage of the following amendments: [sawdust,][alfalfa,][wood chips,][and][_____].

1.4.1.7 Material Measurement

Provide scales, meters, and volumetric measuring devices for measuring oversize materials, feed contaminated materials, reagents, and water which conform to the applicable requirements of NIST HB 44, except that the accuracy must be plus or minus [0.1][_____] percent of the quantity being measured. For scales used to measure weight of material in vehicles, provide scales of sufficient length to permit simultaneous weighing of all axle loads. For any scales used to make measurement for payment, ensure the scale is certified [by an acceptable scales company representative][by an inspector of the State Inspection Bureau charged with scales inspection within the state in which the project is located] prior to weighing any materials. Perform a check of calibration of measuring equipment prior to initial use, and once every [seven][_____] calendar days. The requirements of this paragraph do not apply to measurement of chemical or physical data for purposes of demonstrating compliance with paragraph PERFORMANCE REQUIREMENTS.

1.4.1.8 Utilities

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NOTE: The locations and details (such as utility point of contact, sizes, capacities, and flows) of the utility hookups should be provided on the drawings for the Contractor's use. Verify the utilities are available on-site before including the second sentence.

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In accordance with Section 01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS, provide the utilities associated with windrow composting including, but not limited to: [telecommunications,][electricity,] [water,][gas,][_____], sanitary, and solid waste facilities. The [telecommunications][electricity][water][gas][sanitary][and][solid waste facilities][_____] are available at the site.

1.4.2 Performance Requirements

1.4.2.1 Treatment Criteria and Criteria for Reuse of Composted Soil

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NOTE: Some types of nonvolatile and semi-volatile organic contaminants are believed to be amenable to composting, including some explosives, polynuclear aromatic hydrocarbons (PAHs, as found in creosote), and some pesticides and herbicides (see Engineering Bulletin, Composting, EPA 540/S-96-/502; also, see The Science of Composting, by Epstein, 1997). Since temperatures may exceed 65 degrees C 150 degrees F during composting, the volatility of contaminants of concern should be taken into consideration (see paragraph TEMPERATURE).

Depending on regulatory requirements, both total concentration and leachability concentrations for some compounds may be required. Total concentrations can be used to estimate worst case leachate concentrations. If the contaminated material is classified as characteristic waste, leachability testing will usually be required, and the appropriate leachability test (e.g., EPA Synthetic Precipitation Leachate Procedure (SPLP) or EPA Toxicity Characteristic Leachate Procedure (TCLP)) must be selected. If the treated material will not be disposed of in a landfill, SPLP testing may be appropriate.

Although there are EPA Land Application regulations for metals and pathogens (40 CFR 503 - Standards for Use or Disposal of Sewage Sludge), these regulations are not normally applicable to hazardous waste composting (see paragraph CRITERIA FOR REUSE OF COMPOSTED SOIL). Treatment criteria, and criteria for reuse should be in accordance with Federal, state and local regulations. Prior approval by regulatory representatives should be acquired for treatment criteria values.

For those parent compounds for which partial breakdown products (intermediates) have been defined and analytical standards are readily available, it may be necessary to include testing for key intermediates. A compound should not be targeted for analysis unless there is a defensible basis for including the compound.

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1.4.2.1.1 Treatment Criteria for Composted Soil

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NOTE: Paragraph CONFIRMATION OF ATTAINMENT OF TREATMENT CRITERIAshould be coordinated with this paragraph, and reviewed for guidance on adding a separate set of "ceiling values", 40 CFR 503.13 for each contaminant of concern to this paragraph. In

some cases attaining a target concentration for the site's contaminants of concern might not be sufficient; composting typically does not completely degrade, or mineralize, the contaminants but rather converts them to a series of complex degradation products which may not be analyzable with regular lab methods, and which will likely not have health based screening values. These products may bind irreversibly to the soil, indicating that composting is a technology that has both degradation and stabilization aspects. In this case it may be necessary to augment the treatment criteria by adding a bacterial assay, such as the Ames Mutagenicity test, to verify the safety of the finished compost, or the safety of the leachate from the finished compost. Another factor is that the mixing of the soils with carbon rich amendments, and their bacterial degradation, will change the redox balance of the soil and possibly convert native insoluble metals to mobile forms. This can be detected with TCLP testing of the finished soil. Lastly, there can be the concern that mixing large amounts of amendments with contaminated soil causes dilution of the contaminants, that is, it causes an immediate decrease in contaminant concentration without any composting having occurred. Soil remedial criteria could be reduced by a dilution factor to demonstrate that treatment is actually occurring and not just dilution. However, the amendments should be added to the windrows per the bench-scale treatability study test recommendations and be controlled to ensure the recommended amount of amendments was added. Periodic testing should be conducted to confirm the degradation rate and contaminant concentrations and determine if the performance requirements will be or have been met. This paragraph should be edited to include site-specific criteria. Table 1 would include contaminants specific to the project objectives.

****

The mean of the data for each batch of compost must be less than the criteria shown in Table 1. The definition of a batch of compost, over which a "pass/fail" decision will be made, must be determined during project planning, and may be defined as large as one or more windrows, or as small as individual sampling sections of a windrow. If the batch is as small as the 23 cubic meter 30 cubic yards sampling unit, the workplans must define how such a unit of compost can be removed from the windrow if the unit is the only one in the windrow to attain the Treatment Criteria.

TABLE 1 - TREATMENT CRITERIA FOR ORGANICS	
ORGANIC CONTAMINANT	TOTAL CONCENTRATION IN COMPOST
[_____]	[_____] mg/kg

1.4.2.1.2 Criteria for Reuse of Composted Soil

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NOTE: The land application or beneficial use of the compost will be largely controlled by existing land disposal restrictions (40 CFR 268), specifically toxicity characteristics for RCRA metals, volatiles, and semi-volatiles and any triggered universal treatment standards (40 CFR 268.48). While the metals loading rates found in 40 CFR 503 - Standards for the Use or Disposal of Sewage Sludge (i.e. 40 CFR 503.13 - Pollutant limits) may be useful in evaluating beneficial use alternatives, the designer should be cautioned that the scope of that standard is for domestic sewage sludge. Composted materials may not meet that definition, and therefore the designer must confirm and check with hazardous waste management regulations prior to land application or beneficial use of the materials. The application of ceiling values listed in 40 CFR 503.13 to finished compost not excluded from hazardous waste regulations, is not allowed under regulation (40 CFR 503.6).

Although reductions in concentrations of heavy metals may occur due to dilution (through addition of amendments), composting is usually not considered a treatment process for inorganics. However, depending on regulatory requirements and intended end use, it may be necessary to require testing for some inorganic parameters (in both compost and compost TCLP leachate), for pathogens, and to include requirements to ensure that the compost has been properly cured (see paragraph CURING AND STORAGE). Toxicological testing of treated and untreated material was previously performed as part of a treatability study (see Characterization of Explosives Processing Waste Decomposition Due to Composting [DTIC ADA294505] , prepared for USATHAMA by Oak Ridge National Laboratory, Sep. 1994); however, toxicity testing is usually not required during full-scale operations. This paragraph should be edited to include site-specific criteria.

****

Prior to final disposition, the compost must meet the following criteria to determine if it has been properly cured:

a. Minimum and maximum pH [5.0][_____] and [7.6][_____], respectively.

b. The increase in temperature observed during the Dewar self-heating test must be not more than [15][_____] degrees C[60][_____] degrees F above the ambient temperature; and the ambient temperature must not be greater than 25 degrees C 77 degrees F.

c. The soluble salt concentration (conductivity) of the finished compost must be less than [20][_____] Millimhos per centimeter (mmhos/cm).

d. Dewar self-heating testing, and conductivity testing must be performed

in accordance with paragraph NON-STANDARD SAMPLING AND ANALYSIS, in PART 3.

e. The treated material must meet the criteria shown in Table 2.

TABLE 2 - REUSE CRITERIA FOR INORGANICS	
MAXIMUM TOTAL INORGANIC CONTAMINANT	CONCENTRATION IN COMPOST
[_____]	[_____] mg/kg
[_____]	[_____] mg/kg

1.4.2.2 Treatment Criteria for Contact Water

****

NOTE: Treatment and disposal options for contact water include: onsite treatment and discharge; offsite treatment and disposal; and storage and reuse as irrigation water. It is possible for petroleum, oils and lubricants (POLs) and other fluids from material handling equipment to be spilled onto compost during process operations. Thus, testing for POLs should be considered. The treatment criteria shown below are only examples. This paragraph should be edited to include site-specific criteria. A State permit under the Clean Water Act may be required for onsite discharge of water, and will include criteria that must be met and documented prior to discharge. The permit may limit discharge of the constituents that are being treated, as well as other constituents introduced in the amendments or conditions caused by the introduction of the amendments. If treated contact water is to be disposed of at an offsite facility, the facility's specific standards and analysis criteria should be met.

****

Contact water must meet the criteria shown in Table 3 at the time of [discharge][offsite disposal][_____]. If a State permit is required for onsite discharge, the water must be documented to have met the criteria in the permit prior to discharge.

TABLE 3 - WATER DISPOSAL/DISCHARGE CRITERIA	
PARAMETER	MAXIMUM CONCENTRATION
[_____]	[_____]

1.4.2.3 Treatment Criteria for Other Waste

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NOTE: Other waste may include: excess amendments, sludge resulting from treatment of contact water, oversize material, and manufactured material.

Treatment may not be required for some wastes. Treatment criteria should be provided if treatment will be conducted onsite. Treatment criteria and methods for porous oversize material such as wood chips may be difficult to develop. A separate table should be developed for the criteria. One treatment scenario for each type of waste should be clearly defined. If treatment criteria already provided in the preceding paragraphs do not adequately cover "Other Wastes", it may be necessary to provide additional criteria, specific to "Other Wastes". Oversize material is often pressure-washed prior to disposal. Sludge or sediment may often be blended with contaminated soil for processing in the composting operation.

****

The following materials must be treated prior to disposal: [excess manure and vegetable wastes, sludge resulting from treatment of contact water, and oversize material that has been separated from contaminated soil][_____]. Treatment must be in accordance with regulatory requirements.

1.4.2.4 Emissions and Dust Control

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NOTE: Specifications for emission and dust controls should be provided in Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS. If Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS is not included in the project specifications, emissions, dust, and odor control sources and control activities should be specified here. The remaining text in this note discusses composting technology-specific emission and dust control considerations to incorporate into Section 01 57 19. An air pathways analysis should be performed during design in accordance with EP 200-1-24 Air Pathway Analysis for the Design of Hazardous, Toxic and Radioactive Waste (HTRW) Remedial Action Projects. Depending upon the contaminants of concern in the contaminated materials, the unit processes/operations employed in the treatment plant, the amount of pollutants emitted, and the geographical location of the site, the emission standards and limitations for certain contaminants and dust control can be identified from the following regulations including, but not limited to, National Primary and Secondary Ambient Air Quality Standards, National Emission Standards for Hazardous Air Quality Pollutants, and state and local regulations. For projects near sensitive populations, contaminant, dust, and wind speed monitoring may be considered at the property boundary to provide evidence of no adverse offsite effect. If perimeter air monitoring, and emission control requirements are not necessary, this paragraph should be deleted.

When editing Section 01 57 19 TEMPORARY

ENVIRONMENTAL CONTROLS, consider the following: For each stage of operations, an air pollution control plan must include, but not be limited to: the sources of emissions, dust and odors during each stage of operations, and proposed control measures. The stages of operation must include, but are not limited to: construction of paved or lined surfaced, soil preprocessing; treatment, transport, and disposal of oversize material; blending of soil and amendments; during the composting process, including during mixing; transport of compost; storage of compost; disposal of compost. The plan must specifically address fugitive emissions and odor control during the following activities: amendment delivery and storage; blending of soil and amendments; during the composting process, including during mixing; transport of compost; storage of compost; and disposal of compost. If local air pollution regulations require capture and control of specific emissions, the type of collection and treatment equipment should be identified. If air monitoring will be required, the following must also be included: type and locations of monitoring devices, secure retention of the data ; and for each stage of operations: frequency of sampling, number of samples from each location, the total number of samples, and the parameters to be monitored. If operations are to occur near occupied areas, consideration must be given to using perimeter air monitoring to generate a defensible record showing that unacceptable air concentrations have not extended past the boundaries of the site .

Based on the regulatory requirements, the proper technologies or apparatus for the emissions control if required can be determined. Upon completion of the design of the treatment plant, these emission requirements and control technologies should be defined by the design engineer. It may be necessary to implement control measures during the following activities: the field demonstration, excavation, hauling, stockpiling, separation of oversize materials, blending amendments, blending amendments and soil, construction of windrows, mixing windrows, transport of compost, disposal of finished compost, and reuse of finished compost (e.g., land application). There may be an increased potential for human exposure to ammonia gas and mold spores (e.g., Aspergillus fumagatus) during composting.

If a performance specification is prepared, the emissions, dust sources, and contaminants of concern should meet specified requirements based on applicable regulations. Section 01 57 19 should list the emissions criteria for the contaminants of concern for each emission and dust source, and if applicable, monitoring requirements should be specified. The applicable federal, state, and local regulations should also be identified. If the

specification is prepared based on detailed design, the technologies or apparatus for controlling the emissions and dust sources should also be specified.
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Execute the windrow composting process to meet the emissions and dust control requirements in [Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS][_____].

1.4.3 Composting Work Plan

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NOTE: To avoid duplications in submittal requirements, submittals in this Section should be coordinated with other sections of the contract (e.g., 01 45 00 QUALITY CONTROL, and 01 32 01.00 10 PROJECT SCHEDULE).

If a request-for-proposal contract is being prepared, this paragraph and the Submittals paragraph should be edited and used to form the basis for Contractor proposals.
****

Submit a Composting Work Plan [as an appendix of the Unified Federal Policy-Quality Assurance Project Plan (UFP-QAPP)][as a standalone document] no more than [200][_____] calendar days after notice to proceed.[Prepare [draft for Government review][draft-final for [regulatory][_____] review] and final versions of the Landfarming Work Plan. Allow [30][_____] calendar days for[Government] review[and [30][_____] calendar days for regulatory review]. Allow [45][_____] days for comment resolution following each review and preparing the next version of the document.] The composting work plan must include, but must not be limited to, the following:

1.4.3.1 Schedule

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NOTE: Composting may rely substantially on the supply of seasonal farm-generated amendments like manure and straw. The seasonal availability of these items must be incorporated into the operating schedule. The seasonality may be lessened by stockpiling these materials; if so this feature must be described in the workplan.
****

Provide a schedule specifying dates and durations for: excavation, hauling, stockpiling, start and completion of mobilization, treatment pad construction, separation of oversize materials, delivery and stockpiling of amendments, field demonstration, full-scale treatment of contaminated materials, storage of treated material, disposal of treated material and other wastes, and demobilization. Provide the following details: intended hours of operation, routine maintenance downtime, other scheduled downtime, anticipated time to reach cleanup goals for each batch of soil and amendments, anticipated laboratory turn-around time to receive data from compliance samples.

1.4.3.2 Project Organization and Personnel

Provide an organization chart, including sub-contractors; include the names, responsibilities, education, and resume of the key project personnel. Key personnel must meet the requirements of this paragraph and paragraph KEY PERSONNEL. Key personnel must include, but must not be limited to: project managers, quality control personnel, supervisory operators and technicians, and engineering staff. Clearly define responsibilities of each individual in the organization in terms of project activities including, but not limited to: project management and coordination; scheduling; quality control and quality assurance; sampling; measurement; field and laboratory analysis; data management; operation and maintenance; and health and safety management.

1.4.3.3 Selection of Amendments

The selection of amendments and the prescribed quantities needed should be based on the recommendations of the Bench-Scale Treatability Study Test Report. Provide a description of, and preferred sources for each proposed amendment; including at least one alternative source for each category of amendment. Include total quantity needed, timeframe (estimated year and month) when needed, locations of each source, and distances from the site. Amendment categories must include: carbon and microbial sources (e.g., manure, vegetable waste) and bulking (e.g., alfalfa hay, and wood materials). For amendments that are only available on a seasonal basis, provide a plan for substituting alternative types of amendments. Include the proposed quantity of each amendment that will be added to each cubic meter cubic yard of contaminated soil.

1.4.3.4 Operations and Process Monitoring

Provide a detailed description of the proposed operation in the [UFP-QAPP][the Composting Work Plan]. The description must include: plans for pre-processing of contaminated soils; plans for stockpiling materials; plans and schedule for pick-up, transport, delivery and storage of each amendment during operations; plans for mixing amendments, soil and constructing windrows; initial volumes of soil and amendments to be treated in each batch; methods for measuring quantities of soil, amendments, and compost; treatment pad area required for each batch; water management plans; parameters that will be monitored during composting, curing and storage; frequency of monitoring, windrows turnover, and irrigation/moisture addition during each stage of operations; locations of each windrow sampling station shown from plan view; sampling locations shown on a diagram depicting a cross-section of a windrow; the number of sampling stations per each batch of compost; windrow moisture and temperature monitoring locations must also be shown; and plans for storage of treated materials.

1.4.3.5 Non-Composting Treatment Processes

Provide a detailed description of the procedures for treatment of solid and liquid wastes that will be treated by a process other than composting; including: treatment criteria for oversize material and other wastes.

1.4.3.6 Equipment and Servicing

Provide a detailed description of the proposed treatment equipment. For each proposed piece of equipment, describe: function, design capacity, equipment specifications identifying manufacturer and model number,

material of construction, recommended operating conditions, and the number of units that will be present onsite during each stage of operations. Equipment described must include, but must not be limited to: mixing devices; windrow turning equipment; pumps, valves and other in-line devices; irrigation/moisture equipment.[For equipment that will be in contact with explosives-contaminated material, a copy of the explosives hazard analysis report for each piece of equipment must be provided; this includes equipment used to homogenize and grind samples. Explosives hazard analysis reports must be in accordance with DA PAM 385-64.] Provide plans for servicing equipment and explain how material handling and windrow mixing will be accomplished during servicing of equipment, and during unanticipated breakdown of machinery. Decontamination of equipment is as required in the mobilization and demobilization plans included in the UFP-QAPP.

1.4.3.7 Process Material Tracking Schedule

Provide the Process Material Tracking Schedule for recording and managing the quantities of the contaminated materials treated. Provide the dates and duration of the following activities for each batch of contaminated material: initiation of composting; completion of composting; reprocessing of any treated materials that failed to meet treatment criteria; storage of treated material; disposal of treated material.

1.4.3.8 Disposal and Reuse of Wastes

Provide a detailed description of the plans for disposal or on-site treatment of solid and liquid wastes. For each type of waste that will be generated, specify: origin and description of waste; estimated total quantity of waste; method of transport to disposal location; disposal location; on-site water treatment equipment and planned discharge option if allowed; disposal documentation to be provided by the receiving facility; and schedule showing the anticipated quantities and dates for generation, transport, and disposal of the wastes. Waste types must include, but must not be limited to: finished compost, other treated material, oversize materials, contact water, and other solid and liquid wastes generated during the project.

1.4.3.9 Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP)

Prepare a Uniform Federal Policy Quality Assurance Project Plan (UFP QAPP) in accordance with the requirements set forth in EPA 505-B-04-900A and using the UFP-QAPP WKSTS. Submit the UFP-QAPP no more than [200][_____] calendar days after notice to proceed. Prepare [draft for Government review][draft-final for [regulatory][_____] review] and final versions of the UFP-QAPP. Allow [30][_____] calendar days for [Government] review [and [30][_____] calendar days for regulatory review]. Allow [45][_____] days for comment resolution following each review and preparing the next version of the document.

1.4.3.9.1 Procedures And Tests

Provide a detailed, chronological description of the sequence of procedures and tests that will be used to determine whether the compost has met criteria for[disposal][and][or][reuse]; including: the location of each sampling station shown from plan view; the number of sampling stations per each batch of compost; sampling locations shown on a diagram depicting a cross-section of a compost pile; the number of samples that will be collected and tested for each type of test performed; and the

manner in which the data will be used, such as compositing the data over the entire windrow for a windrow-wide "pass/reject" decision, or dividing a windrow into multiple sectors for individual "pass/reject" decisions.

For the solid and liquid wastes that will be treated by a process other than composting, provide testing parameters; sampling locations; number of samples; monitoring frequency; and laboratory turn-around-time. Describe moisture and temperature control instrumentation and sampling and testing devices for process monitoring.

1.4.3.9.2 Mobilization and Demobilization

Provide a mobilization and demobilization plan as an attachment to the UFP-QAPP to include, but not be limited to: transport of personnel, material, and equipment; decontamination and disposal of materials and equipment that brought to the site; decontamination and disposal of the treatment pad and other paved surfaces; and decontamination of equipment during demobilization. Include a Post-Treatment Cleanup and Sampling Plan in the mobilization and demobilization plan for areas where there was contact with contaminated materials and were disturbed by the Remedial Action/Site Work. Also, discuss the restoration of disturbed areas such as, grading and seeding.

[1.4.3.10 Bench-Scale Treatability Study Test Report

Submit the bench-scale treatability study test report as part of the Composting Work Plan after completion of the bench-scale treatability study test. Include: characterization test results for each amendment; the source and approximate age of each amendment; the proportions of amendments and soil in each recipe tested; the date that each amendment was shipped and received by the laboratory; procedure used to ship each amendment (including type of containers and temperature); how long amendments were stored prior to use and the ambient temperature of the storage area; the date that the bench scale test was initiated; physical and chemical monitoring data; and proposed recipes of soil and amendments for the field demonstration. Graphs of temperature versus time must be provided for each self-heating test performed. Both ambient temperatures and compost temperatures must be provided. After completion of bench-scale testing, review the test results, and propose the recipes of soil and amendments to be included in the field demonstration. Include the proposal for the field demonstration in the Field Demonstration submittal.

]1.4.3.11 Materials Data

Provide safety data sheets (SDSs), certificates of analysis, and product performance data. SDSs must be in accordance with 29 CFR 1910, Section 1200(g).

1.4.3.12 Permits, Permit Equivalents, and Certifications

Provide copies of the permits, permit equivalents and certifications with the Composting Work Plan. For any of the above-listed items requiring a longer time frame, include copies of applications and scheduled dates for receiving final approval.

1.4.4 Other Submittals Requirements

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NOTE: Submittal scheduling should allow for an adequate amount of time for:
1. Preparation and review of submittals.
2. The treatment period of the bench-scale treatability study test and the field demonstration.
3. Receipt of analytical results from the laboratory for samples collected on the last day of the treatment period.

The time periods shown for completing submittals have been sequenced to illustrate this point. Ideally, the Bench-Scale Treatability Study Test Report should be completed before the Contractor is required to submit the Field Demonstration Plan, and the Field Demonstration Report should be completed before the Contractor is required to submit the Composting Work Plan.

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Submit the following as specified:

1.4.4.1 Amendment Test Plan

Submit the amendment test plan not more than [21][_____] calendar days after notice to proceed. Prepare[draft for Government review][draft-final for [regulatory] [_____] review] and final versions of the Amendment Test Plan. Allow [30][_____] calendar days for[Government]review[and [30] [_____] calendar days for regulatory review]. Allow [45][_____] days for comment resolution following each review and preparing the next version of the document. This plan must address, but must not be limited to: the source of each amendment; testing parameters; and the number of samples. Proposed procedures for shipping amendments to the laboratory must also be provided, including: type of containers; and the maximum time periods between shipping, laboratory receipt, and initiation of testing.

[1.4.4.2 Bench-Scale Treatability Study Test Plan

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NOTE: The following reference should be used to evaluate the Bench-Scale Treatability Study Test Plan: EPA 540/R-93-519a, Guidance for Conducting Treatability Studies Under CERCLA, Biodegradation Remedy Selection, 1993. Consider including these references as requirements in for the Bench-Scale Test Plan.

****

Submit the Bench-Scale Treatability Study Test Plan no more than [90][_____] calendar days after notice to proceed. Prepare[draft for Government review][draft-final for [regulatory][_____] review] and final versions of the Bench-Scale Treatability Study Test Plan. Allow [30][_____] calendar days for[Government]review[and [30] [_____] calendar days for regulatory review]. Allow [45][_____] days for comment resolution following each review and preparing the next version of the document. This plan must incorporate the requirements in paragraph BENCH-SCALE TREATABILITY STUDY TEST and must address, but must not be limited to: location of test facility; amendment selection rationale; the various amendment recipes to be testing with rationale; the source of each

amendment; test parameters, number of samples, and sampling locations that will be used determine the source of soil; the proposed proportions of amendments and soil in each recipe; the number of replicate tests for each selected recipe; procedure for mixing soil and amendments; types of containers that will be used; frequency of mixing; testing and monitoring parameters; number of samples; monitoring frequency; length of monitoring period; and laboratory turn-around-time. Proposed procedures for shipping amendments to the laboratory must also be provided, including: type of containers; and the maximum time periods between shipping, test facility receipt, and initiation of testing. Test methods, and other sampling and analysis requirements for the bench-scale treatability study test must be [_____].

]1.4.4.3 Field Demonstration Plan

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NOTE: It is important that the field demonstration match the intended implementation as closely as possible in terms of inputs and process. Composting is sensitive to a variety of factors like moisture, temperature, chemical conditions, etc. The difference in scale between the demonstration and the implementation will inevitably introduce changes in the conditions. The conditions in the demonstration need to be measured to a greater degree than might be initially supposed, such as greater resolution in the temperature and moisture over time and across the volume of soil being treated, so that the differences due to scale can be identified and minimized, and the implementation can reproduce as closely as possible the successful conditions of the demonstration .

****

Submit a field demonstration plan not more than [150][_____] calendar days after notice to proceed. Prepare[draft for Government review][draft-final for [regulatory][_____] review] and final versions of the Field Demonstration Plan. Allow [30][_____] calendar days for[Government]review[and [30][_____] calendar days for regulatory review]. Allow [45][_____] days for comment resolution following each review and preparing the next version of the document. This plan must address, but must not be limited to: target levels of contaminants in soil that will be treated; test parameters, number of samples, and sampling locations that will be used to determine the source of contaminated soil; sources of amendments; the proposed quantity of each amendment that will be added to each cubic meter cubic yard of contaminated soil; irrigation water source; plan for physical and chemical monitoring; laboratory turn-around-time; plan for maintaining proper temperatures, and moisture contents; irrigation and mixing equipment specifications; and waste disposal plan. Test methods, and other sampling and analysis requirements for the field demonstration test must be [_____]. For equipment that will be in contact with explosives-contaminated material, a copy of the explosives hazard analysis report for each piece of equipment must be provided. Explosives hazard analysis reports must be in accordance with DA PAM 385-64.

1.5 SUBMITTALS

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NOTE: Review submittal description (SD) definitions

in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy and Air Force projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Pre-Construction Meeting Agenda

Pre-Construction Meeting Minutes; G, [_____]

Bench-Scale Treatability Study Test Plan; G, [_____]

Field Demonstration Plan; G, [_____]

Amendment Test Plan; G, [_____]

Composting Work Plan; G, [_____]

Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP); G

SD-05 Design Data

Adjusted Design; G

SD-06 Test Reports

Field Demonstration Report; G, [_____]

Operations Reports

Treatment Completion Records

Pre-Operation Examination Report

Preconstruction Equipment Examination Report

Water Supply Analysis

Field Demonstration Operations Report

Bench-Scale Treatability Study Test Report

SD-07 Certificates

Certificate Of Analysis For Synthetic Or Manufactured Additives

Testing Laboratory Validation; G, [_____]

1.6 QUALITY CONTROL

1.6.1 Regulatory Requirements

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NOTE: Regulatory requirements will be location specific and may include local ordinances and State regulatory requirements. Correspondence from regulatory agencies, and other relevant information, should be attached to the specifications to indicate the level of effort necessary for the Contractor to obtain finalized permits, permit equivalents, certifications and to meet substantive regulatory requirements.

For sites addressed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), administrative permit requirements for on-site activities are not required, though the substantive requirements may need to be met. The permits or permit equivalents may include those addressing air discharges, treated water discharge, well installation and abandonment, underground injection, and possibly others. Permitting requirements known to have substantive requirements should be listed here. If permit requirements are covered in other specifications, delete this section.

****

Obtain the permits, permit equivalents and certifications; and meet the substantive regulatory requirements necessary for the installation, operation and closure of the project.[Correspondence from regulatory agencies, and other relevant information, is attached to the specifications to indicate the level of effort necessary to obtain finalized permits, permit equivalents, certifications and to meet

substantive regulatory requirements.]

1.6.2 Qualifications

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NOTE: The majority of composting projects completed to date have involved treatment of soil contaminated primarily with explosive compound trinitrotoluene (TNT). Literature research should be conducted to review past projects or lesson learned to determine if windrow composting is suitable and effective for the site before remedy selection. For sites with unusual, or difficult to treat, contaminants of concern (e.g., exceptionally high levels of HMX or RDX), the designer should consider including a requirement that the Contractor have completed a field demonstration or full-scale project where explosives-contaminated soil was successfully treated. Although including such a requirement may limit the number of qualified bidders and drive up the price of the contract, coordinate with Contracting Office to conduct market research to identify possible qualified vendor or contractor that could perform the contract requirements successfully.
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1.6.2.1 Contractor Experience

Have successfully completed at least [one][_____] windrow composting project[s] that required processing of a volume of compost comparable to the estimated volume of compost that will be generated during this project. Also have successfully completed at least [one][_____] full-scale project[s], that required handling and transport of soil contaminated with a [RCRA hazardous constituent, or CERCLA hazardous substance][_____]. For each project, provide the following: site name, location, the names of the Contractor's key personnel; key points of contact and phone numbers (including government representatives, and other parties involved in the project); dates of mobilization/demobilization; contaminants of concern; and the volume of contaminated soil handled or treated. Provide the following also, if applicable: dates for initiating and completing treatment; quantity of time required to treat each batch of contaminated soil; volume of amendments added per unit volume of contaminated soil; final volume of finished compost; concentrations of contaminants of concern in soil (before treatment), day zero (in compost), during treatment, and after treatment.

1.6.2.2 Key Personnel

Provide key personnel with a minimum of[three][_____] years of composting field experience. Include system operators, quality control personnel, and supervisory engineering and technical staff involved with the landfarming windrow composting operation in key personnel. Perform all survey work under the supervision of a registered land surveyor licensed in the [applicable jurisdiction][State of [_____]].[Perform surveys in accordance with Section:[_____].]

1.6.2.3 Lab Validation

Perform testing by a DoD Environmental Laboratory Accreditation Program (DoD ELAP)accredited commercial testing laboratory in accordance with[Section 01 45 00 QUALITY CONTROL][_____] and approved by the Contracting Officer. Submit testing laboratory validation for the testing to be performed. Do not permit work requiring testing until the Contracting Officer approves use of the testing laboratory.

1.6.3 Drawings

Project drawings must include, and not be limited to:

a. Layout of the facility.

b. Dimensions of amendment storage areas, preprocessing areas, treatment pad, noting areas under roof and within structures.

c. Dimensions and volumes of contaminated soils stockpiles, treated materials stockpiles, and waste stockpiles.

d. Locations, dimensions, and volume of collection sumps and any ancillary water storage facilities.

e. Dimensions, volumes, and cross-sections of windrows.

f. Plan view and cross-sections of perimeter berms and collection sumps.

g. Ancillary water storage facilities.

h. Size of contact water conveyance devices and structures.

i. Piping and instrumentation diagrams.

j. Process flow diagrams.

1.7 DELIVERY, STORAGE, AND HANDLING

Safely transport, store, and handle equipment and raw materials (including reagents). Package and ship these items in compliance with United States Department of Transportation (USDOT) requirements. Store and handle these items onsite in accordance with the manufacturer's recommendations and in compliance with applicable regulatory requirements.

1.8 PROJECT/SITE CONDITIONS

1.8.1 Existing Conditions

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NOTE: The pertinent site characterization data should be placed in the appendices of the technical specifications or on the drawings, and referenced here. If the site contains a significant amount of debris, the available information about its extent and characterization should also be provided. Indicate the detail to which site characterization has been performed. The information should also include: construction limits, property survey, access gates and haul roads available to the

Contractor, locations of utilities, water sources, area available for the field demonstration and treatment cell, restricted areas adjacent to the project site, chemical data, geotechnical data, sampling locations, and boring logs. Reference the administrative record locations, whether they are physical or digital, of the site if they exist.

Indicate if there are multiple dissimilar types of contaminated materials that will require different operations. Materials may be considered dissimilar based on possessing different soil properties, types of contaminants, or relative concentrations of contaminants. Determination of dissimilar materials may be based on site investigations and/or previously completed treatability studies.

****

The existing site conditions are presented[in Appendix [_____]][and][on the drawings]. These include [physical configuration][utilities] [topography][land uses][geotechnical characteristics of the contaminated materials (including [grain size analysis][total organic content][cation exchange capacity][pH][moisture content][density][porosity]) [hydrogeology]][and][nature and extent of contamination][_____]. The existing conditions presented are the result of site investigations at specific locations; variations in the existing site conditions could occur. Perform an independent interpretation of the site characterization data. Notify the Contracting Officer within [48 hours][_____] if discrepancies between the data provided and actual field conditions are discovered.

[1.8.2 Previously Conducted Treatability Studies

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NOTE: This paragraph should be deleted if no previous treatability studies have been conducted.

The methods employed in the previous treatability studies may not be the same as those proposed by the Contractor. Documentation of the previous treatability studies should include the same information shown in the following sub-paragraphs: Bench-Scale Treatability Study Test Report and Field Demonstration Report. Bench-Scale Treatability Study Reports should be prepared to provide prospective Contractors with sufficient information to prepare a responsive bid, or proposal, for the contract. Treatability studies are a necessary part of each composting project. Bench-scale treatability study tests and field demonstrations should be performed to determine which recipes of soil and amendments are most likely to fulfill the treatment criteria.

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Appendix [A][_____] "Bench-Scale Treatability Study Report" is for information purposes only.

]PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

****

NOTE: It may be necessary to perform an explosive hazard analysis on equipment used to process explosives-contaminated material (see DA PAM 385-64). Equipment used on previous composting projects may already have been subject to an explosives hazard analysis (see Hazard Review of KW Windrow Composter, March 1992, in Appendix E of USAEC CETHA-TS-CR-93043).

****

Provide materials and equipment that are the standard products of a manufacturer regularly engaged in the manufacture of such products and essentially duplicate items that have been in satisfactory use for at least two years prior to bid opening. Provide support for equipment by a service organization that is, in the opinion of the Contracting Officer, capable of providing service, materials and equipment in an expedient manner.

2.2 WATER SUPPLY

****

NOTE: One important concern for irrigation water is to ensure that salts do not accumulate to levels that inhibit biological activity. Conductivity is an indicator of salt content. Conductivity may be reported in micro-Siemen per cm, or micro-mho per cm. Total dissolved solids (TDS) testing may be substituted for conductivity.

Possible water sources include: a nearby pond, or other surface water body; a hydrant, or other connection to a water distribution line; used decontamination water; and runoff from precipitation; see paragraph STORAGE VOLUME. For most composting operations, spontaneous combustion is an unlikely occurrence. However, if large quantities of very dry materials (e.g., leaves) will be used as amendments, it may be necessary to include provisions for fire detection and/or fire protection (see paragraph MOISTURE CONTROL). If there are susceptible structures nearby, it may be necessary to ensure that the local water distribution system is adequate to prevent a fire from spreading. It may also be necessary to coordinate this Section with Sections 28 31 60 INTERIOR FIRE ALARM SYSTEM, NON-ADDRESSABLE; 28 31 66 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, NON-ADDRESSABLE; 28 31 70 INTERIOR FIRE ALARM SYSTEM, ADDRESSABLE; or 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE . This Section does not include provisions for fire protection.

****

Provide water for irrigation that does not contain oils, acids, salts, alkalis, organic matter, solids or other substances at concentrations that could be detrimental to the successful treatment of the contaminated materials. The acceptable ranges, or levels, of the following parameters in the irrigation water must not exceed the criteria established in Table 4.

TABLE 4 - IRRIGATION WATER CRITERIA	
PARAMETER	REUSE CRITERIA
maximum conductivity	[_____] micro-mho per cm
minimum pH	[_____] standard units
maximum pH	[_____] standard units
[_____]	[_____]

Provide water for irrigation that does not contain contaminants that would persist through the composting process and that would thereby cause the composted soil to be considered contaminated and not suitable for reuse. Contaminants must also be avoided that may leach through the project site and contaminate groundwater.[If non-potable water is to be used, the irrigation water must be characterized prior to its use using Table 5. Sufficient numbers of samples must be collected to characterize the irrigation water source. Irrigation water that does not meet the criteria in this table may be treated to these criteria prior to windrow composting use. Submit a Water Supply Analysis demonstrating that irrigation water meets requirements.

TABLE 5 - IRRIGATION WATER CONTAMINANT CRITERIA		
ANALYTICAL METHOD NUMBER from US EPA SW-846	ANALYSIS TYPE	CRITERIA TO BE MET
6010[and 7470A]	Metals[and Mercury]	[Less than Maximum Contaminant Level (MCL)] [_____]
8260	Volatile organics	
8270	Semi volatile organics	
8081	Pesticides	
8082	PCBs	
1633	PFAS	

TABLE 5 - IRRIGATION WATER CONTAMINANT CRITERIA		
ANALYTICAL METHOD NUMBER from US EPA SW-846	ANALYSIS TYPE	CRITERIA TO BE MET
Within each Analytical Method, only analyze for analytes which have a [MCL][_____].		

]

2.3 AMENDMENTS

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NOTE: Factors driving selection of amendments should include: seasonal availability, proximity of sources to the site, costs, amenability to storage and handling, moisture content, odor potential, texture and porosity, carbon-to-nitrogen (C:N) ratio, previous experience with using an amendment, and variability in the quality of an amendment. Amendment mixtures that have been successfully used for previous projects, involving treatment of hazardous-waste-contaminated soil, should be given primary consideration.

Theoretically, the C:N ratio of the compost recipe should be between 20:1-40:1. The C and N contents of candidate amendments can be estimated using literature values (see Appendix A of the On-Farm Composting Handbook). Laboratory testing, for moisture and ash content, may also be used to determine carbon content. By subtracting the ash content from the dry weight, the organic matter content can be determined. The carbon content is usually determined by dividing the organic matter content by 1.8. Other amendment selection considerations are provided in paragraph AMENDMENT TESTING AND BENCH-SCALE TREATABILITY STUDY TESTING, .

If the bulk density of the amendment recipe (not including soil) is greater than 640 kg per cubic meter 40 lbs per cubic foot, the recipe may not be sufficiently porous. Wood chips may be used to increase the porosity of a compost recipe; however, depending on plans for end-use, large-diameter materials may have to be separated from the finished material (see paragraphs SOIL PRE-PROCESSING, CURING AND STORAGE, and DISPOSAL). It becomes more difficult to maintain aerobic conditions in the windrow as the porosity decreases, and as the moisture content increases (see paragraph MOISTURE CONTROL in PART 3). Use of amendments with an extremely high moisture content (e.g., liquid manure) should be avoided. The moisture content of the soil and amendments will control the initial moisture content of the compost. If the initial moisture content is too high, the windrow may not heat up properly, and the process may fail.

The following amendment mixture has been

successfully used for full-scale treatment of explosives-contaminated soil: 30 percent soil, 17.5 percent sawdust, 17.5 percent hay, 21 percent cow manure, 10.5 percent chopped potato waste, 3.5 percent chicken manure (as reported in USAEC CETHA-TS-CR-93043). Based on previous, successful composting projects for explosives-contaminated soil, the following recipe of soil and amendments is recommended:

a. 30 percent Contaminated Soil. It may be necessary to reduce the soil percentage if clayey soils are being treated.

b. 15 - 20 percent Saw Dust/Wood Chips. It may be advantageous to substitute all or a portion of the sawdust with wood chips. Wood chips provide for greater porosity in the compost. Use of cedar chips, or other aromatic wood chips, should be avoided.

c. 15 - 17 percent Alfalfa Hay. The quality of the hay may be marginal. Moldy alfalfa hay has been found to perform satisfactorily, and it is usually less expensive than feed quality hay.

d. 10 - 20 percent Potato Waste. Chopped potatoes are better than whole potatoes. It may be possible to use other starch sources in lieu of potatoes.

e. 15 - 25 percent Manure. Must be fresh (not dried). Although chicken manure has a higher nitrogen content, satisfactory results have been obtained using only cow or steer manure. Manure from ruminant animals (e.g., cows) is thought to be the best source of microbial inoculum.

****

Test representative samples from the first shipment of [manure, and potato waste (or other vegetable waste)][_____] for: conductivity, and moisture content. The concentration of glass, plastic, and other foreign materials in each shipment of amendment must not exceed [5][_____] percent, by dry weight. Do not use asbestos containing materials as amendments. The initial soluble salt content (conductivity) of the compost (including soil and amendments) must not exceed [20][_____] mmhos/cm. The initial moisture content of the compost (including soil and amendments) must not exceed [60][_____] percent of the moisture content at field capacity (or water holding capacity).

Analyze manure amendments to verify absence of constituents that would pass unaltered through the windrow composting process and possibly accumulate in the product soil. The following table should be used:

TABLE 6 - MANURE AMENDMENT CONTAMINANT CRITERIA		
ANALYTICAL METHOD NUMBER from USEPA SW-846	ANALYSIS TYPE	CRITERION TO BE MET
6010 [and 7470A]	Metals [and Mercury]	[Less than USEPA Residentional Soil Regional Screening Level if one exists] [_____]
8082	PCBs	
1633	PFAS	
Within each Analytical Method, only analyze for analytes which have a [Residential Soil RegionalScreening Level] [_____].		

2.4 SYNTHETIC OR MANUFACTURED ADDITIVES

****

NOTE: It is usually unnecessary to include synthetic or manufactured additives (e.g., surfactants or microbial inoculum) in compost recipes. This paragraph should be deleted if synthetic or manufactured additives will not be used.

****

A Certificate of Analysis for Synthetic or Manufactured Additives must accompany each shipping unit of synthetic or manufactured additive supplied by the vendor.

[2.5 SAMPLES FOR BENCH-SCALE TREATABILITY STUDY TESTS

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NOTE: To reduce the overall risk to the government, it is strongly advised that the project team should require the Contractor to collect samples for the bench-scale treatability study test unless the nature of the site prevents the Contractor to do so. Depending on site conditions and project needs (e.g. site security, access issue, etc.), the Government may provide samples to the Contractor to conduct bench-scale treatability study tests.

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[The Contracting Officer will provide the required samples to conduct the bench-scale treatability study test.][Select sampling locations and collect representative samples to conduct the bench-scale treatability study test in accordance with the approved work plan. Consider the existing site conditions presented in paragraph EXISTING CONDITIONS when selecting sampling locations. [Conduct sample collection activity in the presence of Contracting Officer.]] The collected bench-scale treatability study test samples must have contaminant concentration levels [representative of the average concentration of the contaminants identified][and][greater than the action level criteria presented in Table 7]. Otherwise, repeat sampling until the contaminant concentration levels exceed the action level criteria. A minimum of [two composite samples][_____] must be tested. Also provide a physical description of each soil sample, either prepared by or under the supervision of a licensed geologist, to demonstrate that soil-type is representative of the

contaminated zone. Do not commence bench-scale treatability study testing until contaminated material sample results meet the aforementioned concentration criteria.

TABLE 7 - ACTION LEVEL CRITERIA	
PARAMETER	ACTION LEVEL CRITERIA
[_____]	[_____] mg/kg

]PART 3 EXECUTION

[3.1 AMENDMENT TESTING AND BENCH-SCALE TREATABILITY STUDY TESTING

****

NOTE: If a proven recipe will be used, testing of amendments may not be necessary (see paragraph AMENDMENTS). However, if a type of amendment has been proposed for which there is no previous experience, the following tests may be warranted: bulk density, moisture content, field capacity (or water holding capacity), free carbonate, organic matter content (or volatile solids), ash content, pH, conductivity, and total Kjeldahl nitrogen. These paragraphs, and the corresponding submittal descriptions, should be deleted if amendment testing and bench-scale treatability study testing were performed prior to awarding this contract.

****

3.1.1 Amendment Test

Prior to the bench-scale treatability study test, collect and test samples of amendments for: [moisture content, pH, and conductivity][_____]. For each type of amendment,[two composite samples][_____] must be tested. The following amendments must be included in testing: [manure, potato waste (or other vegetable waste),][_____]. Submit the amendment test report along with the Bench-Scale Treatability Study Test Report in accordance with paragraph BENCH-SCALE TREATABILITY STUDY TEST REPORT. Include the following in the report: characterization test results for each amendment; the source and approximate age of each amendment; the date that each amendment was shipped, received and tested by the laboratory; procedure used to ship each amendment (including type of containers and temperature); if amendments were stored for any period of time, the temperature of storage; testing methods used; and proposed recipes of soil and amendments for bench-scale treatability study testing.

3.1.2 Bench-Scale Treatability Study Test

****

NOTE: The testing described below is closely related to the Dewar self-heating test that is used to determine the maturity of compost. However, the testing described below requires more intensive monitoring, a larger volume of material, and more time than a standard Dewar self-heating test.

Self-heating tests are typically performed using

insulated containers (e.g., Dewar flasks), and may be used to assess whether recipes of soil and amendments are suitable for composting; a recipe may be suitable if it heats up, and remains at a sufficiently high temperature for an extended period of time. Self-heating tests may also be used to determine if an organic contaminant that has not previously been treated via composting, is amenable to composting.

It is possible to use vacuum-insulated containers with a volume of less than 4 L 1 gallon for self-heating tests; however, a minimum volume of 4 L 1 gallon is recommended for the following reasons: to more accurately simulate conditions of a compost windrow (height of about 1.5 m 5 feet); and to reduce the chances of using soil samples that are not representative of site conditions.

****

After completion of amendment testing, review the test results, and submit the proposed recipes of soil and amendments to be included in the bench-scale treatability study testing designed to optimize the treatment effectiveness. At a minimum, the proposed recipe should include the following: selected carbon/nutrient amendment (e.g., wastewater treatment sludge/biosolids, manure, potato waste, corn processing waste) and selected bulking agent[s] (e.g., mulch, wood bark, corn stalks, straw); ratio of soil to treatment and bulking amendments (e.g., 30 percent soil to 70 percent amendment); moisture level (e.g., 50 percent to 60 percent of field capacity); carbon to nitrogen ratio (e.g., 20-40:1); projected treatment timeframe (typically 15-45 days). Perform at least [three, replicate][_____] self-heating tests simultaneously for each selected recipe. Prior to testing, homogenize and divide each recipe into replicate volumes. The volume of material (including soil and amendments) included in each container for the self-heating tests must be not less than [[4][_____] L [1][_____] gal][_____]. Self-heating tests must be performed for a period of not less than [28 days][_____], during which temperature monitoring must be performed [daily][_____].

]3.2 PREPARATION

3.2.1 Mobilization

****

NOTE: Section 01 35 29.13 HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES includes requirements for decontaminating equipment that has been used in contaminated zones. That section should be modified to extend decontamination/cleaning requirements to equipment being brought on-site to cover the requirements of this paragraph.

****

Do not mobilize to the site until [the Composting Work Plan][UFP-QAPP] has been approved by the Contracting Officer and the Contractor has received written confirmation. Delays caused by the Contractor's failure to meet regulatory requirements must result in no additional cost to the Government. In accordance with[Section 01 35 29.13 HEALTH, SAFETY, AND

EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES][_____], the equipment which is rented and/or previously used for other site remediation must be decontaminated and tested for contaminants of concern before being brought to the site.

3.2.2 Pre-Operation Examination

Conduct a pre-operation examination of the on-site infrastructure, utility conduits, monitoring points, site access constraints, and infrastructure. Photographically document, with identifying labels, the existing condition of infrastructure and utilities, particularly for comparison to post-treatment conditions. Verify locations of critical utilities that cannot be disrupted and those utilities that would potentially have significant impacts on treatment and public safety. Submit a Pre-Operation Examination Report documenting the examination activity [before mobilization begins][_____]. Obtain all necessary utility clearances before initiation of subsurface work.

3.2.3 Pre-Construction Equipment Examination

Conduct a preconstruction examination of the landfarming equipment for damages, defects, and dilapidation. Submit the Preconstruction Equipment Examination Report to the Contracting Officer[before construction begins][____]. The Contracting Officer may conduct an independent examination to ascertain the condition and functionality of the equipment. Based on this examination, the Contracting Officer may reject the entire system or damaged, defective, or dilapidated equipment. The cost associated with equipment or control replacement or repair, and delays caused by the rejection must be borne by the Contractor. Routinely and properly inspect and maintain the equipment to provide the operation as required by the Contract schedule. Schedule delays and the associated costs are the responsibility of the Contractor. Provide an alternate/auxiliary power source if sufficiently reliable sources are not available.

3.3 FIELD DEMONSTRATION

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NOTE: The field demonstration requirements are a function of the uncertainty of the materials to be treated. For well defined wastes that are known to be amenable to composting, optimization testing (performed using full-scale equipment and facilities) may be adequate. If the amenability of the contaminated material to composting has not been established, the field demonstration should be preceded by bench-scale treatability study testing. If the process has yet to be demonstrated on a large scale for the specific soil type and contaminants of concern, it may be advantageous to perform the field demonstration prior to construction of full-scale facilities.

The recipe of soil and amendments used in the field demonstration will be based on the results of the bench-scale treatability study test. To prevent scale-up problems between the field demonstration and full-scale operations, the batch size used for the field demonstration should be at least 23 cubic

meters 30 cubic yards, and not less than 5 percent of the proposed batch size for full-scale operations. A batch is defined as that amount of material, including soil and amendments, for which treatment is initiated at the same time during full-scale operations.

****

Prior to full scale composting operations, perform a field demonstration. If the materials treated during the field demonstration do not meet the treatment criteria, process an equal quantity of the same type of material that failed, using properly modified operating conditions, until satisfactory results are obtained. Segregate any treated materials that failed the field demonstration and return this material to the contaminated materials stockpile area for processing during full-scale remediation. The volume of each windrow, including soil and amendments, included in the field demonstration must be no less than [23][_____] cubic meters [30][_____] cubic yards. Separate windrows, spaced to prevent intermingling of contaminated material, must be provided for each recipe and/or condition being tested. Recipes and/or conditions to be tested must include: [_____]. Conduct the field demonstration using the same windrow dimensions, and similar irrigation and mixing methods as proposed for the full scale operations. Do not initiate the field demonstration until written approval has been received from the Contracting Officer.

3.3.1 Samples for Field Demonstration Tests

****

NOTE: Chemical testing should be performed to verify that the materials to be used for the field demonstration contain the contaminants of concern at high enough concentrations to adequately test the process. Additional testing may be warranted to verify that the physical properties of the materials are representative of site conditions.

****

Obtain contaminated material used for the field demonstration from [the location specified by the Contracting Officer][_____]. Prior to performing the field demonstration, test [three composite samples][_____] of the contaminated material to be used for the field demonstration. Consider the existing site conditions presented in paragraph EXISTING CONDITIONS when selecting sampling locations. The contaminated material samples must have contaminant concentration levels [representative of the average concentration of the contaminants identified] [and] [greater] [than the action level criteria presented in Table 8]. Otherwise, repeat sampling until the contaminant concentration levels exceed the action level criteria. Test samples of contaminated materials intended to be used in the field demonstration in accordance with procedures in paragraph PRE-COMPLIANCE TESTING. Do not commence the field demonstration until soil samples meet the aforementioned concentration criteria. Also provide a physical description of each soil sample, either prepared by or under the supervision of a licensed geologist, to demonstrate that soil-type is representative of the contaminated zone.

TABLE 8 - ACTION LEVEL CRITERIA	
PARAMETER	ACTION LEVEL CRITERIA
[_____]	[_____] mg/kg

3.3.2 Monitoring

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NOTE: Because a more intensive level of monitoring is usually required during the field demonstration than during full-scale operations, a separate set of Operation, Maintenance and Process Monitoring requirements may need to be prepared. The following differences in monitoring requirements are typical for the field demonstration versus full-scale operations: sampling stations may be spaced more densely; temperature, moisture content, and field capacity testing may be performed more frequently; and sampling and analysis for contaminants of concern may be performed on a more frequent, and more regular basis. The field demonstration may also provide an opportunity to develop a site-specific correlation between field, and laboratory analysis methods. A sufficient amount of time, which should be based on the results from the bench-scale treatability study test, should be scheduled for the field demonstration to allow each contaminant of concern to reach asymptotic levels. Also, the amount of sampling and analysis for contaminants of concern should be sufficient to assess the degree of variability in the final concentrations; so that it can be determined if cleanup goals will be reached.

****

During the field demonstration, perform sampling and analysis as indicated under paragraph OPERATION AND FIELD QUALITY CONTROL; in addition to these requirements, implement the following processing monitoring requirements: [_____]. The field demonstration must extend long enough for project treatment goals to be attained with reasonable confidence, or to reach an asymptotic limit to the concentrations, but not to exceed [60][_____] days from the initial blending of soil and amendments until completion of composting.

3.3.3 Field Demonstration Operations Report

During the field demonstration furnish reports weekly. Maintain copies of the reports at the facility. Record and maintain the following information until closure of the facility: description (including sources) of contaminated soil and amendments on site; the locations of all amendments and contaminated soil on site, and the quantity at each location; receipt, storage, treatment, disposal date, offsite disposal location, volume, and weight of hazardous and non-hazardous wastes including contaminated and treated soil and amendments; and manifests/proof of receipt from the disposal facility for hazardous and non-hazardous wastes. Dispose of all hazardous materials and wastes in accordance with Section 02 81 00 TRANSPORTATION AND DISPOSAL OF HAZARDOUS

MATERIALS. Record the location and quantity of each type of material on a map or diagram of the site. Include cross-references to specific manifest document numbers, if the waste was accompanied by a manifest. Provide summary reports and details of all incidents that require implementing contingency plans, or corrective action measures. Also include: date and time of each monitoring or testing event; results from each monitoring or testing event; monitoring procedure, or test method used; individual performing the monitoring or testing, and other individuals present; and remarks. Cross-reference to submittals specified in other Sections to prevent duplicate information in separate submittals.

3.3.4 Field Demonstration Report

****

NOTE: If the results of the field demonstration will be used to inform the Composting Work Plan, it may be preferred to report the field demonstration results in the Composting Work Plan instead of having a separate Field Demonstration Report. Update the Composting Work Plan paragraph and delete this paragraph if using that approach.

****

Submit the field demonstration report not more than [120][_____] calendar days after completion of the field demonstration. Prepare[draft for Government review][draft-final for [regulatory][_____] review]and final versions of the Field Demonstration Report. Allow [30][_____] calendar days for[Government] review[and [30][_____] calendar days for regulatory review]. Allow [45][_____] days for comment resolution following each review and preparing the next version of the document. The report must document relevant data including, but not limited to: characterization test results for each amendment; the source and age of each amendment; the proportions of amendments and soil in each recipe tested; chronological table showing all materials added to each windrow, quantity added, date of addition, and each mixing, precipitation, irrigation and sampling event. The report must also include: physical and chemical monitoring data from before, during and after treatment; degradation rates; final disposition of wastes and treated material; conclusions; recommendations; and proposed recipe of soil and amendments for full-scale operations. In addition, the day-to-day log of operations and adjustments must be included in an appendix. After completion of field demonstration, review the data from the field demonstration. Proposed changes in Operations, Maintenance and Process Monitoring must be included in the Field Demonstration Report submitted to the Contracting Officer for review.

3.4 SOIL PRE-PROCESSING

****

NOTE: Soil pre-processing may include stockpiling, screening, and blending of contaminated materials. The maximum recommended particle diameter for compost mixing equipment can range from 25 to 100 mm 1 to 4 inches. However, the end use for the compost may dictate that the maximum particle diameter not exceed 13 mm 0.5 inch (see paragraph CURING, STORAGE AND DISPOSAL); and that the concentration of glass, plastic, and other foreign materials in soil not exceed 5 percent, by dry weight. Although it may be possible to include relatively large particles in

compost, an additional screening step may also be necessary to remove the large particles prior to disposal. This paragraph should be coordinated with paragraph AMENDMENTS. In addition, composting is generally not effective for materials with high concentration of nitroaromatics. If encountered during pre-processing, materials with high level of nitroaromatics should be segregated and disposed of at an offsite facility. If explosives-contaminated soil will be treated, it may be necessary to require that an explosives hazard analysis be performed on the material handling equipment (see DA PAM 385-64; and Hazard Review of KW Windrow Composter, March 1992, in Appendix E of USAEC CETHA-TS-CR-93043r).

****

Pre-process contaminated soils as necessary by [screening][blending] [shredding][_____] to provide a maximum particle size in soil [compatible with approved material handling equipment][_____]. Separate oversize materials[and materials with high concentration of nitroaromatics that cannot be composted successfully] from contaminated soil prior to mixing soil with amendments.

3.5 OPERATION AND FIELD QUALITY CONTROL

****

NOTE: Operation and monitoring requirements should be based on: applicable literature references; knowledge gained from treatability studies and the field demonstration; and historical data from projects with similar soils, amendments, and contaminants. Diligent process monitoring (e.g., monitoring temperature and controlling moisture content) is fundamental to successful composting. Because there will always be exceptions, where the default values provided in these paragraphs do not suit a specific project, the following paragraphs should be edited appropriately. These paragraphs should be coordinated with Division 1 Sections of the contract; operations, maintenance, and process monitoring requirements are covered in a Division 01 Section of some contracts.

Reference a UFP-QAPP that has been prepared in accordance with DoD and EPA guidance. UFP-QAPPs follow the Data Quality Objectives (DQO) process and are required for DoD environmental restoration work. If a UFP-QAPP has been prepared for the overall project that composting is being used on, referencing to the UFP-QAPP for testing requirements avoids potential for conflicting requirements between the UFP-QAPP and the specifications.

****

Do not initiate full-scale composting operations until the Composting Work Plan [and the UFP-QAPP] has been approved, and written approval has been received from the Contracting Officer. The testing specified in the following sub-paragraphs is needed by the Government to generate documentation that the composting treatment has been accomplished in

accordance with performance requirements in the decision document and approved by the government and regulators (e.g. EPA or other state agencies). The results of these tests may be used as part of the Contractor's QC program; however it is the contractor's sole responsibility to meet the performance requirements specified in this Section. Perform additional testing and measurements to assure that treated materials meet requirements without rejection of batches, retesting, and reprocessing.

3.5.1 Dissimilar Soils

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NOTE: Delete the bracketed text item if dissimilar materials are not known to be present at time of preparing project specifications.
****

Do not mix together dissimilar soils if the bench-scale treatability study and/or field demonstration testing results indicate that different operating conditions have to be implemented to achieve effective treatment of these soils.[Materials known to be dissimilar at the site are defined in [paragraph EXISTING CONDITIONS][_____].]

3.5.2 Amendment Storage

****
NOTE: Manure and vegetable wastes are the primary sources of objectionable odor during composting. After blending manure and vegetable wastes with the woody bulking amendments, objectionable odors will usually dissipate after about 7 to 14 days. It may be allowable to relax the maximum holding time for manure and vegetable wastes, if the site is remotely located and odor control is not an issue.

Depending on amendment selection and other site-specific factors, controls may be necessary to prevent insects and rodents from infesting the amendment storage area. Consider including a requirement here to keep amendment piles covered (if such requirement is not included in other specifications dealing with air/emissions controls).
****

To minimize odor generation, deliver manure and vegetable wastes to the site not more than [72 hours][_____] prior to blending of soil and amendments. Any excess manure and vegetable wastes, not blended with soil, must either be removed from the site not more than [24 hours][_____] after blending was initiated; or must be blended with other excess amendments and composted onsite. Excess manure and vegetable wastes must be disposed of in accordance with regulatory requirements.

3.5.3 Windrow Construction

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NOTE: Initial homogenization may be accomplished by layering the raw materials into the shape of a windrow, and then mixing with windrow turning equipment. However, it may be possible to achieve a

more thorough mix of the soil and amendments if they are blended in a separate vessel prior to forming windrows. The percentage of soil in the compost mixture should be based on previous composting projects, or preferably bench-scale treatabiity study testing and a field demonstration.

Typical dimensions for compost piles created by self propelled windrow turners are: 1.2 to 2.7 m 4 to 9 feet high, and 3 to 6 m 10 to 20 feet wide. However, sufficient temperatures may not be reached unless the initial height of the windrows is at least 1.5 m 5 feet. The height of the windrows will decrease during treatment.

****

The following measures must be taken to prevent freezing of contaminated soil that is scheduled to be composted during sub-freezing conditions: [_____]. The initial height of compost windrows must be not less than [1.5][_____] m [5][_____] feet.

3.5.4 Mixing

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NOTE: If irrigation and turning are performed separately, mixing should be performed soon after irrigation to provide for more uniform distribution of moisture.

The frequency of mixing should be related to temperature monitoring. When temperatures exceed 65 degrees C 150 degrees F, mixing may be implemented to cool the pile. If excessively high temperatures cannot be controlled through turning, then the size of the compost windrows may have to be reduced. Low temperatures may indicate that oxygen levels in pore spaces within the pile are insufficient, and that the pile should be mixed. However, excessive mixing may impede the pile from reaching optimal temperatures. Isolated hot or cool spots may indicate the location of incompletely mixed pockets. After optimal temperatures have been maintained for about 10 days, it may be possible to reduce the frequency of mixing without adversely affecting the process. However, frequent and thorough mixing should result in more homogenous compost, and should reduce the variability of chemical data. On a previous project, daily windrow mixing was discontinued after definitive field analysis indicated that cleanup goals had been met. Thus, after about 12 days of mixing, the windrows were allowed to remain undisturbed until after data from compliance samples was received. Even if mixing is discontinued, temperature and moisture content monitoring should continue.

****

Unless otherwise indicated, mix the compost pile each day. To ensure the entire cross-section of the windrow is mixed, the windrow turner must be

adjusted to its lowest height without actually contacting the treatment pad, and the turner must extend beyond each side of the windrow. Perform mixing at least once per day, for at least [10][_____] days. Additional mixing may be required in response to process monitoring; for example, to control temperature, odor and to provide additional aeration.

3.5.5 Moisture Control

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NOTE: The potential for spontaneous combustion will increase as the moisture content falls below optimum levels. The water content at saturation will vary depending on what raw materials were used in the compost. Determination of water content as a percent of field capacity (or water holding capacity) provides a more "universal" indicator of the degree of saturation. Field capacity is determined by saturating a sample, allowing the free water to drain, and then determining the moisture content; field capacity is the mass of water in the sample divided by the dry weight. According to Bioremediation Using the Land Treatment Concept, EPA 600/R-93/164, field capacity can range from 5 percent (for a sandy soil) to 30 percent (for a clay soil).

The recommended moisture content for windrow composting is between 40 and 80 percent of the moisture content at field capacity. For example, if the field capacity of a soil is determined to be 20 percent, then optimum moisture content would be between 8 and 16 percent. The procedure shown in USAEC CETHA-TS-CR-93043 has been used to determine the field capacity of compost for previous projects. Because the field capacity will change as the compost matures, periodic testing for field capacity should be required. Finally, a crude indicator of proper moisture content has been described as follows: the compost should feel moist, but not so moist that free water is released when squeezed by the hand.

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3.5.5.1 Moisture Content and Field Capacity Testing

Immediately after initiating treatment of each batch of compost, test a minimum of one representative, composite sample per each [69][_____] cubic meters [90][_____] cubic yards of compost to determine percent moisture (by weight) and the moisture content at field capacity. Perform field capacity testing every week for the first [four][_____] weeks and [every two weeks][_____], thereafter. Perform testing for moisture content three times each of the first [four][_____] weeks and twice per week thereafter.

3.5.5.2 Irrigation

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NOTE: Factors influencing irrigation water requirements include the initial moisture content of the soil and amendments, and the climate. A tank

truck or a water storage tank may be necessary if a local water source (e.g., surface water body) is not available; see paragraph STORAGE VOLUME.

****

Irrigate the moisture-deficient portions of each windrow when testing indicates that the moisture content is below [40][_____] percent of the design field capacity. Measure the water application rate. Record the application rate, duration of the irrigation period, and volume of water applied. Provide sufficient irrigation to bring the moisture content to within the acceptable limits in not more than [48][_____] hours. Irrigation and mixing must be synchronized so that water is distributed uniformly throughout the windrows. Immediately cease irrigation if ponded water is observed near any windrow; record the time, date, and location of the ponded water in the Operations Reports, and remove the ponded water.

3.5.5.3 Contact Water Testing

Test contact water, to be reused as irrigation water, for pH and conductivity on the [first,][second,][_____][and][fourth][_____] week after initiating treatment of each batch of compost. If there is more than [13][_____] mm [1/2][_____] inches of precipitation in a 24 hour period, test the pH and conductivity of the contact water after water from the precipitation event has collected in the contact water storage facility. Each time testing is performed, either withdraw one representative sample from the contact water holding vessel, or directly test the water in the holding vessel by immersing the instrument probe in the contact water.

3.5.6 Temperature

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NOTE: Temperature is indicator of microbial activity, and one of the most important parameters for monitoring the composting process. The temperature of windrows should be monitored immediately before and after mixing. The temperature range for the thermophilic stage of composting is usually considered to be between 43 and 65 degrees C 110 and 150 degrees F, preferably between 54 and 60 degrees C 130 and 140 degrees F. When temperatures continue to increase past 71 degrees C 160 degrees F, microbes become dormant or die. See paragraph MIXING regarding control of excessively high temperatures. The temperature of a compost pile will gradually stratify after mixing. The highest temperatures may be observed in the outer layer of the pile while initially heating, but may become highest along the center core of the pile later, especially if not mixed frequently. Temperature is affected by the composting heat generation which is driven by amendment content, moisture, and oxygen availability, and by the heat loss to the environment, so temperature is highly location- and time-dependent in a windrow pile. It is important to have a method to easily measure temperature anywhere in the windrow pile. Reference: TEMPERATURE DISTRIBUTION AND VARIATION IN PASSIVELY AERATED STATIC COMPOST PILES, Bioresource Technology 48 (1994) 257-263.

****

3.5.6.1 Temperature Probe Calibration

Provide temperature probes with a measurement range from [0][_____] to at least [100][_____] degrees C [32][_____] to at least [212][_____] degrees F. Calibrate probes by taking readings in an ice bath, and in boiling water. Mark each temperature probe for identification and calibrate prior to use. Record readings from each probe with each calibration event, before and after calibration, and include the identifier on the temperature probe in the recording. Maintain an identified composting design temperature (e.g., approximately 52 to 68 degrees C 125 to 155 degrees F). Submit corrective measures to the Contracting Officer if an optimal design temperature is not maintained.

3.5.6.2 Temperature Monitoring

Measure the temperature of the windrows each day immediately before and after mixing. Monitor the temperature at a minimum of [two][_____] locations, per [23][_____] cubic meter [30][_____] cubic yard section of compost. Record the temperature, time, and monitoring location during each monitoring event. Record the depth and location of each temperature reading. Record ambient air temperatures in the treatment area, and the time of monitoring daily.

3.5.7 Compost pH

****

NOTE: The pH should usually be maintained between 5.5 and 9, preferably between 6 and 8 standard units. Excessive volatilization of ammonia may result if the pH exceeds 5.5. However, it is usually unnecessary to adjust the pH during composting; and use of pH adjusting agents (e.g., lime) may be detrimental to the process.

****

At a minimum, test the pH of the compost twice during the [first, second, and third][_____] week after initiating treatment of each batch of compost, and once per week thereafter until treatment criteria has been met for contaminants of concern. Perform testing of the pH of compost in accordance with paragraph NON-STANDARD SAMPLING AND ANALYSIS. Maintain pH above 5.5, and preferably below 8. Adjust pH below 5.5 by careful addition of typical soil pH adjusting materials like lime, or limestone. Each time a pH adjustment product is applied, test the soil pH before and after adding the pH adjustment product. Also record the product name, quantity, and supplier of the pH adjustment product used after each application. Do not use aqueous caustics, such as sodium hydroxide, as pH adjusting agents.

3.5.8 Odor Control

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NOTE: If Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS is not included in the project specifications, odor control sources and control activities should be specified here. When editing Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS, consider the following:

Odor is an important indicator of the condition of a compost pile. Strong putrid odors usually indicate that anaerobic conditions are present, and that mixing (aeration) may be necessary for the pile from which odors are arising. Strong odors may also indicate that the pile, or a portion of the pile is too wet. Excessive ammonia odors may indicate that the C:N ratio of the compost recipe is too low, and/or that the pH is too high. Odors will usually be generated during the following activities: amendment delivery and storage; blending of soil and amendments; and during the composting process, including during mixing. See paragraph AMENDMENT STORAGE for more information.

The following text can be considered when editing Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS. Monitor and record the presence or absence of odors in the treatment facility [each day][_____], for not less than [five][_____] days of each week. If objectionable odors are detected, record the following in the Operations Reports: locations where the odors are the strongest; description of the odors; the times and dates when the odors were detected; and the name of individual who observed, described and recorded the odor. If, in the opinion of the Contracting Officer, there is a persistent problem with objectionable odors that has not been properly addressed, the Contractor will be notified to implement measures to reduce odor levels. Odor control measures must be implemented not more than [24][_____] hours after notification from the Contracting Officer. The initial choice of remedy for odor in the windrow pile is additional mixing.

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Implement odor control requirements as specified in [Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS][_____].

3.5.9 Oxygen

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NOTE: The concentration of oxygen in the air spaces within the compost pile should typically be greater than 5 percent by volume (the concentration of oxygen in air is approximately 21 percent by volume). Oxygen levels will continually decrease after each mixing event as aerobic microorganisms consume oxygen. If used, oxygen monitoring should be performed at regular intervals, after each mixing event. Usually, temperature monitoring is adequate to control the composting process, and oxygen monitoring is unnecessary.

****

Regularly scheduled monitoring of interstitial oxygen levels will not be required. However, oxygen monitoring may be used as a diagnostic, or trouble-shooting tool. If oxygen monitoring is performed, record the

monitoring location, the time of the last mixing event, and the time of each oxygen monitoring event. Maintain a minimal oxygen level of greater than 2 percent. Increase the frequency of windrow turnovers if this minimum oxygen level is not maintained.

3.5.10 Non-Standard Sampling and Analysis

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NOTE: This paragraph only contains methods for relatively uncommon tests, and tests that are unique to composting. Field capacity may also be determined via ASTM D6836 Standard Test Methods for Determination of the Soil Water Characteristic Curve for Desorption Using a Hanging Column, Pressure Extractor, Chilled Mirror Hygrometer, and/or Centrifuge.

As alternatives to the Dewar self-heating test, respiration tests may be used to determine the maturity of compost. The text, The Science of Composting, by Epstein, 1997, provides compost stability index values for respiration testing (both for oxygen uptake, and carbon dioxide evolution). ASTM D5975 also uses oxygen consumption to assess compost maturity. Depending on the planned end use for the compost, some tests shown in this paragraph may not be necessary and should be deleted.

The solicitation package should provide prospective Contractors with a means to acquire any references that are not included with the contract documents, and are not publicly available. The BIOCYCLE reference shown below is only a few pages and should be included with the solicitation package to provide information on self-heating tests, and compost stability testing. It is also recommended that copies of USAEC CETHA-TS-CR-93043 be made available to prospective Contractors to provide descriptions of the intended treatment process.

****

Perform testing of compost for field capacity (or water holding capacity) in accordance with USAEC CETHA-TS-CR-93043, Section 3.8.1 (Moisture Monitoring). Perform testing of compost for pH and conductivity (soluble salts) in accordance with NRAES 54, Chapter 3 (Raw Materials), the Saturated Paste Method.[Perform the Dewar self-heating test for compost maturity in accordance with BIOCYCLE][_____].

3.5.11 Sampling and Analysis for Contaminants of Concern

****

NOTE: Under some conditions, it may be more cost-effective to use field analysis methods (e.g., immunoassay or colorimetric methods), than to require laboratory analysis for all contaminants of concern. However, it may also be necessary to develop a site-specific correlation between data from field, and laboratory analysis. Pigmented materials present in extracts from compost samples

may cause interferences in colorimetric, definitive field analysis. For more information see EPA 540 R-97/501, Field Sampling and Selective On-Site Analytical Methods for Explosives in Soil. Laboratory analysis should be required on a minimum percentage of samples to verify data from definitive field analysis.

Collecting samples from the edges and outer surface of the pile should be avoided, since these locations may not be representative of the bulk of the pile. The strategy for sampling and analysis should be consistent with the regulatory requirements for the data. States may impose more restrictive sampling requirements than those under Federal regulations. Compliance testing requirements are usually project specific, and agreed upon by the regulatory officials.

****

Perform sampling and analysis in accordance with the approved UFP-QAPP. Furnish results from each sampling event to the Contracting Officer not more than [24][_____] hours after data are recorded by the Contractor or released by the laboratory.

3.5.11.1 Sampling Frequency and Locations for Pre-Compliance Testing

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NOTE: This is an example of a pre-compliance testing protocol used during a previous composting project, and should be applicable to projects where field analysis will be used.

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At a minimum, conduct sampling two times during treatment of each batch: (1) immediately after initial blending of soil and amendments; and (2) at the estimated time at which the cleanup levels will have been met (based on the results of the field demonstration). To determine locations of sampling stations, divide the windrows into sections. Each section must be a maximum [23][_____] cubic meters [30][_____] cubic yards. Each section must include one sampling station. Sampling stations must be represented by vertical planes that traverse the width of the windrow. Collect samples from a minimum of [four][_____], separate locations within each sampling station. Samples from each sampling station must be [composited prior to testing][_____].

3.5.11.2 Pre-Compliance Testing

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NOTE: Definitive field analysis methods have been used for pre-compliance testing during previous composting projects.

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Test for the following analytes during pre-compliance testing: [_____]. Test using the [field analysis][_____] method for pre-compliance testing.

3.5.11.3 Compliance Sampling

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NOTE: Various methods of statistical analysis may be used to determine if treatment criteria has been attained. For example, after treatment of each batch is completed, the Contractor may be required to show that the mean of the data for each batch is below a specified value, and/or that the upper 95th percentile of the data for each batch is below a specified value. Although the following EPA reference describes procedures for determining whether a specified percentile of material is less than a cleanup standard (EPA 230/02-89-042, Methods of Evaluation and Attainment of Cleanup Standards), it may not be practical to implement this type of requirement. One alternative is to establish "ceiling" values for each contaminant of concern. Thus, in addition to requiring that the mean of the data for each batch be below a specified value, there may be a requirement that "single-sample" values must not exceed a pre-determined ceiling value. Use of ceiling values may eliminate the need for statistical analysis of data by construction QA representatives. There should be a statistical basis for ceiling values, and the basis for establishing ceiling values should be proposed early-on in design (e.g., in the design analysis report). Establishing ceiling values for contaminants of concern should be project specific, and based on negotiations with regulatory officials. The contract should require a UFP-QAPP which provides a clear and consistent basis for determining the amount of sampling and analysis that will be required.

Treatment criteria should be specified on a "per-batch basis" so that the Contractor will be free to proceed with treating subsequent batches after the data from each batch has been received. This paragraph should be coordinated with paragraph, TREATMENT CRITERIA FOR COMPOSTED SOIL. This is only an example of compliance testing requirements, based on a contract from a previous composting project.

****

After pre-compliance testing indicates that a batch of compost has met treatment criteria, and written approval has been received from the Contracting Officer, perform compliance sampling. To determine sampling locations, [use the same section divisions from pre-compliance testing][_____]. Test two discrete samples, collected from randomly selected locations within each section. If the samples collected for analysis contain rock or gravel, remove this material from the sample and return it to the windrow before submitting the sample for analysis . Conduct testing in accordance with [_____].

3.5.11.4 Government Quality Assurance Testing

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NOTE: The need for quality assurance testing should be considered on a project-by-project basis, and if not considered necessary this paragraph should be deleted. Factors to consider include whether the Government has access to a laboratory that can analyze quality assurance samples in a timely manner to not delay the project execution. Use of quality assurance testing data also needs to be considered. A relatively straightforward data use is to compare quality assurance sample results to the project Performance Requirements, and a failing result would be treated the same way as a failing Contractor test result. A more complicated data use is to compare results from quality assurance samples and contractor quality control samples for the purpose of determining if there is meaningful disagreement between the results. In this case, procedures would need to be developed for determining when there is a meaningful disagreement between quality assurance and quality control sample results; corrective actions for when a meaningful disagreement was identified would also need to be developed. The process of defining procedures for identifying and correcting meaningful differences should be documented in a project-specific UFP-QAPP and referenced in this specification; the process is likely too complex to be adequately defined in this specification.

****

Provide duplicate samples to the Government's quality assurance laboratory for Government quality assurance. Submit samples at a frequency of one set of samples per [10][_____] sets of quality control tests performed. Quality assurance samples will be tested for the same parameters as the parent quality control sample. Provide additional quality assurance samples upon request.

3.5.12 Post-Treatment Procedure

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NOTE: If treatment criteria for contaminants of concern have been met, but criteria for re-use (see paragraph TREATMENT CRITERIA AND CRITERIA FOR REUSE OF COMPOSTED SOIL) have not been met, the compost should either remain on the treatment pad, or be moved to a curing/storage area.

****

After compliance test data indicates that treatment criteria have been met, and written approval from the Contracting Officer has been received, the treated material may be removed from the treatment pad to a curing and storage location or kept on the treatment pad until final disposal, at the Contractor's option. Submit Treatment Completion Records which include, but are not limited to, a summary of all activities performed at the site as part of Windrow Composting, materials and equipment used, and all testing and sampling results.

3.5.13 Procedure for Non-Attainment of Treatment Criteria

If the Treatment Criteria and Criteria for Reuse of Composted Soil are not achieved, implement corrective action (continued windrow composting) at no additional cost to the Government until the criteria have been achieved. The corrective action may include: additional sampling to provide more data points for statistical analysis; or continued treatment. If there are portions of compost for which substantial reduction of contaminants of concern was not observed after the end of the estimated treatment period, prepare a report detailing all activities associated with those portions of the compost. The report must include: probable causes as to why significant reductions were not observed; measures that will be implemented to prevent the same problems from recurring; and a proposed plan for continued treatment of those portions of the compost where treatment criteria were not met. Obtain written approval from the Contracting Officer prior to implementing measures that deviate from the approved Composting Work Plan. Continue monitoring and windrow composting (at no additional cost to the Government, and in accordance with paragraph OPERATION AND FIELD QUALITY CONTROL), until the treatment criteria have been attained.

3.5.14 Curing and Storage

****

NOTE: Properly cured compost should have no objectionable odor. Although it is usually unnecessary to turn compost during curing, the compost should remain aerobic. Thus, the size of the piles should be limited. During curing and storage, the potential for spontaneous combustion and development of anaerobic conditions (or souring) increases as the dimensions of the compost piles increase. Monitoring for temperature, moisture and oxygen will be needed for curing piles, though at a lesser frequency than is needed for treatment windrows. On a previous composting project, a cellulose tackifying agent was used to prevent the wind from dispersing treated compost. Only readily biodegradable tackifying agents should be used.

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If anaerobic conditions develop during curing or storage, remix the compost, spread on a covered, dry surface, and allow to aerate for at least 24 hours before reforming the piles.

3.5.15 Post-Treatment Screening

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NOTE: If wood chips or other large diameter particles must be separated from the finished compost prior to disposal, it may be desirable to reuse this material in subsequent batches of compost. If this material cannot be reused in other batches and must instead be repurposed or disposed, it may have to be ground to a powder and representative samples be submitted for chemical analysis to verify that Treatment Criteria have been met and no other contaminants are present above allowable limits.

****

Separate wood chips or other materials whose size exceeds the maximum acceptable size for the intended end use from the finished compost prior to disposal.

3.5.16 Operations Reports

Submit operations reports weekly for the first [10][_____] weeks, and every [two][_____] weeks, thereafter. The report must be kept at the facility during the [field demonstration][and][full-scale operation]. The following information must be recorded and maintained until closure of the facility: description (including sources) of contaminated soil and amendments on site; the dates of receipt, storage, treatment, and disposal of contaminated soil and amendments; the location of all amendments, contaminated soil, and compost on site; and the quantity at each location. The location and quantity of each type of material must be recorded on a map or diagram of the site. This information must include cross-references to specific manifest document numbers, if the waste was accompanied by a manifest. Summary reports and details of all incidents that require implementing contingency plans, or corrective action measures must also be provided. The reports must also include: date and time of each monitoring or testing event; results from each monitoring or testing event; monitoring procedure, or test method used; individual performing the monitoring or testing, and other individuals present; and remarks. Cross-references to submittals specified in other Sections may be provided to prevent duplicate information in separate submittals. Copies of records for treated or processed materials which have been disposed of not more than [45][_____] calendar days after disposal of each batch of materials. The following must be included for each batch of treated material: disposal location; date of transport to disposal location; volume or weight of material; and chemical data reports. Cross-references to the submittal specified in Section 02 81 00 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS, which includes the manifests and disposal certificates, must be provided for materials disposed of offsite. For non-manifested materials disposed of offsite, the following information must also be provided: address, phone number, proof of receipt from the disposal facility, and point of contact for each receiving offsite disposal facility.

3.5.17 Change of Operating Conditions

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NOTE: If adjustment to the composting operating conditions is required due to change in contaminated material characteristics, then the Contractor's adjusted operating conditions should be evaluated by the Contracting Officer for the extent of changes from the previous operating conditions. Further, price negotiation may be required based on the extent of changes from the previous operating conditions.

****

The following two requirements must be met in order to be considered for change of operating conditions: (1) the physical and chemical characteristics of the contaminated materials are significantly different from the originally defined characteristics, and (2) the treatment requirements cannot be met under the current composting amendment design

and related operating conditions. When change of operating condition is necessary, notify the Contracting Officer before changes are made to the amendment design and related operating conditions. The Contracting Officer may require the Contractor to perform a field demonstration for significant changes made to the amendment design and related operating conditions in accordance with paragraph FIELD DEMONSTRATION, for approval. If adjustment to the amendment design and/or operating conditions is required due to change in contaminated material characteristics, submit an adjusted design for the extent of changes from the previous design for approval. Further, price negotiation may be required based on the extent of changes from the previous mix design.

3.6 DISPOSAL

****

NOTE: Depending upon the characteristics and quantities, the potential disposal scenarios for wastes may include: onsite treatment and backfilling; partial onsite backfill and partial offsite disposal; and offsite disposal. Asphalt surfaces may be removed and sent offsite for recycling. One disposal scenario for each type of waste should be clearly defined.

After treatment, a volume decrease of approximately 50 percent may be observed for compost that originally contained 30 percent soil and 70 percent amendments. If the compost will be applied as a soil amendment, the following indices should meet quality guideline standards: pH, the Dewar self-heating test, conductivity, maximum particle size, foreign material content, and the levels of heavy metals. In addition, the plan for final disposition of the compost should take into account the conductivity, maximum particle size, foreign material content, and the levels of heavy metals in the untreated soil to assess if the final product will be suited for the desired end use. See the On-Farm Composting Handbook for more on quality guidelines for different end uses of compost; also, see paragraph TREATMENT CRITERIA AND CRITERIA FOR REUSE OF COMPOSTED SOIL. According to the On-Farm Composting Handbook, if the end use for compost will be as a soil amendment, the compost application rate should not exceed 4 cubic meters per 110 square meters 4 cubic yards per 1,000 square feet.

****

Dispose or recycle/reuse compost that has met treatment criteria [and criteria for reuse] in accordance with regulatory requirements. If necessary, [treat and] dispose of the following materials on-site: [oversize materials][sludge resulting from treatment of contact water][excess amendments][and][_____]. If necessary, treat the following materials and dispose of off-site: [spent personal protective equipment] [spent granular activated carbon][and][_____]. Perform offsite disposal of hazardous material and wastes in accordance with Section 02 81 00 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS, which includes the preparation and submission of manifests and disposal certificates for materials disposed of offsite.

3.7 DEMOBILIZATION

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NOTE: A separate table should be prepared if criteria for soils below the treatment pad, or other areas of the treatment facility, differs from criteria in paragraph TREATMENT CRITERIA AND CRITERIA FOR REUSE OF COMPOSTED SOIL. This paragraph should be edited appropriately if it is desired to retain portions of the composting treatment facilities after project completion. This paragraph should also be coordinated with Division 01 Sections of the contract.

The paragraph ENVIRONMENTAL REQUIREMENTS FOR OFF-SITE SOIL in Section 31 00 00 EARTHWORK should be edited to include an appropriate list of chemical testing parameters for off-site soil. Some backfill sources may have chemical testing data already available; the Government should require chemical testing if the backfill chemical testing data is inadequate or does not exist. Off-site backfill should not be tested for only the site contaminants of concern. At a minimum, samples should be analyzed for target contaminant list (TCL) VOCs, TCL SVOCs, target analyte list (TAL) Metals, and Pesticides/PCBs. Additional analyses such as Total Petroleum Hydrocarbons may be appropriate also. Individual States or military installations may require or recommend additional parameters. Typical frequency of sampling would be one sample per 1,900 to 2,300 cubic meters 2,500 to 3,000 cubic yards. However, individual States or military installations may require or recommend more frequent or less frequent sampling.

****

Do not commence demobilization until written approval is received from the Contracting Officer. Follow the approved mobilization and demobilization plan and requirements under paragraph MOBILIZATION AND DEMOBILIZATION. Demobilization must restore the site to its initial state, prior to the construction and operation of the composting treatment facilities. Demobilization must include, but must not be limited to: [removal of structures and materials used to house or cover the compost piles,][disconnecting of utility service lines,][decontamination and removal of equipment and materials,][disposal of decontamination wastes,][disposal of any residual wastewater,][removal of unused amendments and other materials,][removal of material overlying liners,][removal of liners,][regrading and removal of berms,][demolition and disposal of the treatment pad, other foundation slabs, and paved surfaces,][seeding of disturbed, previously vegetated areas,][_____]. [Perform post-treatment testing of soils below work area surfaces (after the liners or pavement have been removed), to verify that the area is not contaminated. These soils must meet the following criteria: [treatment criteria in accordance with paragraph TREATMENT CRITERIA FOR COMPOSTED SOIL.][_____.]] If soil excavation is also part of the field activity, excavated areas need to be backfilled and restored to the original condition in accordance with Section 02 61 13 EXCAVATION OF AND HANDLING OF CONTAMINATED MATERIAL and

Section 31 00 00 EARTHWORK.[Perform confirmation sampling within the excavated areas in accordance with the UFP QAPP to ensure all contaminated soil above treatment criteria are removed.]

-- End of Section --