DEPARTMENT OF THE AIR FORCE
27TH CIVIL ENGINEER SQUADRON (ACC)
CANNON AIR FORCE BASE NEW MEXICO

Lt Colonel Eric J. Wilbur
Commander
506 N DL Ingram Blvd
Cannon AFB NM 88103-5136

Mr. James Bearzi
Hazardous and Radioactive Materials Bureau
New Mexico Environment Department
2044 Galisteo Street
P O Box 26110
Santa Fe NM 87502

Dear Mr. Bearzi

Enclosed for your information and approval is the Corrective Measures Study Workplan for Solid Waste Management Unit (SWMU) 101, Sewage Lagoons, on Cannon Air Force Base. We would appreciate your prompt attention on this study as we plan to commence fieldwork in Mar 2000 on this project.

If you have any questions, please contact Mr. Sanford Hutsell of my environmental flight at (505) 784-6378.

Sincerely

ERIC J. WILBUR, Lt Col, USAF

Attachment:
Workplan

cc:
NMED w/o atch (G. VonGotten)
NMED GW Bureau (J. Jacobs)
EPA Region VI (D. Neleigh)
EPA Region VI w/o atch (B. Sturdivant)

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#10

Corrective Measures Study Work Plan
SWMU 101—Sewage Lagoons
Cannon Air Force Base
Clovis, New Mexico

December 1999

27TH FIGHTER WING

Project Number: CZQZ979361Z1

12-1-1999

FOSTER WHEELER ENVIRONMENTAL CORPORATION

December 16, 1999
TERC-025.001-99X-007

Mr. Tom Zink
U.S. Army Corps of Engineers
Attn: CENWO-MD-HA, 10th Floor
215 North 17th Street
Omaha, NE 68102-4978

Subject: TERC No. DACW45-94-D-003, Delivery Order 25, WAD 1; AF Project Number: CZQZ979361Z1; Final Corrective Measures Study Work Plan for SWMU 101—Sewage Lagoons; Cannon Air Force Base, Clovis, New Mexico

Dear Mr. Zink:

Enclosed are four copies of the Final Corrective Measure Study (CMS) Work Plan for SWMU 101—Sewage Lagoons at Cannon Air Force Base (AFB), Clovis, New Mexico. By copy of this letter, I am sending six copies of the Final CMS work plan to Sanford Hutsell at Cannon AFB and two copies to Margaret Patterson at the Air Force Combat Command (ACC). Foster Wheeler has provided responses to the comments received from the U.S. Army Corps of Engineers (USACE), Omaha District; and the work plan has been revised to reflect those comments.

The Final Basewide Health and Safety Plan for Cannon AFB will be submitted to USACE and Cannon AFB in January 2000. Currently, comments have been received from Judy Strawhecker and those comments will be addressed once all comments have been received from USACE and Cannon AFB.

Based on conversations with John Pike at Cannon AFB, the Final CMS work plan will be submitted to the New Mexico Environment Department for regulatory review. Regulatory review is estimated to be complete by March 2000. If you have any questions or comments please contact me at (505) 878-8924.

Sincerely,
Foster Wheeler Environmental Corporation

Carol L. Bieniulis

Carol L. Bieniulis
Delivery Order Manager

CLB/clb
Enclosures

6605 UPTOWN BOULEVARD, N.E., SUITE 220
ALBUQUERQUE, NEW MEXICO 87110

cc: J. Pike and S. Hutsell/USAF, Cannon AFB (6 copies)
M. Patterson/USAF ACC (2 copies)
D. Johnson/FWENC, Albuquerque (1 copy)
J. Morning/FWENC, Holloman AFB (1 copy)
P. Moss/FWENC, Denver (1 copy)
S. Seyedian/FWENC, Denver
TERC-4 Program File (1 copy)

CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

DRAFT CORRECTIVE MEASURES STUDY WORK PLAN
SWMU 101—SEWAGE LAGOONS

Reviewer: Kim Mulhern, Project Geologist, U.S. Army Corps of Engineers, Omaha District

No.	Sec./Pg.No.	Comment	Response
1.	1.1/1-1	If the alternatives to be considered in the CMS are to be limited, then the justification for limiting the alternatives needs to be included in this paragraph. Please don't just say that this was limited by the Scope of Services. A clear justification for this "presumptive remedy" is required.	The alternatives being considered in this focused CMS are based on the work completed for Cannon AFB by E&E in 1998. The nature of the evaluation of alternatives in this project is to consider the alternatives that have been selected based on preliminary screening of existing information and recommendations that also provides the basis of a focused CMS.
2.	2.2/2-1	Please include a figure at the appropriate scale of Cannon Air Force Base to show that the site is located in the east central portion of the base. Suggest this be called Figure 2-2, and the current Figure 2-2 would become Figure 2-3. The description of the nature and extent of contamination at the Sewage Lagoons is completely insufficient. The 1992 document is so old that most reviewers won't be able to find their copy, and the 1998 document has not been seen by Omaha District technical people at all. Please give a complete summary of the nature and extent of contamination as described by these two reports. Include figures of boring locations and cross-sections if necessary. Discuss what compounds (including inorganics) were detected at what locations and what concentrations. Discuss which ones exceed screening values (such as RBCs or regulatory standards).	Figure 2-2 has been revised and Figure 2-3 has been deleted from the text. This section has been revised as requested. Tables 2-1 and 2-2 have been included with analyte detections from the two referenced reports.
3.	2.3/2-2	This description is incomplete. A complete version of the normal description of the physical setting for Cannon AFB is available from the Corps technical team in electronic format. It describes and discusses the impact of caliche layers, etc., as wells as climate, soils, demographics, etc. This information is very important for a CMS. Please use this description in the work plan. If you need an electronic version, please contact me and I will e-mail it to you.	A new section for physical setting has been added to the report.

Reviewer: Kim Mulhern, Project Geologist, U.S. Army Corps of Engineers, Omaha District (continued)			
4.	2.3.2/2-3	The groundwater flow direction (not gradient) is to the southeast. A gradient is a dimensionless ratio, not a direction.	The text has been revised as requested.
5.	3.0/3-1	Please see comment #1 above and incorporate the additional justification text in this section as well.	The text has been revised as requested.
6.	3.2/3-1	Please retitle this section as "Applicable or Relevant and Appropriate Standards" which is the terminology that has been requested by NMED for use in documents related to Cannon AFB. Previous CMS documents have used this terminology as well as the acronym "ARAS".	This section has been renamed Applicable or Relevant and Appropriate Requirements, per the request of Judy Strawhecker, CENWO-ED-GI.
7.	Table 3-1	This table was not provided with the copy of the work plans that I received. Please forward a copy of this table to Omaha District for review prior to including it in the Final Work Plans.	Table 7-1 was incorrectly referenced in Section 3. There is no Table 3-1.
8.	3.3/3-2	Please indicate how the values will be weighted – all values should not get equal weighting as the selection criteria are not all equally important	Due to the nature of the focused CMS, each alternative will be discussed and quantitatively evaluated.
9.	3.4/3-3	Please add an additional bullet for "Safety". This is related to how safe it is to implement the alternative (as some alternatives may be more difficult or unsafe to implement from a safety perspective).	A bullet "safety" has been added to the text.
10.	3.5/3-4	For the modeling, please model the concentrations at numerous intervals (say 5 to 10 year-intervals) in between the present and 50 years. Once the model is set up, it is very simple to vary the date numerous times and present the resulting concentrations entering the aquifer. This information could be presented in table and/or graph form. Just modeling 2 time intervals does not show if there is a peak value at some point between the present and 50 years.	The text in Section 3.5 has been revised to include a detailed discussion of the model selected for simulating the fate and transport on contaminants at the sewage lagoons. Fate and transport modeling will simulate infiltration, contaminant release, and subsequent transport of a contaminant on a monthly basis for a period of 50 years.

Reviewer: Kim Mulhern, Project Geologist, U.S. Army Corps of Engineers, Omaha District (continued)			
11.	3.5/3-5	The HELP model only provides the infiltration rate needed for the modeling – it is not a model in and of itself that will predict the concentration entering the aquifer. Please describe the models to be considered in much more detail, including the input parameters (and how the input parameters will be determined), limitations of each, and its advantages and disadvantages. Please make a recommendation in the work plan regarding which model will be used so that the decision can be reviewed and approved by the Project Geologist before the work plans are finalized. Please provide a summary of the justification for the selection of which model will be used.	The text in Section 3.5 has been revised to include a detailed discussion of the model selected for simulating the fate and transport on contaminants at the sewage lagoons. SESOIL is the model that has been selected for fate and transport modeling in the CMS. SESOIL provides a method to simulate infiltration based on actual data that makes the use of a model such as HELP unnecessary.
12.	4.0/4-1	Question the advisability of breaching the berm. It would be better (in my opinion) to leave the berm intact until construction occurs for the corrective measure implementation. Suggest that gravel (and/or soil) be used to build ramps up the outside of the berm (which can then be used to get the rig on top of the berm to drive around to the various access points. Also suggest that gravel ramps be built at each of the sampling points inside the berm. The only ramp that needs to be removed for "site restoration" is the ramp constructed outside the berm (to keep vehicles from access the berm until construction occurs). There is no reason at this point in time to disturb anymore of the sludge that is absolutely necessary. When construction occurs, the ramps can be removed and segregated as uncontaminated materials if necessary.	Based on the condition of the sewage lagoons observed during a site visit on December 3, 1999 it has been determined that the berm will not be breached in order to provide access to the lagoons for heavy equipment and the drill rig as previously discussed. The text has been revised to account for this change.
13.	4.1.2/4-2	Please include a better explanation of what is meant by "sludge stabilization" as it is unclear what will be done or why it will be needed in the investigation stage.	This text pertaining to "sludge stabilization" has been removed from the workplan as it is no longer relevant.

Reviewer: Kim Mulhern, Project Geologist, U.S. Army Corps of Engineers, Omaha District (continued)			
14.	4.1.2.2/4-3	Please include a review of the base-wide HASP in the meeting. Only those things that differ in the site-specific HASP then need to be discussed. All personnel involved in field work should also be required to read both the base-wide and site-specific HASPs. Regarding utility clearances, I believe the POC at the base is no longer Sanford Hutsell. Please check to see who will be the POC for this project. The utility clearances usually consist of the issuance of a "dig permit" by the base. The base usually only issues a permit for the base controlled utilities. If there are, for example, fiber-optic phone lines that transit the base but are not used by the base, it may be necessary to check with the local utility clearance personnel off the facility.	The Basewide HASP will be required reading for all field project personnel and will be covered in the field project kick-off meeting. Currently, Sanford Hutsell is the Point of Contact regarding these issues at Cannon AFB.
15.	4.1.2.3/4-3	Please see comment #12 above.	This writeup has been removed from the text as it is no longer relevant.
16.	4.1.2.3/4-4	What will the thickness of the lifts of materials placed prior to compaction? Will it be all done in one lift, or will there be multiple lifts placed?	The thickness of the lifts of materials will be 1 foot and there will be multiple lifts placed.

Reviewer: Kim Mulhern, Project Geologist, U.S. Army Corps of Engineers, Omaha District (continued)			
17.	4.2.2/4-7	**Disturbed geotechnical samples** will be collected with a 3" stainless steel split-spoon, and density/consistency descriptions will use the adjusted values provided in the table in the SOP. **PLEASE DO NOT USE LINERS INSIDE THE SPLIT-SPOON SAMPLER AS YOU CANNOT TELL WHERE CHANGES IN MATERIAL OCCUR.** Please use the following description regarding collection of disturbed samples: "If a change in material occurs within a split-spoon, a representative sample of each material shall be taken. Under no circumstances shall different materials be combined into one sample. Representative samples of the subsoils are to be taken from the three-inch outside diameter split-spoon sampler, placed in pint jars, and sealed airtight with at least three wraps of electrical tape. Gloves (latex or nitrile) will be changed each and every time that electrical tape is used to prevent cross-contamination to chemical samples. The jars will be properly labeled with the project name, location, hole number, sample number, depth, material classification, sample type, date, and sampler's name. If no sample is retrieved at the specified interval (i.e. no recovery) the unsuccessful sample interval shall be augered out and another sample attempted at the bottom of where the previous sample failed, unless this interferes with undisturbed or chemical sample intervals." **Undisturbed samples** will be collected only with a 3" x 30" thin-walled shelby tube that is approximately as required by the ASTM. **It is not permissible to use any other sampling device to collect undisturbed samples.** Please use the following description for collection of undisturbed samples: "Undisturbed samples shall be performed in the soil borings at the depths indicated. Undisturbed samples shall be performed using a three-inch outside diameter thin-walled Shelby tube sampler pushed a distance of two feet. Undisturbed samples are to be taken in accordance with ASTM D 1587-83. The pressure exerted (psi) and time duration (seconds) required to push the Shelby tube sampler a distance of two feet shall be noted by the field crew and duly recorded on the drill log. A minimum of 1.0 foot is required for the necessary laboratory tests.	The text in Section 4.2 has been revised to incorporate the information provided on geotechnical soil sampling. The corresponding text in the SOPs have been changed to reflect the changes in Section 4.2.

		Upon retrieval of the Shelby tube samples from the hole, the material exposed at both ends of the tube shall be examined and recorded on the drill log. Enough material shall be carefully removed from the ends to allow insertion of the expandable packers into the tube. This shall be done in such a manner so as to prevent sample disturbance. The wing nut of each packer seal shall be tightened until the rubber gasket presses firmly against the entire circumference of the inside wall of the sampler. This creates an airtight seal that prevents desiccation and provides some physical support to the sample. Immediately after securing the packers, the outside of the tube shall be wiped clean and labeled with an indelible marker to include project name, location, boring number, sample number, sample interval, date, and the sampler's initials. A sample tag containing the same information shall be completed, signed by the geologist, wired through one of the holes at the top of the tube and placed inside the tube. The end cap shall be secured over the end of the tube with at least three wraps of electrical tape. Gloves (latex or nitrile) will be changed each and every time that electrical tape is used to prevent cross-contamination to chemical samples. Care shall be taken to ensure that samples remain undisturbed while storing, handling, and transporting them to the lab." Please see that the SOPs are also corrected to reflect these descriptions.	
18.	4.2.4/4-9	Is there any reason why the sample identification scheme has been changed from the sampling scheme normally used at CAFB? Why is either the N or the S needed on the sampling location identifiers or the sample identification numbers? Why not use the depth of the bottom of the sample interval in the sample number instead of using alphabetical designators?	The sample numbering scheme has been revised to reflect comments received from USACE and incorporated the current sample numbering practice at Cannon AFB.
19.	5.9	DQCRs will be distributed to CAFB the following morning. In addition, they need to be forwarded to the Tom Zink, the Corps Project Manager, at the end of every week. If there are any problems encountered during the field investigation, the DQCRs should be faxed to the Corps PM on a daily basis. Please see that this is also revised in the SOP.	The text has been revised to reflect the comment.

Reviewer: Kim Mulhern, Project Geologist, U.S. Army Corps of Engineers, Omaha District (continued)			
20.	Table 5-1/5-9	It is highly likely (95% +) that it will not be able possible to collect samples using the EnCore samplers, due to the cementation of the soils by the caliche that is present across Cannon AFB. What is the backup plan if it is not possible to use the EnCore samplers? Will the analytical method change? Please correct the required sampler for Hydraulic Conductivity samples to a 3 x 30-inch Shelby tube.	In cases where EnCore samplers for VOC sample collection cannot be used, we will collect soils for VOCs using the field preservation with methanol technique (SOP C9). The text has been corrected as requested.
21.	6.0/6-1	It might be useful to discuss which pathways will be evaluated for this CMS.	A discussion of exposure pathways and a conceptual model to support the exposure assessment approach has been included in Section 6.0.
22.	HASP 5.2/5-1	Please reference the SOP.	The text has been revised as requested.
23.	HASP 8.0/8-1	Please define what criteria will be used for PPE upgrades. Please provide a complete description of what equipment is needed for the upgrades.	The PPE for specified levels of protection is presented in the Basewide HASP for Cannon AFB and will be include for use in the Cannon CMS field program. The criteria for PPE respiratory upgrades is presented in Section 9.0 of the SSHP.
24.	HASP Figure 14-1	Please include a figure showing the entire route from the Sewage Lagoons to the Hospital in Clovis. Also, please use a wide dark line to mark the entire route.	A new map has been included in the SSHP to show the route from Cannon AFB to the hospital in Clovis.
25.	HASP 15.0/15-1	Please describe where the field crew is supposed to take cover.	The text has been revised to reflect the comment.
26.	SOPs General	Please revise all SOPs to incorporate all of the above comments that are applicable.	The text has been revised where appropriate to account for all comments previously made.

Reviewer: Kim Mulhern, Project Geologist, U.S. Army Corps of Engineers, Omaha District (continued)			
27.	SOP C-1/C1-3	Please delete the bullet for 0.1N hydrochloric acid (unless this is being used to determine if the cementation is due to caliche). Under Drilling Method, please delete the second sentence. When HSAs are used, they stay in the ground and samples are collected through the augers. The borehole has to stay open. Any drum is assumed to have cutting from all overlying materials, as this is an on-going mixture. For disposal, all drums related to a specific boring generally need to be treated in the same manner, unless all contamination is at depth. Since borings are only going to 10 feet below the interface between sludge and native soils, it is unlikely that more than one drum will be needed for a soil boring. Please do not mix cuttings from different borings in one drum.	The text was revised as requested. The text was revised as requested. After discussions with USACE and Cannon AFB the waste management plan for soil cuttings has been revised indicating that soil cuttings do not require containerization and can be placed on the ground next to the abandoned boring within the sewage lagoons following EPA's Area of Concern policy.
28.	SOP C-1/C1-4	Please list in bullet form what information is to be written on each of the drums. Please eliminate all references to liners in the split-spoons, as they will not be allowed for this project. Please discuss what other sample collection methods will be used to collect samples in the event that it is not possible to use split-spoons or eliminate the sentence from the SOP. Due to the cementation from caliche, it may not be possible to use the EnCore samplers. Please describe how VOC samples will be collected and analyzed if it is not possible to use the EnCores.	Since soil cuttings do require containerization based on the revised Waste Management Plan (Section 7.4) drum labeling is required. All references to the liners in split-spoons has been deleted from the SOPs. The sentence has been deleted from the text since no other sample collection method is anticipated. In cases where EnCore samplers for VOC sample collection cannot be used, we will collect soils for VOCs using the field preservation with methanol technique (SOP C9).

Reviewer: Kim Mulhern, Project Geologist, U.S. Army Corps of Engineers, Omaha District (continued)			
29.	SOP C-1/C1-5	Sampling gloves need to be changed between sample intervals and any time electrical tape is used on the geotechnical samples to prevent cross-contamination between samples.	The text has been revised to reflect the comment.
		Please open the split-spoon sampler on aluminum foil, rather than plastic sheeting.	The text has been revised to reflect the comment.
		If the HNu is going to be used to prescreen the spoon, care needs to be taken not to suck soil particles into the wand as this will prevent the fan in the equipment from functioning and will provide false negatives for all future headspace screening results (this happens way too often).	The text has been revised to indicate that HNus will not be used in the field.
		Please include a statement that the headspace screening sample will be collected immediately after collecting the VOC sample as well as a reference to the SOP.	The text has been revised to reflect the comment.
		The last 2 bullets before the description of homogenization appear to be reversed. Please correct.	The text has been corrected as indicated in the comment.
30.	SOP C-1/C1-6	Please substitute the above descriptions (comment #17) for the first two paragraphs of the description of Geotechnical Soil Sampling.	The text has been revised as requested.
31.	SOP C-2/C2-1	Please use the HTW Drilling Log provided in the Scope of Services (General Geology Scope of Services). Drilling Logs completed using the form in this draft work plan will not be accepted. Paper and electronic versions of the correct form are available for your use and CANNOT be revised or editted. Please let me know if you want the electronic file.	A completed HTW log has been included in the SOP as provided in the project Statement of Work as provided by USACE.
		Be advised that CADD drafted boring logs need to be completed for the draft CMS report, using the electronic file that is available.	Comment noted. All boring logs will be provided to USACE in drafted format as requested.
32.	SOP C-2/C2-2	Please indicate that boring logs must be completed in ink.	The text has been changed to state that all boring logs must be completed in ink.

Reviewer: Kim Mulhern, Project Geologist, U.S. Army Corps of Engineers, Omaha District (continued)			
33.	SOP C-2/C2-3	Unless it is indisputable that the depositional type is known, please do not include a "guess" on the boring log. For the USCS Classification, please reference your Figure C2-3, which provides the information necessary to classify the soils in most cases. The remainder of the SOP frequently conflicts with this table, especially the percentages described at the bottom of the figure. Please revise the text to agree with the information in the figure.	The text has been revised to reflect the comment. The text has been revised to reflect Figure C2-2.
34.	SOP C-2/C2-4	The designations for soil density and consistency are presented in Figure C1-1, not Figure C2-3. Please note that the values are different for 3" OD spoons.	The reference to Figure C2-3 has been changed to C1-1. The table has been revised to present information for the OD dimensions of split-spoon samplers that are considered for use in sample collection.
35.	SOP C-2/C2-5	Please use the blow counts for density and consistency descriptions for this project. Delete the discussions regarding other methods. Under Description, it appears that a hanging indent is needed.	The text has been revised as requested. A hanging indent has been added where necessary.
36.	SOP C-2/C2-6	Please use ONLY a verbal description of the color of the sample, such as "yellow-brown". Please do not use the Munsell color chart as it is a major waste of time and a distraction for the field geologist. Significant color changes are readily apparent when the split-spoon is opened and provides sufficient detail for this project. The Percentages by Weight are not in agreement with Figure C2-3. Please reference the Figure, and don't include the breakdown that is here.	The text has been revised to account for the description of color by manual means not utilizing the Munsell color chart. The text has been revised as requested.
37.	Figure C2-2	Please see the attached sample of an HTW Drilling Log and use this example in your SOP. This is how the Corps' EM states the boring should be logged.	Comment noted. The example HTW log has been included in the SOP.

Reviewer: Kim Mülhern, Project Geologist, U.S. Army Corps of Engineers, Omaha District (continued)			
38.	SOP C-3/C3-1	All borings will be grouted. Please delete the phrase "deeper than 3 ft." from the first bullet. Due to the frequent problems with grout bridging and shrinking, it is preferable to use 30% Solids (High Solids) bentonite to grout the holes. Also Portland cement is very hard to excavate during the construction phase. Please revise this SOP to require 30% Solids bentonite. If you want, you can delete the entire third bullet. The drilling log is the legal document for borehole abandonment. I see no reason to duplicate information in the log book. The log book entry can be as simple as: "Abandoned SB-XXXX, SB-XXXX, and SB-XXXX according to SOP."	The text has been changed as requested. The text has been changed as requested. The text has been changed as requested.
39.	SOP C-4/C4-1	Please delete all discussions of liners as they are not to be used on this project. It appears that the last two bullets before the discussion of sample homogenization are reverse. Please correct.	The text has been changed as requested. The two bullets have been reversed.
40.	SOP C-6/C6-1	Large equipment should also be decontaminated prior to departure from the site after completion of drilling. Please wrap sampling equipment in aluminum foil, not plastic.	The text has been revised to reflect the comment. The SOP has been revised as requested.
41.	SOP C-7/ C7-2	Please double-bag ice in gallon ziplocks for all samples sent to CQAB laboratory. It would be preferable to do this for all samples. Please do not wrap coolers with duct tape.	Ice will be double-bagged in ziplock bags for samples being transported to the CQAB laboratory as requested. Duct tape will not be used to wrap coolers. Instead, only strapping tape will be used.

Reviewer: Kim Mulhern, Project Geologist, U.S. Army Corps of Engineers, Omaha District (concluded)			
42.	SOP C-7/ C7-3	There is absolutely no reason to duplicate the information that is on the boring logs in the log book. The boring log is the legal document. The information that is not on the boring log needs to be included in the log book. If you are doing boring logs for the sludge samples, that is sufficient. If you want to include anything in the log book, it can be as simple as: Started boring SB-XXXX. Completed boring SB-XXXX. Collected the following samples: (and list the samples and analytical parameters and time).	The text has been revised to reflect the comment. The text has been revised to reflect the comment.
43.	SOP C-7/C7-4	Please change "USACE Technical Manager" to "USACE Project Manager". Revise the SOP to incorporate the changes discussed in comment #19 regarding who gets copies of DQCRs and when.	Text has been changed to USACE Project Manager. Please see the response to Comment #19.
44.	COP C-7/C7-4	Please include a copy of the Field Change Request Form used to document field changes and how concurrence was achieved from appropriate Corps personnel. Describe the information that needs to be included on the FCR.	The Field Change Request Form has been included in the SOP as requested.

Reviewer: Brad Jones, Project Geotechnical Engineer, U.S. Army Corps of Engineers, Omaha District			
1.	4.2.2/4-7	The method proposed for obtaining undisturbed samples (split spoon with thin-walled lining) is inconsistent with requirement to use 3-inch diameter Shelby tube per section 2.2.3.3.2 in USACE SOS. The proposed method is unlikely to result in suitable, undisturbed samples for hydraulic conductivity testing.	The text has been changed as requested and is consistent with the text provided by USACE in Comment #17 from Kim Mulhern and Section 2.2.3.3 of the USACE Geology General Scope of Services.
2.	4.2.2/4-8	Paragraph dealing with bag samples should indicate USACE Project Geologist shall be contacted for hydraulic conductivity testing parameters at least 3 days prior to the start of testing per section 2.2.3.3.3 of USACE SOS.	The text has revised to reflect the comment and Section 2.2.3.3 of the USACE Geology General Scope of Services.
3.	SOP C1/C1-6	The method proposed for obtaining undisturbed samples (split spoon with thin-walled lining) is inconsistent with requirement to use 3-inch diameter Shelby tube per section 2.2.3.3.2 in USACE SOS. The proposed method is unlikely to result in suitable, undisturbed samples for hydraulic conductivity testing.	The text has revised to reflect the comment and Section 2.2.3.3 of the USACE Geology General Scope of Services.
4.	General	The Work Plan should require soil from bag samples to be retained in the laboratory a minimum of 90 days per section 2.2.3.3.3 of USACE SOS	The text has revised to reflect the comment and Section 2.2.3.3 of the USACE Geology General Scope of Services.

Reviewer: Jackson Kiker, U.S. Army Corps of Engineers, Omaha District			
1.	Page iv	Add the acronym for E&E.	The acronym has been added as requested.
2.	Page 3-1, paragraph 3.1	Change the reference to Table 3-1 to Table 7-1.	The table reference has been changed.
3.	Page 3-2, Section 3.3	This is a RCRA compliant project, but the workplan is addressing CERCLA FS evaluation criteria, which is appropriate. However, the workplan needs to be expanded to include in the correction action objectives an evaluation of other CERCLA feasibility study requirements. The breakdown of how each work item in the workplan will judge the CERCLA FS evaluation criteria is somewhat confusing. Overall the CMS must address these CERCLA FS evaluation criteria or similar criteria, but it is unclear why these criteria are broken out into section 3.3 and section 3.4.	The text has been revised to reflect that although the CMS is being conducted under RCRA guidelines that the requirements of CERCLA do apply.
4.	Page 3-2, Section 3.2:	Please revise this section. It is unclear what are the actual workefforts encompassed by this workplan. Please spell out in separate bullets or sections the work items. A section should be for the CMS data gaps (ie the collection of soil chemical and geotechnical samples), a section describing the writing of the CMS, and sections about performing the various risk evaluations. The purposes of this workplan need to be more clearly defined.	A description of the work efforts are provided in Sections 1.0, 2.0, and 4.0 of the workplan. The purpose of the CMS is provided in Section 1.0.
5.	Page 3-2, Section 3.4	Please provide the guidance for the CMS report format and content.	A reference to EPA guidance for a CMS report has been added to the text.
6.	Page 3-4, Section 2.5	Summarize the past sampling activities in order to justify this current sampling effort. Explain what data gaps/needs exists and how this sampling will gather the needed data. A QAPP or FSP would be expected to briefly summarize past efforts.	Past sampling activities are currently described in Section 2.0. The data gaps of previous sampling activities are presented in Sections 2.0 and 3.0 to support the necessity of a field sampling effort in the CMS.
7.	Page 3-4, Section 2.5	Explain why this sampling is necessary – what are the impacts of soils on groundwater and what are the impacts of site soil on receptors.	As discussed in the text, additional sampling is necessary in order to characterize the sludge and native soil beneath the sewage lagoons in order to provide information to support corrective action. These additional data are also required to support the evaluation of risk to human health and ecological receptors that could be impacted in the vicinity of the lagoons.

Reviewer: Jackson Kiker, U.S. Army Corps of Engineers, Omaha District (continued)			
8.	Page 3-4, Section 3.5	Explain what pilot/laboratory/ bench scale studies will be performed or amend the paragraph heading to reflect the content.	The text heading has been revised to reflect only the fate and transport modeling that will be completed to support the selection of corrective action alternatives at the sewage lagoons.
9.	Page 4-1, Section 4.0	Add a run-off control plan for the construction project. Explain what efforts will be taken to control run-off (leachate, storm water) from the lagoons once the levees are breached.	A run-off control plan is not required at this time because the berms will not be breached during the CMS field effort.
10.	Page 4-1, Section 4.0	Add an investigation derived waste plan. Explain what will be done with IDW. Explain if the IDW (soil cuttings, decon water) can simply be left on site within the lagoons, as these areas will be remediated in the future. This will eliminate any concern over placement of potentially hazardous wastes and reduce analytical costs.	The Waste Management Plan in Section 7.4 and Table 7-2 has been revised to include the information covered in the comment.
11.	Page 4-6, Section 4.2.1	Re-state the purpose of the soil borings. The borings are being performed to collect soil samples for chemical and geotechnical analysis not to complete HTRW drill logs. The underlying stratigraphy may be needed to aid in RD.	The text has been revised as requested.
12.	Page 4-6, Section 4.2.1	This section indicates that a soil sample shall be obtained at 0', 2', 4', 6', 8', & 10' below the depth of sludge or 5 soil samples shall be collected every 2 feet down to a depth of 10 feet. In following paragraphs, the soil collection depths are 0-2', 4-6', and 8-10' below the depth of sludge. Please clarify this.	The text has been revised to clarify the sludge and soil sample collection strategy concerning depth intervals.
13.	Page 4-9, Section 4.2.3	The analytical results of the sludge sampled during the RFI indicated that SVOCs (phthalates) were found in the sludge. Further the HASP identifies phthalates as a COPC. Add SVOC sampling of the sludge, as the RFI indicates that it is a COPC. Other SVOC compounds may be found in the sludge especially if industrial waste or OWSs waters were sent to the POTW. Add SVOC TCLP to the TCLP testing.	SVOCs have not been added to the analyte list for soil and sludge samples collected at the sewage lagoons. Phthalates were previously attributed to field and laboratory cross-contamination and their low toxicity precludes them from the current analytical protocol.
14.	Page 5-2, (A7)	DQOs are the objectives to meet to ensure the project has data of acceptable sensitivity, precision and accuracy. What are the project's DQOs? Appendix A merely lists Laucks Laboratory historical quality control acceptance parameters.	The text has been revised to reflect the comment.

Reviewer: Jackson Kiker, U.S. Army Corps of Engineers, Omaha District (concluded)			
14.1		The project's sensitivity requirements are another important DQO objective that must be stated. Explain what regulatory levels (ie 20 X TCLP, New Mexico media specific concentrations, LDRs...) the soils and sludges are subject. These levels will then provide the minimum required sensitivity that the laboratory must be able to meet and provide quantifiable data.	The text has been revised in Section 7.4, Waste Management Plan, to reflect the comment.
14.2		Provide the project's DQO for precision and accuracy and verify that the laboratory can meet these DQO's.	The text has been revised to reflect the comment. Precision and accuracy requirements are presented in Appendix A.
15.	Page 7-1, Section 7.0	Explain if LDR's will be an issue for corrective actions at this site. Explain if consolidating the sludge on site will constitute placement. Explain if regulators have offered a judgement on the placement issue.	The applicability of the Land Disposal Restrictions are discussed in Section 7.4.3. Under the EPA AOC Policy soil cuttings may be left in the lagoon without triggering the LDRs, but decontamination water and used PPE will be containerized and managed separately as a newly generated waste.
15.1		Phase IV LDR rules should be investigated for issues concerning placement if LDRs are ARARs.	See the response to the previous comment above.
16.	Page 7-1, Section 7.5.1	Explain in an IDW plan if soil cuttings and decon fluids will be dumped back onto the sludge from which they came. If the cuttings are allowed to stay on site where they will be treated along with the rests of the sludge, the containerization of wastes and further testing will not be required.	The specific steps for management of the various IDW are discussed in Section 7.4 and 7.4.3.
17.	General	Explain how boreholes will be grouted. The boreholes should be abandoned in such a manner to prevent leachate a preferential flowpath through the sludge and underlying soils to deeper soils and groundwater.	A discussion of borehole abandonment has been included in the text and a SOP on borehole abandonment was included in the workplan.

Reviewer: Judy Strawhecker, CENWO-ED-GI			
1.	Section 1.0, page 1-1, second paragraph and Appendix B	The Corps of Engineers prefers the terminology "Site-Specific Safety and Health Plan" and the corresponding acronym "SSHP". This was specified in the USACE Scope of Services and is how it is referenced at Holloman and Kirtland AFBs.	References to the site-specific HASP have been changed to SSHP as requested.
2.	Section 2.2, page 2-1, second paragraph	Please mention (if applicable), if any risk-based standards were exceeded.	Based on results of the 1992 RFI, calculated risk was less than 10^{-6} and RBCs evaluated at that time were not exceeded as indicated in Section 6.0.
3.	Section 2.2, page 2-1, second paragraph	Please indicate what the recommended course of action was from the RFI -- was remedial action suggested? Please elaborate.	Based on the results of the RFI, remedial action was not recommended for the sewage lagoons since they were still an active unit receiving waste. The only recommendation was for the inclusion of the site in a long-term groundwater monitoring program under RCRA. At this time the monitoring wells in the vicinity are sampled annually.
4.	Section 3.0, page 3-1	Please elaborate how a low to moderate risk was determined. Was a risk assessment performed? What was the risk criteria?	The results of the risk assessment completed for the RFI indicated that the HQ for noncarcinogenic chemicals of potential concern was less than 1.0 and that carcinogenic risk was less than 10^{-6}. These results were termed as "low" in the draft workplan.
5.	Section 3.0, page 3-1	Please clarify what will happen to the North Lagoon (future use).	Since the exact future use of the lagoons has not been determined prior to the CMS, a statement on the anticipated use has been included to indicate the after corrective action of the lagoons takes place, the north lagoon will be used as an overflow basin for stormwater.
6.	Section 3.1, page 3-1	Please use the term "Applicable or Relevant and Appropriate Requirements (ARARs).	The text has been revised as requested.

Reviewer: Judy Strawhecker, CENWO-ED-GI (continued)			
7.	Section 3.1, page 3-1	CERCLA regulations are also applicable. The following paragraph should be inserted: "The CERCLA requirements apply to the sewage lagoons at Cannon AFB because they are identified by the Air Force as an IRP site. The IRP was established to investigate potential former waste sites at DoD installations and to comply with the provisions of CERCLA. Consequently, all the activities for investigation and remediation of the lagoons must be consistent with the provisions of CERCLA and the NCP. The lagoons are currently at the RCRA corrective action equivalent of the FS stage of the CERCLA process, having met all recommended milestones up to this point. Cannon AFB is submitting this CMS to satisfy the FS portion of CERCLA guidance which, as stated previously, is compatible with RCRA corrective action guidance."	The text has been revised by including the text provided by USACE. The discussion of regulatory framework has been revised throughout the workplan to reflect this comment.
8.	Section 3.1, page 3-1, second paragraph	Table 3-1 is missing - please insert.	Table 7-1 was incorrectly referenced in Section 3. There is no Table 3-1.
9.	Section 4.1.2.6, page 4-5	The current reference date of the USACE Safety and Health Requirements Manual, EM 385-1-1, is 3 Sep 1996. This was specified reference to be used in the USACE Health and Safety Scope of Services.	The correct date has been added to the text and the correct reference has been added to the Reference list.
10.	Section 4.2.1, page 4-7, top paragraph	This paragraph is confusing. A sample from each interval is needed based upon human health and ecological risk assessment exposure parameters/data needs. Please check again for clarity.	The text has been clarified to indicate the sampling strategy with reference to sample depth intervals.
11.	Section 5.6.1, page 5-2	Agree with Chemist comment - a DQO should be added for IDW/waste determination	The Waste Management Plan in Section 7.4 and Table 7-2 has been revised.
12.	Section 6.0, page 6-1	Provide a brief overview of what was done in the previous RFI pertaining to risk assessment. Are we filling a data gap? Please elaborate.	Information has been added to the text regarding the risk assessment performed in the RI. The human health and ecological risk assessments will evaluate new pathways and receptors based on the current and future uses of the lagoons.
13.	Section 6.1, page 6-1	Typo -- addressed.	The text has been corrected.
14.	Section 6.1.2, page 6-2	A Conceptual Site Model (CSM) is needed to diagram relevant receptors and exposure routes.	A Conceptual Site Model has been added to the document.

Reviewer: Judy Strawhecker, CENWO-ED-GI (continued)			
15.	Section 6.1.2, page 6-2	The alternatives describe what will happen in the South Lagoon - what will happen in the North Lagoon? Please elaborate.	Details for the north lagoon have been added to the document.
16.	Section 6.1.2, page 6-2	Two receptors should be evaluated. A current industrial (maintenance) worker who is exposed to surface sludge and 0-2 ft soils, and a future construction worker who is exposed to sludge and 0-10 ft. soils. (Also - sampling is only occurring down to 10 ft, not 12 ft.)	Based on discussions with Judy Strawhecker, Foster Wheeler has agreed to evaluate an industrial worker for the 0-2 ft interval, and for subsequent depth intervals if necessary, based on the risk results for the 0-2 ft layer. It was agreed that this will address concerns about potential exposure to subsurface material. It was agreed that construction within the empty lagoons is extremely unlikely and thus it is not necessary to evaluate a construction worker. Text was be added to support this view.
17.	Section 6.1.2, page 6-2	It should be stated why an industrial scenario is the only appropriate scenario to be evaluated based on the "no action" alternative. Please give back up data such as Cannon's Management Action Plan indicating the Sewage Lagoon area will remain industrial as long as the base remains in operation.	Information from the Cannon AFB Management Action Plan has been added to support this position.
18.	Section 6.1.2, page 6-2, second paragraph	The maximum concentration in 0-2 ft and 0-10 ft would now be used as the EPCs based upon the two receptors. Also the maximum concentration in the sludge would also be used to look at the risk to sludge in addition to the soils.	This concern has been addressed in Comment #16 above.
19.	Section 7.0, general comment	(This is in agreement with the chemists' comments.) Although it is fine to go through the regulatory requirements of this section to make potential waste determinations, I see nothing wrong in putting the drill cuttings and decon water back in the lagoons (no waste containerization).	See Section 7.4.3, under the EPA AOC Policy soil cuttings may be left in the lagoon without triggering the LDRs, but decontamination water and used PPE will be containerized and managed separately as a newly generated waste.
20.	Section 7.5.1, page 7-4, third paragraph	Mention the 20x Rule when discussing using soil boring data to initially make waste determinations.	Discussed in Section 7.4.3.
21.	Section 7.0, general comment	Add a section (somewhere near Section 7.6) why a Storm Water Pollution Prevention Plan is not necessary at this phase of the investigation -(not disturbing more than an acre, etc.).	Discussed in Section 7.3 'Regulatory Requirements.'

Reviewer: Judy Strawhecker, CENWO-ED-GI			
22.	Section 7.8.1.1, page 7-8, first paragraph, last sentence	49 CFR 100-**178**.	The text has been corrected.
23.	Section 7.8.1.1, page 7-8, second paragraph	The special waste citation should be specified as 20 NMAC 9.1, Subpart VII, Section 702.C.	Section 7.7.1.2 has been revised with the complete reference to the NMAC.
24.	Table 7.1	See previous comment - please use the term "Applicable or Relevant and Appropriate Requirements (ARARs).	The text has been revised to reflect the comment.
25.	Table 7.1	New Mexico Ambient Air Quality Stds: 20 NMAC 2 Part 3, Section 109, **110, and 111**. Please delete any regulations pertaining to 20 NMAC 11 ---these are specific to Albuquerque/Bernalillo County and are not applicable to Cannon AFB.	References to 20 NMAC 11 have been removed from Table 7-1.
26.	SSHP, Section 3.3.6, page 3-4	According to OSHA, the acceptable concentration to avoid discomfort (eye irritation) is 10 ppm, however, I am not against a more conservative action level. Please insert additional text indicating that if this action level frequently occurs during fieldwork, additional assessment will be made by the project PHSM/CIH to make work proceed more efficiently. This would be by either upgrading to Level B or bumping up the respiratory requirement to 10 ppm, rather than constantly stopping work.	The text has been revised to reflect the comment as requested.
27.	SSHP, Table 3-1	Please correct "exposure to hepatitis B" to "exposure to hepatitis A and B".	Hepatitis A has been added to the text.

Reviewer: Judy Strawhecker, CENWO-ED-GI (concluded)			
28.	SSHP, Section 7.0, general comment	Based upon the OSHA chemical data presented in Section 3.3.4 and the concentrations of these constituents in the lagoons as reported in previous documents (presented in Table 3-2), further detail must be presented in text to support the total dust action levels presented in Table 7-1. How was this action level derived? What chemical was the driver? Please elaborate.	Total dust action levels were based on the action levels presented in the SSHP for the corrective action at the sewage lagoons at Holloman AFB. The known levels of contamination at the Holloman site were much higher than the known and anticipated levels at Cannon AFB. For a conservative estimate, the Holloman AFB action levels are presented in Table 7-1. The generation of dust will be limited during the CMS field program because the berms will not be breached, sludge stabilization is not required, and the only invasive work will be drilling.
29.	SSHP, Section 7.1, page 7-1	Please clarify if the personal sampling for hydrogen sulfide will have both continuous monitoring (TWA) and an alarm indicator for the designated action level.	Text revised as requested.
30.	SSHP, Table 7-1	Hydrogen Sulfide Action: Please check this for clarity - acid gas cartridges should not be mentioned or supplied air?	Table revised to reflect that only an upgrade to Level B is permissible in response to elevated concentrations of hydrogen sulfide exceeding action levels.
31.	SSHP, Table 7-1	Hydrogen Sulfide Action Level (5 ppm): See previous comment. If this action level frequently occurs during fieldwork, additional assessment will be made by the project PHSM/CIH to make work proceed more efficiently. This would be by either upgrading to Level B or bumping up the respiratory requirement to 10 ppm, rather than constantly stopping work.	Text revised as requested.
32.	SSHP, Table 8-1	General activities concerning Hydrogen Sulfide: Please go over all air monitoring and PPE requirements for clarity. In this table you have a "Level C" requirement but this is not mentioned in Table 7-1 (or not clear) and not mentioned at all in Section 8.0. The two previous section have a Level D to Level B upgrade and now there is a Level C upgrade. Please revisit this chemical hazard and its monitoring/PPE requirements and revise.	Text and corresponding table revised to reflect the comment.
33.	SSHP, Section 11.0, number 6	ENG Form 3394 is missing, please insert.	This form (correctly referenced as EHS 1-7) is provided in the final report.
34.	SSHP, Section 14.4	The map should have a "highlighted" route from SWMU 101 to the hospital, not just a city map of Clovis. Please revise.	A new map has been included in the SSHP to show the route from Cannon AFB to the hospital in Clovis.

CAFB/RFI/APPI/SWMU 101

CAFB-99-014

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February 11, 2000

Lt Colonel Eric J. Wilbur
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Cannon AFB NM 88103-5136

RE: *Corrective Measures Study Work Plan*
SWMU 101 - Sewage Lagoons
Cannon Air Force Base
EPA ID No.: NM7572124454

Dear Lt Colonel Wilbur:

The Hazardous and Radioactive Materials Bureau (HRMB) of the New Mexico Environment Department has reviewed Cannon Air Force Base's *Corrective Measures Study Work Plan*, submitted under cover received January 11, 2000. Thank you for submitting this work plan for HRMB's review.

After reviewing this work plan, HRMB feels that the tasks specified in this work plan do not match those specified for a Corrective Measures Study (CMS) in Cannon's 1989 HSWA Permit (see Module IV, Section R). More recent CMS guidance is provided in EPA's 1994 *RCRA Corrective Action Plan* (see especially Chapter IV - *Corrective Measures Study*). The field tasks specified in Cannon's proposed work plan appear to be in support of additional contamination characterization and final closure or stabilization of the two impoundments, rather than corrective measures. Closure of the two impoundments may be included in the final corrective measures.

Given that the field work consists primarily of data collection, Cannon should proceed "at risk" with this part of their RCRA Facility Investigation (RFI). The results of the proposed field work and conclusions based on this data and previously collected

data should be submitted as an Addendum to Cannon's 1992 RFI Report (*Remedial Investigation Report for 18 Solid Waste Management Units, Oct. 19, 1992*).

The RFI Report addendum should include a risk assessment based on the new data, as well as previously collected data, to determine whether any releases pose unacceptable risk to either human health or the environment. This risk assessment may be incorporated in a Final RFI Report, an interim corrective measures, or a Corrective Measures Study for this particular SWMU.

Although HRMB did not review Cannon's *"Corrective Measures Work Plan"* in detail, we did note several general problems with this work plan.

Comment 1. Cannon states in § 1.0 that *"The CMS for SWMU 101 is a voluntary program . . . ."* and in § 3.1 makes a similar statement. HRMB wishes to remind Cannon that the RFI and CMS for SWMU 101 is required pursuant to Cannon's 1989 HSWA Permit (see Module IV, Sections G through N) and, therefore, is not a *"voluntary program."*

Comment 2. Cannon also states in § 1.0 that although the CMS is being conducted under the provisions of RCRA, the requirements of CERCLA apply. HRMB believes that earlier RFI documents submitted by Cannon more accurately depict the RCRA/CERCLA relationship at Cannon (for example, see Cannon's *Executive Summary* to *Appendix II - RCRA Facility Investigation - RFI Report*).

HRMB is sensitive to the issue of overlapping RCRA and CERCLA authorities and the similar, although not identical requirements of each program. In the interests of expediting the review and approval process and minimizing duplicative work, HRMB recommends that Cannon adhere as closely as possible to RCRA guidance when submitting RFI work plans, RFI reports, CMS work plans, and CMS reports, pursuant to Cannon's 1989 HSWA permit.

If Cannon wishes to submit site investigation and remediation related documents prepared in accordance with CERCLA guidance rather than RCRA guidance, then HRMB suggests that at a minimum, Cannon should provide a table that compares and discusses both RCRA and CERCLA requirements and guidance to facilitate our review. However, Module IV, Sections Q and R of the 1989 HSWA Permit specify Scopes of Work for RFIs and CMSs; Cannon should adhere to the requirements specified in these permit conditions.

Comment 3. Cannon's statement concerning the purpose of a CMS is inconsistent with CMS guidance. A CMS is required whenever a release has been identified. Cannon's work plan does not specify whether a release has been confirmed at SWMU 101, much less characterize the extent of a release. Please refer to Chapter IV, page 55 of EPA's CMS guidance (*RCRA Corrective Action Plan (Final), OSWER Directive 9902.3-2A, May 1994).*

Comment 4. In § 2.2 Cannon states that ". . . *SWMU 101 was not covered under the Base's Part B Permit. . . .*" HRMB reminds Cannon that SWMU 101 was specified in Appendix I to their 1989 HSWA Permit. Therefore, a RFI and CMS, if appropriate, is required pursuant to Cannon's 1989 HSWA permit.

Comment 5. In your cover letter to this work plan, Cannon indicates that you plan to commence fieldwork in March 2000. In the future, please allow adequate time for regulatory review.

As noted above, HRMB has not reviewed this document in detail; however, in general the work described in this work plan appears technically sound, and HRMB recommends that Cannon implement this work plan "at risk". If you have any questions concerning this review, please call me at 505-827-1558 (extension 1024).

Sincerely,

Glenn von Gonten,
Geologist III

Tracking: HRMB CAFB-99-014

cc: Daniel A. Barnett, Cannon Air Force Base
John S. Pike, Cannon Air Force Base
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CORRECTIVE MEASURES STUDY WORK PLAN
SWMU 101—SEWAGE LAGOONS
CANNON AIR FORCE BASE, NEW MEXICO

Prepared for:

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Under Contract No. DACW45-94-D-0003
Delivery Order No. 25, Work Authorization Directive 1

U.S. Army Corps of Engineers
Omaha District
Omaha, Nebraska

December 1999

Project Number: CZQZ979361Z1

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LIST OF ACRONYMS

AFB	Air Force Base
Air Force	United States Air Force
AOC	area of concern
ARAR	applicable or relevant and appropriate requirement
ASTM	American Society of Testing and Materials
BP	before present
CEC	cation exchange capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CMS	Corrective Measures Study
cm/sec	centimeters per second
C-O-C	chain-of-custody
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CQAB	Chemistry Quality Assurance Branch Laboratory of Waterways Experimentation Station
DO	Delivery Order
DOT	Department of Transportation
DQCR	daily quality control report
DQO	data quality objective
E&E	Ecology and Environment, Inc.
EGL	Environmental Geotechnology Laboratory, Inc.
EPA	United States Environmental Protection Agency
EPC	exposure point concentration
ESQ	environmental safety and quality
ESS	Environmental Safety Specialist
ft	foot/feet
Foster Wheeler	Foster Wheeler Environmental Corporation
FS	feasibility study
gpf	gallon(s) per foot/feet
gpm	gallon(s) per minute
GPS	global positioning system
HASP	Health and Safety Plan
HHRA	human health risk assessment
HHSL	human health medium-specific screening level

LIST OF ACRONYMS (continued)

HTW	hazardous and toxic waste
IRIS	Integrated Risk Assessment System
IRP	Installation Restoration Program
Laucks	Laucks Testing Laboratories
LDR	Land Disposal Restriction
LIMS	Laboratory Information Management System
MDL	method detection limit
mg/kg	milligrams per kilogram
mg/l	milligrams per liter
NCP	National Contingency Plan
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
ORNL	Oak Ridge National Laboratory
PCB	polychlorinated biphenyl
PQL	practical quantitation limit
psi	pounds per square inch
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RCP	Regulatory Compliance Plan
RCRA	Resource Conservation and Conservation Act
RFI	RCRA Facility Investigation
SESOIL	Seasonal Soil Compartment Model
SLERA	screening level ecological risk assessment
SMDP	Scientific/Risk Management Decision Point
SOP	standard operating procedures
SSHP	Site-Specific Safety and Health Plan
SWMU	solid waste management study
TCLP	Toxicity Characteristic Leaching Procedure
TERC	Total Environmental Restoration Contract
TOC	total organic carbon
TRV	toxicity reference value
TSDF	treatment, storage, and disposal facility

LIST OF ACRONYMS (concluded)

USACE	United States Army Corps of Engineers
VOC	volatile organic compound

1.0 INTRODUCTION

This document describes the Corrective Measures Study (CMS) to be conducted for Solid Waste Management Unit (SWMU) 101, the Sewage Lagoons, at Cannon Air Force Base (AFB), New Mexico. The CMS for SWMU 101 is a voluntary program at Cannon AFB aimed at achieving closure of the sewage lagoons, which were active from 1966 through 1998. This work plan complies with the requirements outlined in the Resource Conservation and Recovery Act (RCRA) Corrective Action Plan (EPA, 1994a). Although this CMS is conducted under the provisions of RCRA, the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) apply to the sewage lagoons at Cannon AFB because they are identified by the United States Air Force (Air Force) as an Installation Restoration Program (IRP) site. The IRP was established by the Air Force to investigate potential former waste sites at Department of Defense installations and to comply with the provisions of CERCLA. Consequently, all the activities for investigation and remediation of the lagoons must be consistent with the provisions of CERCLA and the National Contingency Plan (NCP). The lagoons are currently at the RCRA corrective action equivalent of the feasibility study (FS) stage of the CERCLA process, having met all recommended milestones up to this point. Cannon AFB is submitting this CMS to satisfy the FS portion of CERCLA guidance which, as stated previously, is compatible with RCRA corrective action guidance.

Foster Wheeler Environmental Corporation (Foster Wheeler) will conduct the CMS for the United States Army Corps of Engineers (USACE) under the Total Environmental Restoration Contract (TERC) No. DACW-45-94-D0003, Delivery Order 25, Work Authorization Directive 1.

The CMS work plan provides information on site background and previous studies, methodology and technical approach for the evaluation of site-specific risk, overview of corrective action alternatives, the field investigation sampling program required to adequately characterize sludge and soil in the lagoons, project-specific quality assurance (QA) and quality control (QC) protocol, and regulatory compliance. Additionally, a site-specific safety and health plan (SSHP) addendum to the Cannon AFB Basewide Health and Safety Plan (HASP) (Foster Wheeler, 1999) has been prepared for the CMS and is included as Appendix B to this document. All field

activities will be performed in accordance with the Basewide HASP, the site-specific SSHP Addendum (Appendix B), and USACE health and safety requirements.

1.1 PURPOSE OF THE CORRECTIVE MEASURES STUDY

The purpose of the CMS for SWMU 101 is to identify and evaluate potential corrective action alternatives that will prevent future impact to human health and the environment. Corrective action alternatives appropriate for the sewage lagoons should provide containment of any residual contamination present at the site and source control. Human health and ecological risk assessments will be conducted as part of the CMS in order to determine the level at which containment and source control is required at the site.

Existing information is available to support the risk assessment and the selection of corrective action alternatives to be considered in the CMS. However, additional data are required to support the CMS and preliminary remedial design work including collection of analytical and geotechnical data to support the characterization of sludge and native soil within and beneath the lagoons. An ecological survey of the area will also be conducted to support the risk assessment.

1.2 DOCUMENT ORGANIZATION

The work plan consists of the following information necessary to conduct the CMS for SWMU 101:

- Section 1.0–Introduction
- Section 2.0–Site Description and History
- Section 3.0–Corrective Measures Study Overview
- Section 4.0–Field Investigation Activities
- Section 5.0–Quality Assurance Project Plan (QAPP)
- Section 6.0–Risk Assessment Technical Approach
- Section 7.0–Regulatory Compliance Plan (RCP)
- Section 8.0–Project Management
- Section 9.0–References
- Appendix A– Analytical Method Practical Quantitation Limits (PQLs), Precision and Accuracy Objectives
- Appendix B– Site-Specific SSHP Addendum to the Basewide HASP
- Appendix C– Standard Operating Procedures (SOPs)

A summary of site information for SWMU 101 is presented in Section 2.0. An overview of the CMS provides information on the corrective action alternatives to be evaluated for the site in Section 3.0. The field investigation is described in Section 4.0 and includes information on the construction activities supporting the sample collection effort required for the CMS. Section 5.0 provides the QA/QC procedures that will be followed during data collection.

The technical approach for the human health and ecological risk assessments is detailed in Section 6.0. The RCP is provided in Section 7.0 and presents pertinent information on regulatory compliance, documentation, and waste management procedures related to field activities. The Project management is discussed in Section 8.0. References are included in Section 9.0.

Supplemental information to the QAPP is provided in Appendix A including Laucks Testing Laboratories (Laucks) method-specific PQLs, and method precision and accuracy objectives. A site-specific addendum to the Basewide HASP has been included as Appendix B and provides information regarding the CMS field investigation health and safety protocol related to the construction and sampling activities. Appendix C provides the SOPs that will be followed during field investigation activities.

2.0 SITE DESCRIPTION AND HISTORY

A description of Cannon AFB and brief summaries of SWMU 101 including site description, history, geology, and hydrogeology are provided below. The site history and detailed descriptions of previous site activities are presented in previous investigation reports (Woodward Clyde 1992; E&E 1998).

2.1 CANNON AFB DESCRIPTION AND HISTORY

Cannon AFB occupies approximately 4,000 acres south of U.S. Highway 60/84 in Curry County, New Mexico. The Base is situated 6 miles west of the city of Clovis, near the New Mexico-Texas border (Figure 2-1). The area surrounding Cannon AFB is used mainly for farming and ranching. Cannon AFB also maintains several satellite facilities.

In 1942, the Department of Defense established the Clovis Army Air Base, a training facility for B-17, B-24, and B-29 air crews. The Base was renamed Clovis Army Airfield in 1945 and eventually closed in 1947. Reactivated in 1951, the Base was reassigned to the Tactical Air Command and renamed Cannon AFB in 1957. In 1975, the 27th Tactical Fighter Wing became the principal Air Force unit at Cannon AFB. The Base was reassigned to the Air Combat Command in 1992 and currently maintains a combat-ready force and provides replacement training of combat aircrews for tactical organizations worldwide.

2.2 DESCRIPTION AND HISTORY OF SWMU 101

The sewage lagoons were identified as SWMU 101 in the Hazardous Waste Permit of Cannon AFB on November 14, 1989. The sewage lagoons consist of two unlined surface impoundments that were in use from 1966 to 1998 and received combined sanitary and industrial wastes from facilities on the Base. The lagoons operated in series and have a combined surface area of approximately 33 acres (Figure 2-2). The lagoons were constructed with unlined earthen bottoms and concrete-lined banks. With the construction and operation of the Base wastewater treatment plant in 1998, wastewater was no longer discharged to the lagoons.

SWMU 101 was investigated during the Appendix I RCRA Facility Investigation (RFI) in 1992. Information from the RFI indicates that the depth of sludge was approximately 2 feet (ft) and the average depth of water ranged from 3.5 ft to 4.5 ft (Woodward Clyde 1992; E&E 1998). At the time of the RFI, SWMU 101 was not covered under the Base's RCRA Part B Permit and resolution of the regulatory requirement for this unit was to be resolved by Cannon AFB, the

United States Environmental Protection Agency (EPA), and the New Mexico Environment Department (NMED). As a result of the RFI, the only recommendation made for ongoing work at the sewage lagoons was to continue annual groundwater monitoring for volatile organic compounds (VOCs), metals, pesticides, nitrate, sulfate, and total dissolved solids. According to the RFI report, the recommendation for an interim monitoring program was made to support site closure until the regulatory framework was resolved. Currently, groundwater monitoring is conducted on an annual basis at the sewage lagoons to fulfill the requirements of RCRA.

Soils—Four sludge samples from the north lagoon (samples 5001 through 5004) and four sludge samples from the south lagoon (5005 through 5008) were collected during the RFI. Sludge samples were analyzed for toxicity characteristic leaching procedure (TCLP) parameters, VOCs, semivolatile organic compounds (SVOCs), metals, polychlorinated biphenyls (PCBs), and pesticides. Table 2-1 presents a summary of the analytes detected in the sludge samples collected during the RFI.

The VOCs acetone and 2-butanone, and the SVOC bis(2-ethylhexyl) phthalate, were the only organic compounds identified as being present in the sludge samples collected during the RFI. It is possible that the detections of these compounds are attributable to laboratory contamination since they were detected in up to 14 of the method blanks analyzed during the RFI. Metals analysis of the sludge indicated that barium, chromium, copper, selenium, silver, vanadium and zinc all exceeded the background levels for soils at this site. The pesticides 4,4'-DDD, 4,4'-DDE, and chlordane, and PCB-1254 were detected in the sludge samples from both the north and south lagoons. These pesticides and PCB-1254 were uniformly detected at low concentrations throughout the lagoons and are most likely the result of an accumulation of materials from various base activities transferred to the lagoons through the sanitary sewer. Sludge samples 5003 and 5007 were also analyzed for TCLP parameters to evaluate the leachability of detected chemicals. None of the chemicals exceeded the TCLP criteria.

Additional sludge samples were collected in January 1997 to support the preliminary evaluation of corrective action alternatives (E&E 1998). Three sludge samples were collected and analyzed for total nitrogen, total solids, volatile solids, metals, and pathogens. One sample each was collected from the north lagoon, the south lagoon, and the discharge point at the south lagoon

that leads to the playa lake. Table 2-2 presents the analytical results for the 1997 sludge samples. Evaluation of the analytical results by Ecology and Environment, Inc. (E&E) indicated that the levels of analytes detected in the 1997 sludge samples did not exceed RCRA limits for hazardous constituents. E&E concluded that additional samples of the sludge were required to adequately characterize the sludge during the corrective action process of the sewage lagoons.

Groundwater—Four groundwater samples were collected from existing monitoring wells E, F, G, and H at the sewage lagoons during the RFI. Wells F, G, and H are located downgradient from the sewage lagoons, and well E is located upgradient of the site. Groundwater samples were analyzed for Appendix IX constituents.

Metals were the only analytes detected above the analytical reporting limits. Results showed the presence of barium and vanadium in all four groundwater samples. All metal concentrations were below their respective maximum contaminant levels. The concentrations of the metals detected in each well are summarized in Table 2-1.

Surface Water—Three surface water samples, one from the center of the south lagoon (3001), one from the center of the north lagoon (3002), and one near the wastewater flow splitting pool (3003) were collected during the RFI. Surface water samples were analyzed for Appendix IX constituents. Concentrations of the analytes detected in surface water samples are summarized in Table 2-1.

The metals detected in surface water samples included barium, lead, copper, zinc, mercury, silver, and vanadium. Barium was detected in all three samples. Sample 3001 also contained lead. Sample 3002 contained zinc and copper in addition to barium, and 3003 contained seven metals. Sulfide was detected in all three surface water samples with concentrations ranging from 0.19 milligrams per liter (mg/L) to 3.7 mg/L.

2.3 GEOLOGY AND HYDROGEOLOGY

2.3.1 Geology

The near-surface stratigraphic units of interest at Cannon AFB are the Late Miocene-Late Pliocene age Ogallala Formation and the Early Triassic Dockum Group.

The Dockum Group consists of three formations. The stratigraphically lowest unit is the Santa Rosa Sandstone. Overlying the Santa Rosa Sandstone are the Chinle and Redonda Formations. The Chinle and Redonda Formations are composed mainly of red shales with lesser interbedded sands and are known locally as "redbeds." The top of the Dockum Group is marked by an erosional unconformity having relief of up to several hundred ft.

Overlying the Dockum Group redbeds is the Ogallala Formation. The Ogallala Formation extends from eastern New Mexico and Colorado into Texas, Oklahoma, Kansas, Nebraska, and South Dakota. Drillers' logs from Cannon AFB indicate that the Ogallala Formation varies from 360 ft to 415 ft in thickness. The incised upper surface of Triassic redbeds strongly influences the Ogallala thickness. Stream valleys in the post-Triassic unconformity are deep and trend dominantly east–west. Ogallala thickness may thus vary significantly over short north-south distances.

The Ogallala is erosionally truncated to the south along the abandoned Portales Valley, to the west along the Pecos River Valley, and to the north in a series of ephemeral stream valleys. The Ogallala Formation extends more than 125 miles to the east before terminating as an escarpment in Briscoe County, Texas. Springs and seeps are common along the erosional margins of the Ogallala.

The Ogallala dips gently and monoclinally to the southeast in the vicinity of Cannon AFB. As reported in Lee Wan and Associates (1990), data suggest that some Quaternary warping may have occurred; however, most of the structures are well to the northwest and southwest of Cannon AFB. No faults or buried structural lineaments are known to exist in the vicinity of Cannon AFB.

The Ogallala Formation is composed of unconsolidated poorly sorted gravel, sand, silts, and clays. The base of the Ogallala is generally marked by a gravel, cobble, and boulder deposit. This basal member contains sediments derived from igneous and sedimentary rocks transported from the mountains to the west. The Ogallala Formation was laid down by stream and overbank deposits formed within coalescing alluvial fans. These fans form a broad pediment along the eastern flank of the Rocky Mountains. As is typical of alluvial deposits, Ogallala internal stratigraphy varies vertically and horizontally over short distances.

Except where strongly cemented by calcium carbonate (caliche), the sediments of the Ogallala are loose and friable. Authigenic and allogenic clays are found as a trace to abundant matrix mineral (Lee Wan and Associates 1990). As reported by Lee Wan and Associates (1990), five zones have been distinguished within the Ogallala of east central New Mexico on the basis of clay minerals. Smectites (montmorillonites) and attapulgite (with sepeotite) are the dominant clays throughout the Ogallala. Illite is a lesser but persistent clay, as is kaolinite. Smectite is a swelling clay, causing deep cracks to form in dry surface soils. Smectite in particular and, to a lesser extent, attapulgite and illite are clays with moderate to high cation exchange capacities (CEC). The formation as a whole should therefore have a relatively high CEC, which should inhibit the migration of charged contaminants, especially ionic forms of metals.

Caliche is a major feature of the Ogallala Formation, occurring as nearly continuous to discontinuous layers throughout. Caliche is hard, white to pale tan on fresh surfaces, weathering to gray, and has a chalky appearance. Caliche forms as calcium carbonate leached from overlying sediments, and precipitates in the pore space of the host sediments. Precipitation is caused by the evaporation of downward percolating water. The caliche may thus mark the position of ancient vadose zones. Lee Wan and Associates (1990) give radiocarbon dates for the upper "climax" caliche range from approximately 27,000 years before present (BP) to approximately 42,000 years BP.

Caliche is relatively soluble in acidic water (pH<7) or in waters containing dissolved carbon dioxide. The top surface of the upper "climax" caliche in fresh outcrop shows solution etching.

The Ogallala has numerous continuous to discontinuous caliche layers throughout its thickness. The uppermost caliche, termed the "climax" caliche, is pisolitic (Lee Wan and Associates 1990). The pisolites are thought to have formed as the caliche was repeatedly chemically-weathered and brecciated during Pleistocene pluvials and later recemented during drier intervals. This upper caliche outcrops around playas and the bounding escarpments of the Ogallala and is locally termed "caprock." The "climax" caliche is typically 3 to 5 ft thick. Caliches which occur lower in the Ogallala are platy and harder. Caliche is likely thin or absent below playas.

2.3.2 Hydrogeology

The lower portion of the Ogallala Formation is the primary regional aquifer for both potable and irrigation water. No deeper aquifers are used in the vicinity of Cannon AFB. The Ogallala aquifer is part of the High Plains Aquifer which extends continuously from Wyoming and South Dakota into New Mexico and Texas. In east central New Mexico, the Ogallala aquifer rests on Dockum Group redbeds, which serve as the basal confining layer. The Ogallala is a water table, or unconfined, aquifer. The Ogallala aquifer has a southeasterly regional gradient of about 10 to 15 ft per mile (Woodward-Clyde 1992). Well yields vary from less than one gallon per minute (gpm) in thin silts and sands, and up to 1600 gpm in thick sands and gravels (Lee Wan and Associates 1990). Water quality is generally good with dissolved solids ranging from 250 to 500 mg/L (Gutentag et. al 1984) and fluoride ranging from 2.2 to 2.7 mg/L (William Matotan and Associates, Inc. 1985).

At Cannon AFB, the Ogallala aquifer has an average saturated thickness of 120 ft based on mid-1960s data. Saturated thickness ranges from 93 to 143 ft and is influenced by the configuration of the erosional unconformity surface marking the top of the Dockum Group. The local groundwater gradient is southeasterly at 7 to 15 ft per mile (USAF 1990). Flow within the saturated zone may be influenced by the configuration of the top of the Dockum Group. Yields in tests of Cannon AFB water wells have ranged from 205 gpm to 1,150 gpm. Specific capacities range from 11.4 gallons per ft (gpf) to 27.9 gpf (Lee Wan and Associates 1990).

Estimates of hydraulic conductivity were made from well pump tests conducted by Cannon AFB using the Theis equation. The data used in these calculations were obtained to evaluate pump

rates, efficiency, and well yield and were not intended for use in calculating aquifer properties. The results of these calculations should, therefore, be considered as estimates only.

Hydraulic conductivity values for ranged from approximately 2.0×10^{-3} centimeters per second (cm/sec) to 2.0×10^{-2} cm/sec. These estimates appear to be low when compared to published hydraulic conductivity data for sands and gravels (Freeze and Cherry 1979). As reported in Kearney (1987), a groundwater flow velocity of about 150 feet per year has been estimated. Based on this calculation, the hydraulic conductivity is approximately 1.0×10^{-1} cm/sec.

Recharge to the Ogallala is primarily through precipitation. Kearney (1987) indicated that the recharge rate may be as much as 1.0 inches per year. Due to the high evapotranspiration rate and low precipitation, recharge occurs only during heavy rainfall events in which the infiltration capacity of the soil is exceeded and runoff occurs, or during cool months when precipitation exceeds evapotranspiration. Excess runoff flows to playas, and the presence of water in playas allows deep percolation to the aquifer. The occurrence of this process is evidenced by the presence of clay deposits in playas and the possibility that caliche is thin or absent directly below, playas. Caliche is soluble in acidic rain waters and is leached over time to form percolation pathways.

Discharge from the Ogallala occurs through well pumping and springs along the eroded margins. Spring discharge does not occur on or near Cannon AFB. Domestic and irrigation water wells are common on and around the base. However, the rate of discharge exceeds local recharge. Water levels in the Ogallala have declined steadily from the 1930s to the present. From the 1930s to 1980, a decline of 50 to 100 ft has been observed in the area around Clovis, New Mexico. Luckey et. al. (1981) states, "the largest area of water-level decline exceeding 100 ft occurs south of the Canadian River extending from Curry County, New Mexico to Crosby County, Texas."

The Ogallala will continue to be used as the primary source of potable and irrigation water for eastern New Mexico. The New Mexico State Engineer designated Curry County as a Water Basin in 1989. This designation allows for regulation of water rights, usage, and well drilling.

Table 2-1 Summary of Analytes Detected in Samples Collected at the Sewage Lagoons During the RFI **Page 1 of 2**

Analyte	Sludge Samples [1,2]							
	5001	5002	5003	5004	5005	5006	5007	5008
VOCs								
Acetone	610	620	NA	1300 J	6900 J	14,000	12,000	17,000
2-Butanone	410	ND	NA	ND	ND	ND	ND	ND
SVOCs								
Bis(2-ethylhexyl)phthalate	19,000 J	340,000 J	38,000	24,000	150,000 J	31,000 J	ND	16,000 UJ
PCBs								
PCB-1254	ND	82 J	300 J	270 J	490 J	ND	220 J	ND
Pesticides								
4,4-DDD	55 UJ	11 J	29 J	53	ND	ND	16	ND
4,4-DDE	55 UJ	15 UJ	63	55	90	26 J	43	ND
α-Chlordane	28 UJ	7.7 UJ	31	31	23 J	15	7.8 J	ND
γ-Chlordane	28 UJ	4 J	42 J	45	ND	ND	8.2 UJ	ND
Metals								
Barium	309 J	295 J	260	230	528 J	342 J	382 J	635
Chromium	39.8	41.5	28.7	28	51.0 J	34.5	19.2	32.6
Copper	213	346	111	98	312	168	208	289
Selenium	8.7 J	6.5 J	6.6	1.2 J	35.3	13.8 J	11.5	15.6
Silver	54	61	35	31	97	55	61	83
Zinc	388	502	251	212	580	330	450	672
Vanadium	75 J	53 J	45	45	98 J	76 J	60 J	77 J
Lead	ND	ND	ND	ND	ND	ND	ND	ND
Mercury	ND	ND	ND	ND	ND	ND	ND	ND

[1] VOC and SVOC concentrations for sludge samples presented in micrograms per kilogram (mg/kg)
[2] Metal concentrations for sludge samples are presented in milligrams per kilogram (mg/kg)
[3] Metal concentrations for groundwater and surface water samples are presented in milligrams per liter (mg/L)
NA - Maximum contaminant level (MCL) not available
ND - Analyte not detected
J - Value estimated below the certified reporting limit
UJ - Analyte reported as a nondetection by the laboratory, but data validation indicated concentration is an estimated detection below the CRL

Chlordane 2 ug/L
TCLP

Table 2-1 Summary of Analytes Detected in Samples Collected at the Sewage Lagoons During the RFI **Page 2 of 2**

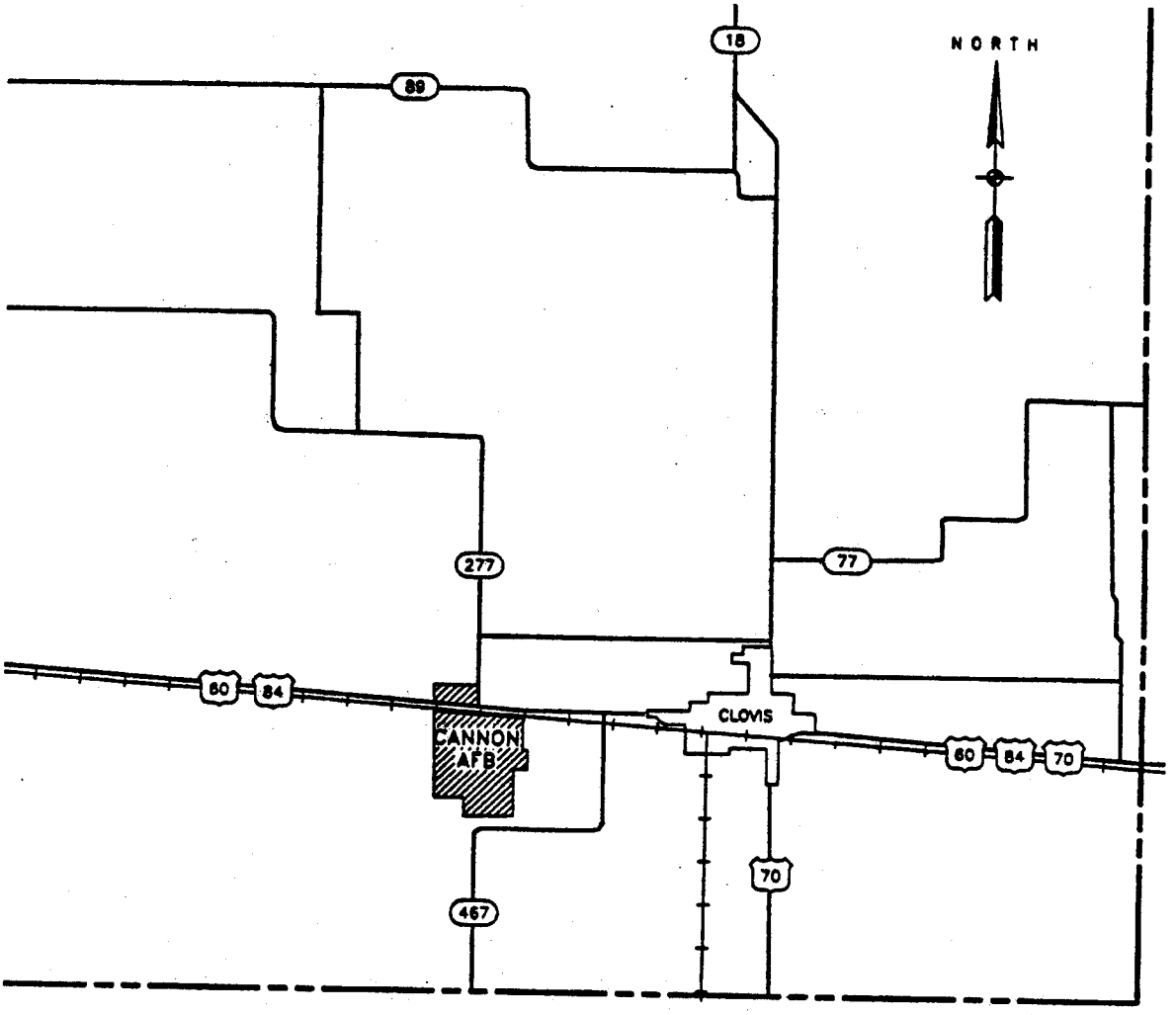
Analyte	Groundwater Samples [3]				MCL	Surface Water Samples [3]		
	E	F	G	H		3001	3002	3003
VOCs								
Acetone	ND	ND	ND	ND	ND	ND	ND	ND
2-Butanone	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs								
Bis(2-ethylhexyl)phthalate	ND	ND	ND	ND	ND	ND	ND	ND
PCBs								
PCB-1254	ND	ND	ND	ND	ND	ND	ND	ND
Pesticides								
4,4-DDD	ND	ND	ND	ND	ND	ND	ND	ND
4,4-DDE	ND	ND	ND	ND	ND	ND	ND	ND
α-Chlordane	ND	ND	ND	ND	ND	ND	ND	ND
γ-Chlordane	ND	ND	ND	ND	ND	ND	ND	ND
Metals								
Barium	0.022 J	0.075	0.026 J	0.026 J	1.0	0.059	0.11	0.1
Chromium	ND	ND	ND	ND	0.1	ND	ND	ND
Copper	ND	ND	ND	ND	1.0	ND	0.02	0.051
Selenium	ND	ND	ND	ND	0.05	ND	ND	ND
Silver	ND	ND	ND	ND	0.1	ND	ND	0.04 J
Zinc	ND	ND	ND	ND	5.0	ND	0.032	0.12
Vanadium	0.02	0.012	0.012	0.016	NA	ND	ND	0.038
Lead	ND	ND	ND	ND		0.032	ND	0.0071
Mercury	ND	ND	ND	ND		ND	ND	0.0011

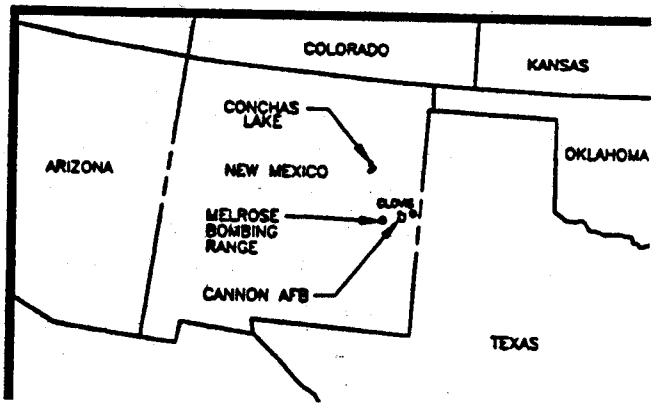
[1] VOC and SVOC concentrations for sludge samples presented in micrograms per kilogram (mg/kg)
[2] Metal concentrations for sludge samples are presented in milligrams per kilogram (mg/kg)
[3] Metal concentrations for groundwater and surface water samples are presented in milligrams per liter (mg/L)
NA - Maximum contaminant level (MCL) not available
ND - Analyte not detected
J - Value estimated below the certified reporting limit
UJ - Analyte reported as a nondetection by the laboratory, but data validation indicated concentration is an estimated detection below the CRL

Table 2-2 Summary of Analytes Detected in Samples Collected at the Sewage Lagoons in 1997

Analyte	Sludge Samples		
	North Lagoon	South Lagoon	Discharge Point
Total nitrogen (mg/kg)	24000	28000	13000
Total solids (%)	9.1	7.9	16
Volatile solids (%)	35	47	42
Pathogens			
Enteric viruses (per 4 grams)	0	0	0
Fecal coliform (MPN per gram)	430	930	730
Helminth ova (per 4 grams)	0	0	0
Salmonella sp. (per 10 grams)	0	0	0
Metals (mg/kg)			
Arsenic	13	12	7.9
Cadmium	11	12	7.9
Chromium	34	40	38
Copper	220	300	200
Lead	72	130	130
Mercury	1.1	2.0	1.4
Molybdenum	ND	ND	ND
Nickel	ND	28	19
Selenium	20	29	17
Zinc	470	710	480

mg/kg - Milligrams per liter
MPN - Most probable number
ND - Analyte not detected





Scale is Approximate

0 5
Miles

CORRECTIVE MEASURES STUDY WORK PLAN
SWMU 101--SEWAGE LAGOONS

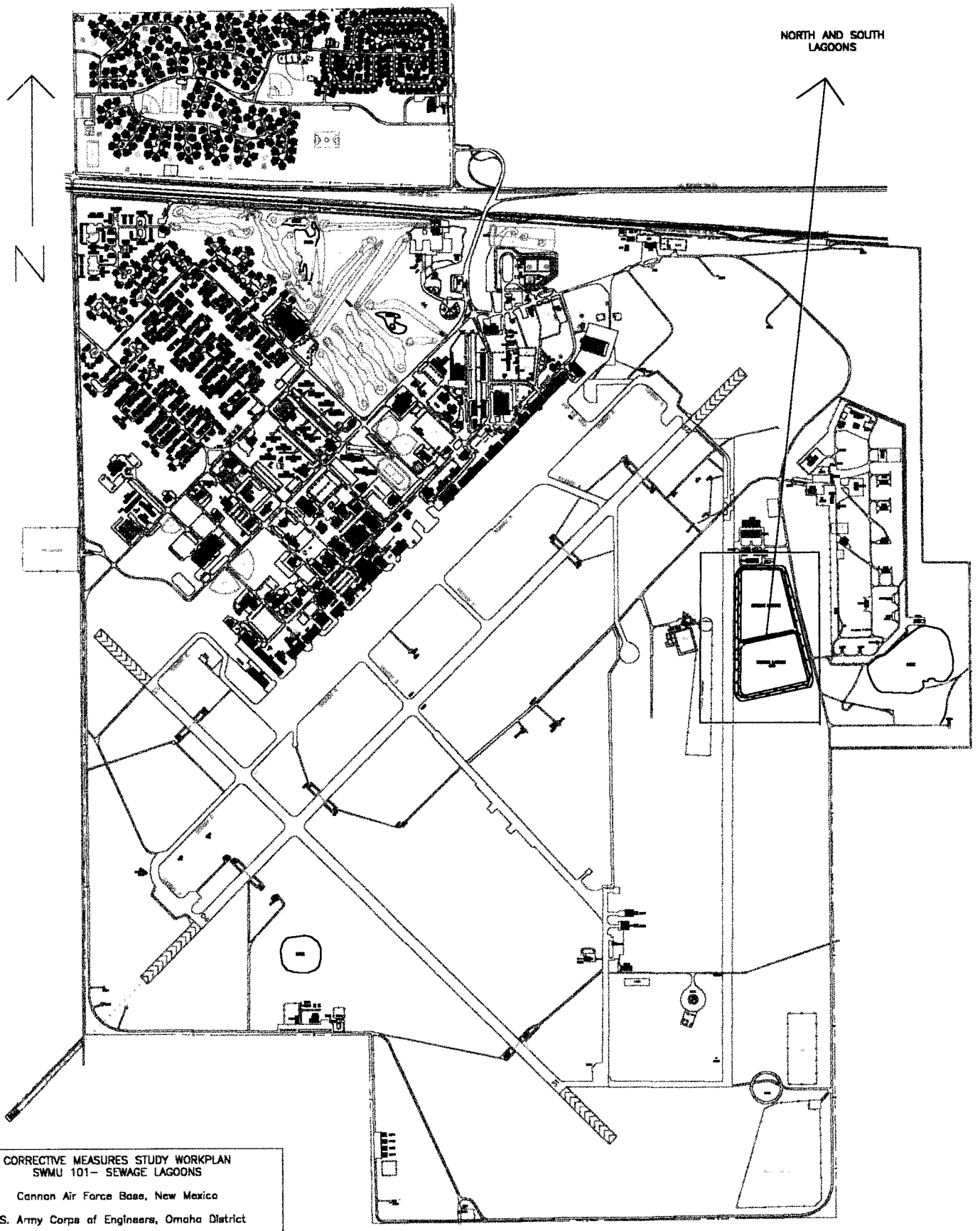
Cannon Air Force Base, New Mexico

U.S. Army Corps of Engineers, Omaha District

Figure 2-1

Base Location Map
Cannon Air Force Base, New Mexico

Foster Wheeler Environmental Corporation



CORRECTIVE MEASURES STUDY WORKPLAN
SWMU 101– SEWAGE LAGOONS

Cannon Air Force Base, New Mexico

U.S. Army Corps of Engineers, Omaha District

Figure 2–2
Location of Sewage Lagoons at Cannon AFB

Foster Wheeler Environmental Corporation

DATE: 12/7/99

3.0 CORRECTIVE MEASURES STUDY OVERVIEW

Results of the RFI (Woodward Clyde, 1992) indicate there is a low relative risk to human and ecological receptors in the vicinity of the sewage lagoons within the east-central region of Cannon AFB (Figure 2-2). The CMS will be guided by the results of RFI and the preliminary evaluation of remedial alternatives presented in the Phase III Sludge Management Compliance Evaluation and Requirements Identification Document (E&E, 1998) where a 10 percent conceptual design was evaluated for corrective action of the sewage lagoons. The remedial alternative evaluated by E&E included dewatering the sludge in both lagoons, consolidating and compacting the sludge in the South lagoon, and covering the sludge with soil. This remedial alternative is the favored corrective measure for the sewage lagoons based on feasibility, long-term effectiveness, and cost.

3.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

This section identifies potentially applicable or relevant and appropriate regulatory requirements (ARARs) to be complied with during the planned activities at SWMU 101. Cannon AFB is completing the CMS activities as a voluntary program. Waste management will comply with RCRA requirements as appropriate. While specific permits are not required for the response actions planned, Cannon AFB will ensure permit equivalency in accordance with RCRA regulations.

Although this CMS is conducted under the provisions of RCRA, the requirements of CERCLA apply to the sewage lagoons at Cannon AFB because they are identified by the Air Force as an IRP site. Consequently, all the activities for investigation and remediation of the lagoons must be consistent with the provisions of CERCLA and the NCP. The lagoons are currently at the RCRA corrective action equivalent of the FS stage of the CERCLA process, having met all recommended milestones up to this point. Cannon AFB is submitting this CMS to satisfy the FS portion of CERCLA guidance which, as stated previously, is compatible with RCRA corrective action guidance.

Potentially applicable regulatory requirements for the SWMU 101 Sewage Lagoons based on the anticipated corrective actions to be implemented at this site are presented in Section 7.0, Table 7-1.

3.2 SPECIFIC CORRECTIVE MEASURE ALTERNATIVES

Three alternatives are being considered during this focused CMS. Alternative 1 is presented as no further action at the site, while Alternatives 2 and 3 were addressed in the Phase III Sludge Management Compliance Evaluation and Requirements Identification Document (E&E 1998). The three alternatives are briefly discussed below.

1. No Action—This alternative is the baseline against which all other alternatives are compared and consists of allowing the existing conditions at the site to continue without any environmental improvements.
2. Sludge Dewatering In-Place, Consolidation, Compaction, and Cover—This alternative involves performing final dewatering of the north and south lagoons; removal of dewatered sludge from the north lagoon and placement into the south lagoon; compaction of the sludge in-place with clean construction and demolition debris; and installing thick, native topsoil layer and appropriate vegetation. Erosion control measures will be installed if necessary.
3. Pump Liquid Sludge to South Lagoon, Dewater Sludge In-Place, and Cover—This alternative involves pumping liquid sludge from the north lagoon into the south lagoon; allowing the combined sludge to dry within the south lagoon; and installing thick, native topsoil layer and appropriate vegetation. Erosion control measures will be installed if necessary.

3.3 GENERAL APPROACH TO EVALUATING POTENTIAL CORRECTIVE MEASURES

The aforementioned corrective measures alternatives for the sewage lagoons will be evaluated based upon the ability of each alternative to meet the following: (1) the corrective action objectives; (2) conceptual design criteria (i.e., permeability of backfill, design life, erosion control, vegetation, etc.); and (3) selection criteria (i.e., effectiveness, cost, risk, final use, aesthetics, etc.). In this focused CMS, individual criterion will be qualitatively evaluated for each alternative. As a result of the evaluation, one alternative will be chosen for further examination during the future design phase of the corrective action process at the sewage lagoons.

3.4 CORRECTIVE MEASURES STUDY REPORT

The CMS report will be prepared once all analytical and geotechnical data are available and an evaluation of the corrective action alternatives has been completed. The CMS report will present

a narrative and supporting information that will ultimately provide a discussion of the details of the screening process of alternatives and the final corrective action selected for the site. Information will be provided in the CMS report that will present an evaluation of other factors that are taken into account when screening corrective action alternatives. These factors represent a combination of technical measures and management control for addressing environmental problems at the site and they include the following (EPA 1994a):

- Long-term reliability and effectiveness
- Reduction of the toxicity, mobility, or volume of wastes
- Short-term effectiveness
- Implementability
- Safety
- Cost

As a result of the evaluation, the presentation of the selected corrective action in the CMS report will illustrate how the alternative meets the following objectives:

- Protect human health and the environment
- Attain media-specific cleanup standards
- Control source of releases
- Comply with applicable standards for waste management

The proposed outline of the CMS report is presented below as provided in CMS guidance (EPA 1994a):

1.0 INTRODUCTION
- 1.1 Project Overview and Purpose
- 1.2 Regulatory Framework

2.0 SITE BACKGROUND
- 2.1 Site Description
- 2.2 Site History
- 2.3 Summary of Previous Investigations

3.0 CORRECTIVE MEASURES STUDY FIELD ACTIVITIES
- 3.1 Field Construction
- 3.2 Field Sampling

4.0 POTENTIAL APPLICABLE REQUIREMENTS

5.0 CORRECTIVE ACTION OBJECTIVES AND SELECTION CRITERIA
- 5.1 Corrective Action Objectives
- 5.2 Conceptual Design Criteria
- 5.3 Selection Criteria

6.0 TECHNOLOGY SCREENING AND CORRECTIVE MEASURES DEVELOPMENT
- 6.1 Development and Screening of Corrective Measures
- 6.2 Screening of Technologies

7.0 EVALUATION OF FINAL CORRECTIVE ACTION ALTERNATIVES
- 7.1 Recommendation of Corrective Action Alternatives
- 7.2 Justification of Corrective Action Alternatives
- 7.3 Cost Estimates

8.0 PUBLIC INVOLVEMENT PLAN

9.0 PROPOSED SCHEDULE

10.0 REFERENCES

APPENDICES
Detailed Cost Estimates

3.5 FATE AND TRANSPORT MODELING

A field sampling effort will be conducted during the CMS field program to obtain additional information necessary to characterize the sewage lagoon sludge and the native soil directly beneath the lagoons. Based on sludge and soil sample results obtained during the previous investigations (E&E, 1998), it is anticipated that the current sludge and soil sampling results will confirm that the sludge and soil are nonhazardous and will not require off-site disposal. Sludge and soil samples will be collected as described in Section 4.0 of the CMS work plan. The analytical results of soil and sludge samples collected during the CMS will be used to model contaminant migration through the vadose zone in the vicinity of the sewage lagoons.

Fate and transport modeling simulating contaminant migration through the vadose zone will be conducted in order to support the evaluation of potential corrective action alternatives and to support the risk assessment. The fate and transport of nitrates, and any other site contaminants

that exceed appropriate screening criteria, will be modeled in two basic scenarios. These two scenarios include:

- Current site conditions to determine the fate and transport of contaminants prior to the implementation of potential corrective action alternatives
- Future conditions following implementation of potential corrective action alternatives to demonstrate whether the alternatives are protective of groundwater at the site

Nitrates have been previously detected in groundwater at the site. It is anticipated that the selected alternative will significantly reduce infiltration or leaching of any sludge or vadose zone contaminants. The modeling will be designed to predict the concentrations of the contaminants entering the groundwater at the present time, for a period of 50 years. Data are available from previous projects at Cannon AFB and will be used to provide input parameters related to the site. The model proposed for use in the CMS for fate and transport modeling is the Seasonal Soil Compartment Model (SESOIL) (GSC 1998). Foster Wheeler has successfully used SESOIL at several sites across the country to evaluate the effectiveness of waste containment cover systems.

SESOIL is a one-dimensional vertical transport model designed to simultaneously simulate water transport, sediment transport, and contaminant fate for the unsaturated soil zone (Wisconsin Department of Natural Resources 1994). It is the model that has been selected for use in determining the fate and transport of contaminants that could potentially leach from sludge and soil at the sewage lagoons. Input data required for SESOIL includes soil physical parameters, contaminant chemical parameters, and the meteorological information indicated in Table 3-1.

The processes modeled by SESOIL are categorized into three cycles: hydrology, sediment washload, and pollutant transport; and each cycle is a separate sub-model within the SESOIL code (Wisconsin Department of Natural Resources 1994). SESOIL is a compartmental model that will allow the user flexibility to divide the unsaturated zone into separate layers (if appropriate) and model contaminant release and migration within each layer down to the water table resulting in a calculated leachate concentration that will be introduced to groundwater. This model will simulate leaching to groundwater and subsequent mixing that will ultimately provide a groundwater concentration as a calculated result.

The output provided by SESOIL is both numerical and graphical. Numerical output consists of monthly calculations for each cycle. Output for the hydrologic cycle consists of the following: rainfall, surface runoff, capillary rise, soil moisture, infiltration, groundwater runoff, and evapotranspiration. The sediment washload cycle output is a monthly prediction based on the results of the hydrologic cycle. The pollutant transport model provides a calculated contaminant concentration for soil moisture, adsorbed soil, and soil air for each layer. A quality assurance check for the SESOIL model will be completed by evaluating the mass balance of the hydrologic and sediment washload cycles as a function of the input and output parameters. Yearly summaries of monthly data are also provided by the model and this information is the basis of graphical output. Graphical output can be provided as graphs depicting concentration versus time or distance versus time.

Table 3-1. Summary of Input Parameters Required for SESOIL

Soil Physical Parameters	**Contaminant Chemical Parameters**
Bulk density [1]	Aqueous solubility [3]
Intrinsic permeability [1]	Air diffusion coefficient [3]
Soil disconnectedness index [1]	Henry's Law constant [3]
Effective porosity [1]	Organic carbon adsorption (K_{oc}) [3]
Organic carbon content [2]	Soil adsorption (K_d) [3]
Cation exchange capacity [2]	Molecular weight [3]
Freundlich exponent [1]	Hydrolysis constants [4]
	Biodegradation rates [4]
Application Information	**Saturated Zone Parameters**
Number of soil layers [5]	Saturated hydraulic conductivity [2]
Contaminant application area [5]	Hydraulic gradient [2]
Latitude [2]	Saturated zone thickness [2,5]
Soil layer thickness [5]	Saturated zone width [2,5]
Contaminant concentration [2]	
Meteorological Information (monthly)	**Time-Dependent Information**
Air temperature [6]	Length of simulation in years (50 years)
Cloud cover fraction [6]	
Relative humidity [6]	
Short wave albedo [6]	
Rainfall depth [6]	
Mean storm duration [6]	
Number of storms [6]	

Sources of Input Parameter Information:

[1] Assumptions based on literature or SESOIL User's Manual
[2] Site-specific or project specific information
[3] Literature values
[4] Set at zero for conservative estimate
[5] CMS field investigation results
[6] Data available from U.S. Weather Service

4.0 FIELD INVESTIGATION ACTIVITIES

The CMS field investigation will allow the collection of additional information necessary to characterize the sewage lagoon sludge and the native soil directly beneath the lagoons. The field investigation will consist of the construction required to gain access to the lagoons and sludge and soil sampling using a hollow-stem auger drilling rig. This section of the CMS work plan provides an explanation of the objectives and technical approach for each field activity. The planned CMS field investigation will be conducted in the following steps:

1. Mobilize personnel and equipment
2. Construct access ramps into the lagoons and to each of the sample locations using road base materials
3. Collect sludge and native soil samples at five locations within each lagoon using a hollow-stem auger rig
4. Restore the site to a state that is comparable to pre-CMS field activities
5. Demobilize personnel and equipment.

The remainder of this section details the field implementation activities and investigative steps.

4.1 FIELD PROGRAM IMPLEMENTATION

This section provides the details for supporting on-site and off-site activities including mobilization, Base access and site security, construction activities, and demobilization.

4.1.1 Base Access and Site Security

Contractor and subcontractor vehicles will access the site via the main gate of the Base. All vehicles will travel along improved roads and will not enter areas marked as secure without receiving prior clearance. Foster Wheeler personnel, subcontractors, and vendors will receive vehicle passes valid for the duration of the project. A valid driver's license, proof of vehicle insurance, and valid vehicle registration will be required to obtain a pass. The site security consists of procedures, structures, and personnel provided by Cannon AFB at the Base perimeter.

4.1.2 On-Site Support Activities

On-site activities will include the following:

- Project kickoff meeting

- Mobilization
- Construction activities including berm demolition and the construction of access roads
- Access roads construction
- Lagoon sludge sampling using a hollow-stem auger drill rig
- Subsurface soil sampling using a hollow-stem auger drill rig
- Site restoration
- Demobilization
- Field engineering
- Health and safety monitoring

4.1.2.1 Project Kickoff Meeting

Foster Wheeler will conduct a project kickoff meeting at the Base prior to initiation of construction with participation from Foster Wheeler, USACE, Cannon AFB, and key subcontractor personnel. The agenda for this conference includes the following topics:

- Introductions, roles, and responsibilities
- Project scope
- Construction schedule
- Mobilization logistics
- Schedule coordination
- QA/QC requirements
- Review of the basewide HASP and project-specific health and safety requirements
- Potential changes and substitutions based site condition at the time of the field program
- Other business related to field activities

The agenda will be formalized prior to the project kickoff meeting.

4.1.2.2 Mobilization

Mobilization will consist of logistical planning and a personnel orientation meeting prior to startup of field activities. This meeting will include a site-specific health and safety briefing covering planned operations, site hazards and procedures, a review of the site-specific SSHP (Appendix B), and training in pollution prevention and waste minimization procedures.

Utility Clearance

Cannon AFB will provide utility clearance for the construction sites. Foster Wheeler will notify Mr. Sanford Hutsell at Cannon AFB a minimum of 7 days prior to mobilization. Mr. Hutsell will obtain the utility clearance for these sites.

Staging and Storage Areas

Staging and storage areas will be determined at the project kickoff meeting. These areas will be used for storage of equipment and supplies, maintenance operations, and general construction administration.

Miscellaneous Site Preparation

Construction and health and safety personnel will establish work zones for the project in accordance with the site-specific SSHP. The decontamination area for the project will be within the lagoons themselves or at a designated area located near Landfill 5 at Cannon AFB.

4.1.2.3 Construction Activities

The following subsections describe the construction activities that will be performed at the excavation areas. Figure 4-2 presents a preliminary schematic diagram of the access roads planned for construction during the CMS field program.

Access Construction Activities

At the planned point of lagoon access, heavy equipment will be used to construct access ramps into the sewage lagoons because the interior slopes are too steep for drilling access. Additional soil or coarse gravel from an off-site source may be used to complete a portion of the longest access roads out to the middle of each lagoon. On-site materials, if available, will be used to complete the four corner-area access roads within each lagoon, but the road leading to the middle of each lagoon may require additional off-site material in order complete the access road in a timely manner.

Placement of Materials

It is anticipated that gravel base-course and soil will be placed directly onto the dried sludge and compacted for the construction of the access roads. Once access road materials are emplaced, these materials will be compacted using a roller.

Fill Material

Upon approval from USACE and Cannon AFB, available on-site soil material or clean material from an off-site supply will be placed and compacted atop the concrete rubble using a sheep's foot type compactor. At least five passes with the compactor will be made. The backfill materials will be brought approximately 24 inches above grade.

Site Restoration Activities

The area outside of the lagoons will be returned to its original condition. The access roads built within the lagoons will remain in-place after the CMS field program.

4.1.2.4 Demobilization

Demobilization activities will include equipment decontamination, site cleanup, disposal of trash, personnel and equipment demobilization, organization of field records, and notification to USACE on the status of each lagoon. USACE and Cannon AFB will be briefed on the anticipated completion of field activities prior to the demobilization of the site and the departure of field personnel.

4.1.2.5 Field Engineering and Quality Control

Field engineering will be performed under the direction of the Site Construction Manager. QC inspections will be conducted, and field change requests, Design Change Notices, and nonconformance notices will be used to document discrepancies between constructed elements, and associated drawings or specifications occur. In addition, daily quality control reports (DQCRs) documenting each day's construction activities will be completed and maintained, and the approximate locations of the construction area incorporated into the as-constructed drawings.

4.1.2.6 Health and Safety

Health and safety activities will be conducted in accordance with the SSHP (Appendix B); Cannon AFB Basewide HASP (Foster Wheeler, 1999); Foster Wheeler Corporate Health and Safety Program; USACE Safety and Health Requirements Manual (EM 385-1-1) (1996); and USACE Appendix B, Safety and Occupational Health Requirements Manual (ER 385-1-1). All site workers, including subcontractors, will review and comply with the project health and safety requirements and procedures.

4.1.3 Off-Site Support Activities

The Delivery Order (DO) Manager will oversee the entire project from the Albuquerque, New Mexico, office. The Site Construction Manager will serve as the point of contact for all inquiries from the project engineering staff regarding field design and construction efforts in compliance with Foster Wheeler corporate procedures and applicable professional standards.

Additional project staff will provide the following administrative support functions:

- Procurement Specialist—Procures subcontractors, equipment, and material
- Contract Compliance Administrator—Assists project management with all issues pertaining to contract compliance.
- Regulatory Compliance Specialist—Oversees permits and regulatory requirements as described in the RCP, Section 7.0 of this work plan.
- Project Health and Safety Manager —Monitors the project-specific health and safety program.
- Foster Wheeler Corporate Safety and Quality Specialist—Evaluates all issues regarding corporate, regulatory, health and safety, and project compliance.

During the project, Denver and Albuquerque office personnel may be required to visit the site to provide routine inspection and technical assistance. Visits and inspections will be coordinated through the DO Manager according to the needs of the project.

4.2 FIELD SAMPLING ACTIVITIES

Soil and sludge samples will be collected, screened, and handled in accordance with SOPs provided in Appendix C of this work plan. The SOPs applicable to activities associated with soil and sludge sampling include the following:

SOP C-1	Drilling and Subsurface Sampling
SOP C-2	Borehole and Sample Logging
SOP C-3	Borehole Abandonment
SOP C-4	Sludge and Sediment Sampling
SOP C-5	Surveying
SOP C-6	Equipment Decontamination
SOP C-7	Sample Handling and Documentation
SOP C-8	Headspace Screening
SOP C-9	Field Preservation for Volatile Organic Compounds Using Methanol

Table 4-1 presents a summary of the analytical and geotechnical soil and sludge samples to be collected during the CMS field program.

4.2.1 Soil Sampling

Soil and sludge sampling will be completed during the CMS field investigation in order to characterize sludge and native soil for the future design phase of the corrective action process at the sewage lagoons.

A total of 10 soil borings, five per sewage lagoon, will be drilled and sampled to a depth of 10 ft below the sludge and native soil interface. Planned soil boring locations are presented in Figure 4-2. The drilling will be completed using a hollow-stem auger drilling rig where continuous soil samples will be collected using split spoons.

To allow for the completion of accurate hazardous and toxic waste (HTW) drilling logs (Appendix C, SOP C-1), one sludge sample will be collected at each soil boring location; and one soil sample will be collected at the top of the native soil contact and every two ft for the remaining depth of the boring to obtain chemical soil samples. Standard penetration tests will be performed in each of the borings in accordance with American Society of Testing and Materials (ASTM) D 1586-84, but no standard penetration test will be taken within 0.5 ft of a potential undisturbed geotechnical sample zone as described in Section 4.2.2.

Headspace screening will be performed for each sample interval in accordance with SOP C-8 and the results of headspace screening and breathing zone screening for each interval will be recorded on the HTW drilling logs.

Soil samples will be collected from the following intervals: 0 to 2 ft, 4 to 6 ft, and 8 to 10 ft below the sludge and native soil interface. Only three of the soil samples collected at each boring will be submitted to the contractor laboratory for the following chemical analyses:

- RCRA Metals:

  —Arsenic, barium, cadmium, chromium, lead, selenium, and silver – SW-846 Method 6010B Trace
- Mercury —SW-846 Method 7471A
- VOCs—SW-846 Methods 5035/8260B
- Pesticides—SW-846 Method 8081A
- PCBs—SW-846 Method 8082
- Nitrate—EPA Method 300.0

- Total Organic Carbon—SW-846 Method 9060 (one sample per boring)

4.2.2 Geotechnical Sampling

Disturbed geotechnical samples of each soil material encountered during drilling will be collected using a split-spoon sampler. All disturbed geotechnical soil samples will be visually examined for soil type and separated into groups of similar material types for laboratory testing. Disturbed geotechnical samples will be analyzed for the following parameters:

- Soil classification–ASTM D 2487
- Grain-size analysis down to the No. 200 sieve–ASTM D 422
- Atterberg limits–ASTM D 4318
- Moisture content–ASTM D 2216.

If a change in material occurs within a split-spoon, a representative sample of each material shall be taken. Under no circumstances shall different materials be combined into one sample. Representative samples of the subsurface soil are to be taken from the three-inch outside diameter split-spoon sampler, placed in pint jars, and sealed airtight with at least three wraps of electrical tape. Gloves (latex or nitrile) will be changed each and every time that electrical tape is used to prevent cross-contamination to chemical samples. The jars will be properly labeled with the project name, location, borehole number, sample number, depth, material classification, sample type, date, and sampler's name. If no sample is retrieved at the specified interval (i.e. no recovery) the unsuccessful sample interval shall be augered out and another sample attempted at the bottom of where the previous sample failed, unless this interferes with undisturbed or chemical sample intervals.

The intervals sampled and type of sampling will be recorded on HTW drilling logs. Jar samples will be handled, labeled, stored, and shipped according to SOP C-7.

Undisturbed samples shall be performed using a three-inch outside diameter, 30-inch-long thin-walled Shelby tube sampler pushed a distance of two ft. Undisturbed samples are to be taken in accordance with ASTM D 1587-83. The pressure exerted in pounds per square inch (psi) and time duration (seconds) required to push the Shelby tube sampler a distance of two ft shall be noted by the field crew and duly recorded on the HTW drill log. A minimum sample length of 1.0 ft is required for the necessary laboratory tests.

Upon retrieval of the Shelby tube samples from the hole, the material exposed at both ends of the tube shall be examined and recorded on the drill log. Enough material shall be carefully removed from the ends to allow insertion of the expandable packers into the tube. This shall be done in such a manner so as to prevent sample disturbance. The wing nut of each packer seal shall be tightened until the rubber gasket presses firmly against the entire circumference of the inside wall of the sampler. This creates an airtight seal that prevents desiccation and provides some physical support to the sample.

Immediately after securing the packers, the outside of the tube shall be wiped clean and labeled with an indelible marker to include project name, location, boring number, sample number, sample interval, date, and the sampler's initials. A sample tag containing the same information shall be completed, signed by the geologist, wired through one of the holes at the top of the tube and placed inside the tube. The end cap shall be secured over the end of the tube with at least three wraps of electrical tape. Gloves (latex or nitrile) will be changed each and every time that electrical tape is used to prevent cross-contamination to chemical samples. Care shall be taken to ensure that samples remain undisturbed while storing, handling, and transporting them to the lab

Two borings will be sampled in each sewage lagoon to collect a total of four intact and undisturbed samples. Within each lagoon, one undisturbed sample each will be collected at 2 to 4 ft and 6 to 8 ft below the sludge and native soil interface. At those locations where the undisturbed geotechnical samples are collected from 2 to 4 ft below the sludge and native soil interface, chemical analytical samples will be collected from 0 to 1.5 ft, 4 to 6 ft, and 8 to 10 ft below the sludge and native soil interface. Chemical analytical samples will be collected from 0 to 2 ft, 4 to 5.5 ft, and 8 to 10 ft below the sludge and native soil interface at the locations where undisturbed samples are collected from 6 to 8 ft below the interface. Undisturbed geotechnical samples will be handled, labeled, stored, and shipped according to SOP C-7.

Undisturbed geotechnical samples will be tested for hydraulic conductivity according to ASTM D 5084 using a consolidation pressure of 3 psi. Additionally, undisturbed samples will be tested for the following parameters:

- Soil classification–ASTM D 2487
- Grain-size analysis down to the No. 200 sieve–ASTM D 422
- Atterberg limits–ASTM D 4318

In the event that layers of caliche or other materials prevent the collection of intact undisturbed samples, bag samples will be obtained from below the sludge and native soil interface. A minimum of 75 pounds of soil will be obtained for each bag sample. Bag samples will be retained by the geotechnical laboratory for a minimum of 90 days. Bag samples may be obtained from soil cuttings generated during hollow-stem auger drilling provided the samples are obtained from approximately the same depth interval as the failed undisturbed Shelby tube samples they replace. Bag samples will be tested after approval of hydraulic conductivity testing parameters at least 3 days prior to the beginning of the analysis. Additional parameters for the analysis of bag samples include:

- Soil classification–ASTM D 2487
- Grain-size analysis down to the No. 200 sieve–ASTM D 422
- Atterberg limits–ASTM D 4318

Borehole soil logging requirements specified in SOP C-2 will be followed during CMS sampling activities. The presence and thicknesses of any caliche layers will be noted on the HTW drilling log and the method of determination (i.e., difficulty in advancing augers) will be noted in the remarks column of the log. HTW drilling logs will be completed in the field and submitted for approval by the USACE Project Geologist within three days of completion of the boring. No boring will be considered completed prior to acceptance of a properly completed HTW log.

4.2.3 Sludge Sampling

One sludge sample will be collected at each borehole location shown on Figure 4-2 for a total of 10 sludge samples. Each sludge sample will be analyzed for the following chemical parameters:

- RCRA Metals

  —Arsenic, barium, cadmium, chromium, lead, selenium, and silver–SW-846 Method 6010B Trace
- Mercury—SW-846 Method 7471A
- VOCs—SW-846 Method 5035/8260B
- Pesticides—SW-846 Method 8081A
- PCBs—SW-846 Method 8082
- Nitrate—EPA Method 300.0

In addition, each sludge sample will be analyzed for TCLP using SW-846 Method 1311. TCLP parameters will include analyses of RCRA metals, VOCs, and pesticides using the methods listed above.

4.2.4 Sample Identification Numbers

Each sludge and soil sample will be uniquely identified by both a field and laboratory sample identification number. The field sample number will be assigned by the field leader using an ten-character alpha-numeric string. The field sample numbering scheme to be used for CMS sampling program will contain a sample location reference, matrix identifier, and a flag identifying the sample as a representative sample or QA/QC sample. An example of a field sample identification number is presented below:

Sample Identification Number: C101SB0100GS

C101	Cannon AFB SWMU 101
SB01	Sample location SB01
00	Top of sample depth interval
GS	Representative environmental sample

Representative environmental samples will be identified using the following codes:

GS–Soil geotechnical sample

01–Soil chemical sample

02–Field duplicate sample

03–CQAB laboratory sample

4.3 SAMPLE LOCATION AND ELEVATION SURVEYING

A portable global positioning system (GPS) unit operated by a trained field geologist or technician will be used to survey sample locations, sewage lagoon boundaries, and the position of important cultural features of the site. The survey data will be downloaded from the GPS unit in New Mexico state planar coordinates (1983 North American Datum) for use in creating an accurate site map.

Table 4-1. Summary of Samples to be Collected During the CMS

Location	Borings to be Sampled	Sample Depth Intervals	RCRA Metals SW-846 Method 6010B Trace	Mercury SW-846 Method 7471A	VOCs SW-846 Methods 5035/8260B	Pesticides SW-846 Method 8081A	PCBs SW-846 Method 8082	Nitrate EPA Method 300.0	TOC SW-846 Method 9060	Soil classification ASTM D 2487	Grain-size analysis ASTM D 422	Atterberg limits ASTM D 4318	Moisture content ASTM D 2216.
North Lagoon	SB01N	Sludge: Directly below access road fill material; one sample at each location	3	3	3	3	3	3	1	See Notes Below			
	SB02N		3	3	3	3	3	3	1				
	SB03N		3	3	3	3	3	3	1				
	SB04N	Soil: 0-2 ft, 4-6 ft, and 8-10 ft below the sludge and native soil interface	3	3	3	3	3	3	1				
	SB05N		3	3	3	3	3	3	1				
South Lagoon	SB06S	Geotechnical samples: See Notes Below	3	3	3	3	3	3	1	See Notes Below			
	SB07S		3	3	3	3	3	3	1				
	SB08S		3	3	3	3	3	3	1				
	SB09S		3	3	3	3	3	3	1				
	SB10S		3	3	3	3	3	3	1				
QA/QC Samples													
Field Duplicates			4	4	4	4	4	4	4	Geotechnical samples do not require QA/QC samples			
CQAB Split Samples			4	4	4	4	4	4	4				
		Total Analyses	38	38	38	38	38	38	18				

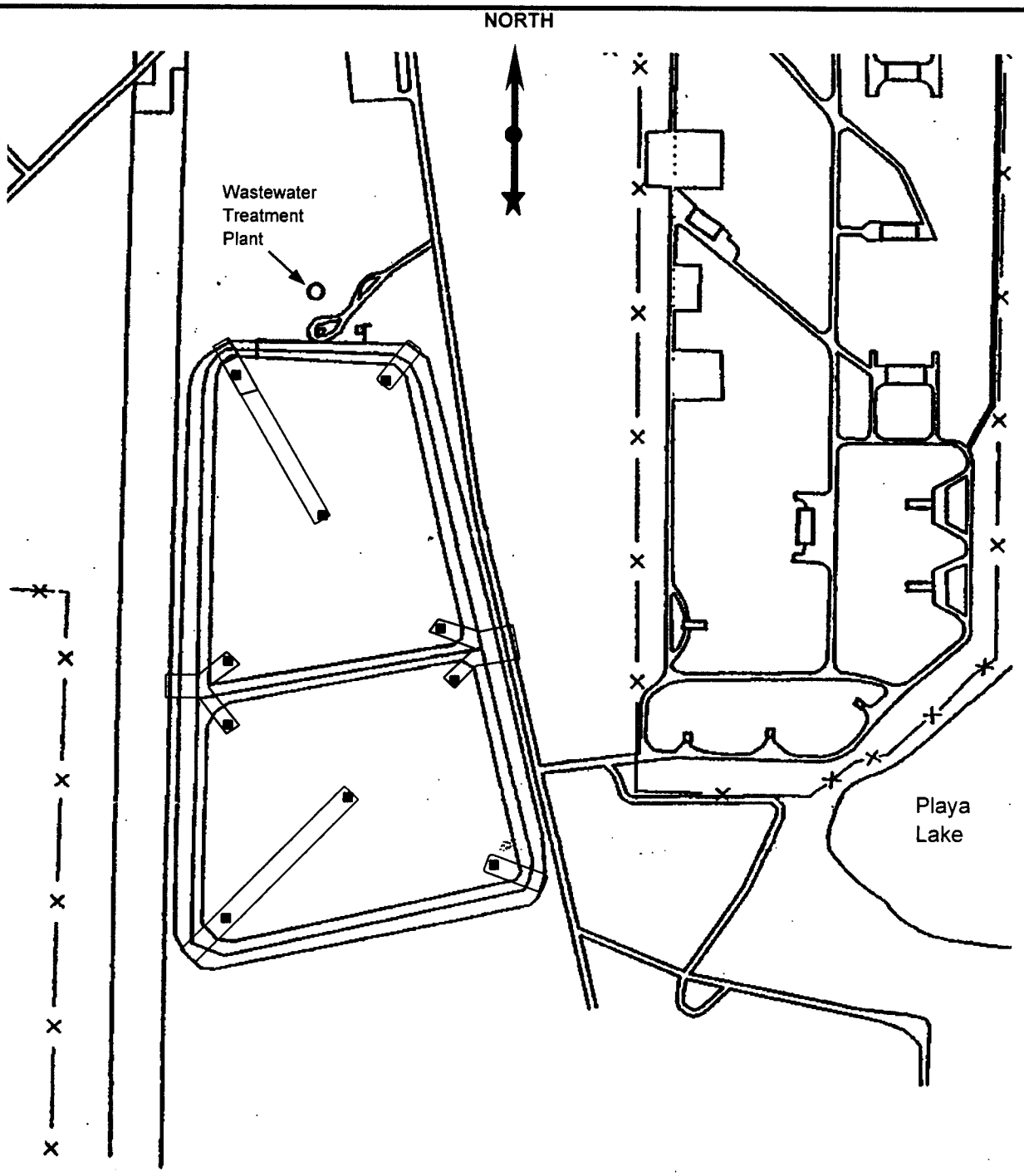
Notes:

Four undisturbed geotechnical samples will be collected from two borings in each lagoon. Depth intervals for undisturbed geotechnical samples will be collected at 2-4 ft and 6-8 ft below the sludge and native soil interface.

At those locations where the undisturbed geotechnical samples are collected from 2-4 ft below the sludge and native soil interface, chemical analytical samples will be collected from 0-1.5 ft, 4-6 ft, and 8 10 ft below the sludge and native soil interface. Chemical analytical samples will be collected from 0-2 ft, 4- 5.5 ft, and 8-10 ft below the sludge and native soil interface at the locations where undisturbed samples are collected from 6-8 ft below the interface.

Disturbed geotechnical samples will be collected at locations different than those planned for chemical and undisturbed geotechnical soil samples.

ASTM	American Society of Testing and Materials
CQAB	Chemistry Quality Assurance Branch Laboratory of Waterways Experimentation Station
EPA	United States Environmental Protection Agency
PCB	Polychlorinated biphenyl
QA/QC	Quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
TOC	Total organic carbon
VOC	Volatile organic compound



500 ft 1000 ft

Planned Access Road

Proposed Sample Location

CORRECTIVE MEASURES STUDY WORK PLAN
SWMU 101--SEWAGE LAGOONS

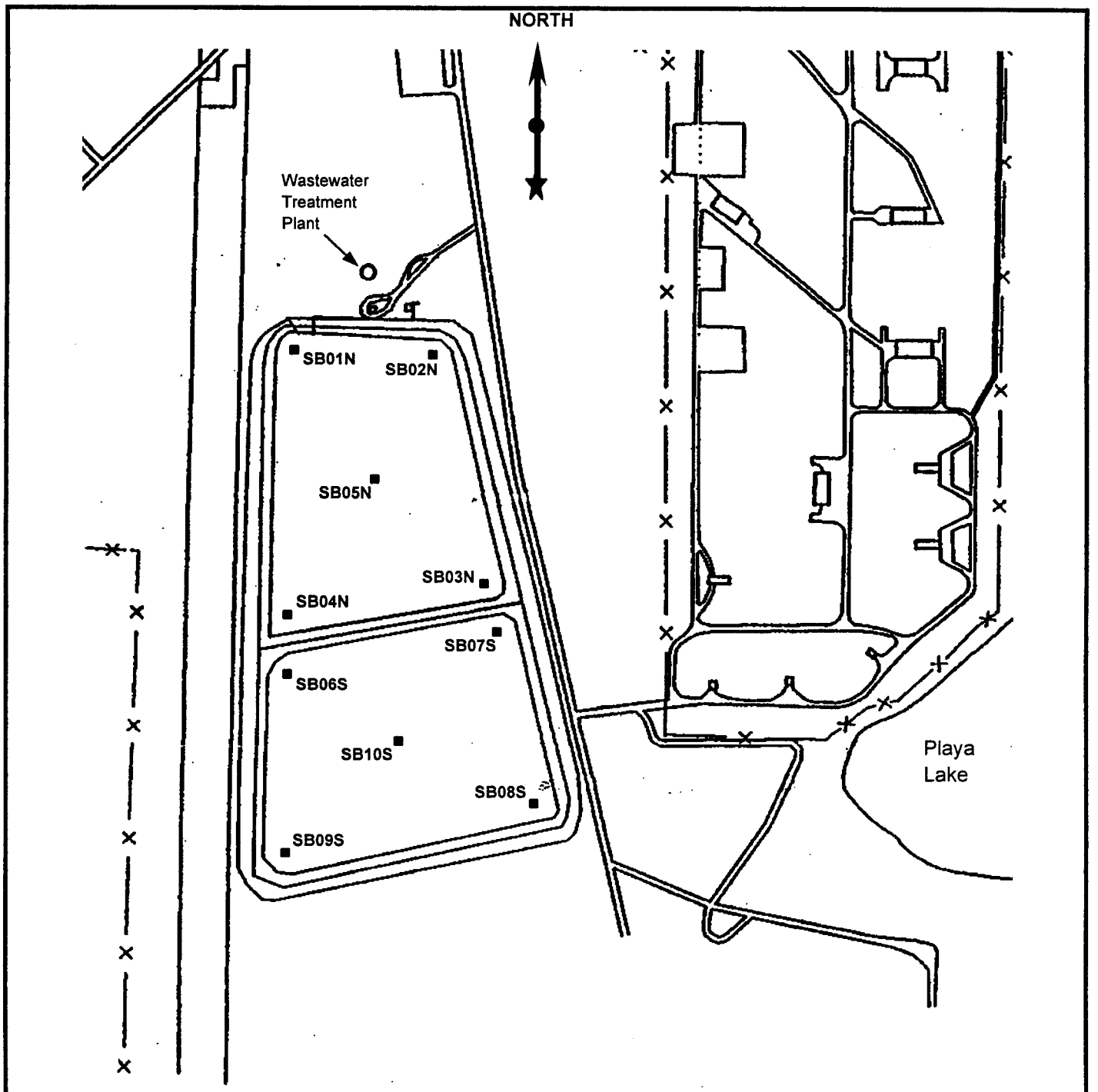
Cannon Air Force Base, New Mexico

U.S. Army Corps of Engineers, Omaha District

Figure 4-1

Preliminary Locations of Sample Location Access Roads

Foster Wheeler Environmental Corporation



500 ft 1000 ft

SB09S Proposed Sample Location

CORRECTIVE MEASURES STUDY WORK PLAN
SWMU 101--SEWAGE LAGOONS

Cannon Air Force Base, New Mexico

U.S. Army Corps of Engineers, Omaha District

Figure 4-2

Proposed Sludge and Soil Boring Sample Locations

Foster Wheeler Environmental Corporation

5.0 QUALITY ASSURANCE PROJECT PLAN

This QAPP was prepared to follow the format provided in the General Chemistry Supplement to the Scope of Services for Studies (USACE 1997). The "A" designations following the section heading numbers correspond to the designation found in the above-referenced document.

5.1 (A2) TABLE OF CONTENTS

The Table of Contents for the QAPP is contained within the Table of Contents for this work plan.

5.2 (A3) DISTRIBUTION LIST

The distribution list is indicated on the transmittal letter for the submittal of this work plan.

5.3 (A4) PROJECT ORGANIZATION AND RESPONSIBILITIES

Ms. Pam Moss of Foster Wheeler is the designated Project Chemist. In this capacity, she is responsible for oversight of laboratory performance and for the validation of the analytical data. Laucks will provide chemical analytical services. Ms. Jenna Gorham is responsible for the overall performance of the laboratory and the implementation of the analytical requirements for the project. Environmental Geotechnology Laboratory, Inc. (EGL), Santa Fe Springs, California will perform the geotechnical testing. Mr. Jack Lee is responsible for the overall performance of EGL.

The DO Manager, Ms. Carol Bieniulis, and the Environmental Safety Specialist (ESS), Mr. James Morning, will be responsible for ensuring that sampling is conducted in accordance with prescribed procedures. All changes and variances to the work plan will be documented and provided to the Foster Wheeler Project QA Manager and the DO Manager for concurrence.

5.4 (A5) PROBLEM BACKGROUND/DEFINITION

Sample matrices generated during the field sampling activities at SWMU 101 in support of the CMS consist of soil and sludge collected from within and beneath the sewage lagoons. Potential site contaminants include metals, pesticides, PCBs, and VOCs. A site description, including the site history and site contamination information is contained in Section 2. The known contaminants were identified during the Appendix I RFI (Woodward Clyde 1992). Additional details regarding contaminants are contained in Section 2.2 of this work plan.

5.5 (A6) PROJECT DESCRIPTION

This QAPP has been prepared to address the specific chemical QA requirements for sampling and analysis conducted during the CMS at SWMU 101. A description of the scope of work is contained within Section 4.0.

5.6 (A7) QUALITY OBJECTIVES

5.6.1 Data Quality Objectives

The data quality objectives (DQOs) for this project are described in the USACE Scope of Services, June 16, 1999, and include the following:

- Characterizing the sludge within and the native soil beneath the sewage lagoons at SWMU 101 by the collection of samples and chemical and geotechnical analysis
- Collecting data of sufficient quantity and quality to evaluate potential risk to human health and ecological receptors
- Collecting data to support corrective measures design and implementation
- Achieve analytical reporting limits for characterization of soil/sludge samples that meet the EPA Region 6 human health medium-specific screening levels for residential soil. The reporting limit for arsenic (1.0 milligrams per kilogram [mg/kg]) exceeds the residential soil screening level of 0.38 mg/kg. All other reporting limits are below the residential screening levels.
- Achieve reporting limits for TCLP analysis of sludge in accordance with 40 CFR 261 Subpart C.
- Achieve a sufficient level of data quality by achieving data accuracy not to exceed ± 40 percent for organics, ± 20 percent for metals, and ± 50 percent for nitrate and total organic carbon (TOC). Precision criteria will include a relative percent difference not to exceed 30 percent for organics and nitrate, and 20 percent for metals and TOC.
- Achieve a project data completeness of 95 percent.

5.6.2 Analytical Support Levels

The analytical support levels for the CMS at SWMU 101 include screening and definitive data levels as determined by the project DQOs. The off-site analytical laboratories for the chemical and geotechnical analysis of the soil and sludge samples will generate definitive data. Screening level data will be generated during sampling activities in accordance with the SSHP.

5.6.3 Data Quality Indicators

Laboratory precision and accuracy data and practical quantitation limits are provided in Appendix A. Analytical methods will be performed in accordance with EPA SW-846, Test

Methods for Evaluating Solid Waste, Third Edition and Updates (EPA 1986); EPA Methods for Chemical Analysis of Water and Waste (EPA 1979); and American Society for Testing and Materials Volumes 4.08 and 4.09 (ASTM 1997; 1996).

5.6.4 Level of Field Quality Control Effort

Three field duplicate soil samples will be collected and sent to Laucks for VOC, pesticide, PCB, metals, nitrate, and total organic carbon (one soil) analyses to assess sampling and analytical precision. In addition, one field duplicate sludge sample will be analyzed for VOCs, pesticides, PCBs, metals, nitrate, and TCLP.

5.7 (A8) PROJECT NARRATIVE

Information required for the project narrative is contained throughout this work plan.

5.8 (A9) SPECIAL VALIDATION

Laucks is validated by the USACE Chemical Quality Assurance Branch (CQAB) Laboratory of the Waterways Experimentation Station to perform the analytical methods required for this project. All contact with Laucks will be made to:

Laucks Testing Laboratories, Inc.
940 S. Harney Street
Seattle, Washington 98108
Phone: 206-767-5060
Attn: Ms. Jenna Gorham

5.9 (A10) DOCUMENTATION AND RECORDS

Documentation and records generated during this project and the associated submittal schedule will consist of the following:

1. HTW Logs, Health and Safety Records, and Field Log Books—Maintained in the Foster Wheeler project files. HTW logs will be submitted to USACE during the course of the field program.
2. DQCRs—Submitted weekly to USACE Project Manager. Submitted daily to the Cannon AFB Point of Contact.
3. Definitive Level Analytical Data Packages–Submitted by Laucks to the Foster Wheeler Project Chemist within 28 working days of sample receipt; data summary forms will be submitted to USACE with the CMS Report.

Additional documentation consisting of the field sampling logbooks will be maintained in the project files.

5.10 (B1) SAMPLING DESIGN PROCESS

The design of data collection operations is presented in Section 4.2 of the CMS work plan. Section 5.10.1 discusses the project-specific requirements related to the type and frequency of sampling, including QC samples, and Section 5.10.2 presents the sample identification scheme to be used for the various samples that will be collected in the field. SOPs are provided in Appendix C of this work plan.

5.11 (B2) SAMPLING METHOD REQUIREMENTS

Sampling procedures for collection of soil and sludge samples are discussed in Section 4.2 of this work plan. The associated SOPs are provided in Appendix C of this plan.

5.12 (B3) SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Sample handling and custody requirements are contained in SOP C-7. This SOP provides detailed information on the processes used for sample labeling, sample preservation, sample handling and shipping, sample documentation and tracking, and the sample C-O-C form. Examples of the sample tag, C-O-C form, and custody seal forms are presented as Figures 5-1, 5-2, and 5-3, respectively. Sample containers, preservation requirements and holding times are presented in Table 5-1.

Soil samples received at Laucks will be documented and logged into their Laboratory Information Management System (LIMS) for tracking purposes. Each sample will be assigned a unique work order sample number and a label exhibiting the unique work order number will be attached to each sample container. The date and time of sample receipt, as well as comment on the sample and container disposition, are recorded on the sample receipt forms. Sample custody is tracked from the point of entry into the laboratory system until time of disposal and the samples are checked into and out of secure storage areas by authorized personnel.

5.13 (B4) ANALYTICAL METHODS REQUIREMENTS

The methods and procedures that will be used to prepare and analyze samples are summarized in Table 5-2. Chemical analyses will be performed according to EPA SW-846, Test Methods for Evaluating Solid Waste (1986), and EPA Methods for Chemical Analysis of Water and Waste (1979). The specific compounds to be analyzed with each method and the associated PQLs are listed in Appendix A. Geotechnical analyses will be performed in accordance with ASTM Volumes 4.08 and 4.09.

The laboratory will perform instrument-specific demonstration of capability and method detection limit (MDL) studies to verify that project-specific PQLs can be met. Analyses will be performed only on instruments with valid and current MDL studies. The MDL documentation is provided in Appendix A.

5.14 (B5) QUALITY CONTROL REQUIREMENTS

Four field duplicate samples (three soil and one sludge) will be collected during the course of the CMS field sampling program and will be analyzed for the same parameters as the associated field samples. In addition to the field duplicate samples, the analytical laboratory will analyze method-specific quality control samples (i.e., duplicates and spike samples).

A split of each of the field duplicate samples will also be sent to the USACE CQAB laboratory to ensure data comparability. The USACE QA samples will be submitted to the CQAB laboratory under LIMS number 5636.

The Laboratory QA Manager will be responsible for identifying nonconforming conditions in the laboratory. All nonconforming conditions and recommended corrective actions will immediately be reported to the Project Chemist and the Project QA Manager.

Laucks will perform sample analysis in accordance with their internal QA program including periodic review and inspection of laboratory procedures, followed by reports to management. The Laboratory QA Manager performs these reviews. The audits are used to ensure proper use of measurement systems, evaluate accuracy of analytical procedures, and to assure the laboratory is adhering to internal policies and procedures are set forth in their QA Plan and SOPs.

5.15 (B6) INSTRUMENT/EQUIPMENT TESTING AND MAINTENANCE REQUIREMENTS

All field and laboratory instruments will be tested to ensure proper functioning prior to sampling and analysis. The laboratory will perform maintenance on all instruments according to an established schedule or based on the manufacturer's recommendation.

5.16 (B7) INSTRUMENT CALIBRATION

Instrument calibration for health and safety monitoring is discussed in the site-specific SSHP (Appendix B).

5.17 (B8) INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES

Level I certified sample containers will be used for collection of field samples for chemical analysis. The off-site laboratory will maintain certification and provide these containers.

Laucks will obtain all standard solutions for analytical testing from reliable sources and prepare these standards with calibrated glassware. Where possible, standards are used that are traceable to the National Institute of Standards and Technology through the stock standard supplier and Lauck's internal system of standards tracking.

5.18 (B9) DATA ACQUISITION REQUIREMENTS

Data presented in the Appendix I RFI and other studies of the site (Woodward Clyde 1992; E&E 1998) was reviewed to determine scope of the field sampling and analysis requirements for the CMS. These data have been determined to meet the project DQOs developed for this for the field program.

5.19 (B10) DATA MANAGEMENT

Definitive data deliverables are required for this project for the off-site laboratory analysis. Hard copies of the data deliverables will be provided to Foster Wheeler within 28 days of receipt of samples at the laboratory. An electronic data submittal to USACE in Environmental Resources Program Information Management System format is not required for this project. The following information is to be included in the hardcopy data deliverables:

- Case narrative – associated analytical problems or deviations
- C-O-C documentation and sample receipt forms
- Sample results
- Holding time information
- Initial and continuing calibration information
- Method blank summary
- Laboratory control sample summary
- Matrix spike/matrix spike duplicate summary
- Laboratory duplicate sample summary
- Surrogate percent recovery data
- Inductively coupled plasma interference check sample results
- Second column confirmation data (organochlorine pesticides and PCBs)

- Raw instrument data

5.20 (C) ASSESSMENT/OVERSIGHT

The Laboratory QA Manager will conduct laboratory oversight as described in the QA Plan. Any deficiencies noted during inspection that requires corrective action will be documented in a Nonconformance Report generated by the laboratory and provided to the Foster Wheeler Project Chemist. Foster Wheeler will not perform an audit of Laucks or EGL in support of the CMS SWMU 101 sampling event. Foster Wheeler will perform oversight of field activities, including an audit and inspection of site activities during the CMS field program.

5.21 (D) DATA VALIDATION AND USABILITY

The Foster Wheeler Project Chemist or designee will validate analytical data generated by Laucks. This validation will be in accordance with the EPA Contract Laboratory Program National Functional Guidelines for Inorganic and Organic Data Review (1994b, c) and will include a review of the following criteria:

- Data and deliverable completeness
- Extraction and analysis holding times
- Blank data (method, equipment)
- System monitoring compound data
- Laboratory control sample recoveries
- Matrix spike and matrix spike duplicate recoveries
- Laboratory duplicate sample data
- Field duplicate sample relative percent difference

A brief summary of data usability will be included with the CMS Report.

Section 5.0 (A1) - Quality Assurance Project Plan

Title and Approval Sheet

For

Corrective Measures Study at SWMU 101 (Sewage Lagoons)
Quality Assurance Project Plan
Cannon AFB
Clovis, NM

Prepared by:

Foster Wheeler Environmental Corporation
143 Union Boulevard, Suite 1010
Lakewood, CO 80228

Foster Wheeler Environmental Corporation Approval:

Carol L Bieniulis — 12-14-99
Carol Bieniulis
Delivery Order Manager
Date

Deborah D Wilson — 12-14-99
Deborah Wilson
Project Quality Assurance Manager
Date

Pam Moss — 12-14-99
Pam Moss
Project Chemist
Date

Table 5-1. Sample Container, Preservation, and Holding Time Requirements for Soil and Sludge Samples

Matrix	Parameter	Container[1]	Preservation[2]	Maximum Holding Times[3]	
				Extraction	Analysis
Soil/Sludge	Metals/Mercury	1 8-oz Glass jar	Ice to 4°C	--	180/28 day
Soil/Sludge	Pesticides	1 8-oz Glass jar	Ice to 4°C	14 day	40 day
Soil/Sludge	Nitrate	--	--	--	14 day
Soil/Sludge	VOCs	EnCore™ sampler [4] 4-oz glass jar	Ice to 4°C	2/14 day	4/14 day
Soil/Sludge	TOC	--	--	--	28 day
Soil/Sludge	TCLP Metals/Mercury	1 8-oz Glass jar	Ice to 4°C	180/28 day	180/28 day
Soil/Sludge	TCLP VOCs	1 8-oz Glass jar	Ice to 4°C	14 day	14 day
Soil/Sludge	TCLP Pesticides	--	--	14 day/7 day	40 day
Soil/Sludge	Hydraulic Conductivity	1 3-in by 30-inch Shelby Tube	NA	NA	NA
Soil/Sludge	Atterberg Limits, Sieve Analysis, Moisture	2 16-oz Glass jar	NA	NA	NA

Notes:

1 All containers must have Teflon®-lined lids.
2 Sample preservation will be done in the field immediately upon sample collection.
3 When only one holding time is given, it implies total holding time from sampling until analysis.
4 Alternative VOC sample collection procedure will be Method 5030, field preservation with methanol.
°C degrees Celsius
oz ounce
NA not applicable
PCB polychlorinated biphenyl
VOC volatile organic compound
TOC total organic carbon
TCLP Toxicity Characteristic Leaching Procedure

Table 5-2. Analytical Procedures for the Corrective Measures Study at SWMU 101

Parameter	Technique	Extraction/Analysis Method
VOCs	GCMS	5035/8260B
Metals	Trace ICPES	3050/6010B
Mercury	CVAA	7471A
Pesticides	GC/ECD	3550/8081A
PCBs	GC/ECD	3550/8082A
Nitrate	IC	300.0
TOC	TOC analyzer	9060
TCLP– Metals, VOCs, Pesticides	ICPES, GCMS, GC/ECD	1311/6010B, 8260B, 8081A
Soil Classification	--	ASTM D 2487
Moisture	--	ASTM D 2216
Atterberg Limits	--	ASTM D 4318
Sieve Analyses (USCS)	--	ASTM D 422
Hydraulic Conductivity	--	ASTM D 5084

Notes:

Method EPA SW-846, Test Methods for Evaluating Solid Waste, Third Edition (1986); EPA Methods for Chemical Analysis of Water and Waste (1979); American Society for Testing and Materials (1997, 1998)
VOC volatile organic compound
TOC total organic carbon
GCMS gas chromatography mass spectrometry
ICPES inductively coupled plasma emission spectroscopy
CVAA cold vapor atomic absorption
GC/ECD gas chromatography/ electron capture detector
PCB polychlorinated biphenyl
IC ion chromatography
TCLP Toxicity Characteristic Leaching Procedure
USCS Unified Soil Classification System
SWMU Solid Waste Management Unit

Figure 5-1 Sample Tag Form

Date collected ___/___/___ Time collected _____

Client ID: _____

Preservative: None

LAUCKS TESTING LABORATORIES, INC.

Figure 5-2 C-O-C Record Form

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Chain-of-Custody Record

AFIID: Cannon AFB	Project: CMS	Sample Date:
Method Type:	Samplers:	

Location Type	Location Identification	Time (Military Standard)	Sample Depth (Feet)	Preservative: HNO3	H2SO4	NaOH	HCL	Analysis Required: Sampling Method	No. of Containers	VOCs	Pesticides/PCBs	Nitrate	RCRA metals	TOC	TCLP Metals	TCLP Pesticides	TCLP VOCs	Grain size – USCS	Atterberg Limits	Hydraulic Conductivity	Moisture									Sample Tag No.

Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*	Date/Time

Remarks: LIMS NO. 5636

FEDERAL EXPRESS #:

MATRIX:
LABCODE:
LOGCODE:

LABORATORY USE ONLY	Y	N
Package Received/Custody Seals Intact		
Sample Labels/C-O-Cs Agree		
Temperature Within Specification ____°C		
Corrected Copy Attached		
Problems or Discrepancies		

Figure 5-3 Custody Seal

CUSTODY SEAL

LAUCKS TESTING LABORATORIES, INC.

940 South Harney St., Seattle, WA 98108
Phone (206) 767-5060 • FAX (206) 767-5063

SIGNATURE _____ DATE _____

6.0 RISK ASSESSMENT TECHNICAL APPROACH

The CMS report will evaluate potential risks to human health and to ecological receptors. The Human Health Risk Assessment (HHRA) and a Screening Level Ecological Risk Assessment (SLERA) will be prepared in accordance with guidance and methodology currently in effect from the NMED and the EPA. Note that EPA Risk Assessment Guidance for Superfund Part D tables will not be provided in the CMS report. Data available from previous investigations will be reviewed for applicability to the selection of chemicals of potential concern (COPCs) in the HHRA and SLERA, however only data collected during the CMS field program will be used to evaluate risk to human health and ecological receptors at this SWMU. An analysis of the uncertainty associated with the assessment of risk to human health and ecological receptors will be included in the risk characterization sections (Sections 6.1.4 and 6.2.4). The following sections summarize the main points of the technical approach to these tasks.

6.1 HUMAN HEALTH RISK ASSESSMENT

The HHRA will include the following sections: Selection of COPCs, Exposure Assessment, Toxicity Assessment, and Risk Characterization. The HHRA documentation is described below.

6.1.1 Selection of Chemicals of Potential Concern

Summary statistics will be provided for each chemical that is detected in sludge and soil. This will include presentation of the minimum and maximum values detected, the range of detection limits, and the frequency of detection. Only soils to a depth of 10 ft below the sludge-native soil contact will be considered since this represents the greatest depth at which construction may occur. Chemicals that are considered laboratory contaminants based on EPA guidelines (EPA, 1989) will be eliminated from further consideration as COPCs. Inorganic chemicals will be compared to background concentrations to determine if on-site concentrations are within naturally occurring levels. Background concentrations will be based on existing Base-specific data. Regional background levels will be used, if necessary, to supplement the Base-specific background comparisons. Inorganic chemicals that exceed background and are essential nutrients (including calcium, magnesium, potassium, and sodium) will be discussed qualitatively, but will not be carried through the risk assessment as COPCs.

After the screening steps above, all chemicals that remain as candidate COPCs will be compared to EPA Region 6 human health medium-specific screening levels (HHSLs) for residential soil

(EPA 1999a). The values for residential soil are used to provide a conservative approach in the COPC selection process. The HHSLs will be used in accordance with EPA Region 6 guidelines. The maximum detected on-site native soil concentrations from the sludge-native soil contact to a depth of 12 ft will be compared to the HHSLs. Chemicals that exceed the screening levels will be carried forward in the risk assessment as COPCs.

6.1.2 Exposure Assessment

Potential exposures to COPCs will be evaluated for selected receptors that could occur at the site under current and future conditions. The Management Action Plan for Cannon AFB (USAF 1993) indicates that the current land use at the sewage lagoons is industrial and that future land use is also expected to be industrial. Therefore, the receptor evaluated in the risk assessment will be an Industrial Worker. Exposures will be quantitatively evaluated for a "no action" scenario, and qualitatively evaluated for the "alternative" condition. For the "no action" scenario, the water in the lagoons will be evaporated and the sludge will be exposed. The alternative condition assumes that all affected sludge and soils from the north lagoon will be placed in the south lagoon and a soil cover will be placed over the south lagoon. Under the alternative conditions, it is assumed that a liner is placed in the north lagoon and that the lagoon is used as a holding area for stormwater runoff. Exposures will be estimated for an Industrial Worker and will include ingestion, dermal contact, and inhalation of soils and sludge. Potential exposure pathways to the Industrial Worker are presented in the Conceptual Site Model (Figure 6-1).

The maximum concentration of each COPC detected from 0-2 ft will be used initially as the exposure point concentration (EPC). If resulting risk estimates are elevated, then risks will be evaluated for the next depth interval, for example, 2-4 ft. This process will be repeated as necessary to the base of contamination. This approach will determine the depth at which there is no elevated risk. For a given depth interval, refinement of the EPC may be performed if necessary (e.g., calculation of the 95% upper confidence limit [UCL]). At a minimum, the north and south lagoons will be treated as separate exposure units.

The exposure assumptions for the Industrial Worker will be based on standard EPA default values as provided by EPA Region 6 (EPA 1999a). If necessary, additional standard EPA guidance documents will be consulted for exposure information, including the Exposure Factors

Handbook (EPA 1997a) and Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual, Supplemental Guidance Dermal Risk Assessment Interim Guidance (EPA 1998).

6.1.3 Toxicity Assessment

Toxicity values for COPCs will be obtained from EPA sources. The primary source will be EPA's Integrated Risk Information System (IRIS) (EPA 1999b). EPA's Health Effects Assessment Summary Tables (EPA 1997b) will be consulted for those chemicals not contained in the Integrated Risk Assessment System. Brief toxicity profiles will be prepared that summarize the noncarcinogenic and carcinogenic effects and toxicity values for the COPCs.

6.1.4 Risk Characterization

Potential risks to industrial workers will be estimated by combining the information developed in the exposure assessment and toxicity assessment sections. Both noncarcinogenic and carcinogenic risks will be estimated. The risk characterization will also include a qualitative discussion of the uncertainties associated with the assessment.

6.2 SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

The SLERA will include the following components: problem formulation, ecological effects evaluation, exposure estimate, and risk characterization. It will be consistent with the general guidelines provided in EPA's Ecological Risk Assessment Guidance for Superfund (EPA 1997c) and in consultation with NMED. The following sections summarize the technical components of the SLERA.

6.2.1 Screening Level Problem Formulation

The problem formulation will include a summary of the potential receptors and pathways at the site, a determination of chemicals of potential ecological concern (COPECs), and a discussion of the goals and endpoints to be evaluated in the assessment. A site visit will be conducted to gather information on habitats in the vicinity of the affected area, potential receptors and exposure pathways, and other relevant site-specific information. Receptors will be characterized as to the habitats, trophic levels, and feeding guilds that they occupy. Based on this information, a conceptual model will be developed to identify potentially complete exposure pathways. For animal receptors, ingestion will be the only exposure route that is quantitatively evaluated.

Dermal and inhalation exposure will be qualitatively addressed since adequate methods are not readily available to quantify these pathways.

Assessment endpoints to be evaluated in the SLERA will be selected after reviewing available information on habitats, potential receptors, and potentially complete pathways. These endpoints will be selected to represent a range of trophic levels and to ensure that site risks are not underestimated.

COPECs for the SLERA will be selected in a manner similar to that used in the HHRA, including identification of laboratory contaminants, comparison to background, and identification of essential nutrients. However, instead of comparing the maximum chemical concentrations to HHSLs, ecological toxicity benchmarks will be used. Ecological toxicity benchmarks will be based on the preliminary remediation goals for soils in Efroymson et al. (1997a). These values were developed for the Department of Energy at Oak Ridge National Laboratory (ORNL). Chemicals that exceed these benchmarks will be selected as COPECs for further evaluation in the SLERA. Only soil samples collected to a depth of 10 ft below the sludge-native soil contact will be considered in the SLERA since this is the lowest depth that is considered relevant to ecological receptors (e.g., burrowing animals).

6.2.2 Screening Level Ecological Effects Evaluation

The ecological effects evaluation will include a summary of toxicity reference values (TRVs) that will be used in the risk assessment. TRVs will be identified for each endpoint receptor. Toxicity information from ORNL will be used as the primary source of TRVs; including Sample et al. (1996), and potentially Efroymson et al. (1997b, 1997c). In general, TRVs are based on no-observed-adverse-effects-levels derived from chronic studies. For COPECs not contained in the ORNL references, other readily available sources may be consulted such as the Toxicological Profiles by the Agency for Toxic Substances and Disease Registry (1999) and the Synoptic Reviews by Ron Eisler of the United States Geological Survey (Eisler, 1985 to present).

6.2.3 Screening Level Exposure Estimate

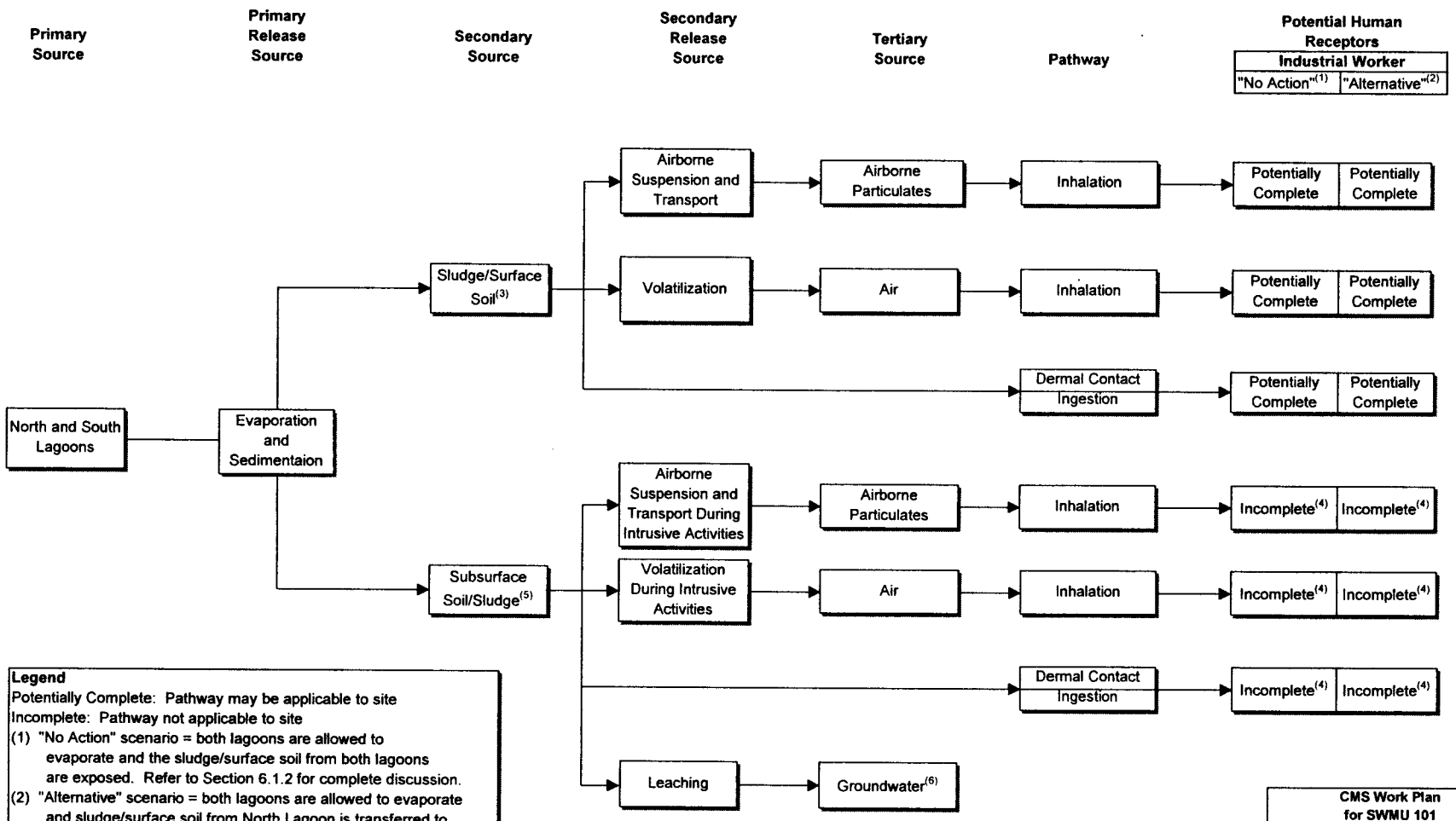
The ecological risk assessment will evaluate potential risks associated with both the "No Action" and the "Alternative Condition". Under "no action" it is assumed that both lagoons are drained and that plants and animals would be potentially exposed to surface and subsurface soils and sludge to a depth of 10 ft. For the "alternative" condition, it is assumed that the north lagoon is

lined and periodically contains water; and the south lagoon receives sludge and is covered. It is assumed that burrowing animals could be exposed to subsurface materials by burrowing beneath the liner or the cover.

The EPCs and chemical intakes (i.e., doses) will be calculated for the selected endpoints. Exposure point concentrations will initially be based on the maximum detected soil concentrations between 0 and 10 ft. EPCs may be refined depending on the outcome of the risk assessment (e.g., calculation of the 95% UCL). Exposure assumptions will be based on information in EPA's Wildlife Exposure Factors Handbook (EPA 1993). For some receptors it may be necessary to consult other references regarding life history information. Information specific to New Mexico will be used where possible. Conservative assumptions about home range will be made to provide maximum exposure estimates. The receptors will be assumed to receive all of their diet from the affected area; thus, the area use factor will be equal to 1.0.

6.2.4 Screening Level Risk Characterization

This section will combine the estimated exposures for each receptor with the selected toxicity values to calculate risks in the form of hazard quotients. This section will also include summary information that will be used by the risk manager at the Scientific/Risk Management Decision Point (SMDP). The SMDP will provide a determination of whether there is negligible site-related risk or whether additional evaluation is warranted. The risk characterization section will also discuss the uncertainties associated with the assumptions and data used in the SLERA.



Legend

Potentially Complete: Pathway may be applicable to site

Incomplete: Pathway not applicable to site

(1) "No Action" scenario = both lagoons are allowed to evaporate and the sludge/surface soil from both lagoons are exposed. Refer to Section 6.1.2 for complete discussion.

(2) "Alternative" scenario = both lagoons are allowed to evaporate and sludge/surface soil from North Lagoon is transferred to the South Lagoon. South Lagoon is then capped and North Lagoon may have a liner. Refer to Section 6.1.2 for complete discussion.

(3) 0 to 2 feet

(4) No construction or intrusive activities are anticipated.

(5) 2 to 10 feet

(6) A model will be used to determine if contaminants in subsurface soil/sludge have the ability to leach to groundwater.

CMS Work Plan for SWMU 101 Cannon Air Force Base, New Mexico

Figure 6-1

Human Health Conceptual Site Model for the North and South Sewage Lagoons

Foster Wheeler Environmental Corporation

7.0 REGULATORY COMPLIANCE PLAN

The RCP was developed specifically to identify necessary regulatory requirements applicable to the removal and disposal of contaminated soil and sludge generated during the CMS investigation and construction activities at the sewage lagoons (SWMU 101) at Cannon AFB. The RCP details the waste management practices, documentation, and training requirements necessary for field activities. The ARARs (regulations and guidance) for the proposed activities are also described. In addition, the RCP provides guidance regarding waste minimization practices to be followed during the project to reduce the volume of waste generated, stored, and removed from the site for disposal.

7.1 REGULATORY FRAMEWORK

Pursuant to the requirements of the RCRA Permit for Cannon AFB, issued by the NMED on behalf of the EPA, corrective action activities have taken place on the Base at sites other than SWMU 101. The NMED is authorized by the EPA to implement the federal RCRA program and oversee corrective action program activities conducted in accordance with the Base's RCRA Permit.

7.2 REGULATED SITE ACTIVITIES

Previous investigations of SWMU 101 have indicated the presence of various constituents at concentrations potentially in excess of current soil health-based screening levels. A more detailed discussion of the SWMU characteristics, contaminant distribution, and the specific investigation activities to be implemented during the project is presented in Sections 2.0, 3.0, and 4.0 of this work plan.

The anticipated regulated activities are as follows:

- Allowing passive dewatering of the sewage lagoons prior to CMS field activities
- Construction of access roads/ramps on the surface of each sewage lagoon for drilling and soil sampling access
- Generation and storage of decontamination water and used PPE and sampling equipment from soil coring and sampling
- Sampling and analysis of decontamination water, if required, for subsequent characterization, management, and disposal purposes
- Assisting Cannon AFB with identification of appropriate transportation companies and disposal facilities for disposal of hazardous waste generated from the SWMU investigation activities

- Preparing and completing documentation, and labeling and placarding waste containers, as necessary for transport to an appropriate disposal facility

7.3 REGULATORY REQUIREMENTS

Project activities are expected to generate nonhazardous and RCRA hazardous wastes. Therefore, the following federal and state regulations are applicable and must be complied with during implementation of planned project activities:

- EPA Regulations for Identification and Management of Hazardous Waste, 40 Code of Federal Regulations (CFR) Parts 260–299
- Department of Transportation (DOT) Rules for Hazardous Materials Transport, 49 CFR Parts 100–178
- New Mexico Hazardous Waste Management Regulations
- New Mexico Air Quality Control Regulations
- Applicable Cannon AFB Permits and Policies and Procedures

Table 7-1 lists and summarizes the regulations applicable to the corrective action activities proposed for SWMU 101.

Because the disturbed area is less than 5 acres, neither a National Pollution Discharge Elimination System stormwater permit nor a stormwater pollution prevention plan are required; appropriate Best Management Practices will be followed to control runon/runoff and minimize fugitive dust emissions during field activities.

7.4 WASTE MANAGEMENT PLAN

This section details how waste generated during corrective action activities will be characterized and classified.

7.4.1 Project Waste Descriptions

The anticipated waste streams associated with the CMS field activities can be categorized as follows:

- Sludge and soil cuttings
- Decontamination fluids
- Used PPE

Table 7-2 presents a summarized table of the applicable waste management, transportation, and disposal requirements for each of the above waste streams.

7.4.2 Waste Minimization

The following techniques will be used during field activities in order to minimize the volume of waste generated and to ensure that no materials are brought on site that would result in the generation of hazardous waste:

- Do not contaminate materials unnecessarily.
  - Plan work ahead based on the work procedure to be used.
  - Take only the material (i.e., chemicals) needed to perform the work activity. Additional material can be brought to the work location if necessary.
  - Materials can be stored in large containers, but the smallest reasonable container will be used to transport the material to the location where it is needed.
  - Maintain cleaning and extra sampling supplies outside any potentially contaminated area to keep them clean and to minimize waste generation.
  - Maintain or construct prefabricated materials, barriers, support equipment, etc., outside potentially contaminated areas.
  - Perform mixing of detergents or decontamination solutions outside potentially contaminated areas.
  - Do not mix or store media considered hazardous for different reasons
  - Use drop cloths or absorbent material to contain small spills or leaks.
  - Avoid a bellows effect when double-bagging contaminated materials.
  - Use containers to minimize the spread of contamination.
  - Do not place contaminated materials with clean materials.
- Decontaminate and reuse material and equipment when practical.
- Use volume reduction techniques when practicable.
  - Verify that waste containers are solidly packed to minimize the number of containers.
  - Use only the size of container to meet needs (i.e., do not use a drum or garbage can when a small polyethylene bag will do).
  - Use less hazardous substances whenever possible (i.e., bring only the volume of standard solutions needed for testing, and use minimal amounts of decontamination water and solvent rinses).

7.4.3 Waste Characterization and Classification

All waste streams will be sampled and characterized in accordance with 40 CFR 262.11 and, if necessary, in accordance with the New Mexico Solid Waste Management Regulations (20 New

Mexico Administrative Code [NMAC] 9.1). These regulations require the generator to determine whether a solid waste is a listed or characteristic hazardous waste or a New Mexico special waste.

Subject to the approval of the NMED, soil cuttings generated from each soil boring within the sewage lagoon will be managed under the EPAs "Area of Contamination (AOC) Policy". The AOC Policy was first articulated in the NCP. Under the AOC Policy, EPA interprets RCRA to allow certain discrete areas of generally dispersed contamination to be considered RCRA units (e.g., landfills). Because an AOC is equated to a RCRA land-based unit, consolidation and *in situ* treatment of hazardous waste within the AOC do not create a new point of hazardous waste generation for purposes of RCRA. This interpretation allows wastes to be consolidated or treated *in situ* within an AOC without triggering land disposal restrictions or minimum technology requirements. The AOC interpretation may be applied to any hazardous remediation waste that is in or on land (EPA 1998). Under this policy, soil cuttings generated within the sewage lagoons can be cleared away from the boring and left in place, and, therefore, be considered consolidated within the same RCRA unit and not "placement" or "generation" of a new waste stream. Under this interpretation, land disposal requirements would not be applicable to the soil cuttings.

Initially, waste characterization of decontamination water and/or used PPE will be based on analytical results corresponding to soil samples collected from the various boring locations. If analytical results from the soil samples indicate that there is a potential for the decontamination water and/or used PPE waste to be characterized as hazardous (e.g., the analytical results exceed 20-times the RCRA hazardous TCLP criteria for VOCs and inorganics), the drummed materials will be sampled and analyzed for RCRA characteristics including reactivity, corrosivity, ignitability, and TCLP parameters.

If analytical results are not available for the waste stream, and an accurate waste characterization cannot be made based on generator knowledge, representative samples will be taken in accordance with federal and New Mexico Hazardous Waste Management Regulations and Solid Waste Management Regulations.

Documentation of all proposed waste classifications will be provided to Cannon AFB for final waste stream characterization. The Base is responsible for making all final waste characterizations and for signing waste manifests.

7.4.4 Hazardous Waste Management

RCRA Subtitle C and the New Mexico Hazardous Waste Management Regulations (20 NMAC 4.1) govern hazardous waste management from the point of generation, through storage and treatment (if necessary), to its ultimate disposal. The NMED Hazardous Waste Bureau oversees management of the hazardous waste program in New Mexico.

Hazardous waste must comply with the following requirements:

- With the exception of soil cuttings, any waste generated during field activities must be characterized to determine whether it is a hazardous waste. Analytical testing requirements are detailed in the scope of work.
- Hazardous waste must be managed in accordance with 40 CFR 262, Standards Applicable to Generators of Hazardous Waste.
- Hazardous waste transported off site must be manifested in accordance with 40 CFR 262 Subpart B, Manifests, and accompanied by land disposal restriction (LDR) certification notices as per 40 CFR 268.7, Waste Analysis and Recordkeeping.
- Hazardous waste must be stored in accordance with 40 CFR 265 Subpart I, Use and Management of Containers.
- All containers of hazardous waste to be stored or disposed will be clearly marked with a completed hazardous waste label, indicating the starting date of accumulation, EPA identification number, EPA waste code, etc., and DOT markings.
- Hazardous waste may be stored on site for a maximum of 90 days. The 90 days begin on the date that the waste is first generated and containerized (i.e., that day the first drop of waste is placed in a container).
- Hazardous waste must be disposed only at a hazardous waste disposal facility permitted for the disposal of the particular type of hazardous waste generated.

7.4.5 Waste Containerization and Storage

Container selection will be performed by DOT-trained personnel based on type and quantity of waste to be generated. Containers may include either DOT-specification drums (1A1 or 1A2) or rolloffs for regulated hazardous material. DOT-specification containers are not required for material that does not meet a DOT hazard. For this project, the following containerization requirements apply:

- Sludge and soil cuttings—No containerization is required. Sludge and soil cuttings will be kept within the SWMU at the boring location from which they were generated.
- Decontamination fluids—Containerization is required. Decontamination fluids are not generated within the SWMU, thus containerization is required in DOT-specification drums.
- PPE—Containerization is required. PPE is not generated within the SWMU, thus containerization is required in DOT-specification drums.

Prior to starting field activities, the Foster Wheeler Construction Site Manager will, in conjunction with Cannon AFB personnel, select areas for the temporary staging and storage of soil cuttings/excavated materials, decontamination fluids, and PPE.

Waste material must be classified according to EPA and DOT criteria before the labels are applied. Upon classification, each container will be marked and labeled as required by EPA and DOT, if applicable. Trained personnel will conduct all DOT functions as required by 49 CFR 172 Subpart H.

At the time of generation, all waste containers will be labeled with the following information using indelible ink:

- Source and location
- Contents and quantity of material in the container
- Potential health, safety, and environmental hazards
- Accumulation start date (the date the first drop of material was put in the container)
- Date container sampled
- Parameters analyzed

Containers determined to contain hazardous waste will immediately be labeled with a completed commercial EPA "HAZARDOUS WASTE" label, which will include the accumulation start date and other requested information.

All hazardous waste stored in drums will also be stored on wooden pallets and subsequently transported off site or to the Cannon AFB Defense Reutilization and Marketing Office. An inventory of waste containers will be maintained for later submittal to and inspection by both USACE and Cannon AFB personnel.

Containers of hazardous waste will be inspected and logged weekly while the field work is in progress. Inspections will encompass evaluation for proper labeling, secure closure, the condition of each container, number of containers, and condition of the storage area. Any signs of deterioration, leaking, or dents will be noted, and containers will be immediately overpacked, if necessary. Inspection results will be provided to the USACE and Cannon AFB.

7.5 REPORTING SPILLS AND RELEASES

Precautions will be taken to prevent oil and hazardous material spills, including daily inspection by the site personnel of equipment, structure(s), and containers. Personnel using hazardous materials will inspect containers before and after use. In the event of a spill/release, the Construction Site Manager will notify the Cannon AFB Fire Department and USACE. Spill response will be conducted in accordance with federal, state, local, and Cannon AFB regulations.

Client Notification

The following chain of communications should be used in case of a spill:

- Ms. Carol Bieniulis, the Foster Wheeler DO Manager and field technical lead, has been designated as the Foster Wheeler Spill and Release Reporting Site Representative. In the event of a spill or release, Ms. Bieniulis will immediately notify Mr. Sanford Hutsell, Cannon AFB ([505] 784-4348), Mr. Tom Zink, USACE ([402] 221-7711), and the Cannon AFB Fire Department.
- Site personnel must contact the Foster Wheeler DO Manager. In addition, the DO Manager must contact the Regional Environmental, Safety, and Quality (ESQ) Manager and the Regulatory Specialist:
  - Foster Wheeler DO Manager: Carol Bieniulis

    Phone: (505) 878-8924
    Fax: (505) 878-8933
  - Foster Wheeler Regional ESQ Manager: Jayne Fitzgerald

    Phone: (714) 444-5534
    Fax: (714) 444-5560
  - Foster Wheeler Regulatory Specialist: Craig O'Rourke

    Phone: (714) 444-5511
    Fax: (714) 444-5560

7.6 TRAINING/CERTIFICATION REQUIREMENTS

This section presents the DOT training and certification requirements for personnel involved in the field activities. In addition to the DOT training, employees will be trained in Foster Wheeler's Waste Management and Environmental Compliance policies and procedures to ensure that they are familiar with the program. These policies and procedures meet Department of Justice requirements for a sound environmental management program. All personnel who perform or oversee DOT-related activities will be trained. Training records will be maintained in project files on site. Foster Wheeler's Corporate ESQ Department will also maintain a copy of the DOT training records.

7.7 DOCUMENTATION AND RECORDS RETENTION

This section presents project requirements relating to documentation and records and their retention.

7.7.1 Documentation

The information contained in this section applies to all waste managed during project activities. Field records will be kept in a bound, numbered field notebook. Information to be recorded includes but is not limited to the following:

- Description of waste generating activities
- Location of waste generation (including depth, if applicable)
- Type of waste
- Date and time of generation
- Name of person recording information
- Name of field manager at time of generation and at time of disposal
- Test results
- Inspection logs, if applicable
- Waste documentation, including:
  - Waste profile sheets
  - LDR certification
  - Hazardous waste manifest
  - Trip tickets or bills of lading
  - Copies of any state or local permits or approvals

7.7.1.1 Transportation

Transportation documentation will comply with DOT regulations 49 CFR 100-178 and will be prepared by appropriately trained Foster Wheeler personnel.

Containers will be marked, labeled, and/or placarded prior for off-site transport. Treatment, Storage, and Disposal Facility (TSDF) waste profile sheets, LDR notifications, waste manifests, and shipping documents will be prepared by Foster Wheeler personnel for Cannon AFB officials to review and sign.

Waste transporters used will be registered with NMED and approved by the Base and in accordance with Foster Wheeler procedures for TSDF and transporter approvals.

7.7.1.2 Hazardous and Special Waste Manifests and LDR Certification

All hazardous waste transported from the site will be accompanied by a Hazardous Waste Manifest. New Mexico does not provide a standard state manifest, so the receiving state manifest must be used. If the state does not have a state manifest, a Uniform Hazardous Waste Manifest may be used. Cannon AFB personnel will be responsible for reviewing and signing all waste documentation, including waste profiles, manifests, and LDR notifications (manifest packages). Prior to signing the manifest, the designated Cannon AFB official will ensure that pre-transport requirements of packaging, labeling, marking, and placarding are met according to 40 CFR 262.30-262.33 and 49 CFR 100-178.

For special waste, a manifest containing the following information will accompany each load of special waste originating from or to be disposed in New Mexico, as specified in 20 NMAC 9.1, Subpart VII 702.C:

- Name, address, and phone number of the generator
- Name, address, and phone number of any and all transporters in the order each will be transporting the waste
- Name, site address, phone number, and identification number of the solid waste facility to which the waste is to be delivered
- Type and proper name of waste being shipped
- Total weight or volume of waste prior to shipment from generator
- Total weight or volume of waste received at solid waste facility
- Type and number of containers in shipment

- Any special handling instructions
- Date and location the waste was delivered
- Date of receipt from the generator and total weight or volume of the special wastes to be provided by the transporter

If more than one transporter is used, each transporter will provide the date of receipt and total weight or volume of said waste received from the previous transporter.

The manifest will be signed by the Cannon AFB personnel, each transporter of the special waste, and the solid waste facility operator. All signatories will be duly authorized agents of their organizations. Significant discrepancies will be reported to the NMED Solid Waste Bureau within 24 hours of discovery.

Cannon AFB will receive one copy of the manifest; the remaining copies will be given to the transporter. The manifest will be returned to the Cannon AFB signatory official to be placed on file.

Copies of all manifests for waste generated at the site will also be kept in a central project file. The state copy of the manifest will be sent to the state by Cannon AFB.

An LDR form will accompany the shipment of hazardous waste to the TSDF. The TSDF must be notified prior to sending the waste. The following items must accompany the notification and are included in one of the following facility specific forms:

- EPA and New Mexico Hazardous Waste Generator ID number (provided by Cannon AFB)
- Manifest number, including state disposal application number
- Waste analysis data
- If the waste is also restricted, corresponding concentration-based or technology-based treatment standards or prohibition

7.7.2 RCRA Records Retention

The designated Cannon AFB manifest signatory official will be responsible for ensuring that all RCRA record-keeping requirements are met according to 40 CFR 262.20-262.44, including retention of signed copies of manifests from the designated facility that received the waste. The copy must be maintained for a period of at least 3 years from the date the waste was accepted by

the initial transporter. Additionally, biennial and exception reporting must be submitted, as necessary, according to 40 CFR 262.41 and 262.42, respectively. Additional reporting may be required according to 40 CFR 262.43.

7.8 UPDATING THE REGULATORY COMPLIANCE PLAN

The RCP will be updated if changes in site activities or changes in applicable regulations occur.

Table 7-1. Summary of Potentially Applicable or Relevant and Appropriate Regulatory Requirements

Requirement	Citation	Description
LOCATION-RELATED REGULATORY REQUIREMENTS		
Clean Water Act	33 CFR Part 323 Sec 404 (33 USC 1344)	Permits for discharges of dredged or fill material to waters of the United States.
CHEMICAL-RELATED REGULATORY REQUIREMENTS		
Clean Water Act	40 CFR Part 403	Pretreatment standards for discharges into publicly owned treatment works (POTWs). POTWs regulate discharges into their systems to meet three objectives: (1) prevent introduction of pollutants that would interfere with equipment or operations, (2) prevent introduction of pollutants that would cause pass through or be incompatible with the POTW, and (3) improve opportunities to recycle and reclaim municipal and industrial wastes and sludges.
New Mexico Standards for Groundwater	20 NMAC 6 Part 2, Subpart III, Section 3104	Unless otherwise provided by this Part, no person will cause or allow effluent, leachate, or water/liquid to discharge so that it may move directly or indirectly into groundwater unless they are discharging pursuant to a discharge plan approved by the secretary of the NMED.
New Mexico Standards for Groundwater	20 NMAC 6 Part 2, Subpart III, Section 3101	The following standards apply to discharges of water to the ground (chemical specific standards to be included in Work Plan): • Human Health Standards—Groundwater: Non-aqueous phase liquid will not be present floating atop of or immersed within groundwater, as can be reasonably measured. • Other Standards for Domestic Water Supply • Standards for Irrigation Use: Groundwater will meet the standards of Subsections A, B, and C unless otherwise provided.
National Ambient Air Quality Standards	40 CFR Part 50	Sources cannot cause or contribute to an exceedance of a national ambient air quality standard.
New Mexico Ambient Air Quality Standards	20 NMAC 2 Part 3, Sections 109, 110, and 111	Sources cannot cause or contribute to an exceedance of New Mexico ambient air quality standards for total suspended solids, sulfur, carbon monoxide, and nitrogen dioxide.

Table 7-1. Summary of Potentially Applicable or Relevant and Appropriate Regulatory Requirements (continued)

Requirement	Citation	Description
ACTION-RELATED REGULATORY REQUIREMENTS		
Air Emissions		
Air Emissions from stationary combustion equipment and diesel-powered vehicles associated with excavation and backfill operations	20 NMAC 2 Part 61, Sections 109 and 110	The owner or operator of stationary combustion equipment shall not permit, cause, suffer, or allow visible emissions from the stationary combustion equipment to equal or exceed an opacity of 20 percent. No person will permit, cause, suffer, or allow the emission into the open air of any smoke having an opacity greater than 30% for any period greater than 10 seconds from any diesel-powered vehicle operating below 8,000 ft (mean sea level).
Waste Characterization		
Determination of Hazardous Waste	40 CFR 262.11 40 CFR Part 261 20 NMAC 4 Part 1, Subpart II	Any wastes generated during remedial activities must be characterized and evaluated according to the following method to determine whether the waste is hazardous: • Determine whether the waste is excluded from regulation under 40 CFR 261.4 • Determine whether the waste is listed under 40 CFR Part 261 • Determine whether the waste is identified in 40 CFR Part 261 by testing the waste according to specified test methods or by applying knowledge of the hazardous characteristics of the waste in light of the materials or the process used.
Waste Management		
Hazardous Waste Generator Standards	40 CFR Part 262 20 NMAC 4 Part 1, Subpart III—Generator Standards 20 NMAC 4 Part I, Subpart VIII—Land Disposal Restriction Standards	Hazardous wastes generated during remedial activities must be managed and disposed of per RCRA requirements pertaining to storage (i.e., container requirements) and disposal at approved offsite permitted hazardous treatment, storage, and disposal facilities.

Table 7-1. Summary of Potentially Applicable or Relevant and Appropriate Regulatory Requirements (concluded)

Requirement	Citation	Description
ACTION-RELATED REGULATORY REQUIREMENTS		
Treatment, Storage, or Disposal of RCRA Hazardous Waste	40 CFR 264.310(a)(4), (5), (b)(1) and (5) 40 CFR 264.117 through 264.120 20 NMAC 4 Part 1, Subpart V 40 CFR Part 264.95 40 CFR 264.16 (a)(1) 20 NMAC 4 Part 1, Subpart V	• Closure and cover requirements for landfills • Post-closure requirements • Groundwater protection standards and point of compliance • Personnel training
Treatment and Disposal of Hazardous Debris	40 CFR 268.45 20 NMAC 4 Part 1, Subpart VIII	Hazardous debris generated during remedial activities must be treated using specific technologies to extract, destroy, or immobilize hazardous constituents on or in the debris if placement occurs. In certain cases, the debris may no longer be subject to RCRA Subtitle C regulations after treatment.
Health and Safety Requirements		
Health and Safety Requirements	29 CFR 1910.120	Hazardous waste site supervisors, workers, and visitors are required to comply with the training and medical surveillance requirements detailed in this citation..

% percent
CFR Code of Federal Regulations
NMAC New Mexico Administrative Code
NMED New Mexico Environment Department
POTW Publicly Owned Treatment Works
RCRA Resource Conservation and Recovery Act
USC United States Code

Table 7-2 Waste Management Summary Table

Waste Types	Characterization Requirements	Applicable Regulations	Allowable Containment	Storage Requirements	Transportation Requirements	Disposal Requirements
Sludge and Soil Cuttings	Soil cuttings from each area will be not be characterized to determine if they are a RCRA hazardous waste. The soil cuttings will be managed under the EPA Area of Contamination Policy. Under this policy, soil will be kept on the ground at each boring location from which it is generated and will not require separate waste characterization until such time the waste is removed from the area for disposal. Prior to disposal, existing soil analytical data for the SWMU will be reviewed in order to characterize the waste. If analytical results indicate the soil is potentially hazardous, a representative sample will be taken from the appropriate soil pile. Analysis will include ignitability, TCLP metals, VOCs, PCBs and pesticides, and TRPH.	20 NMAC 4.1 "Identification & Listing of Hazardous Waste" and "Standards Applicable to Generators of Hazardous Waste" 40 CFR 268.48 — LDR-UTS 40 CFR 262 — Generator Reqs. EPA "Area of Contamination" Policy	Stored on the ground within the SWMU at the boring location from which it was generated.	For containerized soil cuttings characterized as hazardous waste, the 90-day storage limit applies and the container(s) must be labeled with a completed hazardous waste label. Note: Storage clock starts from the date that waste is first put into the container.	Hazardous Waste: Hazardous waste manifest, DOT placarding. Must use an EPA-permitted transporter. Must also have LDR certifications as necessary. Note: Individuals involved in oversight or shipping hazardous materials must meet HM-181 & HM-126F training requirements.	Hazardous Waste: Containerized soil cuttings characterized as hazardous must be disposed of at an approved RCRA TSDF. Note: Foster Wheeler ESQ and Cannon AFB must approve TSDF and transporter prior to shipment of waste.
Decontamination Fluids	Need to determine whether the decontamination water is a hazardous waste. Representative sample to be taken from accumulation container or portable tanks. Analysis should include metals, VOCs, PCBs and pesticides, and SVOCs.	20 NMAC 4.1 "Identification & Listing of Hazardous Waste" and "Standards Applicable to Generators of Hazardous Waste" 40 CFR 268.48 — LDR-UTS 40 CFR 262 — Generator Reqs. WQCC 82-1, Part 3-103	DOT-approved 75-gal (bunghole-type) metal drums (1A1) or DOT-approved portable tanks (DOT 51, 52, 53, 56, 57, and 60) that must be sealed when not being filled.	Hazardous Waste: 90-day storage limit if determined to be a hazardous waste and must be labeled with a completed hazardous waste label. Note: Storage clock starts from the date that waste is first put into the container.	Hazardous Waste: Hazardous waste manifest, DOT placarding. Must use an EPA-permitted transporter. Must have LDR certifications as necessary. Note: Individuals involved in oversight or shipping hazardous materials must meet HM-181 & HM-126F training requirements.	Hazardous Waste: Mus be disposed of at an approved off-site RCRA TSDF. If not a hazardous wast and meets groundwater discharge standards, ca discharge to the ground with approval of NMED. If above ground discharge levels, water may be disposed of, with authorization, to one of the Base's WWTFs.

Table 7-2 Waste Management Summary Table

Waste Types	Characterization Requirements	Applicable Regulations	Allowable Containment	Storage Requirements	Transportation Requirements	Disposal Requirements
Used PPE	Decontaminated PPE will be handled as solid waste; no analysis required.	20 NMAC 9.1 Solid Waste Management Regulations 20 NMAC 4.1 "Identification & Listing of Hazardous Waste" and "Standards Applicable to Generators of Hazardous Waste" 40 CFR 268.48 —LDR-UTS 40 CFR 262 — Generator Reqs.	Double bagged in plastic bags.	N/A	N/A	Non-hazardous solid waste to be disposed of at an approved solid waste landfill. Note: Foster Wheeler ESQ and Cannon AFB must approve TSDF and transporter prior to shipment of waste.

AFB	Air Force Base	gal	gallons	PCB	Polychlorinated biphenyl	SWMU	Solid Waste Management Unit	VOC	Volatile Organic Compound
CFR	Code of Federal Regulations	LDR	Land Disposal Restriction	PPE	Personal protective equipment	TCLP	Toxicity characteristic leaching procedure	WQCC	Water Quality Control Commission
EPA	United States Environmental Protection Agency	N/A	Not applicable	RCRA	Resource Conservation and Recovery Act	TRPH	Total Recoverable Petroleum Hydrocarbons	WWTF	Wastewater Treatment Facility
ESQ	Environmental Safety & Quality	NMAC	New Mexico Administrative Code	Reqs	Requirements	TSDF	Treatment, Storage, and Disposal Facility		
DOT	Department of Transportation	NMED	New Mexico Environment Department	SVOC	Semivolatile Organic Compound	UTS	Universal Treatment Standards		

8.0 PROJECT MANAGEMENT

8.1 PROJECT TEAM

Figure 8-1 depicts the proposed project team for the CMS for SWMU 101, sewage lagoons. The key parties for this project are the Cannon AFB, USACE–Omaha district, and Foster Wheeler. The DO Manager and Task Manager is Ms. Carol Bieniulis who is responsible for the direction, execution, and successful completion of the CMS report. The Project Engineer is Mr. Derek Johnson.

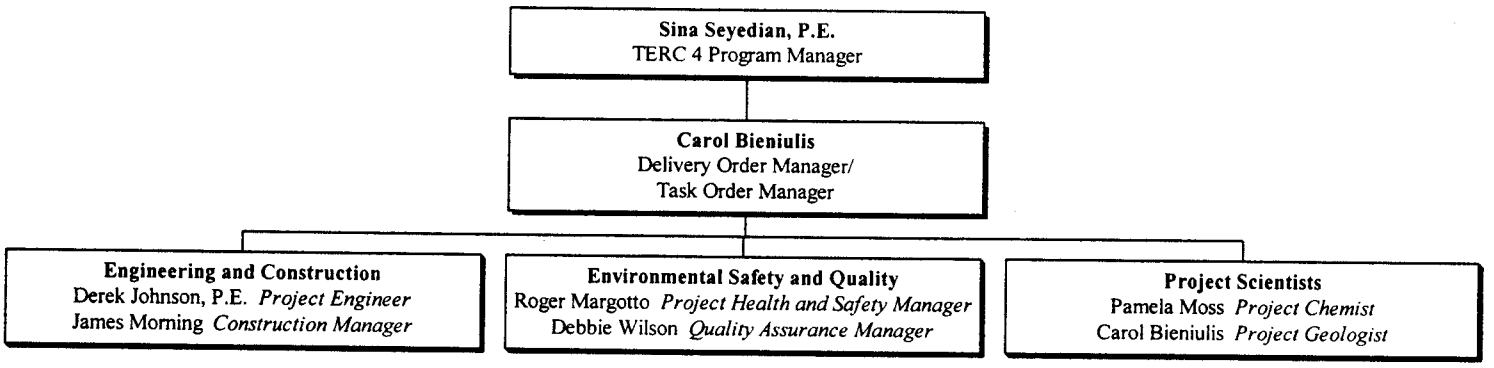
The Task Manager is the primary author of the CMS report with assistance the Project Engineer and a multidisciplinary team comprising representatives from civil engineering, hydrogeology, chemistry, regulatory compliance, quality assurance, and technical editing.

8.2 PROJECT SCHEDULE

A summary of the anticipated schedule to provide the work plan, draft report, and final reports is presented below.

Submittal of Final CMS Work Plan	December 1999
CMS Field Activities	March 2000
Development of Draft CMS Report	May 2000
Submittal of Final CMS Report	July 2000

Figure 8-1 Foster Wheeler Project Team



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APPENDIX A

ANALYTICAL METHOD PRACTICAL QUANTITATION LIMITS, PRECISION, AND ACCURACY OBJECTIVES

Laucks PQLs/MDLs
for SW846, Third Edition
1998/1999

Chemical	CAS Number	Laboratory MDL/IDL 1998-1999	Laboratory MDL/IDL 1998-1999	Low Standard Laboratory PQL Water	Low Standard Laboratory PQL Soil
		(ug/L)	(ug/Kg)	(ug/L)	(ug/Kg)
VOLATILE ORGANIC COMPOUNDS (SW-846 METHOD 8260B WITH 5 ML OR 5 GM PURGE)					
1,1,2,2-Tetrachloroethane	79-34-5	0.7341	0.3431	3	15/300
1,1,1-Trichloroethane	71-55-6	0.2872	0.2284	3	15/300
1,1,2-Trichloroethane	79-00-5	0.2772	0.3148	3	15/300
1,1-Dichloroethane	75-34-3	0.0902	0.3443	3	15/300
1,1-Dichloroethene	75-35-4	0.3714	0.4324	3	15/300
1,2-Dichloroethane	107-06-2	0.1977	0.2417	3	15/300
1,2-Dichloropropane	78-87-5	0.2359	0.2213	3	15/300
2-Butanone	78-93-3	1.313	0.543	5	25/500
2-Hexanone	591-78-6	1.415	0.3804	5	25/500
4-Methyl-2-pentanone	108-10-1	1.067	0.2804	5	25/500
Acetone	67-64-1	1.677	1.64	5	25/500
Benzene	71-43-2	0.2798	0.366	3	15/300
Bromodichloromethane	75-27-4	0.3704	0.1854	3	15/300
Bromoform	75-25-2	0.9736	0.2714	3	15/300
Bromomethane	74-83-9	0.3055	1.598	3	15/300
Carbon disulfide	75-15-0	0.2379	0.309	3	15/300
Carbon tetrachloride	56-23-5	0.269	0.5747	3	15/300
Chlorobenzene	108-90-7	0.1375	0.2942	3	15/300
Chloroethane	75-00-3	0.3002	0.7601	3	15/300
Chloroform	67-66-3	0.0675	0.384	3	15/300
Chloromethane	74-87-3	0.2257	0.8954	3	15/300
cis-1,2-Dichloroethene	156-59-2	0.2207	0.2698	3	15/300
cis-1,3-Dichloropropene	10061-01-5	0.5302	0.3365	3	15/300
Dibromochloromethane	124-48-1	0.6722	0.1049	3	15/300
Dichlorodifluoromethane	75-71-8	0.1985		3	15/300
Ethylbenzene	100-41-4	0.2406	0.3098	3	15/300
Methylene chloride	75-09-2	0.621	0.2298	3	15/300
Styrene	100-42-5	0.2906	0.3994	3	15/300
Tetrachloroethene	127-18-4	0.2226	0.4399	3	15/300
Toluene	108-88-3	0.2466	0.3299	3	15/300
trans-1,2-Dichloroethene	156-60-5	0.2685	0.4324	3	15/300
trans-1,3-Dichloropropene	10061-02-6	0.5427	2010	3	15/300
Trichloroethene	79-01-6	0.167	0.5516	3	15/300
Trichlorofluoromethane	75-69-4	0.222		3	15/300
Vinyl chloride	75-01-4	0.2035	0.3132	3	15/300
m,p-Xylenes	108-38-3	0.4938	0.9441	3	15/300
o-Xylene	95-47-6	0.2315	0.3767	3	15/300
ORGANOCHLORINE PESTICIDES and PCBs (SW-846 METHOD 8081A/8082)					
Aldrin	309-00-2	0.0089/0.0103	0.21/0.30	0.05	1.7
Alpha-BHC	319-84-6	0.0025/0.0031	0.18/0.22	0.05	1.7
Alpha-chlordane	5103-71-9	0.0026/0.0096	0.36/0.73	0.05	1.7
Beta-BHC	319-85-7	0.0029/0.0105	0.082/0.82	0.05	1.7
Chlordane	57-74-9			0.5	17
4,4'-DDD	72-54-8	0.0100/0.0042	0.63/0.66	0.1	3.3
4,4'-DDE	72-55-9	0.0066/0.0052	0.64/0.71	0.1	3.3
4,4'-DDT	50-29-3	0.0057/0.0058	0.74/0.81	0.1	3.3
Delta-BHC	319-86-8	0.0059/0.0127	0.39/0.36	0.05	1.7
Dieldrin	60-57-1	0.0046/0.0064	0.70/0.70	0.1	3.3
Endosulfan I	959-98-8	0.0027/0.0132	0.36/0.90	0.05	1.7
Endosulfan II	33213-65-9	0.0088/0.0062	0.74/0.77	0.1	3.3
Endosulfan sulfate	1031-07-8	0.0059/0.0072	0.67/0.71	0.1	3.3
Endrin	72-20-8	0.0052/0.0054	0.64/0.75	0.1	3.3
Endrin aldehyde	7421-93-4	0.0058/0.0067	0.48/0.50	0.1	3.3
Endrin Ketone	53494-70-5	0.0059/0.0064	0.73/0.85	0.1	3.3
Gamma-BHC (Lindane)	58-89-9	0.0024/0.0032	0.20/0.27	0.05	1.7
Gamma-chlordane	5103-74-2	0.0021/0.0040	0.36/0.40	0.05	1.7
Heptachlor	76-44-8	0.0078/0.0093	0.26/0.27	0.05	1.7
Heptachlor epoxide	1024-57-3	0.0030/0.0037	0.30/0.42	0.05	1.7
Methoxychlor	72-43-5	0.0312/0.0356	3.7/4.2	0.5	17
Toxaphene	8001-35-2	0.70/1.1	18.4/13.8	5	170
Aroclor-1016	12674-11-2	0.072/0.10	6.9/7.2	1	33
Aroclor-1221	11104-28-2	0.084/0.080	10.5/10.1	2	66
Aroclor-1232	11141-16-5	0.21/0.23	12.2/12.4	1	33

Laucks PQLs/MDLs
for SW846, Third Edition
1998/1999

Chemical	CAS Number	Laboratory MDL/IDL 1998-1999	Laboratory MDL/IDL 1998-1999	Low Standard Laboratory PQL Water	Low Standard Laboratory PQL Soil
		(ug/L)	(ug/Kg)	(ug/L)	(ug/Kg)
Aroclor-1242	53469-21-9	0.33/0.37	11.7/13.5	1	33
Aroclor-1248	12672-29-6	0.11/0.061	16.2/17.8	1	33
Aroclor-1254	11097-69-1	0.11/0.11	21.8/21.4	1	33
Aroclor-1260	11096-82-5	0.041/0.066	8.8/9.0	1	33
Trace Metals (SW-846 6010B/7000 series)			(mg/Kg)		(mg/Kg)
Arsenic	7440-38-2	2.0	0.36	10	1
Barium	7440-39-3	0.35	0.043	5	0.5
Cadmium	7440-43-9	0.43	0.022	5	0.5
Chromium (total)	7440-47-8	0.54	0.065	10	1
Lead	7439-92-1	2.3	0.14	3	0.3
Mercury (SW-846 Method 7470A/7471A)	7439-97-6	0.07	0.03	0.2	0.1
Selenium	7782-49-2	2.1	0.20	5	0.5
Silver	7440-22-4	0.40	0.043	10	1
MISCELLANEOUS PARAMETERS			(mg/Kg)		(mg/Kg)
Nitrate (SW-846 - 9056 or EPA 300.0)	00620	36		200	4
Total Organic Carbon (TOC) (SW-846 - 9060)	00680	800		1000	100

Laucks Testing Labs
Control Limits
1999

Chemical	WATER					SOIL				
	LCS	LCSD	MATRIX SPIKE	SAMPLE DUPE	MSD	LCS	LCSD	MATRIX SPIKE	SAMPLE DUPE	MSD
	%Recovery	RPD	%Recovery	RPD	RPD	%Recovery	RPD	%Recovery	RPD	RPD
VOLATILE ORGANIC COMPOUNDS (SW-846 METHOD 8260B WITH 5 ML OR 5 GM PURGE)										
1,1-Dichloroethene	64-140	20	56-146	NA	23	60-140	22	48-140	NA	22
Benzene	60-140	16	81-126	NA	9	60-140	19	65-128	NA	19
Chlorobenzene	60-140	15	83-112	NA	10	60-140	19	56-122	NA	19
Toluene	60-140	26	52-148	NA	15	60-140	22	47-137	NA	22
Trichloroethene	60-140	15	53-134	NA	12	60-140	24	47-123	NA	24
ORGANOCHLORINE PESTICIDES and PCBs (SW-846 METHOD 8081A/8082)										
Aldrin	16-126	34	34-127	NA	50	22-133	29	20-138	NA	50
Gamma-BHC (Lindane)	49-134	20	20-159	NA	50	31-130	30	20-128	NA	50
Heptachlor	27-117	24	29-122	NA	50	33-119	20	20-131	NA	50
Aroclor-1260	53-116	20	39-149	NA	50	33-131	20	20-160	NA	50
MISCELLANEOUS PARAMETERS										
Nitrate (SW-846 - 9056 or EPA 300.0)	90-110	10	79-117	10	10	50-150	30	50-150	30	30
Total Organic Carbon (TOC) (SW-846 - 9060)	90-110	11	70-119	11	11	50-150	20	50-150	20	20
Metals (SW-846 6010B/7000 series)										
Arsenic	80-120	20	75-125	20	20	80-120	20	75-125	20	20
Barium	80-120	20	75-125	20	20	80-120	20	75-125	20	20
Cadmium	80-120	20	75-125	20	20	80-120	20	75-125	20	20
Chromium (total)	80-120	20	75-125	20	20	80-120	20	75-125	20	20
Lead	80-120	20	75-125	20	20	80-120	20	75-125	20	20
Mercury (SW-846 Method 7470A/7471A)	80-120	20	75-125	20	20	80-120	20	75-125	20	20
Selenium	80-120	20	75-125	20	20	80-120	20	75-125	20	20
Silver	80-120	20	75-125	20	20	80-120	20	75-125	20	20

SITE-SPECIFIC SAFETY AND HEALTH PLAN ADDENDUM
SWMU 101—SEWAGE LAGOONS CORRECTIVE MEASURES STUDY
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

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U.S. Army Corps of Engineers
Omaha District
Omaha, Nebraska

December 1999

Project Number: CZQZ979361Z1

SITE-SPECIFIC SAFETY AND HEALTH PLAN APPROVAL

This Site-Specific Safety and Health Plan Addendum provides the health and safety guidelines and procedures for the Sewage Lagoons Corrective Measure Study Project (CMS) at Cannon Air Force Base, New Mexico. The signatures below indicate concurrence with the procedures specified in the plan and a commitment to the philosophy of quality made by all project personnel.

James Morning
Environmental Safety Specialist/Construction Manager, Foster Wheeler Environmental Corporation

Signature _____ Date 10/4/99

Carol Bieniulis
Delivery Order Manager, Foster Wheeler Environmental Corporation

Signature Carol L Bieniulis Date 10/4/99

Roger Margotto, CIH
Project Health and Safety Manager, Foster Wheeler Environmental Corporation

Signature Roger N Margotto Date 10-4-99

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LIST OF ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
AFB	Air Force Base
AHA	Activity Hazard Analysis
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CMC	Corporate Medical Consultant
CMS	Corrective Measures Study
CPR	cardiopulmonary resuscitation
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenylethane
DDT	dichlorodiphenyltrichloroethane
DO	Delivery Order
EHS	Environmental Health and Safety
EPA	United States Environmental Protection Agency
ESS	Environmental Safety Specialist
Foster Wheeler	Foster Wheeler Environmental Corporation
GFCI	ground-fault circuit interrupter
HASP	Health and Safety Plan
mg/m^3	milligrams per cubic meter
mg/kg	milligrams per kilogram
µg/kg	micrograms per kilogram
MSDS	Material Safety Data Sheet
NIOSH	National Institute of Occupational Safety and Health
OHST	Occupational Health and Safety Technician
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PEL	permissible exposure limit
PESM	Project Environmental Safety Manager
PFD	personal flotation device
PID	photoionization detector
POC	Point of Contact
PPE	personal protective equipment

ppm	parts per million
REL	recommended exposure limit
SHSO	Site Health and Safety Officer
SSHP	Site-Specific Safety and Health Plan
STEL	short-term exposure limit
TERC	Total Environmental Restoration Contract
TLV	threshold limit value
TWA	time-weighted average
USACE	United States Army Corps of Engineers

1.0 INTRODUCTION

Foster Wheeler Environmental Corporation (Foster Wheeler) is conducting environmental services for the United States Army Corps of Engineers (USACE), Omaha District, Total Environmental Restoration Contract, Contract No. DACW-45-94-D-003. This Site-Specific Safety and Health Plan (SSHP), which is an addendum to the Basewide HASP for Cannon Air Force Base (AFB) (Foster Wheeler, 1999a), identifies the health and safety requirements and procedures for the Corrective Measure Study (CMS) to be conducted for Solid Waste Management Unit 101, the Sewage Lagoons at Cannon AFB, New Mexico. This SSHP has been prepared in accordance with Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) Section 1910.120 and 29 CFR Part 1926, the USACE Safety and Health Requirements Manual EM 385-1-1, and Base and contract requirements.

This SSHP provides Foster Wheeler field personnel, subcontractors, and site visitors with an understanding of the potential chemical and physical hazards that exist or may arise during performance of tasks associated with the CMS and documents procedures to ensure protection of on-site personnel performing field activities. The general procedures and guidance presented in Sections 2.0 through 16.0 of this SSHP are based on the current understanding of site conditions and required scope of field activities and apply to all personnel working at the CMS sites. This SSHP supplements information contained in the Basewide HASP (Foster Wheeler, 1999a) and the Foster Wheeler Project Rules Handbook (1999b).

All personnel participating in the field investigation must sign a statement acknowledging they have read this plan, understand its provisions, and will adhere to the requirements contained herein.

1.1 SCOPE OF WORK

A description of the scope of work is outlined in the CMS work plan and includes the following activities:

- Constructing access roads
- Drying and aerating the sewage lagoon sludges, including pumping liquids, if necessary

- Demolition of concrete slabs on interior of berms to use for sludge stabilization
- Preparing access points at lagoon berms
- Handling soil from an off-site excavation area (borrow material)
- Placing and compacting a minimum 2-foot-thick layer of berm soil and borrow material on top of compacted sludge to provide for drill rig access to sampling locations
- Collecting subsurface samples via drill rig
- Decontamination of equipment and supplies
- Demobilization

1.2 SITE LOCATION

Cannon AFB is located in northeast New Mexico in Curry County, south of Highway 60/84. The Base property includes approximately 4,000 acres. The nearest population center is the city of Clovis, New Mexico, which is located approximately 6 miles east of the Base.

The sewage lagoon system was used to store and treat both industrial and domestic wastewater. The sewage lagoon sludges contain residual hazardous constituents that were deposited as a result of former industrial waste management practices at Cannon AFB. Based on analytical results from investigations of the site, these constituents include volatile organic compounds, phthalates, polychlorinated biphenyls (PCBs), pesticides, and metals.

2.0 ORGANIZATION/KEY PERSONNEL AND RESPONSIBILITIES

2.1 PROJECT TEAM

The on-site project personnel include the following:

Team	Project Title/Assigned Role	Phone Numbers
James Morning, Occupational Health and Safety Technician (OHST)	Construction Manager/ Site Health and Safety Officer (SHSO)	(505) 479-2668 (505) 430-2307 (*mobile*)
Carol Bieniulis	SHSO/Project Field Geologist	(505) 878-8924 (505) 934-0879 (mobile)

Other project personnel include the following:

Name	Project Title/Assigned Role	Phone Numbers
Sina Seyedian, P.E.	Program Manager	(303) 980-3573
Roger Margotto, Certified Industrial Hygienist (CIH)	Project Environmental Safety Manager (PESM)	(619) 234-8696 (714) 810-3742 (*pager*)
Carol Bieniulis	Delivery Order (DO) Manager	(505) 878-8924 (505) 934-0879 (mobile)

2.2 ROLES AND RESPONSIBILITIES

The roles and responsibilities of key project personnel are addressed in the Basewide HASP (Foster Wheeler, 1999a).

3.0 HAZARD ANALYSIS

3.1 HAZARD IDENTIFICATION

The activity hazard analysis (AHA), presented in Table 3-1, identifies the potential hazards associated with the CMS tasks; additional task elements may be added to the AHA in the future to address any unanticipated hazards. The Basewide HASP (Foster Wheeler, 1999a) also details several of the hazards identified in the site-specific AHA.

The SHSO will inspect the site to ensure that all project tasks are performed according to the AHA. The minimum personal protective equipment (PPE) required for the field activities is Level D (work clothes with hard hat, steel-toed boots, and safety glasses); however, upgrades may be necessary based on dermal or inhalation exposure potential (Table 8-1). The SHSO shall periodically review the SSHP to determine whether changes to the SSHP are needed. Any revisions resulting from changes in the project scope of work and/or site conditions shall be approved by the CIH and documented using the Field Change Request Form, provided in the Contractor Quality Control Plan, Appendix D to the CMS work plan.

3.2 HAZARD ASSESSMENT

The following hazard assessment applies only to the activities within the specified scope of this SSHP.

3.3 CHEMICAL HAZARDS

The following paragraphs discuss the chemical hazards that potentially exist on site, the health risks posed by these classes of chemicals (or specific constituents, where applicable), and a description of symptoms resulting from exposure. A list of chemical contaminants that may be encountered during field activities is presented in Table 3-2; Attachment 2 contains representative Material Safety Data Sheets (MSDSs) for each. MSDSs will be provided in all field copies of the SSHP, and will be kept on file by the SHSO on site. The selection of the these chemicals, which are considered representative of the site, was based either on previous detections in sewage lagoon soils, sludges, or water at levels of concern or their suspected

occurrence in soil or groundwater. The main potential routes of exposure to chemicals in site soil and groundwater are through dermal contact and inhalation.

3.3.1 Organochlorine Herbicides and Pesticides

The organochlorine pesticides potentially occurring at the sewage lagoons include DDD, DDE, α-chlordane, and γ-chlordane. DDD and DDE, both degradation products of DDT, are classified as Class B2 carcinogens by the United States Environmental Protection Agency (EPA). OSHA has not established permissible exposure limits (PELs) for DDD and DDE; however, ingestion during laboratory studies of both chemicals has been linked to formation of liver and thyroid tumors, and ingestion of DDD has caused lung tumors as well. The ACGIH TLV for DDT, DDD or DDE is 1.0 milligrams per cubic meter (mg/m^3).

Chlordane isomers are not suspected or known human carcinogens. The ACGIH TLV for α-chlordane and γ-chlordane is 0.5 mg/m^3.

3.3.2 Semivolatile Organic Compounds

Only one semivolatile organic compound (SVOC) has been identified in the sludge of the sewage lagoons. Many SVOCs are classified as coal tar pitch volatiles which have a TLV of 0.2 milligrams per cubic meter (mg/m^3) and includes bis(2-ethylhexyl)phthalate.

Bis(2-ethylhexyl)phthalate is a suspected carcinogen and experimental teratogen. It is a mild skin and eye irritant and affects the gastrointestinal tract.

3.3.3 Polychlorinated Biphenyls

Arochlor-1254 is a member of the PCB family. Data on human PCB exposure are limited to a few poisoning incidents. Ingestion of PCB-contaminated (1,500–2,000 parts per million [ppm]) rice bran oil has caused nausea, lethargy, chloracne, brown skin pigmentation, subcutaneous edema of the face, a cheese-like discharge from the eyes, and jaundice. Industrial skin exposures have caused dermatitis and chloracne. A slight increase in the incidence of cancer, particularly melanoma of the skin, has been reported in a small group of men exposed occupationally to Arochlor-1254. Animal

studies indicate that Arochlor-1254 and other PCBs are capable of increasing the incidence of several types of cancer. The OSHA PEL for exposure to this PCB is 1 mg/m^3.

3.3.4 Metals

Several metals have been detected in the sludges of the sewage lagoon system. These metals include barium, cadmium, chromium, copper, selenium, silver, vanadium, and zinc. Of these metals, only cadmium and chromium exhibit carcinogenicity. The primary route of exposure to metals at the sewage lagoons is inhalation of dust. The TLVs for barium, copper, selenium, silver, vanadium, and zinc are shown below:

- Barium 0.50 mg/m^3
- Copper 1.0 mg/m^3
- Selenium 0.20 mg/m^3
- Silver 0.1 mg/m^3
- Vanadium 0.05 mg/m^3
- Zinc 10.0 mg/m^3

Cadmium is an ACGIH suspect human carcinogen (A_2). Inhalation is the route of concern for exposure to cadmium. Repeated long-term chronic exposure to cadmium at low concentrations may result in kidney damage and increased risk of lung and prostrate cancer. Ingestion of cadmium has been associated with significant detections of protein in urine, which is a symptom of renal (kidney) poisoning. The TLV for cadmium (as dust) is 0.002 mg/m^3.

ACGIH recommends that some forms of chromium (hexavalent) be classified as confirmed human carcinogens (A_1). Certain forms of chromium (VI) have been found to cause increased respiratory cancer mortality. Inhalation exposure to most forms of chromium may cause respiratory irritation. Irritation may be severe in the nasal region, resulting in tissue destruction and chrome holes. Dermal exposure to chromium can cause skin necrosis. The OSHA PEL is 0.5 mg/m^3 to 1.0 mg/m^3, depending on the chromium compound of concern.

3.3.5 Volatile Organic Compounds

Acetone is moderately toxic through various routes of exposure and is a skin and severe eye irritant. Health effects by inhalation include nasal irritation, eye irritation, respiratory system effects, nausea and vomiting, and muscle weakness. The OSHA PEL is 1,000 ppm.

2-Butanone (methyl ethyl ketone) is moderately toxic by ingestion and skin contact routes. Health effects by inhalation include eye and upper respiratory irritation. It is an experimental teratogen and affects the peripheral nervous system and central nervous system. The TLV is 200 ppm and the short-term exposure limit (STEL) is 300 ppm.

3.3.6 Hydrogen Sulfide

The anaerobic degradation of sludges in the sewage may produce hydrogen sulfide gas, which has a characteristic odor of rotten eggs. The odor threshold is 0.05 ppm. The odor cannot be used as indicator of the presence of hydrogen sulfide because the sense of smell becomes rapidly fatigued. Hydrogen sulfide acts directly upon the nervous system, resulting in paralysis of the respiratory center and severely diminishing the ability to smell. At low to moderate concentrations, hydrogen sulfide causes eye and respiratory tract irritation. Very high vapor concentrations result in sudden collapse and unconsciousness, with the possibility of death from rapid respiratory paralysis. The OSHA PEL for hydrogen sulfide is a ceiling concentration of 20 ppm and a peak concentration (ten minute maximum) of 50 ppm. The ACGIH proposes to change the TLV to 5 ppm. For this project the PESM/CIH has selected a TWA of 5 ppm with a ceiling level of 10 ppm. If the hydrogen sulfide action level of 5 ppm frequently occurs during field work, an additional assessment will be conducted by the PESM in order to make work proceed more efficiently.

The potential for exposure of site personnel to hydrogen sulfide is expected to be low because initial analytical results indicated very low sulfide concentrations in lagoon sludge samples. However, as a precaution, employees personal monitoring of hydrogen sulfide will take place during the field activities and respiratory protection will take place in accordance with the requirements listed in Table 7-1.

3.4 PHYSICAL HAZARDS

The SHSO must perform frequent and regular inspections of the site, materials, and equipment to identify site hazards in accordance with 29 CFR 1926.20. All on-site personnel will be provided with the information and training necessary to avoid accidental injury, including literature on maintaining the site in such a way that slip, trip, and fall hazards are recognized and eliminated or controlled. Basic PPE (steel-toe boots, hard hats, and safety glasses) must be available and site management will enforce its use.

3.4.1 Electrical

OSHA regulations require that employees who may be exposed to electrical equipment be trained to recognize the potential hazards and identify the appropriate control methods. All extension cords used for portable tools or other equipment must be designed for hard or extra hard usage and must be three-wire grounded. In addition, All 120-volt, single-phase, 15- and 20-ampere receptacle outlets on construction sites and other locations where moisture/water contact may occur must be equipped with ground-fault circuit interrupter (GFCI) units. GFCI units must be attached directly to or as close as possible to the receptacle to increase effectiveness.

Whenever conducting maintenance on electrical equipment, lockout/tagout procedures to isolate the unit and all associated equipment must be used. Lockout/tagout procedures are presented in the Draft Basewide HASP (Foster Wheeler, 1999a) and in Foster Wheeler Environmental, Health and Safety (EHS) procedure EHS 6-4, Lockout/Tagout (Corporate Reference Library).

All temporary lighting lamps for general illumination must be protected from accidental breakage. Metal case sockets must be grounded.

All electrical equipment (tools, lights, extension cords) must be visually inspected prior to use. Equipment that could expose personnel to electric shock must be removed from service.

If overhead utilities are present in the work area, all equipment that may come into contact with the utilities must maintain adequate clearance. Clearance requirements are addressed in the Draft Basewide HASP (Foster Wheeler, 1999a) and USACE EM 385-1-1.

3.4.2 Heat and Cold Stress

Overexposure to temperature extremes can present significant risks to personnel if simple precautions are not observed. Typical control measures designed to prevent heat stress include dressing properly, drinking plenty of fluids, and establishing an appropriate work/break regimen. Typical control measures designed to prevent cold stress include dressing properly and establishing an appropriate work/break regimen. The SHSO must ensure that the appropriate measures are observed. Additional guidance concerning heat and cold stress is provided in the Draft Basewide HASP (Foster Wheeler, 1999a).

3.4.3 Traffic Safety

All project staff operating a vehicle on site must follow all Base traffic regulations. The use of seat belts is required when vehicles are in motion.

3.4.4 Pedestrian Traffic

The uncontrolled presence of pedestrians during site activities can be hazardous to both pedestrians and site workers. Prior to the initiation of site activities, the site should be surveyed to determine whether pedestrians can gain access to the site. This survey should include the investigation of walkways, parking lots, gates, and doorways. If work activities are subject to pedestrian traffic, barriers or caution tape should be used to exclude all pedestrian traffic not related to project work.

3.4.5 Noise

Mechanical equipment (pumps and heavy equipment) used for the CMS is a potential source of noise exposure. To reduce noise exposure, personnel working in the presence of such equipment should use appropriate hearing protection (ear plugs or ear muffs). All employees are required to wear hearing protection when the OSHA action level of 85 decibels is exceeded for an 8-hour

TWA. The SHSO will make this determination and document in the logbook when hearing protection is required. Additional guidance on hearing conservation and noise monitoring is provided in Foster Wheeler procedure EHS 4-4, Hearing Conservation (Corporate Reference Library), and EHS Guideline EFG1-5, Noise Monitoring (Corporate Reference Library), respectively.

3.4.6 Manual Lifting and Material Handling

Manual lifting and material handling procedures include the following:

- Always bend at the knees when lifting heavy objects.
- Keep the weight close to your body. Do not twist or turn your body while lifting.
- Get help or use a mechanical lifting device for awkwardly shaped objects or objects that are too heavy for one person to lift.

3.4.7 Drill Rig Safety

Drill rigs will be inspected prior to acceptance on site and daily in accordance with Foster Wheeler procedure EHS 6-2, Drill Rigs (Corporate Reference Library). No leaks from any system will be acceptable, and all safety devices will be fully operational.

3.4.8 Heavy Equipment Safety

Heavy equipment shall be operated by qualified operators in accordance with Foster Wheeler Construction procedure CP-7, Construction Tools and Equipment (Corporate Reference Library). Equipment shall be properly equipped for operations in the presence of high levels of hydrogen sulfide, i.e., supplied air and escape equipment. All heavy equipment shall be inspected prior to initial acceptance on site, and thereafter, before, during, and after daily use.

3.5 BIOLOGICAL HAZARDS

3.5.1 Bloodborne Pathogens

The potential exists for exposure to bloodborne pathogens regulated under the Bloodborne Pathogen Standard (29 CFR 1910.1030) as a result of the materials potentially disposed in the sewage lagoons. Traditionally, sewage lagoons would not be a concern for exposure risk to

Hepatitis B or Human Immune Deficiency virus because these vectors are not transmitted readily by oral-fecal routes. However, Hepatitis A exposure is related to the oral-fecal exposure route. Foster Wheeler's Corporate Medical Consultant (CMC) has assessed the risk of exposure to agents addressed by the Bloodborne Pathogen Standard as extremely low. As a result, the requirements of the Bloodborne Pathogen Standard are not applicable to the CMS. However, strictly as a precautionary and hazard awareness measure, all workers will be offered the Hepatitis A and B vaccination series and receive site-specific awareness training on the potential exposure risk and the contents of the Bloodborne Pathogen Standard.

3.5.2 Insects

Stinging insects, primarily spiders, scorpions, bees, and wasps, are prevalent at the site during the warmer months. Field personnel should exercise caution and avoid contact with these insects by always looking ahead to where they will be walking, standing, sitting, or leaning. Personnel who have experienced serious reactions to previous insect bites are urged to secure possible immunization or have an antidote readily available to prevent future reactions.

3.5.3 Rattlesnakes

Field personnel performing site activities could encounter rattlesnakes. Employees are advised to be alert to this danger. Snake bites can be painful and lead to serious illness if not treated immediately; if bitten, personnel must seek medical attention immediately. The best thing to do, however, is to avoid contact as follows:

- Wear sturdy leather boots
- Avoid walking in areas where snakes may hide
- Use extreme caution when moving or lifting objects that could be used by snakes as cover
- Never reach under or behind such objects or into other areas where snakes may hide.

3.5.4 Mosquitoes

Mosquitoes could be prevalent at the site during certain times of the year. The risk of disease transmission via the mosquito vector is considered to be very low. Use of PPE will provide some protection from mosquitoes during normal site operations, and insect repellent should be used when mosquitoes can not be avoided. Creation of mosquito breeding habitat (areas of standing water) will be avoided whenever possible.

Table 3-1. Activity Hazard Analysis

Activity	Potential Hazards	Recommended Control Measures
All activities	Improper lifting	• Design of work flow to minimize manual lifting and minimize distance loads are carried. • Lift heavy or awkward loads using a mechanical device or ask other individuals for help. • Provide training in proper lifting technique.
	Slips, trips, and falls	• Keep work area clean and orderly at all times. Regularly dispose of all debris. • Use guard rails or other appropriate fall-protection systems for all work activities that take place 6 feet or more above the next working surface. • Be aware of slipping hazards due to water and sludge near ponds and decontamination pad.
	Struck by equipment	• Ensure that all equipment is equipped with backup alarm. • Provide a spotter during movement of equipment. • Ensure dust control. • Traffic control.
	Electrocution	• Inspect all portable power tools for defects prior to use. • Use GFCIs for all portable power tools. • Protect all electrical cords going through doorways and across roadways.
	Drowning	• Wear life jackets. • Boating safety as outlined per EHS 6-6 in the Foster Wheeler Corporate Safety Manual.
	Noise	• Use hearing protection for comfort or when required due to monitoring.
	Heat Stress	• Training in hazards of heat stress. • Provide adequate supplies of cool drinking water or electrolyte drinks. • Implement buddy system. • Take breaks in shaded areas as necessary.
	Fire	• NEC/NFPA-approved electrical and mechanical components as required by the design specifications. • Complete training in the use of fire extinguishers. • Use fire extinguishers on small fires. • Coordinate emergency response procedures with the Fire Department. • Store all flammable liquids in accordance with 29 CFR 1910.106. • Only use bonded and grounded containers to transfer flammable liquids. • Only use UL- or FM-approved fuel storage cans used for gasoline or diesel.
	Cuts, abrasions, contusions, or burns	• Use hand tools for the job they were designed. • Wear leather gloves as appropriate. • Be aware of and avoid hot surfaces.

Table 3-1. Activity Hazard Analysis

Activity	Potential Hazards	Recommended Control Measures
	Chemical exposures	• PPE as required by Table 8-1. • Proper storage. • Follow manufacturers and MSDS recommendations for safe storage and handling of odor control chemicals. • Air monitoring if necessary.
	Fuel spill or fire	• Operate pump per manufacturer's specification • Only use UL- or FM-approved fuel storage cans used for gasoline or diesel.
	Potential exposure to hepatitis A and B	• All personnel vaccinated for hepatitis A and B prior to starting work at the ponds.

Table 3-2 Potential Chemical Contaminants at Cannon AFB Sewage Lagoons

Chemical	Maximum Sludge Concentration
Barium	635 mg/kg
Cadmium	5.1 mg/kg
Chromium (total)	51.0 J mg/kg
Copper	346 mg/kg
Selenium	35.3 mg/kg
Silver	97 mg/kg
Vanadium	98 J mg/kg
Zinc	672 mg/kg
α-Chlordane	31 μg/kg
γ-Chlordane	45 μg/kg
4,4'-DDD	53 μg/kg
4,4'-DDE	90 μg/kg
Arochlor-1254	490 J μg/kg
Acetone	17,000 μg/kg
Bis(2-ethylhexyl) phthalate	340,000 J μg/kg

Source: Phase III Sludge Management Compliance Evaluation and Requirements Identification (E&E,1998); Remedial Investigation Report for 18 Solid Waste Management Units, Cannon Air Force Base, New Mexico (Woodward Clyde, 1992)

J Detected at a concentration less than the method reporting limit
mg/kg milligrams per kilogram
μg/kg micrograms per kilogram

4.0 SITE CONTROLS

4.1 SITE WORK ZONES

The exclusion zone and contamination reduction zone for the CMS are within a fenced area surrounding the lagoons. All personnel entering these site work zones must have the appropriate training to conduct work activities. Untrained visitors may enter the area if escorted by a trained worker.

All areas outside the fenced area are not access controlled and are considered a part of the support zone. Temporary exclusion zones within the support zone will be established for activities of short duration.

4.2 OTHER SITE CONTROL MEASURES/WORK LIMITATIONS

The following measures are designed to augment the specific health and safety guidelines provided in this plan:

- The "buddy system" will be used by all field personnel. No one performing system maintenance or repair operations is allowed to work alone in the exclusion zone. Employees performing routine surveillance or system monitoring may work alone but must carry a cellular phone at all times.

- Avoidance of contamination is of the utmost importance. Whenever possible, avoid contact with contaminated (or potentially contaminated) surfaces or materials. Walk around (not through) puddles and discolored surfaces.

- Hands and face must be thoroughly washed upon leaving the work area and before eating, drinking, or performing any other activities.

- Eating, drinking, chewing gum or tobacco, smoking, or performing any activity that increases the probability of hand-to-mouth transfer and ingestion of materials is prohibited except in the support zone after proper decontamination.

- Beards or other facial hair that interfere with respirator fit are prohibited for anyone who is required to wear a respirator.

- The use of alcohol or drugs is prohibited during the conduct of field operations.

All equipment must be decontaminated or discarded, as designated by the SHSO, before leaving the site.

5.0 DECONTAMINATION

5.1 PERSONNEL DECONTAMINATION

Personnel decontamination will be accomplished by following a systematic procedure of cleaning and removal of PPE. Disposable gloves or Tyvek will be rinsed free of gross contamination and disposed as general refuse. Respirators will be cleaned after each use and will be stored in plastic bags after cleaning. General refuse will be placed in plastic bags and then into an on-site dumpster.

Personnel are required to wash their hands and face following all maintenance, operation, monitoring, or repair activities to minimize the potential for ingesting contaminants.

5.2 EQUIPMENT DECONTAMINATION

All equipment used to perform activities for the CMS must be decontaminated. Decontamination of equipment will be performed with a surfactant (such as Alconox) wash and rinse or by proper disposal methods (SOP C-6).

6.0 MEDICAL SURVEILLANCE

6.1 GENERAL

Personnel covered by this SSHP are active participants in the Foster Wheeler or a similar medical surveillance program that complies with OSHA 29 CFR 1910.120(f), American National Standards Institute Z88.2, and the USACE Safety and Health Requirements Manual EM 385-1-1, Appendix K. Each individual must complete an annual surveillance examination and/or an initial baseline examination within the last year prior to performing any work covered by this SSHP.

7.0 AIR MONITORING

The SHSO will continuously monitor the exposure of on-site personnel to chemical and physical hazards to ensure that potential hazards are identified, evaluated, and controlled. Air monitoring will be conducted for total organic vapor, hydrogen sulfide, and total dust during the CMS. Hydrogen sulfide will be monitored by both personal monitors and general area monitoring. Action levels for potential air contaminants are addressed in Table 7-1.

7.1 PERSONAL EXPOSURE MONITORING

According to OSHA 29 CFR 1910.120, personal exposure monitoring for the purpose of determining individual TWA exposures is required during certain site cleanup or other remedial activities. Determinations regarding individual exposure potentials will be based on the work area monitoring described above. Personal air sampling will be conducted for hydrogen sulfide. The air sampling will not be conducted by using personal monitoring equipment for continuous monitoring that will provide a time-weighted average with an alarm indicator set at the actions levels described in Table 7-1.

Table 7-1. Air Monitoring Requirements and Action Levels

Contaminant	Activity	Instrument	Action Levels	Action
Total Organic Vapors	• All activities	Photoionization detector (PID) with a 10.2 or 10.6 eV lamp	Background - 10 ppm 10 - 100 ppm > 100 ppm	No respiratory protection required Full facepiece air-purifying respirator with GME-H cartridges must be worn Stop work and consult with PESM
Total Dust	• Compaction of sludge material	Miniram	Background–1.5 mg/m^3 1.5–3.0 mg/m^3 >3.0 mg/m^3	No respiratory protection required Full facepiece air-purifying respirator with GME-H cartridges must be worn Stop work and consult with PESM
Hydrogen Sulfide	• All activities	Hydrogen sulfide personal monitor	0–1 ppm 1–5 ppm	No respiratory protection Level B–Full facepiece supplied air respirator.
			>5 ppm	Leave area until airborne concentration is less than 5 ppm or upgrade to Level B respiratory protection.

8.0 PERSONAL PROTECTIVE EQUIPMENT

Based on analysis of the potential site-specific health and safety hazards identified in Section 3.0 of this plan, the expected minimum level of PPE required for performance of the CMS field activities is Level D, except for equipment operators engaged in operations that disturb lagoon sludges. Level B operations are not anticipated based on previous data collected. However, because of the potential for intermittant, high-concentration releases of hydrogen sulfide that may occur during the movement of the sludges, the SHSO will provide the equipment operators with airline respiratory protection if deemed necessary by the PESM. The project respiratory protection program is provided in Section 9.0 of this SSHP. Table 8-1 is a matrix that identifies the minimum level of PPE required for field activities. Should Level B PPE be required, the PESM will be notified and consulted before upgrade in level of protection takes effect.

Table 8-1 Personal Protective Equipment Requirements

Activity	Required PPE
General activities	• Work clothing (sleeved shirts, long pants) • Tyvek™ coveralls as needed to keep clean • Hard hat • Full facepiece respirator with acid gas cartridges for all sludge moving operations (if $H_2S > 1$ ppm but less than 5 ppm) • Steel-toed work boots • Hearing protection • Nitrile gloves
Equipment decontamination	• Work clothing (sleeved shirts, long pants) • Tyvek™ coveralls or splash resistant protective clothing such as raingear where contact with potentially contaminated liquid is anticipated. • Hard hat • Full face splash shield or full facepiece respirator • Steel-toed work boots • Hearing protection • Nitrile gloves
Clean soil compaction	• Work clothing (sleeved shirts, long pants) • Hard hat • Safety glasses • Steel-toed leather work boots • Hearing protection

9.0 RESPIRATORY PROTECTION PROGRAM

Air purifying and air-supplied respiratory protection may be required during site activities. The respiratory protection selection is based on the anticipated and measured air concentrations of hydrogen sulfide and on other action levels provided in Section 7.0 of this SSHP. Use and selection of respirators is in accordance with Foster Wheeler's Corporate Respiratory Protection Program, EHS 5-2 (Corporate Reference Library) and the OSHA Respiratory Protection Standard, 29 CFR 1910.134.

All personnel required to don air-purifying respirators will be qualitatively fit tested for the particular brand and size respirator he/she will be wearing on site. Fit tests will be current within the last year. The PESM will specify a cartridge change schedule for air purifying respirators based on the contaminant for which protection is required. Table 7-1 presents the respiratory protection protocol for the CMS field program.

Normal eyeglasses cannot be worn under full-face respirators because the temple bars interfere with the face seal. Special spectacles designed for use with respirators must be made available to workers requiring corrective facepiece lenses. Contact lenses should not be worn at sites where the potential for contact with corrosive liquids or solids exists.

10.0 TRAINING AND COMMUNICATION

10.1 GENERAL TRAINING REQUIREMENTS

Personnel covered by this SSHP must be active participants in the Foster Wheeler Hazardous Waste Operation and Health and Safety Training Program, which complies with OSHA 29 CFR 1910.120(e), OSHA 29 CFR 1926.20, and the USACE Safety and Health Requirements Manual EM 385-1-1 (Section 28.D). Individuals planning to work in the active, designated exclusion and/or contamination reduction zones must first have completed an annual 8-hour refresher training course and/or initial 40-hour classroom and 3-day on-site supervised training courses.

10.1.1 First Aid Training

Individuals assigned to perform first aid and cardiopulmonary resuscitation (CPR), as specified in Section 11 of this SSHP, must hold current American Red Cross or equivalent training certification. At least two site workers will be currently certified in first aid and CPR during all phases of field work.

10.1.2 Bloodborne Pathogen Standard

As discussed in Section 3.5.1 of this SSHP, Foster Wheeler has determined that the Bloodborne Pathogen Standard does not apply to the work activities conducted for the CMS. However, to promote awareness and alleviate concerns, all employees will receive site-specific training on the potential bloodborne pathogen exposure risks and the contents of the Bloodborne Pathogen Standard.

10.2 ON-SITE COMMUNICATIONS

Verbal communication at the sites may be impeded by on-site background noise, ongoing activities, or the use of PPE. Hand signals may be used between personnel and will be reviewed during daily/preshift safety meetings. The use of the buddy system will ensure that any information is communicated between all workers on site. Visual contact must be maintained between paired personnel when respiratory protection is used.

External communications between on-site personnel will be conducted through the use of cellular telephones. Exact locations of the site facility telephones and emergency telephone numbers will be determined before site activities begin and communicated to all site personnel.

10.3 NOTIFICATION OF ACTIVITIES

The SHSO will contact the Cannon AFB fire department and hospital prior to stating work to discuss project scope and potential hazards at the site and confirm emergency response capabilities.

10.4 SAFETY ORIENTATION/TAILGATE MEETINGS

The SHSO will conduct a daily (or preshift) tailgate safety meeting to review the physical hazards and chemical and toxicological properties of chemicals that may be present at the site. Proper and safe work practices will be reviewed. This meeting will also address contingency plans for potential emergency situations and location(s) of available safety equipment. The SHSO will inspect the site to ensure that the SSHP is being properly implemented, and shall also periodically review the SSHP to ensure that all physical and chemical hazards encountered during field activities are recognized and addressed therein.

11.0 FIRST AID PLAN

The following general guidelines apply to first aid services for the CMS:

1. Survey the situation. Do not endanger your own life. Do not enter a confined space to rescue someone who has been overcome unless properly equipped and a standby person is present.
2. Call the fire department immediately. Explain the physical injury, chemical exposure, fire, or release.
3. Decontaminate the victim without delaying life-saving procedures.
4. If the victim's condition appears to be noncritical, but seems to be more severe than minor cuts, he/she should be transported to the nearest hospital by trained Emergency Medical Services personnel. The attending physician has the responsibility for determining the severity of the injury.
5. When transporting an injured person to a hospital, bring this SSHP to assist medical personnel with diagnosis and treatment. In all cases of chemical overexposure, follow standard procedures as outlined for poison management, first aid, and, if applicable, CPR.
6. Notify the DO Manager and the SHSO. Follow Foster Wheeler incident reporting procedures and also complete the Incident/Near Miss Report Form EHS 1-7 (Appendix A) within 24 hours.

First aid equipment and supplies will be kept in a project vehicle or at a location that is near the work areas at the sewage lagoons. Table 11-1 details the first aid equipment that will be present on site during CMS field activities.

Table 11-1 First Aid Equipment and Supplies

Equipment	Size	Location
First aid kits w/bloodborne pathogen kit	10-person capacity for every 5 workers	In each project vehicle
Emergency eye wash	1 portable unit with 15-minute flush capacity	On site or in project vehicle
Spill control	Absorbent pads, drum, and shovels	On site or in project vehicle
Fire extinguishers	10 pound ABC— at least 2 units	On site or in project vehicle

12.0 GENERAL SAFETY RULES

1. All site personnel must attend the daily or preshift tailgate safety meeting.

2. Any individual taking prescribed drugs shall inform the SHSO of the type of medication. The SHSO will review the matter with the PESM and the CMC, who will decide whether the employee can safely work on site while taking the medication.

3. The PPE specified by the SHSO and the SSHP shall be worn by all site personnel. This includes hard hats, steel-toed boots, and safety glasses, which must be worn at all times in active work areas.

4. Facial hair (beards, long sideburns, or mustaches) that may interfere with a satisfactory fit of a respiratory mask is not allowed on any person who may be required to wear a respirator.

5. Personnel must follow proper decontamination procedures.

6. Eating, drinking, chewing tobacco or gum, smoking, and any other practice that may increase the possibility of hand-to-mouth contact is prohibited in the exclusion zone or the contamination reduction zone. (Exceptions may be permitted by the PESM to allow fluid intake during heat stress conditions.)

7. All lighters, matches, cigarettes, and other forms of tobacco are prohibited in the exclusion zone. Smoking is permitted only in specific designated areas.

8. All signs and demarcations shall be followed. Such signs and demarcations shall not be removed except as authorized by the SHSO.

9. No one shall enter a permit-required confined space without a permit. Confined space entry permits must be followed. No confined space entry is permitted on this project without specific authorization of the PESM.

10. All personnel must follow Hot Work permits.

11. All personnel must use the buddy system in the exclusion zone.

12. All personnel must follow the work-rest regimens and other practices required by the heat stress program.

13. All personnel must follow lockout/tagout procedures when working on equipment involving moving parts or hazardous energy sources.

14. No person shall operate equipment unless trained and authorized.

15. No one may enter an excavation greater than 4-feet-deep unless authorized by the Competent Person. Excavations must be sloped or shored properly. Safe means of access and egress from excavations must be maintained.

16. Ladders and scaffolds shall be solidly constructed, in good working condition, and inspected prior to use. No one may use defective ladders or scaffolds.

17. Fall protection or fall arrest systems must be in place when working at elevations greater than 6 feet for temporary working surfaces or 4 feet for fixed platforms.

18. Safety harnesses and lanyards must be selected by the SHSO. Safety belts for fall protection are not authorized. The user must inspect the equipment prior to use. No defective personal fall-protection equipment shall be used. Personal fall protection that has been shock loaded must be discarded.

19. Hand and portable power tools must be inspected prior to use. Defective tools and equipment shall not be used.

20. GFCIs shall be used for cord and plug equipment used outdoors or in damp locations. Electrical cords shall be kept out of walkways and puddles unless protected and rated for such service. Vehicles and equipment will not drive over any electrical cords.

21. Improper use, mishandling, or tampering with health and safety equipment and/or samples is prohibited.

22. Horseplay of any kind is prohibited.

23. Possession or use of alcoholic beverages, controlled substances, or firearms on any site is forbidden.

24. All incidents, no matter how minor, must be reported immediately to the DO Manager and the SHSO.

25. All personnel shall be familiar with the Site Emergency Action Plan, Section 14.0 of this SSHP.

Additional guidelines for safe work practices and health and safety work rules are presented in the Foster Wheeler Project Rules Handbook (1999).

13.0 VISITOR REQUIREMENTS

Visitors to the site will be required to participate in a site-specific safety orientation briefing. In accordance with the contract requirements, four sets of PPE (excluding respirators, prescription glasses, and safety shoes) will be maintained in storage for government representatives. Visitors will sign in and sign out.

14.0 EMERGENCY ACTION PLAN

14.1 GENERAL REQUIREMENTS

Personnel covered by this SSHP are not expected to participate in an emergency response where there are potential safety or health hazards (i.e., fire, explosion, or chemical exposure).

14.2 EMERGENCY TELEPHONE NUMBERS

Ambulance (Base)		(505) 784-4033 or 911
Fire Dept. (Base)		(505) 784-2578 or 911
Base Hospital		(505) 784-4033 or 911
Poison Control		(800) 432-6866
EPA (Info line)		(800) 424-9346
National Response Center		(800) 424-8802
Chemtrec		(800) 424-9300
Plains Regional Medical Center—Civilian Hospital		(505) 769-2141
Sina Seyedian	Program Manager	(303) 988-2202
James Morning, OHST	Construction Manager/SHSO	(505) 430-2307
Roger Margotto, CIH	PESM	(619) 234 8696
		(714) 810-3742 (*pager*)
Carol Bieniulis	DO Manager/Field Project Geologist/SHSO	(505) 878-8924
		(505) 934-0879 (*mobile*)
Tom Zink	Technical Manager	(402) 221-7711
John Pike/Sanford Hutsell	Base Point of Contact (POC)	(505) 784-4348
Jayne Fitzgerald	Regional Compliance Manager	(714) 444-5534

14.3 INCIDENT REPORTING PROCEDURES

In the event of an accident or incident, an Accident/Incident Report Form (Foster Wheeler form) and Accident Report ENG Form 3394 (Attachment 1) must be completed within 24 hours. Depending upon the nature of the incident, additional agencies or individuals that may need to be notified, including the EPA, New Mexico Environment Department, OSHA, and Base POC. Unless otherwise mandated by law, no outside agency may be contacted without the explicit approval by Cannon AFB.

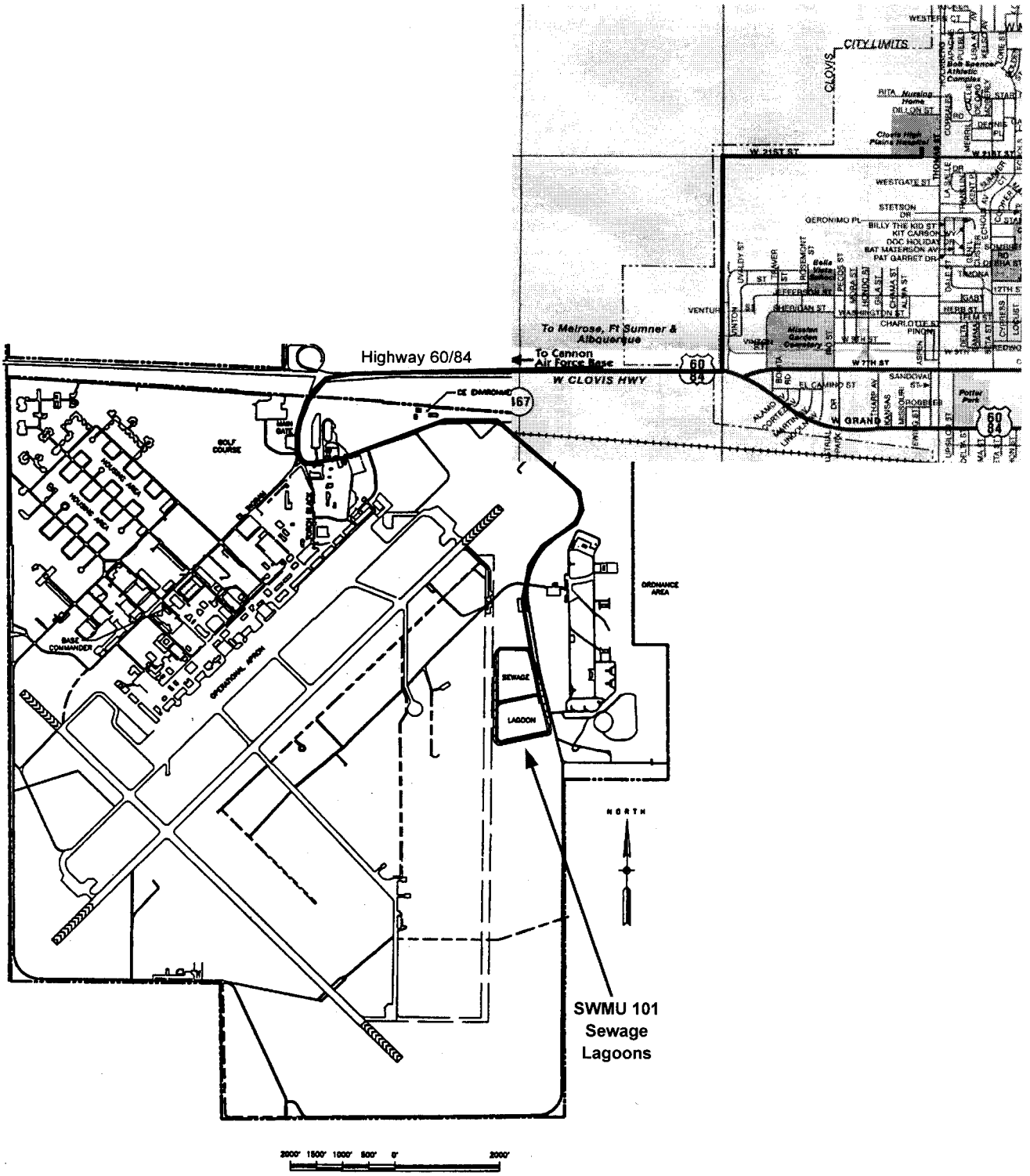
All incidents resulting in injury, illness, or property damage require completion of an accident investigation and report. The investigation should be initiated as soon as emergency conditions

are under control. The purpose of this investigation is not to attribute blame but to determine the pertinent facts so that repeat or similar occurrences can be avoided.

The investigation should begin while details are still fresh in the mind of the personnel involved. The person administering first aid may be able to start the fact gathering process if the injured are able to speak. Pertinent facts must be determined. Questions beginning with who, what, when, where, and how are usually most effective in discovering ways to improve job performance in terms of efficiency and quality of work as well as safety and health concerns.

14.4 MEDICAL TREATMENT FACILITIES

The routes to the Cannon AFB Hospital and to Plains Regional Medical Center Hospital in Clovis, New Mexico, are shown on Figure 14-1.



Scale in Feet is Approximate

SITE-SPECIFIC SAFETY AND HEALTH PLAN

Cannon Air Force Base, New Mexico

U.S. Army Corps of Engineers, Omaha District

Figure 14-1

Hospital Route Map

Foster Wheeler Environmental Corporation

15.0 DANGEROUS WEATHER RESPONSE PLAN

Work will not be permitted during severe weather conditions that will endanger the health and safety of on-site workers or imminent threat of severe weather. Additionally, site workers are advised to do the following:

1. Stop work during electrical storms and other extreme weather conditions such as extreme heat or cold temperatures.
2. Take cover in vehicles or at a designated building provided for field operations by Cannon AFB.
3. Listen to local forecasts for warnings about specific weather hazards such as tornadoes, flash floods, or electrical storms.
4. Take frequent work breaks during extreme heat or cold conditions.

16.0 SPILL PREVENTION AND CONTROL

Precautions will be taken to prevent oil and hazardous material spills, including daily inspection by the site personnel of equipment, structure(s), and containers. Personnel using hazardous materials will inspect containers before and after use. In the event of a spill/release, the Construction Site Manager will notify the Cannon AFB Fire Department and USACE. Spill response will be conducted in accordance with federal, state, local, and Cannon AFB regulations.

Client Notification

The following chain of communications should be used in case of a spill:

- Ms. Carol Bieniulis, the Foster Wheeler DO manager and field technical lead, has been designated as the Foster Wheeler Spill and Release Reporting Site Representative. In the event of a spill or release, Ms. Bieniulis will immediately notify Mr. Sanford Hutsell, Cannon AFB ([505] 784-4348), Mr. Tom Zink, USACE ([402] 221-7711), and the Cannon AFB Fire Department.
- Site personnel must contact the Foster Wheeler DO Manager. In addition, the DO Manager must contact the Regional Environmental, Safety, and Quality (ESQ) Manager and the Regulatory Specialist:
  - Foster Wheeler Environmental DO Manager: Carol Bieniulis
    Phone: (505) 878-8924
    Mobile: (505) 934-0879
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  - Foster Wheeler Environmental Regional ESQ Manager: Jayne Fitzgerald
    Phone: (714) 444-5534
    Fax: (714) 444-5560
  - Foster Wheeler Environmental Regulatory Specialist: Craig O'Rourke
    Phone: (714) 444-5511
    Fax: (714) 444-5560

17.0 REFERENCES

E&E. (Ecology and Environment, Inc.)
1998. Phase III Sludge Management Compliance Evaluation and Requirements Identification.

Foster Wheeler (Foster Wheeler Environmental Corporation)
1999a Draft Basewide Health and Safety Plan, Cannon AFB, October

1999b Foster Wheeler Environmental Corporation Environmental Health and Safety Program Manual and Project Rules Handbook.

Woodward Clyde (Woodward Clyde Consultants)
1992. Remedial Investigation Report for 18 Solid Waste Management Units. Cannon Air Force Base, Clovis, New Mexico. October 1992.

ATTACHMENT 1

HEALTH AND SAFETY FORMS

HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT

This form serves as documentation that field personnel have read, have been informed, and understand the provisions of the Cannon AFB Basewide Health and Safety Plan (HASP) and the project-specific Addendum to the HASP for the Corrective Measures Study (CMS) of the Sewage Lagoons (SWMU 101).

Each field team member, including subcontractors, will read the Basewide HASP and the project-specific addendum. Once the plans have been read each person will sign this form after the site-specific training is complete before being permitted to work on site. In signing this form each person will understand the following statement:

I have read, or have been informed of, the Cannon AFB Basewide HASP and the project-specific addendum for CMS of SWMU 101. I understand the information presented and will comply the provisions contained therein.

Name	Signature	Date

EHS WEEKLY/MONTHLY CHECKLIST AND ACTION ITEM REPORT

Project: _____ **Area of Inspection:** _____

Inspection Type: ☐ **Weekly** ☐ **Monthly**

Inspector: _____ **Date:** _____

Signature: _____ **Time:** _____

REQUIREMENTS	OBSERVATIONS (N/A if not applicable)	FINDING YES/NO
Work Conditions		
1 Walking /Working Surfaces		
2 Aisles and Passageways		
3 Platforms/ Scaffolding		
4 Ladders		
5 Stairs		
6 Exits/Egress		
7 Roadways		
Ventilation		
9 Lighting		
10 Noise Exposure		
11 Ergonomics		
Materials		
1 Stacking and Storage		
2 Chemicals and Fuel		
3 Compressed Gases		
Equipment		
1 Hand / Portable Tools		
2 Machine, Tools, Guarding		
3 Mobile/ Heavy Equipment		
4 Lifting Gear Equipment		
5 Materials Handling Equipment		
6 Mechanical Power Systems		
7 Hydraulic Power Systems		
Pneumatic Power Systems		
9 Electrical Power Systems		

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EHS WEEKLY/MONTHLY CHECKLIST AND ACTION ITEM REPORT

REQUIREMENTS	OBSERVATIONS (N/A if not applicable)	FINDING YES/NO
10 Valves and Controls		
Hazard Controls		
1 Other Heavy Equipment		
2 Lock-Out Systems		
3 Signs and Tags		
4 Color Coding		
5 Materials Labeling		
6 Warning Systems		
Emergency Systems		
1 Emergency Instructions		
2 Fire Protection		
3 Eye Wash and Showers		
4 First Aid Kits/ Stations		
5 Emergency Rescue Equipment		
Protective Equipment		
Eye Protection		
2 Ear Protection		
3 Respiratory Protection		
4 Head Protection		
5 Hand Protection		
6 Foot Protection		
7 Body Protection		
8 Fall Protection		
Hazardous Waste Storage Area(s)/Satellite Accumulation Areas[1] [2]		
1 Designated, secured area with "Hazardous Waste" signage. For SAA area is marked "SAA". (SAA)		
2 Containers:		
a. DOT-spec. containers (for wastes to go off-site only)		
b. Intact/in good condition (SAA)		

[1] For sites with multiple storage areas or Satellite Accumulation Areas (SAAs), indicate location where deficiencies are noted.
[2] For SAAs, evaluate only rows marked with (SAA).

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EHS WEEKLY/MONTHLY CHECKLIST AND ACTION ITEM REPORT

REQUIREMENTS	OBSERVATIONS (N/A if not applicable)	FINDING YES/NO
c. Waste compatible with containers (e.g., no evidence of corrosion, softening, bulging) (SAA)		
d. Marked "Hazardous Waste"/ visible Accumulation Date. *For SAA, marked "Hazardous Waste" or identify container contents and Accumulation date (SAA)*		
e. Securely closed and stored to prevent rupture/leaking, except when add/remove waste. (SAA)		
f. Labeled with EPA Id. No.		
g. For SAA only, Stored "at the point of generation" and meets quantity limits.		
3 Reactive/ignitable wastes stored at least fifty (50) feet from property.		
4 Liquid wastes within secondary containment.		
5 Incompatible wastes separated by a dike, wall, berm or other device.		
6 Stored for less than 90 days. *(CERCLA projects may have storage variance).*[3]		
7 Container tracking log accurately reflects containers stored. (SAA)		
8 Area maintained in an orderly fashion and complies with state/EHS plan requirements. (SAA)		
Hazardous Waste Tank Storage Area *(Daily inspection is being conducted and maintained on-site)*		
Waste/Stockpiles - State Regulated Non-Hazardous Wastes ***(Refer to PESM Checklists, if applicable)***		
TSCA PCB Wastes – must be inspected at least every 30 days (GMP - weekly) *(Refer to PESM TSCA Checklist for inspection items)*		
Point Source Discharges/ Air Emissions		
1 Permit conditions are being met.		
2 Monitoring equipment is fully operational.		
3 Equipment calibrations and maintenance is up-to-date.		

[3] If stored on-site 75 or more days, TSDF/transporter has been selected (EHS 1-4), pick-up date scheduled and PM/PESM are aware of 90-day limit.

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EHS WEEKLY/MONTHLY CHECKLIST AND ACTION ITEM REPORT

REQUIREMENTS	OBSERVATIONS (N/A if not applicable)	FINDING YES/NO
4 Discharge sampling performed at required intervals.		
5 Review monitoring results *(Report permit exceedences per EHS 1-7)*		
6 DMR and Plant Logs properly completed, signed, and submitted (if required).		
7 Fugitive Dust – Appropriate BMPs are instituted for fugutive dust emissions.		
Stormwater Discharge Activities		
1 SWPPP /Soil Plan reflects current activities.		
2 Monitoring/sampling performed at required intervals.		
3 Review monitoring results *(Report permit exceedences per EHS 1-7)*		
4 BMPs in SWPPP/Soil Plan implemented.		
5 Visual observations indicate stormwater meets water quality criteria.		
Inspections conducted as required and documented. Corrective actions are implemented and documented.		
Other Conditions or Work Practices		
1		
2		
3		
4		

- End of Checklist-

Monthly Inspections must be sent to PESM and Project Manager.

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EHS WEEKLY/MONTHLY CHECKLIST AND ACTION ITEM REPORT

Review previous week's/month's Action Item Report. Carry forward action items that have not been implemented. Note outstanding action items with an (F) in the "Action Item" column on this report. Note an (F) in the "Date Completed" column on previous week's/month's Action Item Report.

Project:

Area of Inspection:

Inspection Type: ☐ **Weekly** ☐ **Monthly**

Date of Inspection:

ACTION ITEM	RESPONSIBLE PARTY	SCHEDULE	DATE COMPLETED
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			

Reviewed by: _____ _____

Site Superintendent/ Site Manager Date

cc: Project Manager (monthly only)
PESM (monthly only)

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CORPORATE ESQ REPORT # _____

FOSTER WHEELER ENVIRONMENTAL CORPORATION

FOSTER WHEELER ENVIRONMENTAL CORPORATION
INCIDENT/NEAR MISS REPORT AND INVESTIGATION

TYPE OF INCIDENT - CHECK ALL THAT APPLY

❒ INJURY/ILLNESS	❒ VEHICLE DAMAGE	❒ PROPERTY DAMAGE	❒ FIRE
❒ SPILL/RELEASE	❒ PERMIT EXCEEDENCE	❒ HIGH LOSS POTENTIAL (NEAR MISS)	❒ OTHER

GENERAL INFORMATION

PROJECT/OFFICE: REPORT #: DATE OF REPORT:

DATE OF INCIDENT: MILITARY TIME: ____ DAY OF WEEK: ____

FW SUPERVISOR ON DUTY: AT SCENE OF INCIDENT: ❒ YES ❒ NO

LOCATION OF INCIDENT:

WEATHER CONDITIONS: ADEQUATE LIGHTING AT SCENE: ❒ YES ❒ NO ❒ N/A

DESCRIBE WHAT HAPPENED (STEP BY STEP - use additional pages if necessary)

AFFECTED EMPLOYEE INFORMATION

NAME: FWENC EMPLOYEE: ❒ YES ❒ NO

HOME ADDRESS:

SOCIAL SECURITY #: HOME PHONE #:

JOB CLASSIFICATION: YEARS IN JOB CLASSIFICATION:

HOURS WORKED ON SHIFT PRIOR TO INCIDENT: YEARS WITH FWENC: AGE:

DID INCIDENT RELATE TO ROUTINE TASK FOR JOB CLASSIFICATION: ❒ YES ❒ NO

INJURY/ILLNESS INFORMATION

NATURE OF INJURY OR ILLNESS:

OBJECT/EQUIPMENT/SUBSTANCE CAUSING HARM:

FIRST AID PROVIDED: ❒ YES ❒ NO

IF YES, WHERE WAS IT GIVEN: ❒ ON SITE ❒ OFF SITE

IF YES, WHO PROVIDED FIRST AID:

WILL THE INJURY/ILLNESS RESULT IN: ❒ RESTRICTED DUTY ❒ LOST TIME ❒ UNKNOWN

MEDICAL TREATMENT INFORMATION			
WAS MEDICAL TREATMENT PROVIDED?:	❒ YES	❒ NO	
IF YES, WAS MEDICAL TREATMENT PROVIDED:	❒ ON SITE	❒ DR.'S OFFICE	❒ HOSPITAL
NAME OF PERSON(S) PROVIDING TREATMENT:			
ADDRESS WHERE TREATMENT WAS PROVIDED:			
TYPE OF TREATMENT:			
VEHICLE AND PROPERTY DAMAGE INFORMATION			
VEHICLE/PROPERTY DAMAGED:			
DESCRIPTION OF DAMAGE:			
SPILL AND AIR EMISSIONS INFORMATION			
SUBSTANCE SPILLED OR RELEASED:	FROM WHERE:	TO WHERE:	
ESTIMATED QUANTITY/DURATION:			
CERCLA HAZARDOUS SUBSTANCE? YES ❒ NO ❒	RQ EXCEEDED? YES ❒ NO ❒ SPECIFY: _____		
REPORTABLE TO AGENCY? YES ❒ NO ❒	SPECIFY: _____		
WRITTEN REPORT? YES ❒ NO ❒	TIME FRAME: _____		
RESPONSE ACTION TAKEN			
PERMIT EXCEEDENCE			
TYPE OF PERMIT:	PERMIT #:		
DATE OF EXCEEDENCE:	DATE FIRST KNOWLEDGE OF EXCEEDENCE:		
PERMITTED LEVEL OR CRITERIA (e.g., Water quality):			
EXCEEDENCE LEVEL OR CRITERIA:	EXCEEDENCE DURATION:		
REPORTABLE TO AGENCY? YES ❒ NO ❒	SPECIFY: _____		
WRITTEN REPORT? YES ❒ NO ❒	TIME FRAME: _____		
RESPONSE ACTION TAKEN:			
NOTIFICATIONS			
NAME(S) OF FWENC PERSONNEL NOTIFIED:		DATE/TIME:	
CLIENT NOTIFIED:	DATE/TIME:		
AGENCY NOTIFIED:	DATE/TIME:	❒ NOT REQUIRED	
CONTACT NAME:			
PERSONS PREPARING REPORT			
EMPLOYEE'S NAME: (PRINT)	SIGN:		
EMPLOYEE'S NAME (PRINT)	SIGN:		
SUPERVISOR'S NAME: (PRINT)	SIGN:		
NOTE: Supervisor to forward a copy of Incident Report to immediate supervisor, PESM, ESS or ESC, and other personnel as identified in Table 1 of this procedure ASAP, but no later then 24 hours.			

REPORT #:_____

INVESTIGATIVE REPORT

DATE OF INCIDENT:_____ DATE OF INVESTIGATION REPORT:_____

INCIDENT COST: ESTIMATED: $_____ ACTUAL: $_____

OSHA RECORDABLE(S): ❒ YES ❒ NO # RESTRICTED DAYS_____ # DAYS AWAY FROM WORK_____

CAUSE ANALYSIS

IMMEDIATE CAUSES – WHAT ACTIONS AND CONDITIONS CONTRIBUTED TO THIS EVENT? (USE NEXT PAGE)

BASIC CAUSES - WHAT SPECIFIC PERSONAL OR JOB FACTORS CONTRIBUTED TO THIS EVENT? (USE NEXT PAGE)

ACTION PLAN

REMEDIAL ACTIONS - WHAT HAS AND OR SHOULD BE DONE TO CONTROL EACH OF THE CAUSES LISTED? INCLUDE MANAGEMENT PROGRAMS (SEE ATTACHED LIST) FOR CONTROL OF INCIDENTS IF APPLICABLE.

ACTION	PERSON RESPONSIBLE	TARGET DATE	COMPLETION DATE

PERSONS PERFORMING INVESTIGATION

INVESTIGATOR'S NAME: (PRINT) SIGN: DATE:

INVESTIGATOR'S NAME: (PRINT) SIGN: DATE:

INVESTIGATOR'S NAME: (PRINT) SIGN: DATE:

MANAGEMENT REVIEW

PROJECT/OFFICE MANAGER (PRINT) SIGN:

COMMENTS:

PESM or ESC (PRINT) SIGN:

COMMENTS:

NOTE: Attach additional information as necessary. Supervisor to forward copy of Investigative Report to the PM or OM, PESM or ESC ASAP, but no later then 72 hours after the incident. A copy shall be sent to the Director, Health and Safety Programs within 24 hours of completion of the report.

EXAMPLES OF IMMEDIATE CAUSES	
SUBSTANDARD ACTIONS	SUBSTANDARD CONDITIONS
1. OPERATING EQUIPMENT WITHOUT AUTHORITY	1. GUARDS OR BARRIERS
2. FAILURE TO WARN	2. PROTECTIVE EQUIPMENT
3. FAILURE TO SECURE	3. TOOLS, EQUIPMENT, OR MATERIALS
4. OPERATING AT IMPROPER SPEED	4. CONGESTION
5. MAKING SAFETY DEVICES INOPERABLE	5. WARNING SYSTEM
6. REMOVING SAFETY DEVICES	6. FIRE AND EXPLOSION HAZARDS
7. USING DEFECTIVE EQUIPMENT	7. POOR HOUSEKEEPING
8. FAILURE TO USE PPE PROPERLY	8. NOISE EXPOSURE
9. IMPROPER LOADING	9. EXPOSURE TO HAZARDOUS MATERIALS
10. IMPROPER PLACEMENT	10. EXTREME TEMPERATURE EXPOSURE
11. IMPROPER LIFTING	11. ILLUMINATION
12. IMPROPER POSITION FOR TASK	12. VENTILATION
13. SERVICING EQUIPMENT IN OPERATION	13. VISIBILITY
14. UNDER INFLUENCE OF ALCOHOL/DRUGS	
15. HORSEPLAY	

EXAMPLES OF BASIC CAUSES	
PERSONAL FACTORS	JOB FACTORS
1. CAPABILITY	1. SUPERVISION
2. KNOWLEDGE	2. ENGINEERING
3. SKILL	3. PURCHASING
4. STRESS	4. MAINTENANCE
5. MOTIVATION	5. TOOLS/EQUIPMENT
	6. WORK STANDARDS
	7. WEAR AND TEAR
	8. ABUSE OR MISUSE

MANAGEMENT PROGRAMS FOR CONTROL OF INCIDENTS	
1. LEADERSHIP AND ADMINISTRATION	10. HEALTH CONTROL
2. MANAGEMENT TRAINING	11. PROGRAM AUDITS
3. PLANNED INSPECTIONS	12. ENGINEERING CONTROLS
4. TASK ANALYSIS AND PROCEDURES	13. PERSONAL COMMUNICATIONS
5. TASK OBSERVATION	14. GROUP MEETINGS
6. EMERGENCY PREPAREDNESS	15. GENERAL PROMOTION
7. ORGANIZATIONAL RULES	16. HIRING AND PLACEMENT
8. ACCIDENT/INCIDENT ANALYSIS	17. PURCHASING CONTROLS
9. PERSONAL PROTECTIVE EQUIPMENT	

NOTIFICATION REMINDER
Fatalities or hospitalization (admittance) of three or more individuals requires notification to OSHA within 8 hours. Contact the Director, Health and Safety Programs or Director, ESQ Programs to make the notification. If unavailable, the senior operations person on site should make the notification.

INCIDENT/NEAR MISS REPORT AND INVESTIGATION INSTRUCTIONS

General : The incident report (pages 1 and 2) must be completed within 24 hours. Do not delay the report if any information is unknown. It can be provided later by revising the Report.

Type of Incident: Check all that apply. A High Loss Potential (Near Miss) incident is one that does not result in loss, but under slightly different circumstances, could have resulted in an OSHA Recordable injury, spill, release, permit exceedence, fire, or vehicle/property damage in excess of $500. All High Loss Potential (Near Miss) incidents are to be investigated.

General Information

Project/Office: If the incident occurs on a delivery order contract, give the contract/program name, DO# and location. If the incident occurs on a C&E field project, give the Office location managing the project as well as the project/location.

Report No.: Optional numbering field for offices/projects.

FW Supervisor: The Foster Wheeler Supervisor responsible for the work effort involving the incident. Do not give a subcontractor supervisor or craft foreman name. If a Foster Wheeler Supervisor was the Affected Employee, this field should contain the name of his or her supervisor. The Supervisor is the project supervisor if the incident happens on a project, or the administrative supervisor if the incident happens in the office. E.g., a geologist, acting as an FOL gets injured on a job site, or in a motor vehicle in the course of project work. The FW Supervisor is most likely the Project Manager. If the same geologist gets injured lifting a box in his office, the FW Supervisor is likely the Office Science Lead.

Location of Incident: The specific location on the project, in the office, or off-site location.

Weather Conditions: Temperature, precipitation, approximate wind speed and direction, cloud cover, relative humidity. This information may be included in the description section, and must be given in detail whenever it is a factor in the cause or impact., e.g., spill, release, heat stress, wind blown material.

Describe What Happened: This section must be completed in sufficient detail to adequately describe the events and conditions leading up to and resulting from the incident. Try to answer the questions who, what, where, when, and how. This information is then used to determine why (cause). Provide details such as work objective, procedure being used, body position, and PPE. Include diagrams or sketches for all incidents involving vehicles/equipment and other incidents where they aid in providing detail or perspective. Consider attaching photographs. Follow the guidelines in Practical Loss Control Leadership, and consider the impact of each of the following:

P - People
E - Equipment
M – Material
E – Environment

To do an effective job, a visual inspection of the scene is usually necessary along with private interviews of affected employees and witnesses.

Where appropriate, use terms indicating the type of contact, e.g., struck by; struck against; fall from elevation; fall on same level; caught in; caught between or under; caught on; contact with; overstress; equipment failure; environmental release; fire.

Affected Employee Information

FWENC Employee: Direct hire, whether professional, administrative, or craft; full-time or part-time; permanent or temporary. If the affected employee is not a FWENC employee, give the name of the employer and business relationship (e.g., client, subcontractor) in the description section above.

Hours Worked on Shift Prior to the Incident: Only include the amount of time the employee worked that shift or day prior to the incident.

Years with FWENC: For FWENC employees, give the number of years employed with FWENC. If the employee has worked for FWENC for less than a year, do not write <1. Give the answer in fraction of year, or specify the number of months, e.g., 0.1 or 1 month.

Injury/Illness Information

Nature of Injury or Illness: If the incident resulted in an injury or illness, give a brief description of the body part affected and type of injury or illness, e.g., fractured thumb, left hand; carpal tunnel syndrome, right hand.

First Aid Provided: First Aid is any treatment that does not have to be provided by a health care professional, even if it is. E.g., a laceration that is cleaned and bandaged in a clinic may constitute first aid, if sutures are not given.

Will the Injury Result In:. Do not delay the report if this information is unknown.

Medical Treatment Information

Was Medical Treatment Provided? Medical treatment is that treatment that must be provided by a licensed medical practitioner, e.g., sutures, prescription medication, etc.

Type of Treatment: This information is important in determining OSHA recordability, since some forms of treatment would not constitute a Recordable case (e.g., one-time administration of prescriptions, negative diagnostic exams). Attach a copy of the treating professional's statement/work release.

Vehicle and Property Damage Information

Vehicle/Property Damaged: For vehicles, indicate VIN and whether it is company owned or leased, business trip rental (Avis) or owned by others.

Description of Damage: Be specific as to the identity of damaged part, location and extent.

Spill and Air Emissions Information

Substance Spilled or Released: For pure substances, list materials by common name/chemical. For wastes, indicate waste code. For mixtures or contaminated media, provide contaminant name, CAS No., concentration.

RQ Exceeded? Reportable quantity. Contact your ESQ representative for guidance. Specify the RQ for the material, whether you answer yes or no.

Reportable to Agency? If yes, specify the federal, state or local agency that must be provided with verbal and/or written notification.

Written Report? Answer yes if the release requires a written report to be filed and note the time frame.

Response Action Taken: Describe the mitigation efforts, as well as any reports made, beyond initial notification.

Permit Exceedence

Type of Permit: List name of permit including the agency name where applicable (e.g., NPDES, PSAPCA NOC)

Date of Exceedence: Specify date exceedence occurred (e.g., date discharge in excess of permit limits occurred)

Date First Knowledge of Exceedence: Specify date when first knew there was an exceedence (i.e., date analytical received). This date may be different from the date of the xceedence listed above.

Permitted Level or Criteria: List numerical discharge or emission limit or narrative criteria specified in the permit (e.g., 20% opacity limit, Best Management Practices (BMP) implementation per SWPPP).

Exceedence Level or Criteria: Specify actual numerical discharge/emission limit or narrative criteria which was exceeded (e.g., 22% opacity, failure of BMPs (silt fencing collapse) per SWPPP)

Exceedence Duration: Specify time frame by date and hours (using military time) during which exceedence occurred.

See "**Spill/Release Information**" (above) for description of remaining questions.

Persons Preparing Report

Employee's Name: The affected employee described on page 1 should review the report and sign here, as well as other employees witnessing or involved in the incident.

Supervisor's Name: The FWENC Supervisor must review and sign the report indicating agreement. The FWENC Supervisor and the Investigator (next page) should be the same person.

Investigative Report

Report No.: This is the same as the project/office optional report number from page 1 of the Incident/Near Miss Report.

Date of Investigative Report: This date should be within 72 hours of the incident. In cases where the investigation is not completed until a later date, submit the incomplete report within the 72 hours, and a revised report should be submitted when the missing information is obtained .

Incident Cost: For all vehicle/equipment or property damage cases, an estimated or actual loss value must be entered. If an estimated value is entered, the report must be revised when the actual costs are known.

OSHA Recordables: This section should be completed in consultation with the PESM. If it cannot be determined at the time of the report, the PESM should consult with the Director, Health and Safety Programs and revise the report when a determination is made.

No. of Restricted Days: This relates to days of restricted work activity, not restrictions on motion or physical capability. If the employee is capable of doing his normal job the day after the injury and thereafter, there are no restricted days, even if the physician indicates a physical restriction. It does not include the day of the injury.

No. of Days Away from Work: The number of days after the day of the injury that the employee was scheduled to work but could not due to an occupational injury. If the treating physician releases an employee to return to work, but the employee chooses not to come to work, do not count those days. In this case the PESM should contact the Director, Health and Safety Programs.

Cause Analysis

Immediate Causes: Determine the immediate causes, using the example on page 4. If one or more of the examples fits the circumstance, use those words in the cause description. This facilitates statistical analysis of the incident database for program evaluation/modification. However, do not confine your cause determination to the guide words. Explain, e.g., Improper Lifting – employee attempted to lift box by bending at the waist and twisting while lifting. Be sure that the incident description on page 1 is sufficiently detailed to support the causal analysis in this section. An assumption of cause (e.g., improper lifting) from the injury (low back pain) is not acceptable.

Basic Causes: Like the Immediate Causes, use the guide words in the attachment whenever appropriate and explain. For example, improper motivation may be because the correct way takes more time or effort; short cutting standard procedure is tolerated or positively reinforced; or the person thinks there is no personal benefit to always doing the job correctly.

Note: The investigator is encouraged to review the Practical Loss Control Leadership chapters on *Causes and Effects of Loss* and *Accident/Incident Investigation* before doing the causal analysis. As a check, the investigator may refer to the S.C.A.T. Chart available from the PESM.

Remedial Actions: Include all actions taken or those that should be taken to prevent recurrence. Be sure that actions address the causes. For example, training (safety meetings) may be a necessary response for lack of knowledge, but may be inadequate for improper motivation. If completion dates exceed the 72 hours reporting period, a revised report must be submitted when all remedial actions are complete.

Persons Performing Investigation: The primary investigator is the FWENC Supervisor in charge of the work where the incident occurred. Others participating in the investigation, such as the Project Manager, ESS, QC, site engineer, foreman, etc. should also sign the report.

Management Review: The Project or Office Manager and the PESM or office ESC must sign the report indicating their satisfaction with thoroughness of the investigation and the report, and their concurrence that the action items address the identified causes. This constitutes the peer review, and the report, particularly the description, should be clear to readers not familiar with the project or incident.

ATTACHMENT 2

MATERIAL SAFETY DATA SHEETS
(Provided in field copies of the SSHP and kept on file by the SHSO on site)

APPENDIX C
STANDARD OPERATING PROCEDURES

The Standard Operating Procedures for the field investigation activities of SWMU 101, the Sewage Lagoons CMS at Cannon Air Force Base are included in this Appendix. It is understood that at all times the site-specific requirements supersede these generic requirements.

LIST OF STANDARD OPERATING PROCEDURES

SOP C-1 Drilling and Subsurface Sampling

SOP C-2 Borehole and Sample Logging

SOP C-3 Borehole Abandonment

SOP C-4 Sludge Sampling

SOP C-5 Surveying

SOP C-6 Equipment Decontamination

SOP C-7 Sample Handling and Documentation

SOP C-8 Headspace Screening

SOP C-9 Field Preservation for Volatile Organic Compounds Using Methanol

LIST OF TABLES

Number	Title
C7-1	Sample Containers, Preservation, and Holding Times for Soil

LIST OF FIGURES

Number	Title
C1-1	Standard Penetration Test
C2-1	HTW Drilling Log
C2-2	USCS Classification Chart
C7-1	Daily Quality Control Summary Report
C7-2	Typical Chain-of-Custody Record
C7-3	Field Change Request

LIST OF ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
ASTM	American Society for Testing and Materials
C-O-C	chain-of-custody
CQAB	Chemical Quality Assurance Branch of the Waterways Experimentation Station
DPT	Direct Push Technology
DQCR	Daily Quality Control Report
FCR	Field Change Request
ft	foot/feet
HSA	hollow-stem auger
HTW	hazardous and toxic waste
in	inch/inches
lb	pound
NGVD	National Geodetic Vertical Datum
PCB	polychlorinated biphenyl
PID	photoionization detector
PPE	personal protective equipment
RCP	Regulatory Compliance Plan
SSHP	Site-Specific Health and Safety Plan
SOP	Standard Operating Procedure
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
VOC	volatile organic compound
°C	degrees Celsius

STANDARD OPERATING PROCEDURE C-1
DRILLING AND SUBSURFACE SAMPLING

PURPOSE

The procedures presented herein describe the Standard Operating Procedures (SOPs) to be followed for hollow-stem auger (HSA) drilling and associated subsurface soil sampling.

PROCEDURE

Fundamentals

The following elements will apply to all soil borings and subsurface sampling, unless expressly modified by subsequent project-specific plans:

- All drilling will conform to state and local regulations. Permits, applications, and other documents required by state and local authorities will be obtained.
- The location of all borings will be approved in writing by the U.S. Army Corps of Engineers (USACE) before drilling commences. If approved locations must be offset greater than 20 feet (ft) due conditions at the borehole location, approval for offset locations shall be obtained from the USACE in writing prior to drilling. However, if a boring is offset less than 20 ft from the approved location the new location may be considered approved by the USACE.
- The drill rig and all equipment that enters a borehole will be decontaminated in accordance with SOP C-6.
- The drill rig will not leak any fluids that may enter the hole, contaminate equipment that is placed in the hole, or contaminate the ground surface. Temporary use of rags or diapers to absorb leaking fluids is unacceptable.
- Hollow-stem auger drilling will be the primary drilling method.
- The method of sample collection is dependent on the drilling method used. A standard penetration test will be performed each time a split spoon sample is taken. The test will be performed in accordance with the American Society of Testing and Materials (ASTM) D 1586.
- Soils samples analyzed for volatile organic compounds (VOCs) will be collected using an EnCore™ sampler. These samples will not be composited or homogenized.
- Surface water and extraneous materials will not enter the boring
- Boreholes will be abandoned as specified in SOP C-3
- All trash and drill cuttings will be disposed as dictated in the Regulatory Compliance Plan (RCP).

Lithologic logging is necessary to determine the physical characteristics of the subsurface. This information will be used in conjunction with contaminant chemical and physical data to

determine how the contaminant will move from its source to potential receptors. This data will also be used for evaluating the feasibility of various remediation technologies for cleanup of subsurface contamination. The stratigraphy at Cannon Air Force Base (AFB) may be complex with lateral and vertical variation of heterogeneous lithofacies. Small lenses of clay or sand present in these lithofacies can have an effect on contaminant transport. These lenses may be missed if lithologic sampling is not continuous.

Base Clearance

Completion of a digging permit, Base Civil Engineering Work Clearance Request form, may be required before drilling commences. If so, the permit needs approved by the Head of Environmental Restoration for Cannon AFB. The work clearance request is typically processed prior to the start of work. If delays are encountered and the conditions at the job site change, this work clearance request may need to be reprocessed. The type of information typically required to accompany this type of permit includes the following:

- Location
- Work order/job number
- Contract number
- Whether the area has been staked/clearly marked or not
- A sketch of the excavation
- Type of facility work involved (e.g., pavements, drainage systems, railroad tracks, overhead or underground utility or communications, aircraft or vehicular traffic flow, security)
- Start and end dates of work activity
- Name of requesting official, phone number, and organization

Sampling Equipment

The following is a list of soil sampling equipment that may be required:

- Hollow-stem auger rig with appropriate equipment for drilling and sampling, including HSA and rock-coring capability
- Split-spoon sampler, 2-in outer diameter lined with stainless steel or brass rings
- Stainless steel mixing bowl
- Stainless steel stirring devices
- High-pressure steamer/sprayer (provided by drilling contractor)

- Long-handled bristle brushes
- Wash/rinse tubs
- Liquinox detergent
- Weighted tape measure
- Drums or rolloff boxes for containment of cuttings
- Appropriate health and safety equipment
- Log book
- HTW drilling log forms (Figure C2-1)
- Tape (electrical, duct, and Teflon®)
- Waterproof markers and labels
- Paper towels
- Sandwich and resealable plastic bags
- Large plastic bags
- Aluminum foil

Drilling Method

Borings will be drilled using a truck-mounted drilling rig using hollow-stem auger drilling techniques.

Personal protective equipment (PPE) specified in the SSHP will be donned before proceeding with subsurface drilling and soil sampling. The SSHP will specify action levels for various contaminants and the field monitoring required to measure ambient conditions.

All work areas around exploratory borings will be restored, as closely as practical, to a physical condition equivalent to the pre-drilling condition. This will include removal of drill cuttings and ruts.

All drill cuttings will be handled in accordance with the procedures laid out in the RCP. In general, all drill cuttings will be placed on the ground next to the soil boring location. The disposal of soil, and all other investigation-derived wastes will be dependent on analytical laboratory results, as applicable, and will conform to the requirements of the RCP.

Soil Sampling Method

Intact subsurface soil samples will be taken for physical description, and chemical and geotechnical analyses. Samples will be collected according to the methods outlined below. In addition to the targeted sampling intervals, the geologist responsible for sample collection shall pay close attention to any evidence of contamination, such as discoloration of soil cuttings, elevated readings of photoionization detector (PID) or flame ionization detector monitoring equipment, oily or greasy sheen on cuttings or sampled materials, or anomalous or foreign substances to ensure that potentially significant non-standard sampling intervals are not overlooked. Standard penetration tests will be conducted for each sample interval in accordance with ASTM Method D 1586-84.

Samples will be collected with a standard stainless steel split-spoon sampler. The sampler will be driven using a 140-pound (lb) hammer with a 30-in drop. Standard blow counts for driving the sampler 6 and 12 in will be recorded, according to ASTM Method D 1586-84. Provisions will be made to use other sample collection methods if this method results in poor sample recovery in some depth intervals. Soil samples for VOC analyses will be obtained from the sampler exhibiting the highest PID reading for the targeted interval. Sampling will be conducted as soon as possible after the split-spoon sample is taken from the boring and samples will be collected immediately upon opening of the split spoon.

For VOC samples, soil will be collected and 5.0 grams (± 0.1 gram) will be weighed and placed in an EnCore™ sampler for transport to the analytical laboratory. The portion of the split-spoon sample that represents slough will not be sampled. The remaining portion of the soil sample (to be analyzed for pesticides, polychlorinated biphenyls, metals, and nitrates) will be homogenized in a stainless steel bowl using stainless steel stirring devices.

Split-Spoon Sampler Sampling Procedure

The following procedure will be used for collecting split-spoon samples:

- Wear appropriate PPE as outlined in the SSHP. In addition, samplers will don new sampling gloves for each sample.
- Use a decontaminated split-spoon for each sample collected for chemical analysis.
- Drill borehole to the desired sampling depth. Drive sampler into the undisturbed soil to be sampled.

- Record the number of blows required for each 6 in. of penetration or fraction thereof. The first 6 in. is considered to be a seating drive. The sum of the number of blows required for the second and third 6-in intervals is termed the penetration resistance. If the sampler is driven less than 2 ft, the penetration resistance is the number of blows encountered in the 2nd and 3rd 6-in intervals. If more than 50 blows have been counted for a particular 6-in interval, the number of blow counts and the distance driven will be entered on the HTW drilling log form (see SOP C-2).
- Bring the sampler to the surface and remove both ends and one-half of the split-spoon or split-barrel sampler. Place the split-spoon on clean aluminum foil. Take readings of the soil within the split-spoon using a PID. The portion of the open split spoon exhibiting the highest PID reading from the target interval will be selected for VOC analysis. A headspace screening sample will be collected and analyzed after the sample has been collected for VOC analysis using the procedures outlined in SOP C-8. For split-spoon sampling, the recovered soil rests in the remaining half of the barrel. Describe the sample thoroughly on the HTW drilling log, including the approximate recovery (length), Unified Soil Classification Service (USCS) classification, composition, color, moisture, etc., of the recovered soil, according to the procedures presented in SOP C-2.
- Empty remaining contents of the split-spoon into a decontaminated stainless steel pan or bowl.
- Fill sample container jars with soil for remaining analyses using stainless steel spatulas or spoons after homogenization of the soil following the procedures below.

Homogenize soil samples as follows:

- Remove any debris not considered part of the sample and thoroughly mix the remaining sample using a stainless steel spoon. The soil in the pan is scraped from the sides and bottom of the pan or bowl, rolled to the middle of the pan or bowl, and mixed. The sample is then be quartered. Each quarter of the sample should be mixed individually, rolled to the center of the container, and the entire sample mixed again before placing into sample containers.
- Decontaminate split-spoon sampler and other sample handling equipment according to the procedures outlined in SOP C-6.
- Place analytical samples in sample cooler, chill to 4 degrees Centigrade (°C), and ship samples to the laboratory within 24 hours.
- Fill out field notebook, HTW Drilling Log form, labels, custody seals, and chain-of-custody (C-O-C) forms for analytical samples according to the procedures outlined in SOP C-7.

Geotechnical Soil Sampling

Disturbed Samples— Disturbed geotechnical samples of each soil material encountered during drilling will be collected using a split-spoon sampler. All disturbed geotechnical soil samples will be visually examined for soil type and separated into groups of similar material types for

laboratory testing. If a change in material occurs within a split-spoon, a representative sample of each material shall be taken. Under no circumstances shall different materials be combined into one sample. Representative samples of the subsurface soil are to be taken from the three-inch outside diameter split-spoon sampler, placed in pint jars, and sealed airtight with at least three wraps of electrical tape. Gloves (latex or nitrile) will be changed each and every time that electrical tape is used to prevent cross-contamination to chemical samples. The jars will be properly labeled with the project name, location, hole number, sample number, depth, material classification, sample type, date, and sampler's name. If no sample is retrieved at the specified interval (i.e. no recovery) the unsuccessful sample interval shall be augered out and another sample attempted at the bottom of where the previous sample failed, unless this interferes with undisturbed or chemical sample intervals.

Undisturbed Samples—Undisturbed geotechnical samples shall be collected using a three-inch outside diameter, 30-inch long thin-walled Shelby tube sampler pushed a distance of two feet. Undisturbed samples are to be taken in accordance with ASTM D 1587-83. The pressure exerted in pounds per square inch (psi) and time duration (seconds) required to push the Shelby tube sampler a distance of two feet shall be noted by the field crew and duly recorded on the HTW drill log. A minimum sample length of 1.0 ft is required for the necessary laboratory tests.

Upon retrieval of the Shelby tube samples from the hole, the material exposed at both ends of the tube shall be examined and recorded on the drill log. Enough material shall be carefully removed from the ends to allow insertion of the expandable packers into the tube. This shall be done in such a manner so as to prevent sample disturbance. The wing nut of each packer seal shall be tightened until the rubber gasket presses firmly against the entire circumference of the inside wall of the sampler. This creates an airtight seal that prevents desiccation and provides some physical support to the sample.

Immediately after securing the packers, the outside of the tube shall be wiped clean and labeled with an indelible marker to include project name, location, boring number, sample number, sample interval, date, and the sampler's initials. A sample tag containing the same information shall be completed, signed by the geologist, wired through one of the holes at the top of the tube and placed inside the tube. The end cap shall be secured over the end of the tube with at least

three wraps of electrical tape. Gloves (latex or nitrile) will be changed each and every time that electrical tape is used to prevent cross-contamination to chemical samples. Care shall be taken to ensure that samples remain undisturbed while storing, handling, and transporting them to the lab

Bulk Samples—Bulk geotechnical samples will be collected in the event that layers of caliche or other materials prevent the collection of intact undisturbed samples. Bag samples will be obtained from below the sludge and native soil interface. A minimum of 75 pounds of soil will be obtained for each bag sample. Bag samples may be obtained from soil cuttings generated during hollow-stem auger drilling provided the samples are obtained from approximately the same depth interval as the failed undisturbed Shelby tube samples they replace.

Figure C1-1. Standard Penetration Test

Standard Penetration Test (SPT)

Density (Sand and Gravel)				Consistency (Silt and Clay)				
	Spoon Diameter (O.D.) - Inches				Spoon Diameter (O.D.) - Inches			
	2.0	2.5	3.0		2.0	2.5	3.0	
Description	(Blows/ft)			Description	(Blows/ft)			Field Identification Methods
Very loose	0 - 4	0 - 5	0 - 7	Very soft	0 - 2	0 - 2	0 - 2	Easily penetrated several inches by fist
Loose	4 - 10	5 - 12	7 - 18	Soft	2 - 4	2 - 4	2 - 4	Easily penetrated several inches by thumb
Medium dense	10 - 29	12 - 37	18 - 51	Medium soft	4 - 8	4 - 9	4 - 9	Can be penetrated several inches by thumb
Dense	29 - 47	37 - 60	51 - 86	Stiff	8 - 15	9 - 17	9 - 18	Readily indented by thumb
Very Dense	47 +	60 +	86 +	Very Stiff	15 - 30	17 - 39	18 - 42	Readily indented by thumbnail
				Hard	30 - 60	39 - 79	42 - 85	Indented with difficulty by thumbnail
				Very hard	60 +	79 +	85 +	

STANDARD OPERATING PROCEDURE C-2
BOREHOLE AND SAMPLE LOGGING

PURPOSE

The purpose of this SOP is to establish guidelines for the logging of boreholes and soil samples. The USCS classification of soils and other soil identification techniques to be used during all drilling operations are presented in this SOP.

PROCEDURE

Each boring will be fully described on the HTW Drilling Log (Figure C2-1). The rig geologist will log the boring in the field as it is being drilled by recording relevant data, listed below, on the HTW log. Each log will be signed by the preparer. All log entries will be completed in black or blue ink, and must be clear and legible. All relevant information blanks in the log heading and log body will be completed. If surveyed horizontal control is not available at the time of drilling, location sketches referenced by measured distances from prominent surface features will be shown on, or attached to the log. Log scale will be 1 in. equals 1 ft. HTW Drilling logs will be submitted for approval to the USACE Project Geologist and completed electronically for inclusion in the required project deliverable.

Data to be included in the logs, includes, at a minimum, the following:

- Identification number and location of each boring.
- Direct measured depths in feet to the nearest one-tenth of a ft.
- Soil classifications in accordance with the USCS. These classifications will be prepared in the field by the geologist and are subject to revision based on laboratory tests or subsequent review.
- A full description of soil samples. For split-spoon, soil core, or otherwise intact samples, the description will include, but not be limited to, the USCS classification, description of color, moisture, consistency, plasticity, cementation, and grain size.
- Depth limits and type and number of each sample taken. All samples will be numbered consecutively.
- The number of blows required for each 6-in penetration of the split-spoon sampler and for each 12-in penetration of casing; the hammer weight and length of fall for split-spoon or driven samplers.
- Depth to water as first encountered during drilling, along with the method of determination. Any distinct water-bearing zones below the first zone also will be noted. Other observations during drilling will also be noted, such as bit chatter, rod binding, rod drops, flowing or heaving sands, bit pressure, and rod rotations per minute.

- A general description of the drilling equipment used. This description, including such information as rod size, bit type, pump type, rig manufacturer, and model, may be provided in a general heading.
- Dates and times of start and completion of boring.
- Names of contractor, driller, and rig geologist.
- Size and length of casing or auger used in each borehole.
- Observations of visible contamination for each sample or cuttings that appear to be contaminated.
- Field instrument (PID/organic vapor analyzer) readings.
- Health and safety monitoring.

As the boring is drilled, the rig geologist will evaluate adjacent samples recovered, together with observation of the drill cuttings, washwater (if any), drill performance, etc., to determine appropriate stratigraphic definitions or distinctions within the soil column. Such contacts or breaks between strata must be indicated as such by the rig geologist and indicated on the HTW Drilling Log. Observed stratigraphic contacts will be designated with a solid line and inferred contacts will be designated with a dashed line. See Figure C2-1 for the proper way to complete the HTW Drilling Log. Each and every material type encountered will be described in Column C of the HTW Drilling Log form. All logs will be completed in ink.

In general, a stratigraphic unit contains only similar soils that can be classified within the same USCS classification category symbol. In some cases, significant differences in soil color, grain-size distribution, strength, etc., would be sufficient to classify soils that have the same USCS classification category symbol as belonging to two or more distinct strata.

After the rig geologist has indicated the appropriate stratigraphic breaks on the HTW Drilling log, he/she will develop and record an appropriate description for each defined stratigraphic unit.

Classification of Soils

All classification data will be written directly on the HTW Drilling Log. The method of deriving the classification will be described, or reference to this guideline or other manuals will be made. Handling of samples during soil classification will be coordinated with chemical sampling activities where appropriate. Unconsolidated materials will be described as follows and in the following sequence:

- Descriptive USCS classification in accordance with ASTM D 2488-84
- Plasticity
- Consistency of cohesive materials or apparent density of non-cohesive materials
- Cementation
- Moisture content assessment, (e.g., moist, wet, saturated)
- Color
- Soil component
- Other descriptive features (e.g., bedding characteristics, organic materials, macrostructure of fine-grained soils, such as root holes, fractures)

USCS Classification

Soils are to be classified according to the USCS. This method of classification is detailed in Figure C2-2. This method of classification identifies soil types on the basis of grain size and liquid limits and categorizes them by two-letter symbols.

In the USCS system, fine-grained soils, or fines, are classified as those that will pass through a No. 200 U.S. standard sieve (0.074 millimeter) and are of two types: silt (M) and clay (C). Some classification systems define size ranges for these soil particles, but for field classification purposes, they are identified by their respective behaviors only. Organic material (O) is common component of soil, but has no size range, and is recognized by its composition.

Gravely soils are identified by a (G) as the first letter in the two-letter symbol, whereas sandy soils are identified with an (S). The term "rock fragments" should be used to indicate granular materials resulting from the breakup of rock. These materials are normally angular, indicating little or no transport from their source. When the term "rock fragments" is used it should be followed by a size designation, such as "1/4–1/2" diameter or "coarse-sand size" either immediately after the entry or in the remarks column. The USCS classification would not be affected by this variation in terms.

The second letter in the two-letter USCS symbol provides information about the grain-size distribution of granular soils or the plasticity characteristics of fine-grained soils. These second-letter modifiers are (P) well sorted, (W) well graded/poorly sorted, (C) clayey, (M) silty, (L) low

plasticity, or (H) high plasticity. Note that the term "poorly graded" implies a uniform grain-size distribution and is the same as "well sorted."

Plasticity

Soil plasticity will be described according to the following criteria:

Description	Criteria
Nonplastic	A 1/8-in thread of soil cannot be rolled at any water content
Low	The thread of soil can barely be rolled
Medium	The thread of soil is relatively easy to roll
High	The thread of soil is very easy to roll and can be rerolled several times

Relative Density and Consistency

To classify the relative density and/or consistency of a soil, the geologist must first identify the soil type. Granular soils predominantly contain sands and gravels and are generally noncohesive (particles do not adhere when compressed). Finer-grained soils (silts and clays) are cohesive (particles will adhere together when compressed).

The density of noncohesive granular soils is classified according to standard penetration resistances obtained from split-spoon sampling methods detailed in SOP C-4, Split-Spoon Sampling Procedure section. The designations for soil density are presented in Figure C1-1.

Standard penetration resistance is the number of blows required to drive a split-barrel sampler with a 3-in outside diameter (2.5-in inner diameter) 12 in into the material using a 140-lb hammer falling freely through 30 in. The sampler is driven through an 18-in or 24 in sample interval and number of blows is recorded for each 6-in increment. The density designation of granular soils is obtained by adding the number of blows required to penetrate the second and third 6-in increment of each sample interval. If gravel or rock fragments are broken by the sampler or if rock fragments are logged in the tip, the resulting blow count will be erroneously high, reflecting a higher density than actually exists. Accordingly, the occurrence of rock fragments will be duly noted on the HTW drilling log and referenced to the sample number.

Cementation

All coarse grained soils may be cemented to some degree. Describe the cementation of coarse grained soils as outlined below:

Description	Criteria
None	Soil is not cemented. It crumbles without handling.
Weak	Crumbles with handling or slight finger pressure.
Moderate	Crumbles with considerable finger pressure.
Strong	Will not crumble with strong finger pressure.

Moisture

Moisture content is estimated in the field according to four categories: dry, moist, wet, and saturated. A dry soil appears to contain little or no water, while a saturated soil appears to be soaked with water. Moist and wet classifications can be somewhat subjective. A suggested parameter for judging this in a fine-grained soil would be calling a soil wet if rolling it in the hand or on a porous surface liberates water, i.e., dirties or muddies the surface. Whatever method is adopted for describing moisture, it is important that the method used by an individual remains consistent throughout an entire drilling job.

Laboratory or field tests for water content should be performed if the natural water content is important.

Color

Soil colors will be described using a single color descriptor that is preceded, when necessary, by a modifier to denote variations in shade or color mixtures. A soil could therefore be referred to as "gray" or "light gray" or "blue-gray." Since color can be utilized in correlating units between sampling locations, it is important that color descriptions be kept consistent throughout field operations.

Colors must be described while the sample is still moist. Soil samples should be broken or split vertically to describe internal colors since soil sampling devices tend to smear the sample surface creating color differences between the sample interior and exterior.

Soil Component

In nature, soils are comprised of particles of varying size and shape and are combinations of the various soil types. The grain shape of coarse grained soils should be described as angular, subangular, subrounded, or rounded. Figure C2-2 lists grain size classifications to be used in describing soils or rocks.

Stratification

The stratification or bedding thickness for soil and rock is dependent on grain size and composition. The classification to be used for stratification description is described below:

Thickness (metric)	Thickness (U.S. customary)	Classification
>1 meter	> 3.3 feet	Very thickly bedded
30 cm–1 meter	1.0 ft–3.3 ft	Thickly Bedded
10 cm–30 cm	4.0 in–1.0 ft	Medium Bedded
3 cm–10 cm	1.0 in–4 in	Thinly Bedded
1 cm–3 cm	2/5 in–1 in	Very Thinly Bedded
3 mm–1 cm	1/8 in–2/5 in	Laminated
1 mm–3 mm	1/32 in–1/8 in	Thinly Laminated
<1 mm	<1/32 in	Micro Laminated

Figure C2-1. HTW Drilling Log

HTW DRILLING LOG

HOLE NO. MW 92-01

1. COMPANY NAME: CONTRACTING FIRM, INC.	2. DRILLING SUBCONTRACTOR: SUBCONTRACT DRILLERS, INC.
SHEET 1 OF 4 SHEETS	
PROJECT: BIG SUPERFUND SITE	4. LOCATION: Site A, Gasoline Storage Facility
5. NAME OF DRILLER: JOE SUPERDRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL: CME-75 Milwaukee Heavy Duty Drill Rig, Car. No. 4120 (core)
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: CME-75, using 4¼" hollow stem augers, 3" O.D. stainless steel split-spoons (chemical and geotech), bullet bit (over) drag bit (inner)	8. HOLE LOCATION: See Attached Location Map
	9. SURFACE ELEVATION: Not Yet Available
	10. DATE STARTED: 8-6-92 / 11. DATE COMPLETED: 8-7-92
12. OVERBURDEN THICKNESS: 32.0'	15. DEPTH GROUNDWATER ENCOUNTERED: 22.0'
13. DEPTH DRILLED INTO ROCK: Ø	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 24.5' TOC ~72 hours (in well)
14. TOTAL DEPTH OF HOLE: 32.0'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	1	Ø	Ø

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
			BTEX 4 x 4oz. jars	TRPH 2 x 8oz. jars	Lead 2 x 8oz. jars	Ø %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		8-6-92		Field Geologist

ELEV.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d. (ppm)	GEOTECH SAMPLE OR CORE BOX NO. e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	0	SC - Clayey Sand, medium dense, non plastic, noncemented, dry, medium brown, fine-grained, subrounded, 15-20% pieces of concrete (fill).	Calibrated HNu w/ isobutylene at 55 ppm at 190 psi. BACKGROUND = 0.8 BREATH = 0.8 SCREEN = 0.9	0.0	S-MW01-02/BT 2x4oz jar -02/T 1x8oz jar -02/L 1x8oz jar	5	Drilling in cow pasture - numerous manure piles - may be increasing HNu readings.
	1			1.3'		10	N (Blows) = 22
						12	Rec (Recovery) = 1.3'
	2					12	TIME - 1012
				NO SAMPLE OR NO RECOVERY			
	3	SC - Clayey Sand, same as above.	BREATH = 0.8 SCREEN = 0.7	3.0'		9	
						9	N = 21
	4					12	Rec = 1.8' TIME - 1019
	5			4.5'		11	

PROJECT: BIG SUPERFUND SITE — HOLE NO. MW92-01

HTW DRILLING LOG

HOLE NO. MW92-01

PROJECT: BIG SUPERFUND SITE

INSPECTOR: Field Geologist

SHEET 2 OF 4 SHEETS

EV. a.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	5						Plug same at end of central road. Tried driving split-spoon – no recovery. Offset ~1.5' and drilled back down to 8.0'.
	6						
	7						
	8	CL- Sandy Lean Clay, stiff, low to medium plastic, non-cemented, moist, ~15% very fine-grained sand, dark brown.	BREATH = 0.8	8.0'		2	
	9		SCREEN = 0.5			4	N = 9
						5	Rec = 2.0'
						6	Time = 1048
	10	SP- Poorly Graded Sand, loose, non plastic, noncemented, dry to slightly moist, light brown to white, very fine to fine-grained, subrounded		10.0'			
	11						
	12						
	13	SC- Clayey Sand, medium dense, non plastic noncemented, slightly moist, light brown, very fine-to-fine-grained, subrounded, ~20% clay	BREATH = 0.8	13.0'		5	N = 17
	14		SCREEN = 0.5			8	Rec = 2.0'
						9	Time - 1102

HTW DRILLING LOG

HOLE NO. MW92-01

PROJECT: BIG SUPERFUND SITE

INSPECTOR: Field Geologist

SHEET 3 OF 4 SHEETS

S.V.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	15					5	
	16						
	17						
	18	SP- Poorly Graded Sand, dense, nonplastic, patchy light cementation, moist, light brown to grayish white, very fine to fine-grained, subrounded.	BREATH = 0.6 SCREEN = 0.7	18.0'	S-MW01 -20/BT 2x4oz jar -20/T 1x8oz jar -20/L 1x8oz jar	17 21 30 35	N = 51 Rec = 2.0' Time - 1112
	19						
	20			20.0'			
	21						
-▽- H_2O encountered on drill rods & measured in augers at 1125	22						
	23	SP- Poorly Graded Sand, same as above	Breath = 0.8 Screen = 22.5	23.0' D-1		15 18	N = 80 Rec = 2.0' Time = 1144
	24						

HTW DRILLING LOG

HOLE NO. MW92-01

PROJECT: BIG SUPERFUND SITE

INSPECTOR: Field Geologist

SHEET 4 OF 4 SHEETS

ELEV. i.	DEPTH b.	DESCRIPTION OF MATERIALS c.	FIELD SCREENING RESULTS d.	GEOTECH SAMPLE OR CORE BOX NO e.	ANALYTICAL SAMPLE NO. f.	BLOW COUNTS g.	REMARKS h.
	24					23	Below water table, collected no more BTEX samples
						34	
	25			25.0'			
	26	By Driller's Estimate, no change in material.					
	27						
	28						
	29						
	30	SP- Poorly Graded Sand, same as above.		30.0'			
			Breath = 0.8			6	
						24	N = 80 Rec = 2.0' Time - 1144
	31		Screen = 0.7			56	
						60	
	32			32.0'			
		Bottom of Hole = 32.0'					Bailed sand from inside bottom of augers. Installed well to top of seal. 8-7-92 - Grouted to surface. Did surface completion. See attached well construction diagram
	33						

Figure C2-2. USCS Classification Chart

CRITERIA FOR ASSIGNING GROUP SYMBOLS AND GROUP NAMES[A]			SOIL CLASSIFICATION	
MAJOR DIVISIONS			Group Symbols	TYPICAL NAMES[B]
COARSE GRAINED SOILS (More than 50% of material is larger than No. 200)	GRAVELS (More than 50% of the coarse fraction is LARGER than the No. 4 sieve size)	CLEAN GRAVELS (≤5% fines)[C]	GW	Well graded gravel,[E] gravel-sand mixture
			GP	Poorly graded gravel,[E] gravel-sand mixture
		GRAVELS WITH FINES (≥12% fines)[C]	GM	Silty gravel,[E,F,G] gravel-sand-silt mixture
			GC	Clayey gravel,[E,F,G] gravel-sand-clay mixture
	SANDS (More than 50% of the coarse fraction is SMALLER than the No. 4 sieve size)	CLEAN SANDS (≤5% fines)[D]	SW	Well graded sand,[H] gravelly sand
			SP	Poorly graded sand,[H] gravelly sand
		SANDS WITH FINES (≥12% fines)[D]	SM	Silty sand,[F,G,H] sand-silt mixture
			SC	Clayey sand,[F,G,H] sand-clay mixture
FINE GRAINED SOILS (More than 50% of material is smaller than No. 200 sieve size)	SILTS & CLAYS (Liquid limit <50)	Inorganic	CL	Lean clay,[I,J,K] inorganic clay of low-medium plasticity, gravelly clay, sandy clay, silty clay
			ML	Silt [I,J,K] and very fine sand, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
		Organic	OL	Organic clay [I,J,K] of low plasticity organic silt [I,J,K] of low plasticity
	SILTS & CLAYS (Liquid limit ≥50)	Inorganic	CH	Fat clay,[I,J,K] inorganic clay of high plasticity
			MH	Elastic silt,[I,J,K] inorganic silt, micaceous or diatomaceous fine sandy of silty soils
		Organic	OH	Organic clay [I,J,K] of medium to high plasticity organic silt [I,J,K]
Highly Organic Soils			PT	Peat and other highly organic soils

A Based on the material passing the 3-in (75-mm) sieve.

B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

C Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

D Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

E If soil contains ≥15% sand, add "with sand" to group name.

F If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

G If fines are organic, add "with organic fines" to group name.

H If soil contains ≥15% gravel, add "with gravel" to group name.

I If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

J If soil contains ≥30% plus No. 200, predominantly sand, add "sandy" to group name.

K If soil contains ≥30% plus No. 200, predominantly gravel, add "gravelly" to group name.

STANDARD OPERATING PROCEDURE C-3
BOREHOLE ABANDONMENT

PURPOSE

Abandonment is the procedure by which any boring or well is permanently closed. Abandonment procedures should preclude any current or subsequent discharges from entering the abandoned boring or well and thereby terminate access to the subsurface environment through that borehole.

PROCEDURE

Borehole Abandonment

Borings not slated for well installation or other sampling (such as direct push borings) will be abandoned immediately on completion of soil sampling and advancement of the boring to its predetermined depth, unless saturated conditions have been encountered. If saturated conditions were encountered, the water level must be allowed to stabilize for 24 hours. Once it has stabilized, a water-level measurement will be taken. Borings left open overnight will be covered to lessen the potential for injury to personnel and to minimize the potential for any surface drainage to enter the boring. The following steps will be performed to abandon a boring:

- Grout all boreholes. Upon completion of drilling, the borings will be grouted while the drilling equipment is moved progressively upward as the boring is filled. Grouting will be accomplished by placing a tremie pipe to the bottom of the boring and pumping grout through this pipe until undiluted grout flows from the boring at ground surface. The grout, containing 30 percent solids will be mixed as follows: bentonite, 70 pounds of Portland cement and 30 pounds of powdered bentonite per a maximum of 7 gallons of water. Twenty-four hours after grouting, the borehole will be checked for grout settlement and will be topped off to the ground surface with grout if necessary.
- Upon completion of the boring, scrape all downhole equipment clean as it is withdrawn from the hole. Decontamination and cuttings disposal will be performed in accordance with SOP C-6, Equipment Decontamination, SOP C-1, Drilling and Subsurface Sampling, and the RCP.
- Document borehole abandonment in
  - Open depth prior to grouting and depth to which tremie pipe was placed as measured from the ground surface
  - Description and total quantity of grout used to initially fill borehole
  - Description and daily quantities of grout used to compensate for settlement
  - Dates of grouting
  - Water level prior to grouting and date measured

STANDARD OPERATING PROCEDURE C-4
SLUDGE SAMPLING

PURPOSE

The following procedures are applicable to manual-collection methods for sludge sampling, which will take place using a hollow-stem auger rig at the time of soil sampling. The sample jar quantities and sizes are dependent on the analyses being run and are detailed in Table C7-1.

PROCEDURE

Sludge Sampling

Sludge sampling will be accomplished as follows:

- Wear appropriate PPE as outlined in the SSHP. In addition, samplers will don new sampling gloves at each location.
- Use a decontaminated split-spoon for each sample collected for chemical analysis.
- Drill borehole to the desired sampling depth directly below the access road fill material. Drive sampler into the undisturbed sludge to be sampled.
- Record the number of blows required for each 6 in. of penetration or fraction thereof. The first 6 in. is considered to be a seating drive. The sum of the number of blows required for the second and third 6-in intervals is termed the penetration resistance. If the sampler is driven less than 2 ft, the penetration resistance is the number of blows encountered in the 2nd and 3rd 6-in intervals. If more than 50 blows have been counted for a particular 6-in interval, the number of blow counts and the distance driven will be entered on the HTW drilling log form (see SOP C-2).
- Bring the sampler to the surface and remove both ends and one-half of the split-spoon or split-barrel sampler. Place the split-spoon on clean aluminum foil. The portion of the open split spoon exhibiting the highest PID reading from the target interval will be selected for VOC analysis. For split-spoon sampling, the recovered sludge rests in the remaining half of the barrel. Describe the sample thoroughly on the HTW drilling log, including the approximate recovery (length), USCS classification, composition, color, moisture, etc., of the recovered soil, according to the procedures presented in SOP C-2.
- Empty remaining contents of the split-spoon into a decontaminated stainless steel pan or bowl.
- Fill sample container jars with sludge for remaining analyses using stainless steel spatulas or spoons after homogenization of the sludge following the procedures below.

Homogenize sludge samples as follows:

- Remove any debris not considered part of the sample and thoroughly mix the remaining sample using a stainless steel spoon. The sludge in the pan is scraped from the sides and bottom of the pan or bowl, rolled to the middle of the pan or bowl, and mixed. The sample is then be quartered. Each quarter of the sample should be mixed individually,

rolled to the center of the container, and the entire sample mixed again before placing into sample containers.

- Decontaminate split-spoon sampler and other sample handling equipment according to the procedures outlined in SOP C-6.
- Place analytical samples in sample cooler, chill to 4°C, and ship samples to the laboratory within 24 hours.
- Fill out field notebook, HTW Drilling Log form, labels, custody seals, and C-O-C forms for analytical samples according to the procedures outlined in SOP C-7.

STANDARD OPERATING PROCEDURE C-5
FIELD GPS SURVEYING

PURPOSE

All sampling locations and other physical features designated as important for the construction of accurate site maps will be surveyed and referenced to the New Mexico State Plane Coordinate System, East Zone, by a field technician trained in the use of a portable geographic positioning system. If the State Plane Coordinate System is not available, an existing local grid system will be used. Location coordinates should be translatable to the Cannon AFB survey coordinate systems.

PROCEDURE

All sampling locations will be staked to facilitate subsequent surveys. Originals or a legible, reproducible copy of the surveys and field books will be supplied to the USACE. The surveys will, at minimum, conform to the requirements stated in the following paragraphs.

Soil Borings/Sampling Points

Coordinates and elevations will be established for each soil boring location. The coordinates will be measured to the closest whole foot and referenced to the New Mexico State Plane Coordinate System, if available, or other existing local coordinate system as noted above. A ground elevation to the nearest whole ft will be obtained for each sample location . These elevations will be referenced to mean sea level, specifically to the (National Geodetic Vertical Datum) NGVD of 1983. If the NGVD of 1983 is not available, the NGVD of 1929 will be used. All positions and coordinates of all permanent points within the control traverse will be shown.

Physical Features

At each site, all aboveground and, where possible, underground physical features will either be verified using previous maps or be determined as required. All aboveground physical features will be located/verified to the nearest ft. Permanent control monuments will be placed in accessible locations within the limits of the work if no existing permanent monuments are located within 1,000 ft of a site. One set of monuments is allowable for adjacent sites. These monuments will be set no closer than 500 ft to each other.

Documentation

The location, identification, coordinates, and elevations of the sampling locations and monuments will be plotted on maps at a scale large enough to show their location with reference to other structures at the individual sites. A tabulated list of the sample locations and monuments, copies of all field books, and all computation sheets will be prepared and submitted to USACE, no later than the draft project report. The tabulation will consist of the designated number of the sample location or monument, the X and Y coordinates, and all of the required elevations.

STANDARD OPERATING PROCEDURE C-6
EQUIPMENT DECONTAMINATION

PROCEDURE

Decontamination of Large Equipment

The following procedure will be used to decontaminate large pieces of equipment such as drilling casings, auger flights, drilling pipe and rods, and those portions of the drill rig that may stand directly over a boring or well location or that come into contact with casing, auger flights, pipe, or rods:

- Wash the external surfaces of equipment with high-pressure hot water and a detergent solution consisting of 4 pounds of Liquinox (or equivalent no-phosphate, laboratory-grade detergent) mixed in 10 gallons of potable water. If necessary, scrub until all visible dirt, grease, oil, loose paint, rust flakes, etc., have been removed. Also wash the inside surfaces of the casing and auger flights as described above.
- Rinse with potable water.
- Perform this decontamination procedure before equipment is used and between each sampling location.

Decontamination of Sampling Equipment

The following procedure will be used to decontaminate devices, such as split-spoons, spoons, spatulas, and stainless steel bowls, that come in direct contact with the samples:

- Wash and scrub with detergent solution formulated as described above
- Rinse with potable water
- Triple rinse with deionized, analyte-free water
- Air dry
- Wrap in aluminum foil

Decontamination of sampling equipment will be kept to a minimum in the field and, whenever possible, dedicated sampling equipment will be used. All large equipment will be decontaminated prior to leaving the site. Mobile or temporary decontamination stations will be constructed, as appropriate, to adequately capture and contain decontamination fluids. Decontamination fluids will be disposed as discussed in the RCP. If the Cannon AFB wash rack is available, all decontamination fluids will be disposed in this facility. Personnel directly involved in equipment decontamination will wear appropriate personal protective equipment including nitrile gloves and safety glasses or face shield.

STANDARD OPERATING PROCEDURE C-7
SAMPLE HANDLING AND DOCUMENTATION

PURPOSE

Field sample coordination activities will be in accordance with the Quality Assurance Project Plan, Section 5.0 of the CMS work plan.

PROCEDURE

Labeling

All sample containers will be labeled. Labels may be partially completed prior to sample collection. The date, time, and sampler's name should **NOT** be completed until the time of sample collection. Self-adhesive sample labels containing all appropriate sample information including sample identification, field sample number, sample type, and analyses requested, will be generated by the field sampling team. Sample labels will be completed with waterproof ink. Soil samples collected in stainless steel liners will be capped and sealed immediately following collection and a completed label attached. Sample labels should be completed and attached prior to sample collection for soil samples collected in jars.

At a minimum, each numbered label shall contain the following information:

- Project and Facility
- Date and time of sample collection
- Analyses required
- Preservation used
- Sampler's initials
- Sample identification number

Sampling Containers

Certified, commercially clean sample containers will be obtained from the contract analytical lab. If appropriate, the bottles will be labeled by the lab to indicate the type of sample to be collected. Subsurface soil samples will typically be collected in EnCore™ samplers, wide-mouth sample jars, or in stainless steel liners. For samples collected in stainless-steel liners, the liners will be sealed by covering each end with a square of Teflon® tape and a plastic cap. Caps will be secured with electrical tape prior to affixing the sample label.

Sample Preservation

All samples will be stored on ice in an insulated cooler immediately following sample collection. Soil and sludge samples do not require additional preservation. Table C7-1 lists appropriate sample containers for the specific matrix and analyses required for this project.

Sample Handling and Shipping

Sample containers will be placed in recloseable plastic storage bags and wrapped in protective packing material (if appropriate). Ice (double-bagged using gallon ziplocks) will be placed on top of the samples in a cooler for shipment to the laboratory. The drain on the cooler will be taped shut. Samples collected in glass containers will be packed in bubble packing or styrofoam peanuts to ensure that no breakage occurs during shipment. Samples will be shipped by overnight express carrier for delivery to the analytical laboratory and to the Chemical Quality Assurance Branch of the Waterways Experimentation Station (CQAB) laboratory. The CQAB laboratory will be notified prior to the arrival of the first shipment, after the final shipment, and prior to any Saturday delivery.

A completed C-O-C form for each cooler will be placed in a resealable plastic bag and taped to the inside of the cooler lid. Coolers will be wrapped with strapping tape at two locations to secure lids. Date and signed custody seals will be placed on the outside of each cooler. Note that each cooler cannot exceed the weight limit set by the shipper.

Holding Times and Analyses

The holding time is specified as the maximum allowable time between sample collection and analysis and/or extraction, based on the analyte of interest, stability factors, and preservation methods. Allowable holding times are listed in Table C7-1. Samples should be sent by overnight courier service to the laboratory daily after collection.

Chemical constituents which will be analyzed during the field investigation have been identified in the CMS work plan.

Sample Documentation and Tracking

This section describes documentation required in the field notes, Daily Quality Control Reports (DQCRs), and sample C-O-C requirements.

Field Notes

Documentation of observations and data acquired in the field will provide information on the acquisition of samples and also provide a permanent record of field activities. The observations and data will be recorded with waterproof ink in a permanently bound weatherproof field book with consecutively numbered pages and, if applicable, on field sampling data sheets.

The information in the field book will include the following as a minimum. Additional information is included in the specific SOPs regarding the appropriate data sheets:

- Project name
- Location of sample and time collected
- Description of samples (matrix sampled)
- Number and volume of samples
- Sample methods or reference to the appropriate SOP
- Sample handling, including preservation, as appropriate for samples
- Field observations
- Personnel present
- Weather conditions

Changes or deletions in the field book should be lined out with a single strike mark, initialed and dated by person making change, and remain legible. Sufficient information should be recorded to allow the sampling event to be reconstructed without relying on the collector's memory.

Each page of the field book will be signed by the person making the entry. Anyone making entries in another person's field book will initial and date those entries.

Daily Quality Control Report

To supplement the information recorded in the field book, DQCRs will also be maintained to document daily field activities and will note any nonconformances and corrective actions taken at every sampling location. An example of the DQCR is shown as Figure C7-1. DQCRs will be maintained by the field sampling team and cross-checked for completeness at the end of each day by a field team member and/or the Field Operations Leader. They will be signed and dated by the individual making entries and initialed by the reviewer upon completion. Copies of the DQCR will be forwarded to the Quality Assurance Manager for review and submitted to the

USACE Project Manager on a weekly basis. If problem situations occur, they DQCR will be faxed to the USACE Project Manager on a daily basis, until the problems are corrected. DQCRs will be submitted to the Base Point of Contact on a daily basis.

Sample Chain-Of-Custody

During field sampling activities, traceability of the sample must be maintained from the time the samples are collected until laboratory data are issued. Information on the custody, transfer, handling, and shipping of samples will be recorded on a C-O-C form. An example C-O-C form is shown on Figure C7-2. C-O-Cs will be generated in the field by the field sampling team and will include site identification, field sample number, sample type, and analysis requested.

The C-O-C will be signed by the sampler when the sampler relinquishes the samples to anyone else. It is not necessary for Federal Express to sign C-O-C; however, the airbill will be retained by the sample handler for tracking purposes. A C-O-C form will be completed for each set of samples collected daily, and will contain the following information:

- Sampler's signature
- Project name
- Date and time of sample collection
- Sample identification number
- Sample type/matrix
- Sample depth intervals (if applicable)
- Preservative used
- Analyses requested
- Number of containers
- Signature of persons relinquishing custody, dates, and times
- Signature of persons accepting custody, dates, and times (laboratory)
- Method of shipment (i.e. Federal Express)

The person responsible for delivery of the samples to the air carrier will sign the C-O-C form, retain the last copy of the C-O-C form, document the method shipment, and send the original and the second copy of the C-O-C form with the sample (taped in a resealable plastic bag to inner cooler lid). Upon receipt by the laboratory, the person receiving the samples will sign the C-O-C

form and return the second copy to the Project manager. Copies of the C-O-C forms and all custody documentation will be received and kept in the central files. The original C-O-C forms will remain with the samples until final disposition of the samples by the laboratory. The analytical laboratory will dispose of the samples in an appropriate manner 60 to 90 days after data reporting.

Field Change Requests (FCRs) will be submitted to USACE for approval if any deviation from the procedures or specifications contained in the workplan occurs.

Changes will be qualified as follows:

- Major change—one that affects intent of the original design, including equipment, component, system, or structure that relates to function, operation, or safety.
- Minor change—One that does not affect intent of the original drawing or product, including equipment, component, system, or structure, which relates to function, operation, or safety.

Where the FCR is marked "Minor Change," the Field Engineer may execute the change and, in parallel, obtain concurrence from the Project Engineer that the change was indeed "minor."

Where the FCR is marked "Major Change," disposition must be sought from the Project Engineer before execution. The Project Engineer will respond by issuing an appropriately executed Design Change Notice. A Design Change Notice will not be issued for a "minor change" FCR.

The Project Engineer has the responsibility for identifying and providing input data relative to "record" conditions. "Record Drawings" are drawings that reflect the as-installed conditions and consist of the latest revision of the project drawing plus copies of approved changes.

Table C7-1. Sample Container, Preservation, and Holding Time Requirements for Soil and Sludge Samples

Matrix	Parameter	Container[1]	Preservation[2]	Maximum Holding Times[3]	
				Extraction	Analysis
Soil/Sludge	Metals/Mercury	1 8-oz Glass jar	Ice to 4°C	--	180/28 day
Soil/Sludge	Pesticides	1 8-oz Glass jar	Ice to 4°C	14 day	40 day
Soil/Sludge	Nitrate	--	--	--	14 day
Soil/Sludge	VOCs	EnCore™ sampler [4] 4-oz glass jar	Ice to 4°C	2/14 day	4/14 day
Soil/Sludge	TOC	--	--	--	28 day
Soil/Sludge	TCLP Metals/Mercury	1 8-oz Glass jar	Ice to 4°C	180/28 day	180/28 day
Soil/Sludge	TCLP VOCs	1 8-oz Glass jar	Ice to 4°C	14 day	14 day
Soil/Sludge	TCLP Pesticides	--	--	14 day/7 day	40 day
Soil/Sludge	Hydraulic Conductivity	1 3-in by 30-inch Shelby Tube	NA	NA	NA
Soil/Sludge	Atterberg Limits, Sieve Analysis, Moisture	2 16-oz Glass jar	NA	NA	NA

Notes:

1 All containers must have Teflon®-lined lids.
2 Sample preservation will be done in the field immediately upon sample collection.
3 When only one holding time is given, it implies total holding time from sampling until analysis.
4 Alternative VOC sample collection procedure will be Method 5030, field preservation with methanol.
°C degrees Celsius
oz ounce
NA not applicable
PCB polychlorinated biphenyl
VOC volatile organic compound
TOC total organic carbon
TCLP Toxicity Characteristic Leaching Procedure

Figure 7-1

DAILY QUALITY CONTROL REPORT

Page 1 of 3

Daily Report No.: _____ Date: _____

Contract No.: _____

Project Title & Location: _____

Weather: _____ Precipitation: _____ In.: ___ Temp.: _____ Min.: _____ Max.: _____

1. Contract/Subcontractors and Area of Responsibility:

NUMBER	TRADE	HOURS	EMPLOYER	LOCATION/DESCRIPTION OF WORK

2. Operating Plant or Equipment (not hand tools):

Plant/Equipment	Date of Arrival/Departure	Date of Safety Check	Hours Used	Hours Idle	Hours Repair

Figure 7-1 (Continued)
DAILY QUALITY CONTROL REPORT

3. Work Performed Today: (Indicate location and description of work performed by prime and/or subcontractors. When network analysis is used, identify work by NAS activity number).

4. Control Activities Performed:

- Preparatory Inspections: Identify feature of work and attach minutes.
- Initial Inspections: Identify feature of work and attach minutes.
- Follow-up Inspections: List inspections performed, results of inspection compared to specification requirements, and corrective actions taken when deficiencies are noted.

5. Tests Performed and Test Results: Identify test requirement by paragraph number in specifications and/or sheet number in plans.

6. Material Received: Note inspection results and storage provided.

Figure 7-1 (Concluded)
DAILY QUALITY CONTROL REPORT

Page 3 of 3

7. Submittals Reviewed:

(a) Submittal No.	(b) Spec/Plan Reference	(c) By Whom	(d) Action

8. Off-Site Surveillance Activities, Including Action Taken:

_____
_____
_____
_____
_____

9. Job Safety: List items checked, results, instructions, and corrective actions taken.

_____
_____
_____
_____

10. Remarks: Instructions received or given. Conflict(s) in plans and/or specifications. Delays encountered.

_____
_____
_____
_____
_____
_____

Contractor's Verification: On behalf of the Contractor, I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as may be noted above.

_____ CQC SYSTEMS MANAGER

_____ DATE

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Chain-of-Custody Record

AFIID: Cannon AFB	Project: CMS	Sample Date:
Method Type:	Samplers:	

Location Type	Location Identification	Time (Military Standard)	Sample Depth (Feet)	Preservative: HNO3	H2SO4	NaOH	HCL	Analysis Required: Sampling Method	No. of Containers	VOCs	Pesticides/PCBs	Nitrate	RCRA metals	TOC	TCLP Metals	TCLP Pesticides	TCLP VOCs	Grain size – USCS	Atterberg Limits	Hydraulic Conductivity	Moisture									Sample Tag No.

Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*	Date/Time

Remarks: LIMS NO. 5636

FEDERAL EXPRESS #:

MATRIX:
LABCODE:
LOGCODE:

LABORATORY USE ONLY		
Package Received/Custody Seals Intact		
Sample Labels/C-O-Cs Agree		
Temperature Within Specification _____ °C		
Corrected Copy Attached		
Problems or Discrepancies		

FWENC\CMSC-O-C97 10/02/99 5:06 PM

Figure C7-2

Figure 7-3. Field Change Request

FIELD CHANGE REQUEST

PROJECT	PROJ. NO.	FIELD CHANGE NO.

TO _____ DEPT. USACE LOCATION Cannon, AFB DATE _____

RE: ☐ DRAWING NO. _____ TITLE _____
☐ SPEC NO. _____ TITLE _____
☐ OTHER. _____

1. DESCRIPTION (Items involved, submit sketch if applicable)_____

2. REASONS FOR CHANGE (If from disposition of nonconformance report, list report number)_____

3. RECOMMENDED DISPOSITION ☐ MINOR CHANGE ☐ MAJOR CHANGE

	DATE	PROJECT SUPT. CONCURRENCE (Signature)	DATE

5. DISPOSITION

☐ NOT APPROVED (Give Reason)

☐ CONSIDERED MINOR CHANGE - Approval per Recommended Disposition - Design Documents will not be normally revised; field to maintain as-built records

☐ CONSIDERED MAJOR CHANGE - Action will be taken as prescribed on DCN -

LEAD DISCIPLINE ENGINEER OR DESIGNEE (Signature)	DATE	PROJECT ENGR OR DESIGNEE (Signature)	DATE
		GEORGE FISH (USACE)	

Project Engineer signs and returns to LDE for transmittal to Resident Engineer with copies to:

Project Manager _____ *Others as Required* _____

Project Supt. _____

Project Files _____

STANDARD OPERATING PROCEDURE C-8
HEADSPACE SCREENING

PURPOSE

Field screening for VOCs in soil samples will be performed at during sludge and soil sampling. An organic vapor analyzer equipped with either a PID or a FID will be used to perform field screening of soil samples. The specific instrumentation used will be chosen based on its capabilities and limitations. The instrument will be configured to optimize the detection of the contaminants of concern at the site.

PROCEDURE

The following procedures will be used for headspace screening:

- Immediately upon opening the split-spoon (or other sampling device) and after collecting the volatile organic sample (if required), collect a representative portion of the sample and place it in a clean, contaminant-free jar. Wide mouth sample jars will be used such that an effective field decontamination may be done, and the sample jars may be reused. Alternatively, the sample jar may be lined with a new, clean, plastic sandwich bag to minimize the number of new jars required. If sandwich bags are used, take readings inside the empty bags to ensure that contamination is not introduced into the sample. If the volume of sample recovered is insufficient for all analytical requirements, then the material used for the field headspace analysis may be submitted for non-volatile analyses (i.e., the sample material may be used to fulfill the geotechnical requirements). If additional sampling attempts are required to obtain sufficient material for a given sample interval, additional headspace analysis will not be required.
- Seal the jar containing headspace analysis material with at least one continuous sheet of aluminum foil, using the jar lid to secure the foil. Alternatively, the jar lid may be configured with a fitting and tube such that headspace gas may be extracted without removing the lid and thus minimizing dilution of the sample with the ambient air. If the jar lid is configured in this manner, the lid and hardware will be fabricated such that is may be decontaminated and reused.
- Vigorously agitate the sample jar for at least 15 seconds and then allow a minimum of 10 minutes (or as environmental conditions dictate) for the sample to adequately volatilize before analysis.
- During cold weather, warm the field headspace samples to near room temperature prior to taking the headspace measurement.
- After the designated volatilization time, shake the sample jar again and remove the lid. Immediately insert the vapor sampling probe through the aluminum foil or connect to the fitting on the lid with the valve opened. The maximum meter response is recorded (which typically occurs within 2 to 5 seconds). Erratic responses will be evaluated in terms of high organic vapor concentrations or conditions of elevated headspace moisture.

- Record the headspace screening results on the USACE HTW Drilling Log and other documentation (e.g., field notebook, C-O-C, etc.) as appropriate.
- Calibrate the instrument used for field headspace analysis using the appropriate span gas as per the manufacturer's operating instructions. The instrument will be calibrated a minimum of twice daily, and after a down period (e.g., lunch breaks, equipment breakdowns, weather delays, etc.).
- If sample jars are reused for headspace samples, clean them according to field decontamination procedures for sampling equipment. In addition, take headspace readings from field-cleaned jars to ensure that no residual organic vapors remain in the jars, and record these readings in the field notebook.
- Note any deviation(s) from the approved procedures on the USACE HTW Drilling Log form, and the DQCR providing the basis for the deviation(s).
- USACE HTW Drilling Log forms and field log book notes will be maintained in the field file.

SOP C-9
FIELD PRESERVATION FOR VOCS USING METHANOL

1.9 This method is restricted to use by or under the supervision of trained analysts. Each analyst must demonstrate the ability to generate acceptable results with this method.

2.0 SUMMARY OF METHOD

2.1 Low concentration soil method - generally applicable to and soils and other solid samples with VOC concentrations in the range of 0.5 to 200 µg/kg.

Volatile organic compounds (VOCs) are determined by collecting an approximately 5-g sample, weighed in the field at the time of collection, and placing it in a pre-weighed vial with a septum-sealed screw-cap (see Sec. 4) that already contains a stirring bar and a sodium bisulfate preservative solution. The vial is sealed and shipped to a laboratory or appropriate analysis site. The entire vial is then placed, unopened, into the instrument carousel. Immediately before analysis, organic-free reagent water, surrogates, and internal standards (if applicable) are automatically added without opening the sample vial. The vial containing the sample is heated to 40°C and the volatiles purged into an appropriate trap using an inert gas combined with agitation of the sample. Purged components travel via a transfer line to a trap. When purging is complete, the trap is heated and backflushed with helium to desorb the trapped sample components into a gas chromatograph for analysis by an appropriate determinative method.

2.2 High concentration soil method - generally applicable to soils and other solid samples with VOC concentrations greater than 200 µg/kg.

The sample introduction technique in Sec. 2.1 is not applicable to all samples, particularly those containing high concentrations (generally greater than 200 µg/kg) of VOCs which may overload either the volatile trapping material or exceed the working range of the determinative instrument system (e.g., GC/MS, GC/FID, GC/EC, etc.). In such instances, this method describes two sample collection options and the corresponding sample purging procedures.

2.2.1 The first option is to collect a bulk sample in a vial or other suitable container without the use of the preservative solution described in Sec. 2.1. A portion of that sample is removed from the container in the laboratory and is dispersed in a water-miscible solvent to dissolve the volatile organic constituents. An aliquot of the solution is added to 5 mL of reagent water in a purge tube. Surrogates and internal standards (if applicable) are added to the solution, then purged using Method 5030, and analyzed by an appropriate determinative method. Because the procedure involves opening the vial and removing a portion of the soil, some volatile constituents may be lost during handling.

2.2.2 The second option is to collect an approximately 5-g sample in a pre-weighed vial with a septum-sealed screw-cap (see Sec 4) that contains 5 mL of a water-miscible organic solvent (e.g., methanol). At the time of analysis, surrogates are added to the vial, then an aliquot of the solvent is removed from the vial, purged using Method 5030 and analyzed by an appropriate determinative method.

2.3 High concentration oily waste method - generally applicable to oily samples with VOC concentrations greater than 200 µg/kg that can be diluted in a water-miscible solvent.

Samples that are comprised of oils or samples that contain significant amounts of oil present additional analytical challenges. This procedure is generally appropriate for such samples when they are soluble in a water-miscible solvent.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

Refer to the introductory material in this chapter, Organic Analytes, Sec. 4.1, for general sample collection information. The low concentration portion of this method employs sample vials that are filled and weighed in the field and never opened during the analytical process. As a result, sampling personnel should be equipped with a portable balance capable of weighing to 0.01 g.

6.1 Preparation of sample vials

The specific preparation procedures for sample vials depend on the expected concentration range of the sample, with separate preparation procedures for low concentration soil samples and high concentration soil and solid waste samples. Sample vials should be prepared in a fixed laboratory or other controlled environment, sealed, and shipped to the field location. Gloves should be worn during the preparation steps.

6.1.1 Low concentration soil samples

The following steps apply to the preparation of vials used in the collection of low concentration soil samples to be analyzed by the closed-system purge-and-trap equipment described in Method 5035.

6.1.1.1 Add a clean magnetic stirring bar to each clean vial. If the purge-and-trap device (Sec. 4.2) employs a means of stirring the sample other than a magnetic stirrer (e.g., sonication or other mechanical means), then the stir bar is omitted.

6.1.1.2 Add preservative to each vial. The preservative is added to each vial prior to shipping the vial to the field. Add approximately 1 g of sodium bisulfate to each vial. If samples markedly smaller or larger than 5 g are to be collected, adjust the amount of preservative added to correspond to approximately 0.2 g of preservative for each 1 g of sample. Enough sodium bisulfate should be present to ensure a sample pH of ≤ 2.

6.1.1.3 Add 5 mL of organic-free reagent water to each vial. The water and the preservative will form an acid solution that will reduce or eliminate the majority of the biological activity in the sample, thereby preventing biodegradation of the volatile target analytes.

6.1.1.4 Seal the vial with the screw-cap and septum seal. If the double-ended, fritted, vials are used, seal both ends as recommended by the manufacturer.

6.1.1.5 Affix a label to each vial. This eliminates the need to label the vials in the field and assures that the tare weight of the vial includes the label. (The weight of any markings added to the label in the field is negligible).

6.1.1.6 Weigh the prepared vial to the nearest 0.01 g, record the tare weight, and write it on the label.

6.1.1.7 Because volatile organics will partition into the headspace of the vial from the aqueous solution and will be lost when the vial is opened, surrogates, matrix spikes, and internal standards (if applicable) should only be added to the vials after the sample has been added to the vial. These standards should be introduced back in the

laboratory, either manually by puncturing the septum with a small-gauge needle or automatically by the sample introduction system, just prior to analysis.

6.1.2 High concentration soil samples collected without a preservative

When high concentration samples are collected without a preservative, a variety of sample containers may be employed, including 60-mL glass vials with septum seals (see Sec. 4.4).

6.1.3 High concentration soil samples collected and preserved in the field

The following steps apply to the preparation of vials used in the collection of high concentration soil samples to be preserved in the field with methanol and analyzed by the aqueous purge-and-trap equipment described in Method 5030.

6.1.3.1 Add 10 mL of methanol to each vial.

6.1.3.2 Seal the vial with the screw-cap and septum seal.

6.1.3.3 Affix a label to each vial. This eliminates the need to label the vials in the field and assures that the tare weight of the vial includes the label. (The weight of any markings added to the label in the field is negligible).

6.1.3.4 Weigh the prepared vial to the nearest 0.01 g, record the tare weight, and write it on the label.

NOTE: Vials containing methanol should be weighed a second time on the day that they are to be used. Vials found to have lost methanol (reduction in weight of >0.01 g) should not be used for sample collection.

6.1.3.5 Surrogates, internal standards and matrix spikes (if applicable) should be added to the sample after it is returned to the laboratory and prior to analysis.

6.1.4 Oily waste samples

When oily waste samples are known to be soluble in methanol or PEG, sample vials may be prepared as described in Sec. 6.1.3, using the appropriate solvent. However, when the solubility of the waste is unknown, the sample should be collected without the use of a preservative, in a vial such as that described in Sec. 6.1.2.

6.2 Sample collection

Collect the sample according to the procedures outlined in the sampling plan. As with any sampling procedure for volatiles, care must be taken to minimize the disturbance of the sample in order to minimize the loss of the volatile components. Several techniques may be used to transfer a sample to the relatively narrow opening of the low concentration soil vial. These include devices such as the EnCore™ sampler, the Purge-and-Trap Soil Sampler ™, and a cut plastic syringe. Always wear gloves whenever handling the tared sample vials.

6.2.1 Low concentration soil samples

6.2.1.1 Using an appropriate sample collection device, collect approximately 5 g of sample as soon as possible after the surface of the soil or other solid material has been exposed to the atmosphere: generally within a few minutes at most. Carefully wipe the exterior of the sample collection device with a clean cloth or towel.

6.2.1.2 Using the sample collection device, add about 5 g (2 - 3 cm) of soil to the sample vial containing the preservative solution. Quickly brush any soil off the vial threads and immediately seal the vial with the septum and screw-cap. Store samples on ice at 4°C.

NOTE: Soil samples that contain carbonate minerals (either from natural sources or applied as an amendment) may effervesce upon contact with the acidic preservative solution in the low concentration sample vial. If the amount of gas generated is very small (i.e., several mL), any loss of volatiles as a result of such effervescence may be minimal if the vial is sealed quickly. However, if larger amounts of gas are generated, not only may the sample lose a significant amount of analyte, but the gas pressure may shatter the vial if the sample vial is sealed. Therefore, when samples are known or suspected to contain high levels of carbonates, a test sample should be collected, added to a vial, and checked for effervescence. If a rapid or vigorous reaction occurs, discard the sample and collect low concentration samples in vials that do not contain the preservative solution.

6.2.1.3 When practical, use a portable balance to weigh the sealed vial containing the sample to ensure that 5.0 ± 0.5 g of sample were added. The balance should be calibrated in the field using an appropriate weight for the sample containers employed (Sec. 4.5.5). Record the weight of the sealed vial containing the sample to the nearest 0.01 g.

6.2.1.4 Alternatively, collect several trial samples with plastic syringes. Weigh each trial sample and note the length of the soil column in the syringe. Use these data to determine the length of soil in the syringe that corresponds to 5.0 ± 0.5 g. Discard each trial sample.

6.2.1.5 As with the collection of aqueous samples for volatiles, collect at least two replicate samples. This will allow the laboratory an additional sample for reanalysis. The second sample should be taken from the same soil stratum or the same section of the solid waste being sampled, and within close proximity to the location from which the original sample was collected.

6.2.1.6 In addition, since the soil vial cannot be opened without compromising the integrity of the sample, at least one additional aliquot of sample must be collected for screening, dry weight determination, and high concentration analysis (if necessary). This third aliquot may be collected in a 60-mL glass vial or a third 40-mL soil sample vial. However, this third vial must *not* contain the sample preservative solution, as an aliquot will be used to determine dry weight. If high concentration samples are collected in vials containing methanol, then two additional aliquots should be collected, one for high concentration analysis collected in a vial containing methanol, and another for the dry weight determination in a vial without either methanol or the low concentration aqueous preservative solution.

6.2.1.7 If samples are known or expected to contain target analytes over a wide range of concentrations, thereby requiring the analyses of multiple sample aliquots, it may be advisable and practical to take an additional sample aliquot in a low concentration soil vial containing the preservative, but collecting only 1-2 g instead of the 5 g collected in Sec. 6.2.1.1. This aliquot may be used for those analytes that exceed the instrument calibration range in the 5-g analysis.

6.2.1.8 The EnCore™ sampler has not been thoroughly evaluated by EPA as a sample storage device. While preliminary results indicate that storage in the EnCore™ device may be appropriate for up to 48 hours, samples collected in this device should be transferred to the soil sample vials as soon as possible, or analyzed within 48 hours.

6.2.1.9 The collection of low concentration soil samples in vials that contain methanol is <u>not</u> appropriate for samples analyzed with the closed-system purge-and-trap equipment described in this method (see Sec. 6.2.2).

6.2.2 High concentration soil samples preserved in the field

The collection of soil samples in vials that contain methanol has been suggested by some as a combined preservation and extraction procedure. However, this procedure is <u>not</u> appropriate for use with the low concentration soil procedure described in this method.

<u>NOTE</u>: The use of methanol preservation has not been formally evaluated by EPA and analysts must be aware of two potential problems. First, the use of methanol as a preservative and extraction solvent introduces a significant dilution factor that will raise the method quantitation limit beyond the operating range of the low concentration direct purge-and-trap procedure (0.5-200 µg/kg). The exact dilution factor will depend on the masses of solvent and sample, but generally exceeds 1000, and may make it difficult to demonstrate compliance with regulatory limits or action levels for some analytes. Because the analytes of interest are volatile, the methanol extract cannot be concentrated to overcome the dilution problem. Thus, for samples of unknown composition, it may still be necessary to collect an aliquot for analysis by this closed-system procedure and another aliquot preserved in methanol and analyzed by other procedures. The second problem is that the addition of methanol to the sample is likely to cause the sample to fail the ignitability characteristic, thereby making the unused sample volume a hazardous waste.

6.2.2.1 When samples are <u>known</u> to contain volatiles at concentrations high enough that the dilution factor will not preclude obtaining results within the calibration range of the appropriate determinative method, a sample may be collected and immediately placed in a sample vial containing purge-and-trap grade methanol.

6.2.2.2 Using an appropriate sample collection device, collect approximately 5 g of sample as soon as possible after the surface of the soil or other solid material has been exposed to the atmosphere: generally within a few minutes at most. Carefully wipe the exterior of the sample collection device with a clean cloth or towel.

6.2.2.3 Using the sample collection device, add about 5 g (2 - 3 cm) of soil to the vial containing 10 mL of methanol. Quickly brush any soil off the vial threads and immediately seal the vial with the septum and screw-cap. Store samples on ice at 4°C.