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GENERAL PLANS FREE PRODUCT REMOVAL PROJECT FUEL FARM 216 NAS CORPUS CHRISTI TX
12/6/1995
MORRISON KNUDSEN CORPORATION

(2)

GENERAL PLANS

FREE PRODUCT REMOVAL PROJECT
FUEL FARM 216

NAVAL AIR STATION CORPUS CHRISTI
CORPUS CHRISTI, TEXAS

CONTRACT N62467-93-D-1106
DELIVERY ORDER 0016
STATEMENT OF WORK 024

REVISION 0
DECEMBER 6, 1995

Prepared For:

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GENERAL PLANS

Free Product Removal Project

Fuel Farm 216

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MK Quality Program Manager — Date: 20-Dec-95

MK Sr. Project Manager — Date: 20 Dec 95

MK Program Manager — Date: 20 Dec 95

ACCEPTANCE

U.S. Navy Responsible Authority — Date

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SITE SAFETY AND HEALTH PLAN (SSHP)

NAS CORPUS CHRISTI FREE PRODUCT REMOVAL PROJECT
CORPUS CHRISTI, TEXAS

CONTRACT #N62467-93-D-1106
DELIVERY ORDER #0016
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1.0 SITE DESCRIPTION, CONTAMINANT CHARACTERIZATION AND REFERENCES

1.1 INTRODUCTION

This Site Safety and Health Plan (SSHP) describes safety and health requirements for remediation activities at NAS Corpus Christi, Free Product Removal Project. This SSHP is consistent with requirements of the Occupational Safety and Health Administration's (OSHA) Hazardous Waste Site Regulations, 29 CFR 1910.120 and 29 CFR 1926.65 along with the U.S. Army Corps of Engineers' (ACOE) *Safety and Health Requirements Manual* EM 385-1-1 dated October 1992. This SSHP is applicable to all personnel who enter into work areas described in this SSHP and who are under Morrison Knudsen Corporation (MK) or MK's Subcontractors' control.

1.2 SITE DESCRIPTION

NAS Corpus Christi is located on the Gulf of Mexico in south Texas adjacent to the City of Corpus Christi. Work will be conducted at the non operational Fuel Farm 216 located in the northwestern portion of the base. Fuel Farm 216 contains 36 25,000-gallon underground storage tanks (USTs) which stored jet fuel (JP-4) and aviation gasoline. The fuel farm was closed in 1987 and each UST was closed in place. An additional area adjacent to Fuel Farm 216 designated Tank Nest 162 contained two 10,000 UST's used to store diesel fuel. Both tanks were closed by removal in 1991. Figure 1 is included as the vicinity map and Figure 2 as the work site map.

The scope of the work will include the following: 1) hydro punching into soil to assess product pools; 2) over-drill three existing recovery wells; 3) install two additional recovery wells; 4) install recovery system from wells consisting of pneumatic dual pump system incorporating a skimmer attachment; 4) install recovery system piping and mechanical; 5) install oil/water separator and 1,000 gallon recovery tank; 6) install 600 gallon groundwater recovery tank with piping and mechanical to permit discharge to existing lift station in Building 15; and 7) install concrete pad with fencing for treatment equipment.

1.3 CONTAMINANT CHARACTERISTICS

Potential contaminants expected to be encountered during remedial construction include residuals of Jet Fuel (JP-4), aviation gasoline (AVGAS) and possibly diesel fuel present in the soil and/or groundwater. More specifically, the contaminants include benzene, toluene, ethylbenzene and xylene, referred to the BTEX constituents of petroleum products. In addition, polycyclic aromatic hydrocarbons (PAHs) have been detected in soil and groundwaters around the site as reported in the EA&H Contamination Assessment Report (CAR). The PAHs of any significance include naphthalene, 2-methylnaphthalene and 1-methylnapthalene. Groundwater sample results indicate

Total Petroleum Hydrocarbons (TPH), BTEX and semi volatiles, which include 2 methylnaphthalene; phenol; n-nitrosodi n-propylamine; and naphthalene.

Additional contaminants could be present. They include coal tar pitch volatiles. Cresols, manganese, N,N-dimethylformamide and octane are common constituents of aviation fuels, kerosene, diesel, and fuel oil. Tetraethyl lead was a common constituent of jet fuels and gasoline and may be present in residual product. Triorthocresylphosphate (TOCP) is a common constituent of gasoline and may be present in residual product.

Refer to Table 1 which is provided as a summary on each known potential contaminant. Its description, exposure limits, signs and symptoms of acute exposure and recommended first aid is listed. MSDS's or NIOSH Pocket Guides for each of the contaminants and other chemical substances used in remedial construction shall be organized into separate MSDS Binders by the MK SSHO to be located on site.

1.4 REFERENCES

1. *Draft Contamination Assessment Report (CAR), NAS Corpus Christi*, EnSafe/Allen and Hoshall (EA&H), June 9, 1995.

   Draft Remedial Action Plan (RAP), NAS Corpus Christi, EnSafe/Allen and Hoshall (EA&H), October 6, 1995.

   Niemi to Jackman, *Free Product Recovery System Design Naval Air Station Corpus Christi*, MK-Boise, September 27, 1995.

2. *Safety and Health Requirements Manual*, US Army Corps of Engineers (ACOE), EM 385-1-1, October 1992.
3. *Pocket Guide to Chemical Hazards*, National Institute for Occupational Safety and Health (NIOSH), Publication N. 94-116, June 1994.
4. *Limits for Air Contaminants*, Title 29 CFR Part 1910 Section 1000, Table Z-1, July 1, 1994 revision.
5. *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Indices*, American Conference of Governmental Industrial Hygienists (ACGIH), 1994 - 1995.
6. *Accident Prevention Plan For Naval Facilities Engineering Command Southern Division,* Prepared by Morrison Knudsen under contract N62467-93-D- 1 106, May 20, 1994, Revision 0.
7. *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities,* NIOSH/OSHA/USCG/EPA, DHHS (NIOSH) Publication No. 85-115, October 1985.
8. Maslansky, Carol J. and Steven P., *Air Monitoring Instrumentation, A Manual for Emergency, Investigatory, and Emergency Responders*, Van Nostrand Reinhold, 1993.
9. *Industrial Hygiene Procedures Manual,* Morrison Knudsen Corporation EC&E Group, Rev.No 0, April 1994.

10. *Safety and Health Program Description for Hazardous Waste Operations,* Morrison Knudsen Corporation, Rev. 1, September 1994.
11. *Safety Manual,* Morrison Knudsen Corporation, MK-Ferguson Group, 1/27/89.
12. The following MK NAVFAC SouthDiv Project Procedures:

PHSP 01.1, Hazardous Energy Control (Lockout/Tagout), 9/13/95.
PHSP 02.1, Emergency Response, 9/13/95.
PHSP 03.1, Spill Response, 9/13/95.
PHSP 04.1, Incident Reporting, 9/13/95.
PHSP 05.1, Excavations, 9/13/95.

2.0 SAFETY AND HEALTH HAZARDS SUMMARY

2.1 OVERVIEW

During removal activities, the potential risk of acute exposure to the chemical contaminants listed in Table 1 is considered low. Engineering controls, Administrative Controls and Personal Protective Equipment (PPE) requirements shall be strictly adhered to. The chemical agents posing the highest health risk are benzene and tetraethyl lead. An airborne concentration of benzene near the breathing zone of a worker is considered very unlikely. During drilling activities, organic vapor concentrations in borings could be high, especially when free product is contacted. Breathing zone concentrations are not expected to exceed any action levels. This assumption will be validated by an ongoing air monitoring program, and if necessary, an air sampling program.

Contaminants posing dermal absorption risks such as tetraethyl lead are not expected to be airborne threats. Based on our previous work experiences with similar contaminants reported in the parts per million (ppm) concentrations, direct contact poses more of an exposure threat then airborne. Therefore, Personal Protective Equipment (PPE)(mainly skin protection), decontamination and good hygiene practices are critical when working with the listed contaminants, and will be emphasized throughout the work campaign. Remedial construction physical hazards are probably the greatest contributor to any risk on this job as discussed below.

2.2 ACTIVITY HAZARD ANALYSES (AHA)

AHA have been prepared for each anticipated task in accordance with EM 385-1-1, October 1992 (ACOE, 1992). These hazard analyses are in the form of worksheets contained in Appendix A of this SSHP. Each site activity shall be reviewed by field supervision, namely the MK SSHO, MK General Superintendent and Subcontractor Job Supervisors(s) prior to starting work to determine if the prepared AHA adequately addresses the planned activity. If the prepared AHA requires revision or a new task is identified, additional hazard analysis will be prepared as needed. A new AHA worksheet shall be field prepared by the Subcontractor Job Supervisor and the MK SSHO before the activity takes place. The Pre-Entry Briefing meeting is utilized to review the AHA and is conducted with all affected workers by the Subcontractor Job Supervisor.

2.3 CHEMICAL HAZARDS

The potential chemical contaminants considered most significant!on this project are benzene by inhalation mode and tetraethyl lead by absorption mode. Table 1 for a summary on potential chemicals of concern.

2.4 BIOLOGICAL HAZARDS

None anticipated, however, use caution and assess work areas for specific insect and snake concerns along with biohazard plant life. The MK SSHO shall meet with base medical staff and discuss and potential concerns.

2.5 CONSTRUCTION SAFETY HAZARDS

2.5.1 Physical Hazards

The physical hazards associated with the project include the use of heavy equipment, power and handtools and special power equipment. Examples include backhoes and drill rigs, underground utilities and electrical lines and process lines. Other physical hazards include could include heat stress; adverse weather conditions, and noise. Other possible safety hazards include the potential for slipping, falling, head trauma, lifting heavy objects, struck by and struck against and pinch points. All these physical hazards could cause slips, trips, and falls, cuts, contusions, and lacerations, traffic accidents, electrical shock, fires and explosions, crunching, pinching, injury from falling objects and heat/cold stress related disorders. Hazards also arise from vehicular traffic in and around the parking areas during construction activities. An active run-way is located south and southwest of the work area. Elevated equipment such as drill rigs will be flagged when in elevated position in accordance with guidance from the Resident Officer In Charge of Construction (ROICC). Each Contractor shall take proactive measures to prevent foreign object damage to aircraft from potential projectiles when work is being done in the near vicinity of the flightline and hangar areas.

2.5.2 Noise

Well construction operations may create noise levels that exceed the applicable limits. Hearing protection will be provided for all field personnel and its use is required when noise levels exceed 85 dBA steady state or 140 dBA impulse, regardless of the duration of exposure. A comprehensive Hearing Conservation Program will be implemented when noise levels equal or exceed 85 dBA as an 8-hour time weighted average.

2.5.3 Heat and Cold Stress

All employees are to be alert to the signs and symptoms of heat stress. Should any of the following symptoms occur: extreme fatigue, cramps, dizziness, headache, nausea, profuse sweating, rapid pulse, pale clammy skin, the employee is to immediately leave the work area, rest, cool off, and drink plenty of cool water. If the symptoms do not subside after a reasonable rest period, the employee shall notify their supervisor who in turn will notify the MK SSHO and

seek medical assistance. The MK SSHO and the site supervisor will be alert to signs of heat stress in site personnel and increase the frequency of breaks and fluid consumption as necessary. Cold stress is not anticipated as an occupational risk.

2.5.4 Excavations

MK Project Procedure PHSP 05.1 shall be followed regarding excavation safety.
Positive identification of underground utilities and services is required at least 24 hours prior to any excavation or trenching. An Excavation and Trenching Permit as found in the referenced procedure shall be posted at the excavation site. The Mechanical and Electrical Subcontractor, and if necessary the Well Driller/Installer Subcontractor will provide and coordinate additional underground utility locator service with MK. See Section 2.5.6 that follows. Individuals shall be properly trained prior to initiating work activities. A competent person shall evaluate all excavations and trenches on a daily basis regardless of whether personnel will enter. The competent person must be present whenever water removal is taken place from an excavation.

2.5.5 Underground Utilities

Underground utilities will be located to the extent possible via historical information, as-built drawings, and through the use of metal detectors and/or other devices such as ground penetrating radar prior to initiating excavation. Positive identification of underground utilities and services is required. An Excavation and Trenching Permit system shall be used whenever excavation, trenching or penetrations are planned. If energy control is anticipated for underground utilities, the requirements established in MK project procedure PHSP 01.1 shall be followed.

Utility identification will be coordinated by MK. For facilities related utility and process system locations, the MK Project Engineer will work with the NAS Corpus Christi Public Works Department (PWD) and prepare a site specific utility diagram for each work area. NAS Corpus Christie site drawings will be reviewed to identify locations of all electrical, gas, water, and storm drain lines and they will be located on a single site drawing. MK will notify the ROICC at least 5 working days in advance of excavating, trenching and penetration activities to verify underground installations. The Subcontractor shall use metal detectors prior to the excavation/penetration activity to locate underground anomalies or designated utility. A site walk shall be conducted after utilities have been identified as a final check to assure agreement between all parties involved. Personnel attending shall include PWD personnel, utility locate personnel, MK, and Subcontractor personnel.

2.5.6 Fire and Explosion

No hot work or open flames will be allowed in the work area without a "Hot Work Permit". The MK Hot Work Permit form will be available through the MK SSHO. When fire or explosion hazards exist, all tools shall be of the non-sparking variety and pumps/blowers will be bonded or grounded to minimize hazards associated with static discharge. Use of any tool that can be considered an ignition hazard where fire and explosion hazards may exist is strictly prohibited. Portable power tools shall be explosion proof in accordance with NFPA 70B and 70E, Class 1, Division 1, Group D or otherwise approved for use in potentially explosive atmospheres.

At least two 20 lb "ABC" multi purpose dry chemical fire extinguishers shall be maintained for fire response at the entrance to the Contamination Reduction Zone (CRZ). All mobile heavy equipment must be fitted with a minimum 10 lb "ABC" fire extinguisher. Any temporary trailers or structures must have fire extinguishers installed in accordance with NFPA 10. Depending on the fire loading, in most cases a 5 lb "ABC" is sufficient in each office trailer. This extinguisher must be mounted at least four feet from the floor next to a egress door.

2.5.7 Electrical Hazards, Control of Hazardous Energy (Lockout/Tagout)

When energy control is anticipated for any utility and/or mechanical and process equipments, the requirements established in MK project procedure PHSP 01.1 shall be followed. Ground Fault Circuit Interrupters (GFCIs) will be installed on all portable electrical equipment and installations in accordance with EM 385-1-1 Section 11.C.05. All extension cords shall have GFCI protection and shall be inspected and determined to be free of cracks or frays. The MK Site Superintendent and the Subcontractor Supervisor have the responsibility for energy control. Energy control involving any NAS Corpus Christi utility or process equipment shall be coordinated through the PWD by the MK Site Superintendent. The Subcontractor will initiate all energy control requests to MK three working days in advance of anticipated work commencement.

In addition, energy controls apply to motorized heavy equipment and the following requirement applies. At a minimum, during service and maintenance of motorized equipment, the key shall be removed and in possession of the service or maintenance person and a "Do Not Operate" tag signed by this person shall be displayed near the start-up controls.

2.5.8 General Motor Vehicle, Hand and Power Equipment Safety

The following traffic rules will apply to all motorized vehicles and equipment while on site:

- Equipment carrying waste shall always have the right-of-way within the Work Zones.

- The speed limit is 10 mph, or as posted. Exceeding the speed limit is cause for disciplinary action, including removal from the site. Trucks used for hauling materials, equipment, debris and rubbish shall be equipped with and use tailgates. Loads shall be covered and measures be taken to ensure hauling routes do not have debris which has inadvertently fallen off trucks.

- Personnel shall not ride equipment that has not been specifically designed for the transport of personnel.

- Seatbelts shall be worn at all times when operating any motorized equipment or vehicle.

- All motor vehicles and equipment including hand and power tools shall be subject to an incoming safety inspection by the MK SSHO. The MK SSHO reserves the right to reject any subcontractor equipment. A "DO NOT USE" or "DEFECTIVE" tag will

be placed on the equipment and documented in the MK SSHO Logbook. Corrective action will be pursued with the Subcontractor Supervisor.

- Daily safety checklists shall be completed by Subcontractor heavy equipment operators, especially any type of overhead crane or lifting equipment including the drill rig, and delivered to the MK Site Project Office on a daily basis. The checklist should be based on the equipment manufacturers recommended guidelines for daily checks using a format established and prepared by the owner/operator/subcontractor and approved by the MK SSHO.

2.5.9 Traffic and Work Site Control Safety

Potential hazards from vehicular traffic around the work areas will be controlled by placing approved barricades and signs around the work area. Workers required to work in active traffic areas or roadways will be required to wear high visibility reflective vests. Suggested types of barricades along with placement and signs will follow the requirements of EM 385-1-1, Section 8 and 29 CFR 1926.201 and 202. Elevated equipment such as drill rigs will be flagged when in elevated position in accordance with guidance from the Resident Officer In Charge of Construction (ROICC). All road closures shall be scheduled ten days in advance with the PWD.

3.0 RESPONSIBILITIES AND AUTHORITIES SUMMARY

This section describes the roles and responsibilities of project personnel with regard to safety and health. Ultimately, responsibility for the safety and health lies with the individual. All personnel must be cognizant of the hazards and the methods of reducing the risk of injury and illness. All personnel will comply with the rules and procedures set forth in this plan and will make project management aware of any conditions which may jeopardize the welfare of project workers and/or the general public. The specific personnel names and telephone numbers of responsible persons are presented in Table 2 herein.

3.1 MK PROJECT MANAGER (PM)

The PM is responsible for the management of all aspects of the project, including safety and health. The PM is responsible for ensuring that all project tasks receive appropriate safety and health review before commencement of field activities and that the necessary equipment and facilities are available to implement the SSHP.

3.2 MK GENERAL SUPERINTENDENT AND SUBCONTRACTOR JOB SUPERVISORS

The MK General Superintendent and the Subcontractor Job Supervisor(s) are responsible for ensuring that the safety and health aspects for their particular task are addressed. They are responsible for the implementation of the SSHP in the field and for ensuring that all project personnel comply with provisions of the plan. The MK General Superintendent and Subcontractor Job Supervisor(s) are also responsible for notifying the MK Site Safety and Health Officer (SSHO) of any changes in work conditions which may affect the safety and health aspects

of the task. The MK General Superintendent is responsible for conducting Plan of the Day (POD) meetings. The Subcontractor Job Supervisor(s) are responsible for conducting Pre-Entry Briefings and Post Entry Briefings.

The Subcontractor Job Supervisor(s) must notify the MK SSHO and MK General Superintendent of all accidents and incidents as soon as possible. The Subcontractor Job Supervisor(s) shall conduct an accident investigation and record the results of the investigation on a Supervisor Accident Investigation Report form or equivalent form. The initial investigation report shall be formally transmitted to the MK Project Manager within four hours after critical management of the incident is complete. The MK Project Manager shall follow the reporting requirements described in Section 11.2 of this SSHP. Section 11.2 references the MK Project Procedure PHSP-04-1. The MK General Superintendent shall conduct a critique of the incident with selected MK and Subcontractor personnel as soon as possible after critical management of the incident is complete. Lessons learned will then be developed by the MK General Superintendent and Subcontractor Job Supervisor(s) and communicated to all affected personnel.

3.3 MK CERTIFIED INDUSTRIAL HYGIENIST (CIH)

The MK CIH who is the MK Project Management Office (PMO) Health and Safety Manager is responsible for preparation of the Site Safety and Health Plan (SSHP). The CIH is based out of the Boise, ID office. The CIH is responsible for making modifications to the plans and recommending changes to the work tasks if they affect safety and health. The CIH is responsible for ensuring that all required sampling/monitoring is performed and that all required safety and health documentation is maintained. The CIH may assign some tasks to the MK SSHO for implementation.

3.4 MK SITE SAFETY AND HEALTH OFFICER (SSHO)

The MK SSHO is responsible for the day-to-day implementation of the Site Safety and Health Plan (SSHP), and verification of compliance with the SSHP and all applicable occupational safety and health rules and regulations. The MK SSHO has the authority to suspend work at any time if there is an imminent threat to the health and safety of project workers or the general public. The MK SSHO shall assure the Navy's designated authority at the site is notified immediately of any accident including spills. The MK SSHO shall assist in the accident investigation effort and shall have final approval authority for accident reports. The MK Work Plan document describes in detail the role and responsibilities of the MK SSHO on this project.

3.5 SUBCONTRACTOR DESIGNATED COMPETENT SAFETY PERSON

The Well Driller and Mechanical/Electrical Subcontractor's shall designate a competent and qualified person, subject to the approval of the MK SSHO and the MK Site Project Engineer, responsible for the implementation of this SSHP and their Company's safety and health program. This designated person shall be referred to as the Subcontractor SSHO. The Subcontractor's SSHO shall be qualified to perform air monitoring to support the subcontractor's operation and be supplied with the appropriate monitoring equipment described in Section 7 of this plan. The Subcontractor SSHO shall provide the MK SSHO copies of all factory calibration certificates and

the forms to be used to record daily field calibrations for each instrument. The Subcontractor SSHO shall provide a daily site safety report and shall coordinate his efforts with the MK SSHO.

3.6 SUBCONTRACTOR PERSONNEL

All subcontractors are required to have a qualified designated competent safety person who will assure and abide by the requirements of this SSHP as stated above. They are also required to comply with all applicable and appropriate federal, state, and local laws, standards, and regulations. Subcontractors must notify the MK SSHO and MK General Superintendent of all accidents as soon as possible. Subcontractors must maintain records of all first aid rendered and recordable, and lost time injuries. Subcontractors must notify the MK SSHO of any changes in work conditions which may affect the safety and health aspects of the task.

3.7 NEAREST EMERGENCY MEDICAL FACILITIES

Directions to Naval Hospital Corpus Christi

1. Located off of Avenue E just east of Lexington Blvd.
2. Travel distance is approximately one mile, travel time approximately five minutes.

Directions to Spohn Hospital

1. Ocean Drive west, turn left on Ayers Street.
2. Proceed two blocks and turn right on Third Street, the emergency room will be on the right.
3. Travel distance is approximately nine miles, travel time approximately twenty minutes.

A copy of the map to the hospital shall be posted at work sites for reference, refer to Figure 3 for a copy of this map plus Table 2 for phone numbers. **Note: a clean copy of this map shall be obtained by MK SSHO during mobilization.**

4.0 TRAINING AND SAFETY MEETING REQUIREMENTS SUMMARY

This Section lists all regulatory driven and project specific training required for this job. Table 3 provides a summary on training requirements. Safety related meetings required for this project are described beginning in Section 4.10. A training and meeting requirements matrix is shown in Table 3.

4.1 HAZARDOUS WASTE OPERATIONS TRAINING

All personnel entering a contamination reduction zone or exclusion zone shall have completed the initial 40-Hour Hazardous Waste Operations Safety and Health Training and three days of supervised experience pursuant to 29 CFR 1910.120(e)(3). All personnel shall receive eight hours of refresher training annually, pursuant to 29 CFR 1910.120(e)(8), as necessary. All on-site

supervisors and managers as well as subcontractor superintendents and foremen shall receive an additional eight hours of specialized training pursuant to 29 CFR 1910.120(e)(4).

4.2 SITE SPECIFIC TRAINING

All personnel shall receive site-specific training prior to entering the site or commencement of work. All site employees and subcontractors, including those working in the support zone, shall receive this training. The Subcontractor Job Supervisor(s) are responsible for identifying personnel requiring this training and coordinated with the MK SSHO regarding scheduling of this training. The MK SSHO or designated alternate will conduct the training. Site visitors shall receive site-specific training prior to entering an exclusion zone. An abbreviated version of this training will be given to site visitors not entering an exclusion zone but whose business will be conducted unescorted in the near vicinity of the Work Zones. The format and content will be left up to the discretion of the MK SSHO. This training will cover the SSHP, but not necessarily be limited to, the following topics.

- Names of site safety and health personnel.
- Safety and health hazards present on the site and anticipated during the work campaign.
- Hazard Communication.
- PPE requirements.
- Safe work practices.
- Engineering and Administrative controls .
- Medical surveillance requirements, including recognition or symptoms and signs which might indicate overexposure to hazards.
- Decontamination procedures.
- Emergency procedures.
- Spill containment plan.
- Energy Control.
- Requirements of this SSHP.

4.3 CONFINED SPACE ENTRY TRAINING

Not anticipated on this project.

4.4 RESPIRATORY PROTECTION TRAINING

All MK personnel and subcontractors required to use respiratory protection shall be trained in respirator use, care and maintenance pursuant to 29 CFR 1926.103 and 29 CFR 1910.134. Each individual shall be medically qualified to wear a respiratory device and have documented evidence of successfully completing respiratory training and fit testing.

4.5 HAZARD COMMUNICATION TRAINING

All personnel shall complete hazard communication training pursuant to 29 CFR 1910.1200 and 29 CFR 1926.59 regarding all potentially hazardous chemicals to which they may be exposed.

In the event that the OSHA regulations regarding other contaminants or hazards become applicable, substance-specific training pursuant to the subject regulation will be performed for the affected project personnel.

Each subcontractor shall have a written Hazard Communication Program in accordance with OSHA's Hazard Communication Standard, 29 CFR 1910.1200 and applicable State Department of Health Regulations. Material Safety Data Sheets (MSDS) for all hazardous materials in the work area shall be readily available for employees to review. MSDSs and/or NIOSH Pocket Guides for the contaminants suspected to be in the various work sites will be placed in a site MSDS Right-To-Know Binder. Copies will be maintained at each work site or some location convenient for employees to review plus a copy will be kept at the MK Project Office and the Subcontractor(s) Project Office.

Hazard Communication training will be included as part of the Site-Specific Training required in Section 4.2. When new chemicals are brought onto the work site or new chemical contaminants are identified, an MSDS and/or NIOSH Pocket Guide will be added to the MSDS Right-To-Know Binder(s) with a corresponding review by the MK SSHO and Subcontractor Job Supervisor(s) and if necessary, training shall be conducted with affected individuals. The MK SSHO has overall responsibility for maintenance of the MSDS database. Subcontractors are responsible for notifying the MK SSHO of new chemicals or substances being used in the work place. Subcontractor Job Supervisor(s) are responsible for reviewing the MSDS, identifying training needs for affected workers and transmitting a copy of the MSDS to the MK SSHO.

4.6 CPR/FIRST AID AND BLOODBORNE PATHOGENS

At least two employees on each shift shall be qualified to administer first aid and CPR. At the minimum, the MK SSHO and each Subcontractor shall have at least one person First Aid/CPR qualified. These personnel are also required to be trained to 29 CFR 1910.1030 (Bloodborne Pathogens) as stated and in accordance with MK IH Procedure 11. Trained first aid CPR personnel shall be identified by hard hat stickers or other means of identification.

4.7 DEPARTMENT OF TRANSPORTATION (DOT) HAZARDOUS MATERIALS TRAINING

All personnel required to classify, mark, select packaging, inspect, load and transport hazardous materials must be trained to 49 CFR Part 172 Subpart H. This includes personnel responsible for packaging of samples to be sent to off site laboratories for analysis. Also included are personnel responsible for completing a hazardous waste or hazardous material manifest and insuring the hazardous waste/material is properly prepared for off site shipment.

4.8 SAFETY MEETINGS

Safety meetings for all MK employees and subcontractors personnel shall be conducted on a weekly basis. This group meeting by design will be intended to be a self assessment of safety performance and a chance to review any lessons learned as a group plus an opportunity to introduced specialized training topics. The meeting shall be chaired by the MK General

Superintendent and Subcontractor Supervisor(s) with assistance by the MK SSHO and/or subcontractor designated competent safety person. This safety meeting can also be used to describe any changes in the Site Specific Training described in Section 4.4. Safety Meetings are documented using Figure 4 from this plan or equivalent. An additional Safety Meeting for all MK personnel and Subcontractor Job Supervisor(s) shall be conducted at least once per month. The monthly meeting is chaired by the MK Project Manager or General Superintendent with assistance from the MK SSHO. Its purpose is to review and rate safety performance and identify any areas requiring additional specialized training. This meeting shall be documented to include date, time, personnel in attendance, topics, and instructor. The Safety Meeting shall be documented using Figure 4 or equivalent.

4.9 PLAN OF THE DAY (POD) MEETINGS

Plan Of The Day (POD) Meetings shall be held at the beginning of each shift to review the planned work of the day as well as any safety and quality concerns. The meeting is chaired by the MK General Superintendent or MK PM. The attendees include the Subcontractor(s) Job Supervisor, the MK Quality Control representative, the MK SSHO and other selected personnel. The date, time, personnel attending and meeting minutes shall be documented using Figure 3 or equivalent.

4.10 PRE- AND POST-ENTRY BRIEFINGS (MEETING)

Pre-entry briefings shall be held for employees prior to their initiating any new or differing site activity in an exclusion zone and at such other times as necessary to ensure employees are knowledgeable of the work plan activity, the Activity Hazards Analysis, and that the plan and analyses are being followed. Pre Entry Briefs are the responsibility of the Subcontractor Job Supervisor. Attendance shall be documented using Figure 5 from this Plan. In addition, a sign-in and sign-out sheet shall be made available at the CRZ for personnel to sign and record time in and out of the exclusion zone.

Post-entry briefings shall be held as needed to assure changes in conditions or work methods are promptly reported and addressed. In addition, all incidents will be promptly evaluated and the evaluation results will be communicated to personnel in post-entry briefings and other meetings. Lessons-learned from these evaluations shall be communicated to all affected personnel. Post Entry Briefs are the responsibility of the Subcontractor Job Supervisor. They are not required to be formally documented using Figure 5 from this plan, a logbook entry is sufficient.

4.11 QUALITY CONTROL PREPARATORY PHASE INSPECTION MEETING

The MK SSHO shall attend all Quality Control Preparatory Phase Inspection Meetings to discuss any safety and health concerns requiring special attention and to review anticipated safety requirements for a specific definable feature of work, and to review specific air monitoring required.

4.12 RECORDKEEPING

Written records of all required training and meetings shall be maintained on site by the MK SSHO. These records shall be made available to U.S. Navy personnel upon request. Subcontractors to MK shall provide copies of training certifications along with proof of medical surveillance physical and respirator certification to the MK Project Manager or MK SSHO prior to personnel working on site.

5.0 MEDICAL PROGRAM SURVEILLANCE PROGRAM REQUIREMENTS

5.1 SUMMARY

All project personnel who work within the exclusion zone for more than three days per month, or are required to use respiratory protection regardless of the time within the exclusion zone, will participate in a medical surveillance program in accordance with OSHA 1910.120 and 1926.65, Section 16 from the MK Safety and Health Program Description for Hazardous Waste Site Operations, and as described in this section. New construction activities will not require participation in the Medical Surveillance Program unless special tasks dictate as determined by the MK SSHO.

The medical surveillance program consists of a baseline or initial examination, an annual medical examination, a termination examination, and episodic medical examinations as necessary. Termination exams specify to this job have been determined to not be necessary unless specific criteria is met as discussed in the MK Safety and Health Program for Hazardous Waste Site Operations, Section 16. Assess the need for termination physicals for both MK and Subcontractor personnel.

At a minimum, the content of the initial, annual and termination examinations shall consist of the following medical tests and procedures (or as determined by the examining physician):

- Medical and occupation history.
- Complete physical examination.
- Pulmonary function test (FVC and FEV_1).
- Complete blood count, generally SMAC-22 or 24 biochemical profile.
- Audiometry.
- Complete urinalysis.
- Resting electrocardiogram.
- Vision screen.
- Chest X-ray (PA) (at the direction of the examining physician).

An episodic examination will be required if any worker develops signs or symptoms related to the possible overexposure to hazardous substances or other health hazards, or that the employee has been injured or exposed above the permissible exposure limits or published exposure levels in an emergency situation. The scope of any episodic examination will be left to the discretion of the examining physician.

A copy of the examining physician's written opinion about the employee's ability to perform work on this hazardous waste site and use respiratory protection, and a statement that the physician has informed the employee of the results of the examination shall be kept on site. Subcontractors must provide this information to the MK Project Manager or the MK SSHO prior to mobilization activities on site. These statements must not contain the specific results of medical examinations or tests.

5.2 DRUG ABUSE PREVENTION PROGRAM

Drug screening is required for work at this site. Results must be provided for all personnel to the MK Project Manager prior to beginning any work at this site. Morrison Knudsen Corporation is committed to the establishment and maintenance of a safe and efficient work environment for all employees free from the effects of alcohol, illegal drugs, other controlled substances, and prohibited items.

5.3 RECORDKEEPING

Arrangements shall be made with the examining physician(s) or others to assure long-term storage of medical records in accordance with 29 CFR 1910.120 and 1926.65. MK will manage medical surveillance records for MK employee's only. The statements by the examining physician(s) attesting to the medical qualification of individual workers shall be maintained at the project site for both MK and the Subcontractor and will remain a part of the project files. The subcontractor's are responsible for all medical records management for their direct hire employees in accordance with OSHA 1910.120 and 1926.65.

6.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

6.1 GENERAL REQUIREMENTS

In addition to engineering controls and work practices, personal protective equipment (PPE) shall be used to protect personnel from exposure to contaminants which may be encountered during activities on site as warranted. The following guidelines will be followed:

- Respirators and other PPE necessary to protect the health of employees shall be provided by their employer.
- Only NIOSH/MSHA-approved respirators and cartridges shall be used.
- The respirator user's medical status shall be reviewed by the MK SSHO before work is performed requiring respirator use.
- MK IH Procedure 14.0 shall serve as the written standard operating procedure governing the use of respirators at the job site. Section 10 from MK Safety and Health Program Description for Hazardous Waste Operations shall serve as the written standard operating procedure governing the use of PPE at the job site.

- Respirators will be assigned to individual employees for their exclusive use and marked to indicate to whom it was assigned, for the duration of this scope of work.

Table 4 presents the basic levels (Level B, C, Modified D, and D) of PPE.

Table 5 lists the minimum PPE level required for each task or operation. If air sampling/monitoring indicates that modification to the levels of protection are warranted, the SSHO is empowered with the authority to authorize the modification based on the guidance provided in **Table 6**, Airborne Contaminant Response Criteria.

The PPE has been selected based on the site specific hazards. If conditions change, PPE selection and use shall be reviewed by the MK SSHO. Personnel will be trained if necessary on the use and limitations of specific pieces of PPE prior to initiation of work by their designated supervisors with assistance when necessary from the MK SSHO.

PPE will be maintained and stored in accordance with the manufacturer's recommendation and good industrial hygiene practices. Personnel will inspect PPE prior to each use to assure the PPE is clean and good working order. Training will be provided to personnel concerning PPE inspection criteria if determined to be necessary by the MK SSHO. Where needed, PPE donning and doffing procedures will be developed or reviewed and personnel will be trained on these procedures by the MK SSHO.

The MK SSHO shall conduct evaluations of effectiveness of PPE. Revisions in PPE selection and use will be made as warranted. The Subcontractor(s) Job Supervisor and/or Subcontractor designated competent safety person in coordination with the MK SSHO shall address medical considerations, including work limitations due to temperature extremes, when assigning or revising PPE requirements to personnel in accordance with MK Procedure on PPE.

7.0 AIR MONITORING AND SAMPLING

Air monitoring refers to direct real time reading of airborne concentrations and air sampling refers to time integrated air sampling either personal or area samples. The Well Driller/Installer and Mechanical/Electrical Subcontractors are responsible for supplying one photoionizing detector (PID) with 10.2 or 10.6 eV lamp; a supply of colormetric indicator tubes and hand pump, and one combustible gas indicator (CGI)/ oxygen (O_2) meter as described in subsections 7.2.1 and 7.2.2. The MK SSHO will maintain an additional PID and CGI/O_2 meter, plus an assortment of colormetric indicator tubes and a sound level meter. Execution of real time air monitoring will be coordinated by the MK SSHO in accordance with the requirements for air monitoring depicted in Table 8. Time integrated air sampling, if necessary will be completed by the MK SSHO.

7.1 GENERAL

This section describes the air sampling and air monitoring program performed to evaluate project worker exposure to potentially hazardous airborne materials and to evaluate off-site impacts. The air sampling/monitoring results will be used to:

- Assess worker exposure to potentially hazardous materials with respect to the Permissible Exposure Limit (PEL) for Air Contaminants (Title 29 Code of Federal Regulations, Part 1910.1000) or other published exposure levels.

- Assess the adequacy of engineering controls and respiratory protection.

- Delineate areas where controls or respiratory protection is needed.

- Establish work control zones.

7.2 AIR MONITORING

7.2.1 Volatile Organic Compounds

A direct-reading, real-time photoionization detection (PID) with a 10.2 or 10.6 eV lamp capable of detecting volatile organic compounds (VOCs) will be used whenever excavation and penetration in potentially contaminated areas occurs. Depending on degree of soil contamination encountered, monitoring can be completed on a periodic basis at the discretion of the MK SSHO. Readings will be taken at locations that reflect approximate concentrations of organic vapors and gases in the breathing zone of personnel in the work area. Results of the monitoring will be documented. If necessary, the level of PPE used by personnel in the exclusion zone work area will be modified. Table 6 lists the level of PPE used based on the concentration of organic vapors and gases in the breathing zone of project personnel. The direct-reading real-time organic vapor and gas monitoring equipment will be "response checked" according to the manufacturer's instructions prior to use each day, and calibrated by the manufacturer or other qualified personnel yearly. Records of the response check, maintenance and annual calibration will be maintained on site.

Colorimetric indicator tubes (e.g., Dräeger tubes) shall be used at the MK SSHO's discretion whenever the PID instrument measures breathing zone concentrations of organic gases or vapors exceeding 5 parts per million (ppm) PID equivalents greater than background concentrations for time period greater than five minutes. Colorimetric Tubes are used to further characterize the potential exposure. Generally, the frequency of sampling with indicator tubes is driven on the monitoring results of the PID. The following compounds shall be measured by colorimetric indicator tubes as determined by the MK SSHO: benzene, petroleum hydrocarbons (n-Octane), toluene, xylene, and ethylbenzene. If benzene is detected, or if any organic is detected at concentrations approaching it's action level, the level of PPE will be upgraded as specified in Table 6, or as determined by the MK SSHO. In the event of multiple organic exposures, it will be necessary for the MK SSHO to determine additive effects of the mixtures using the guidelines of the ACGIH "Additive Effects" method.

7.2.2 Combustible Gas and Oxygen Monitoring

A direct reading real time combination instrument capable of measuring % Lower Explosive Level (LEL) and percent of oxygen O_2 will be used whenever excavation and penetration in potentially contaminated areas occurs. Depending on degree of soil contamination if any,

monitoring can be completed on a periodic basis at the discretion of the MK SSHO. Results of the measurements will be documented. If necessary, the level of PPE will be modified. Table 6 describes the level of PPE to be used based on the concentration of organic vapors and gases in the breathing zone of project personnel. The combination gas meter will be "response checked" according to the manufacturer's instructions prior to use each day, and calibrated by the manufacturer or other qualified personnel yearly. Records of the response check, maintenance and annual calibration will be maintained on site.

7.2.3 Noise Monitoring

Noise monitoring will be performed by the MK SSHO at the initiation of each task or operation presenting an excessive sound level risk. Sound levels will be determined at locations that best approximate the sound levels at the ear of potentially affected personnel. Noise monitoring equipment will be "response checked" according to the manufacturer's instructions prior to use each day, and calibrated by the manufacturer or other qualified personnel yearly. Records of the response check, maintenance and annual calibration will be maintained on site. Areas requiring hearing protection will be posted to alert workers to the requirement for hearing protection.

7.2.4 Heat Stress and Cold Stress Monitoring

When temperatures at the site are above 65°F, the wet bulb globe temperature (WBGT) may be used to monitor the potential for heat stress. Work/rest periods will be adjusted according to the guidelines stated in the current edition of *ACGIH Threshold Limit Values for Chemical Substances and Physical Agents*. When the clothing worn differs from the ACGIH standard ensemble such as in the case of workers wearing semipermeable or impermeable clothing, guidelines established in the NIOSH/OSHA/USCG/EPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, Section 8 should be consulted. The following is a summary from that document.

When employees are required to wear impermeable chemical protective clothing in temperatures exceeding 70°F, employees shall use the "buddy system" to monitor each other's pulse rate at the start of each rest period. If the pulse rate exceeds 110 beats per minute, the next work period shall be shortened by one-third without shortening the rest period. The pulse rate shall be monitored again at the beginning of the next rest period and if the pulse rate exceeds 110 beats per minute, the work period shall again be shortened by one-third. No employee shall be permitted to continue working in PPE if his or her pulse rate exceeds 110 beats per minute continuously. Table 7, reprinted from reference 8 can be used to establish work/rest periods and the frequency of monitoring pulse rates. Cold Stress monitoring is not anticipated as necessary for this job.

7.3 AIR SAMPLING

7.3.1 Organic Compounds

Time-integrated air sampling for aromatic hydrocarbons using personal air sampling pumps will be performed by the MK SSHO whenever the real-time monitoring measures concentrations in

the personal breathing zone exceeding 5 ppm organic gases or vapors for more than five consecutive minutes and the MK SSHO has reason to believe benzene could be contributing significantly to the exposure threat or any other organic vapor contaminant is present in concentration levels greater than its PEL or TLV-TWA. Time-integrated air samples will be collected and analyzed at the MK SSHO's discretion for aromatic hydrocarbons. The air samples will be collected and analyzed in accordance with NIOSH Method 1501 or equivalent method for benzene; or collected using 50/100 charcoal/coconut sorbent tubes for other organics. The air sampling pump will be calibrated before and after sample collection. Passive dosimeters may be used in conjunction with air sampling pumps. Analysis of all air samples will be performed by an American Industrial Hygiene Association (AIHA) accredited laboratory.

7.4 RECORDKEEPING AND CHAIN OF CUSTODY

Written records of all monitoring will be maintained on site and affected employees will be notified of monitoring results representative of their exposure. For industrial hygiene sampling requiring collection and shipment of a sample to an approved analytical laboratory, Chain-of-Custody forms will be properly completed and accompany all collected samples in accordance with MK Industrial Hygiene Procedures Manual, Procedure 7.0, titled Analytical Laboratory Procedures. The selected AIHA accredited industrial hygiene lab will be American Analytical Laboratories, Inc., Akron, Ohio (216-535-1300) or a local accredited laboratory when one is located and approved by MK. Turn-around time is estimated at 5-10 working days. Workers will be notified of time integrated sampling results via memo to the designated supervisor. The Navy will receive all sampling records and results as part of the Closure Report.

8.0 GENERAL SAFETY RULES AND PROCEDURES

8.1 GENERAL

Operations shall be conducted in a safe manner consistent with the policies and procedures outlined in this SSHP. The number of personnel shall be restricted to the minimum necessary to complete the required work as an administrative control to limit personnel exposures to potential site chemical, physical and biological hazards.

All project and subcontractor personnel assigned to this project are responsible for following this SSHP unless modified in the subcontracting special conditions document, for using safe practices, and for wearing the PPE specified by the MK SSHO. Project personnel shall report hazards and unsafe conditions and practices to the MK SSHO. All federal, state and local occupational health and safety regulations must be complied with by project personnel. Violations of project procedures may include disciplinary measures up to and including termination.

8.2 RULES AND PROCEDURES

- The Subcontractor shall have available two 20 lb rated ABC multipurpose dry chemical fire extinguishers; first aid kit including CPR kit (Pocket Mask) and biohazards control kit; emergency eyewash; and spill response equipment available at every controlled work location. Also, the Subcontractor shall complete the Work Zone Map and post it at each

work site including emergency phone numbers. Work zone signs shall be posted in accordance with the requirements of Section 9.1.4 of this SSHP.

- Avoid driving over dry grass that is higher than the ground clearance of the vehicle. Catalytic converters on the undercarriage of vehicles are sufficiently hot to ignite dry prairie grass. Never allow a vehicle with a warm undercarriage to sit in a stationary location over dry grass or other combustible materials.

- Do not eat, drink, smoke, take medications, chew gum or tobacco, or put objects in mouth while in the exclusion zone and contamination reduction zone or when handling samples.

- After handling samples, thoroughly wash hands and, if necessary, face, before eating or putting anything in mouth (i.e., avoid hand-to-mouth contamination).

- At a minimum, wear hard hats, safety glasses and steel-toed boots when inside the work boundaries.

- Remain a safe distance from the excavation equipment when not involved in operation or monitoring activities.

- Do not under any circumstances enter or ride in or on any backhoe/excavator bucket, materials hoist or any other device not specifically designed for carrying human passengers.

- Remain aware of your own and other's positions with regard to rotating equipment and be extremely careful when assembling, lifting and carrying items that may cause pinch point injuries and collisions.

- Be alert to the symptoms of fatigue, heat stress and cold stress and their effect on the normal caution and judgment of personnel.

- Use explosion proof sampling equipment and tools.

- Use ground fault circuit interrupters (GFCI) with all electrical tools and equipment.

- Stand clear of trenches during excavation. Always approach the excavation from upwind. Stand upwind, whenever possible, of excavations and other sites where the soil has been disturbed.

- Be alert to potentially changing exposure conditions as evidenced by perceptible odors, unusual appearance of excavated soils, oily sheen on water, or other evidence of possible contamination.

- Do not enter any excavation or trench greater than five feet in depth unless authorized by the MK SSHO.

- Keep hand tools off the ground and centrally located on a plastic cover or area of no contamination whenever possible to avoid tripping hazards and the spread of contamination.

- Use the buddy system at all times while working at the site in controlled work zones. No one is to work alone in the Exclusion Zone or Contamination Reduction Zone without permission from the MK SSHO and MK General Superintendent.

- Minimize truck tire disturbance of all stabilized sites and areas beyond the work area boundaries.

- Cease all work operations on the site at sunset unless the control zone is adequately illuminated with artificial lighting.

- Subcontractor Job Supervisors shall attend the POD meeting prior to the start of the work and conduct pre and post entry briefs with all affected workers. All personnel shall sign and record the time in and out of all Exclusion Zones.

- Avoid direct contact with contaminated materials unless necessary for sample collection or required observation. PPE shall be worn at all times, as required.

- Remove disposable clothing and follow decontamination procedures.

- Always use an appropriate level of personal protection as assigned in this SSHP. Lesser levels of protection can result in otherwise preventable exposure.

- Maintain a high level of awareness of the limitations in mobility, dexterity and visual impairment inherent in the use of Level B and Level C PPE.

- Establish prearranged hand signals or other means of emergency communication when wearing respiratory equipment, since this equipment impairs speech communication.

- Wear hearing protection if you have to shout to communicate at a distance of three feet in steady-state (continuous) noise or when you expect loud impact noise from certain activities. The MK SSHO will assess potential noise exposure and provide recommendation on correct hearing protection.

9.0 SITE CONTROL MEASURES

9.1 SITE WORK ZONES

Where a potential for worker exposure to potentially hazardous substances and physical hazards, work zones will be established and the flow of personnel and equipment will be controlled. The establishment of work zones will ensure that personnel are properly protected against hazards present in the work area, work activities and contamination are confined to the appropriate areas, and personnel can be located and evacuated in an emergency.

Prior to the commencement of field activities, Work Zones shall be established by the Excavation Subcontractor with the approval of the MK SSHO as necessary to meet operational and safety objectives. These work zones will be depicted on Work Zone Maps that are field prepared by the Well Driller/Installer and/or Mechanical/Electrical Subcontractor to be posted by the Subcontractor Job Supervisor near the entrance to the work area. In addition to the zones, these maps should show assembly points; evacuation routes; location of first aid equipment, fire extinguisher and eye wash; spill containment equipment; and emergency communications equipment. One copy of the work zone maps and all revisions shall be delivered to the MK SSHO by the Subcontractor Job Supervisor to be retained by the MK SSHO in Appendix B of the field master copy SSHP. Posted with the Work Zone Map shall be the list of emergency phone numbers and route map to hospital. Each Subcontractor shall maintain a sign-in and sign-out log at the entrance to the Contamination Reduction Zone (CRZ) for personnel entering the Exclusion Zone (EZ).

9.1.1 Exclusion Zone

The exclusion zone (EZ) is the designated area where hazardous substances are present or expected to be encountered during remedial construction activities. Entry into this area is limited to personnel required to perform the work and who are wearing the specified PPE and have attended a Pre-Entry Briefing. Everyone entering the EZ shall have completed the required health and safety training and participate in the medical surveillance program. The boundary of the EZ will be determined for each activity and may change depending on activities and conditions.

An EZ will be established to encompass the excavation/penetration area. For this job, the EZ for each excavation/penetration area will consist of the immediate in process excavation/penetration area extending outward for approximately 20 feet if space allows or the size necessary to meet safety and health objectives . Additionally, any stockpiled excavated soil classified as potentially contaminated will be included in the EZ.

The EZ will be clearly delineated through the use of fences with appropriate signs, or other suitable means. Access control points into the contamination reduction zone will be established to regulate the flow of personnel and equipment in an out of the zone and to help verify that proper procedures for entry and exit are followed. PPE levels in the EZ are initially scoped as Modified Level D and C depending on the task to be completed (see Table 5 of this SSHP). Decontamination will follow guidelines established in Section 10 noting gross contamination of both personnel and equipment will be removed in the EZ followed by additional decontamination in the Contamination Reduction Zone (CRZ). The boundary line from the EZ to the CRZ will be based on the following criteria:

a) Approximately 20 feet outward from contaminated work area or as much as necessary to include the heavy equipment operating in the zone and the temporary staging of any materials.

b) Perimeter air monitoring for VOCs reads no increase in ppm-equivalents above background. Levels for background are those obtained from a Support Zone location not likely to be affected by any of activity ongoing in the EZ.

9.1.2 Contamination Reduction Zone (CRZ)

The CRZ is the transition area between the contaminated area, the EZ and the clean area, the Support Zone (SZ). While designed primarily to reduce the possibility of the support zone becoming contaminated or affected by EZ activities, the CRZ is also used for decontamination of personnel and equipment. No personnel or equipment will be allowed to exit the contamination reduction and exclusion zones without being properly decontaminated except in emergency situations. The immediate area around the EZ extending outward as much as necessary to accommodate the complete length of the longest piece of heavy equipment will be designated the CRZ. Used PPE will be removed and stored in properly marked plastic lined 55-gallon drums or other containers for later disposal. A sign-in and sign-out log sheet shall be maintained by the Subcontractor at the CRZ and all personnel entering the EZ must sign in and out. Copies of the completed log sheet shall be distributed to the MK SSHO by the Subcontractor Job Supervisor or Subcontractor SSHO on a weekly basis.

9.1.3 Support Zone (SZ)

The SZ consists of all areas outside the exclusion and contamination reduction zones. These areas are used for all site activities which are not limited to the EZ or CRZ equipment and material storage, offices, parking, etc. The SZ will also serve as the staging area for all activities to be conducted.

9.1.4 Work Zone Controls

Before site operations begin, the SZ MK site office and Subcontractor offices shall be identified with signs identifying as such. Each Subcontractor shall post signs at entrances to the CRZ and EZ stating the following or equivalent:

HAZARDOUS AREA KEEP OUT
DANGER
AUTHORIZED PERSONNEL ONLY
PERSONAL PROTECTIVE EQUIPMENT IS REQUIRED IN THIS AREA

The Subcontractor shall also post signs at the entrance to the CRZ before operations begin, stating:

NO SMOKING, DRINKING OR EATING BEYOND THIS POINT

10.0 PERSONNEL AND EQUIPMENT DECONTAMINATION AND HYGIENE PROCEDURES

10.1 GENERAL

All personnel, clothing and equipment leaving an exclusion zone (contaminated or potentially contaminated area) shall be inspected and, if necessary, decontaminated to remove any potentially harmful substances that may have adhered to them. Some equipment/clothing may be disposed of rather than decontaminated. In this case, the used PPE and/or equipment (e.g. disposable sampling equipment) will be stored in properly marked, plastic lined 55-gallon drums in the CRZ. A decontamination facility and/or station shall be constructed for personnel decontamination and for equipment decontamination. This section gives guidelines regarding the decontamination procedures to be implemented. Final details will be described during the site-specific safety and health briefing prior to commencing field operations.

10.2 PERSONNEL DECONTAMINATION

Decontamination (decon) stations will be established in the contamination reduction zone. The decon stations will consist of the following, as appropriate:

- Equipment drop to include used respirator receptacle.
- Boot wash station with boot pick for cleaning initial mud cakes from boots (a tub of water and detergent (Alconox®) with brushes for cleaning and another tub of water for rinsing.
- Outer glove wash station (similar to boot wash station).
- Sampling equipment wash station (similar to boot wash station).
- Disposable clothing drop. All contaminated or potentially contaminated disposable clothing shall be placed into labeled 6-mil plastic bags within a 55-gallon drum for disposal.

10.3 EMERGENCY PERSONNEL DECONTAMINATION

Based on the type of emergency that is postulated, the following types of response actions are anticipated for personnel emergencies within the exclusion zone.

A. Critical Triage Condition (life threatening) - Emergency evacuation or extrication from the exclusion zone to contamination reduction zone where emergency medical treatment and stabilization will be attempted until arrival of first responding medical unit. Or, emergency medical treatment and stabilization will be completed in the exclusion zone till arrival of first responding medical unit. In either case, gross decontamination will be completed to the extent possible by removal PPE, wiping patient down to remove contamination and/or wrapping patient to prevent spread of contamination.

B. Marginal Triage Condition (non life threatening) - patient will be evacuated from exclusion zone and treated in the contamination reduction zone followed by decontamination and patient preparation for transport to emergency medical facility. Decontamination could occur first followed by medical treatment in selected scenarios.

10.4 EQUIPMENT DECONTAMINATION

All equipment/tools used in the exclusion zone will be inspected for contamination prior to removal from the site. Any equipment/tools with visible contamination will be cleaned prior to removal from the site. A water and detergent solution will be used for highly contaminated equipment, followed by a high-pressure water rinse if necessary. All water used during decontamination will be contained for disposal.

10.5 WASHING FACILITIES

A hand and face washing facility shall be made available in the CRZ or in the very near vicinity, consisting of water, towels and soap for personnel, as necessary.

10.6 DECONTAMINATION WASH WATER

Equipment and personnel decontamination areas will be designed to allow for collection of all wash/rinse waters into 55-gallon drums or a larger temporary storage container.

10.7 SANITATION AND PERSONAL HYGIENE

Personnel exiting the CRZ are required to thoroughly wash their hands and face prior to eating, drinking, smoking, or using toilet facilities. Adequate toilet, hand washing and lunchroom facilities free of contaminants shall be made available by the subcontractor in accordance with EM 385-1-1 Section 2.

11.0 ON-SITE FIRST AID AND EQUIPMENT

11.1 FIRST AID AND MEDICAL FACILITY REQUIREMENTS

At a minimum, 16-unit first aid kits shall be maintained by MK in their office trailer and each of the Subcontractors shall maintain a first aid kit at their office trailer and have sufficient supply of kits for each of the work sites. The location of the first aid kit shall be communicated to project personnel as part of the site-specific and pre-entry brief training. Included with the first aid kit shall be a CPR Pocket Mask and a biohazards control kit (used to clean up incidents involving body fluid's). The MK SSHO can require upgrades to the first aid equipment requirements as deemed necessary for this job.

An emergency eyewash kit, fire extinguisher and spill control kit shall be available at each controlled work area. The Subcontractor is responsible for furnishing their office trailers and each controlled work location with this equipment as stated in Section 8.2 of this SSHP. The emergency phone number list and route map to medical facilities shall be posted at each office trailer and at each controlled work zone as part of the Contractor prepared Work Zone Map.

11.2 REPORT OF FIRST AID CASES

All first aid cases, accidents and incidents shall be promptly reported to the MK SSHO. The MK SSHO shall immediately notify the Navy Technical Representative (NTR) or the Navy Resident Officer in Charge of Construction (ROICC) of all injuries even if preliminary information is available. The MK SSHO and MK PM shall follow the guidance presented in MK NAVFAC SOUTHDIV Procedure PHSP-04.1 titled Incident Reporting dated 9/13/95.

The MK Charleston Project Management Office (PMO) should be notified shortly after notification to the Navy's designated authority. If an on-site official cannot be reached, the MK Charleston PMO still should be promptly notified at (803) 554-0100. A written report of the injury must be provided to the ROICC and MK Charleston PMO within 24 hours of the incident via memo form. This report is to include as attachments:

a. Employer's First Report of Injury (Workman's Comp Insurance Form)
b. Supervisor's Accident Investigation Report (MK Form CAS 24/77)
c. Accident Data Report (MK Form 6783/91)
d. Any records provided by the Medical Service Provider such as 1) Hospital Emergency room Report, 2) Examining Physician's designation of work restriction, and 3) Examining Physician's Work Release.

12.0 EMERGENCY RESPONSE PLAN AND CONTINGENCY PROCEDURES

12.1 GENERAL

This section describes a contingency plan to be implemented in the event of injuries, illnesses, accidents, and fires. The contingency plan provides guidelines for the proper response to emergency situations, however the actual response will depend on the situation.

In the event of an emergency, the MK SSHO, MK General Superintendent and/or Subcontractor Job Supervisors will direct all personnel to take appropriate action which could include any or all of the following:

- Evacuate all personnel involved to a safe place of refuge.
- Notify emergency services using phone numbers identified in Table 2.
- Initiate emergency response action.

12.2 PRE-EMERGENCY PLANNING

During mobilization activities for this project, the MK Project Manager, MK General Superintendent and the MK SSHO shall review the NAVFAC SouthDiv Project Procedure PHSP 02.1 and execute the steps necessary to assure effective emergency response requirements and resources are established for this project.

In addition to the guidance provided in this document and the preconstruction meeting, all safety meetings and pre-entry briefs shall include emergency response preplanning specific to each task and work site as a topic area. This training will include:

- Assembly Points. If the work activity may result in a release of hazardous substances, more than one assembly point will be specified to ensure that at least one upwind assembly point is accessible. This also pertains to fires and sites subjected to adverse weather conditions. Information must be included on the Work Zone Maps to be completed by the MK Subcontractors.

- Emergency Response Coordinator. The MK SSHO, as the on-site emergency response coordinator, will contact the emergency response providers, account for individuals at the assembly point, and plan the appropriate response.

- Evacuation Routes. Routes will be specified as needed. Information must be included on the Work Zone Maps.

- Means of Evacuation. The number of personnel that may be evacuated from the work site by various routes will be evaluated by the MK SSHO.

- Means of Communication. This will include the means of alerting personnel to an emergency at all points in the work site and should consider the sound screening potential of hearing protection, distance and noisy equipment when specifying the use of alarms, horns and sirens. The means of communication with emergency response providers will be considered. Information must be included on the Work Zone Maps.

- Designation of a location for first aid services, fire extinguisher(s) and spill control equipment. Information must be included on the Work Zone Maps.

- Procedures to be followed by employees who remain to manage critical operations to insure safe shutdown.

12.3 RESPONSIBILITIES

The following is a description of personnel roles, lines of authority, and the emergency response communication/notification responsibilities for site personnel.

12.3.1 Project Personnel

It is the responsibility of all project personnel to recognize conditions that have the potential for resulting in a personal injury or damage to property, and to report the condition immediately to their supervisor or the MK SSHO.

12.3.2 MK Project Manager (PM)

The MK PM is responsible for assuring adherence to the administrative elements and implementation of the Emergency Response Plan, as referenced in this document. He will evaluate the site's preparedness for emergency responses and identify special conditions which may require additional preparations. He will ensure that necessary equipment and facilities are provided to support this plan.

12.3.3 MK Certified Industrial Hygienist (CIH)

The CIH is responsible for preparing the Emergency Response Plan (this section of the SSHP). The CIH will develop and review the Emergency Response Plan, evacuation plans, and oversee implementation at the site. The CIH will ensure that supervisors and employees meet the training requirements of the plan and approve the equipment used in the plan. The CIH may designate duties on site to the MK SSHO. The CIH is the designated Health and Safety Manager based in Boise, ID.

12.3.4 MK Site Safety and Health Officer (SSHO)

The MK SSHO is responsible for directing response actions to emergency situations. He will coordinate with project management to ensure the availability of response equipment and supplies, and initiate drills. Emergency response plans will be evaluated over the course of the project by the MK SSHO to keep them up-to-date and to ensure that they are applicable and relevant to emergency response organizations.

12.3.5 Subcontractors

All MK and Subcontractor personnel will comply with the provisions of this plan and participate in training as required to implement response procedures. All personnel will be cognizant of their work areas and notify their supervisors and the MK SSHO of hazards at the site.

12.4 EMERGENCY RECOGNITION AND PREVENTION

Site personnel shall be apprised of hazards and life-threatening emergency situations during site-specific training to include the project kickoff site specific training, safety meetings and briefs. Means to control hazards and mitigate emergency situations will be addressed at that time.

12.5 SAFETY ZONES

Suitable assembly points will be established at the start of the project for each work site. These assembly points will provide a safe point of refuge for site personnel. Additional information will be provided in the site briefing concerning other hazards that may arise at the site. Safety Zones or assembly points must be included on the Work Zone Map.

12.6 SITE SECURITY AND CONTROL

At all times, site personnel working in an area in the near vicinity of an emergency situation shall be apprised of the emergency as soon as possible. Only authorized personnel shall be allowed into the emergency area. As necessary, the emergency area may be cordoned off and access restricted by MK and the Subcontractors.

12.7 EVACUATION ROUTES

Evacuation routes will be established based on scope of work, location of work and atmospheric conditions. Evacuation routes shall be posted in various locations on the site if necessary and included on the Work Zone Map. All site personnel will be made aware of evacuation procedures during site-specific training especially pre entry briefings. Topography, layout and prevailing wind conditions shall be considered in establishing evacuations routes and assembly points.

12.8 EMERGENCY DECONTAMINATION

In the event an employee is injured or becomes ill and requires hospital treatment, the extent of decontamination to be performed will be assessed based on severity of the injury or illness and time delay that decontamination may cause. If the employee has any signs of contamination, the ambulance and hospital staff will be notified of this and the nature of the contamination. Reasonable effort will be expended to decontaminate the victim prior to removal from the site, refer to Section 10.3 for more information. The medical facilities shall be notified by the MK SSHO of the intended scope of work and the potential for contaminated personnel. The medical facilities will receive copies of all the Material Safety Data Sheets (MSDSs) and/or NIOSH Pocket Guides applicable to this project. The MK SSHO shall contact the medical facility to establish a contact person for the necessary information.

12.9 EMERGENCY MEDICAL TREATMENT AND FIRST AID

See Section 11.

12.10 COMMUNICATIONS

The MK SSHO, the MK General Superintendent and the Subcontractor Job Supervisor(s) at each work site area shall be equipped with two-way radios for communications on site as warranted. Additional communications with outside emergency services will be accomplished through the use of cellular telephones if necessary. Both two way radios and cellular phones are to be used for emergency's only. In the radios will be used for standard field construction communication, then the MK SSHO shall establish strict protocols for radio communication and insure all personnel who carry radios understand the protocols.

12.11 CRITIQUE OF RESPONSE AND FOLLOW-UP

All actual emergencies shall be critiqued and follow-up corrective actions shall be implemented as needed. Drills and exercises if completed shall also be critiqued. The critique will be conducted as part of a safety meeting first by supervisory personnel and second with all MK and Subcontractor personnel.

12.12 INITIAL REPORTING AND MANAGEMENT OF INCIDENTS

All emergencies will be promptly reported to the Emergency Response Number as follows: 1) AMBULANCE X-2424; 2) FIRE X-3333; 3) SECURITY X-2376 on site and to the MK SSHO. The MK SSHO will assure that the Navy designated authority is notified promptly and directing initial emergency response actions until the arrival of the NAS Corpus Christi designated authority. The designated authority can include the officer in charge of security, fire department and/or ambulance services.

The following contains the initial response actions to be taken by MK personnel and subcontractors at the work site for the type of incident incurred.

A. Incident Type: Accident involving vehicles and mobile equipment, process equipment and support structures.

Response Actions:

1. Notify the Fire Department at x3333, include the following information:

    A. Name and phone number of person calling;
    B. Location of incident;
    C. Type of incident;
    D. Is anyone injured or trapped and potential material release or spill conditions.

2. MK SSHO, MK General Superintendent or Subcontractor Job Supervisor(s) designates one person to meet the emergency response units at the nearest road where the units will be approaching.

3. MK SSHO, MK General Superintendent or Subcontractor Job Supervisor(s) assumes initial command of the situation and directs personnel to do one of the following either separately or concurrently:

    A. Emergency shutdown of process equipment or mobile equipment, evacuate the work zone or immediate area to a safe place of refuge and meet the incoming response units and provide all available information.

    B. If fire is present, initiate initial fire attack and knockdown using available fire extinguishing equipment followed by evacuating the work zone or immediate area.

B. Incident Type: Preparation for adverse weather condition to include high winds, tornados or hurricanes, heavy rains, severe lightning.

Response Actions:

1. MK SSHO, MK General Superintendent or Subcontractor Job Supervisor(s) notify Security at X-2376, and include the following information:

    A. Name and phone number of person calling;
    B. Location of work site(s);
    C. Preparation for adverse weather condition has begun;
    D. Permanent structure location where personnel will be relocating to on Base.

2. MK SSHO, MK General Superintendent or Subcontractor Job Supervisor(s) direct personnel to shutdown operations, secure loose materials, park and secure mobile equipment. Personnel shall be directed to a permanent building after completing decontamination procedures.

3. MK SSHO, MK General Superintendent or Subcontractor Job Supervisor(s) complete accountability and await clearance from Base Security to resume operations or take other action.

4. MK SSHO, MK General Superintendent or Subcontractor Job Supervisor(s) shall inspect all offices, trailers, mobile equipment, work sites for damage or downed power lines.

5. Designated excavation Competent Person shall inspect all excavations for faulting, flooding, or cave in potential prior to restart of any work in that area.

C. Incident Type: Medical and Rescue Emergencies.

Response Actions:

1. Notify the Ambulance at x2424, include the following information:

    A. Name and phone number of person calling;
    B. Location of incident;
    C. Type of incident;
    D. Person(s) injured or trapped and if exposure to hazardous material.

2. MK SSHO, MK General Superintendent or Subcontractor Job Supervisor(s) designates one person to meet the emergency response units at the nearest road where the units will be approaching.

3. MK SSHO, MK General Superintendent or Subcontractor Job Supervisor(s) assumes initial command of the situation and completes or directs personnel to do one or both of the following:

    A. Emergency shutdown of process equipment or mobile equipment and any other necessary action to mitigate or control the incident.

    B. Initiate emergency first aid actions until arrival of emergency units.

13.0 LOGS, REPORTS, AND RECORDKEEPING

13.1 SAFETY AND HEALTH LOGBOOK

The MK SSHO shall maintain a Project Safety and Health Logbook for the duration of work activities at the site. Entries in the logbook shall be time sequenced. The entries must be written in ink and the bottom of each page must be signed. The logbook shall be hard bound. No pages will be removed from the log book. Corrections must be lined out and initialed. The logbook will contain specific information recorded on a daily basis utilizing the Form shown in Figure 6.

A separate file folder shall be maintained for Figure 6. Additional forms supporting Figure 4 shall be attached to Figure 6 and held in file folder. Separate file folders shall be established for this SSHP; calibration data sheets if not attached to Figure 6; safety and IH instrument serial numbers and shipping papers; field specific safety and health procedures; all safety and health related permits; and weekly safety inspections. Records of training and site orientations; briefings including pre entry briefs; Subcontractor prepared equipment inspection sheets and exclusion zone sign-in and sign-out logs shall also be maintained in file folders by the MK SSHO.

13.2 REPORTS

A weekly site safety and health inspection report shall be prepared by the SSHO. This report shall identify work activities, safety and health-related deficiencies, and corrective measures. As a minimum, the checklist shown in Figure 7 shall be completed by the MK SSHO. All near miss incidents and incidents that result in property damage, personnel injuries or illness will be investigated and notification/reporting requirements shall be followed in accordance with PHSP 004.1.

13.3 FIELD MASTER COPY OF SSHP

The MK SSHO shall maintain a field master copy of this SSHP document to include all redlines and the completed work zone maps. This copy shall be properly filed with project records at the completion of the project to be sent to MK PMO office in Charleston.

13.4 RECORDKEEPING

The MK SSHO shall maintain records of all injuries and illnesses for MK employees only incidental to the work in accordance with 29 CFR 1904, including copies of the Worker's Compensation First Report of Injury. Accidents and Incidents data reporting requirements shall be managed in accordance with MK NAVFAC SOUTHDIV Procedure PHSP-04.1 titled Incident Reporting dated 9/13/95 for both MK and Subcontractor personnel as stated in Section 11.3.

The MK SSHO shall receive copies of all records for injuries and illnesses of Subcontractor personnel incidental to the work, including copies of the Worker's Compensation First Report of Injury. The Subcontractor shall record injury and illnesses on their OSHA 200 Log, a copy of which is delivered to the MK SSHO on a monthly basis. Reporting shall follow the guidance stated above. A record of all first aid treatments not otherwise recordable shall be maintained and furnished to the Navy's designated authority upon request. The MK SSHO shall maintain records of employee exposure to potentially harmful toxic materials, harmful physical agents and medical records, in accordance with 29 CFR 1910.120. Employee's will be notified of time integrated sampling results where applicable via memo to his/her employer.

13.5 SAFETY AND HEALTH PROJECT COMPLETION REPORT

The MK SSHO shall complete a safety and health project completion report at the conclusion of the field work. The purpose of the report is to a self assessment summarizing effectiveness of the safety and health program implemented in the field; lessons learned and suggestions for program improvement; accident and incidents; air monitoring and sampling results including ratings on instrument useability; and how well the original prepared Activity Hazards Analysis (AHA) worksheets reflected field conditions. The report shall be directed to the MK SouthDiv Program Health and Safety Manager within ten working days after project demobilization.

14.0 ON-SITE WORK PLANS

A Remedial Action Plan (RAP) was developed to define the work tasks and identify the work objectives. The means and personnel required to complete the task is identified along with consideration for methods, logistics, quality control/assurance and resources.

15.0 COMMUNICATION PROCEDURES

15.1 RADIO COMMUNICATION, TELEPHONE, ALARMS AND DRILLS/EXERCISES

Refer to Section 12.10 of this Plan. Cellular telephones shall be selected as a secondary choice of emergency communication. An emergency alarm, such as an air horn, shall be available if necessary at each major work site to warn personnel of an emergency. Personnel shall be trained on what actions they are to take if the alarm is sounded to include evacuation routes and assembly points. Drills and exercises shall be conducted to ensure that communication methods are adequate. The MK SSHO will test the two way communication for confirmation of emergency communication using NAS Corpus Christi protocols.

16.0 SPILL CONTAINMENT PLAN

16.1 GENERAL

Spill and release accident scenarios during remediation could occur and involve residue process material and reinstates from decontamination activities. The following information will be used by project personnel to respond to and mitigate any releases on the project site. In the event of a spill or release, the MK SSHO, MK General Superintendent and/or Subcontractor Job Supervisors will direct all personnel to take appropriate action which could include any one or all of the following:

- Initiate spill response action and notify emergency services.
- Notify the FIRE DEPARTMENT at X-3333.
- Evacuate the work zone to a safe place of refuge.

16.2 PREPLANNING FOR SPILL CONTROL

Remedial construction activities will be reviewed for release potential and the capability of on-site personnel to adequately respond. Base personnel will be contacted to determine their capability to respond to various releases. All aspects of the Emergency Response Plan as described in Section 12, will be reviewed by site personnel to ensure adequacy and that resources are available.

During mobilization activities for this project, the MK Project Manager, MK SSHO, and the MK General Superintendent shall review the NAVFAC SouthDiv Project Procedure PHSP 03.1 and execute the steps necessary to assure effective spill response planning requirements and resources are established for this project. MK will cooperate with the base; other site contractors; and federal, state and local directors of emergency preparedness and response to ensure a coordinated

effort in preparing for a spill emergency, with response plans that are compatible and integrated. Prior to the start of work, MK will review any site specific requirements and meet with site representatives on spill control to assure the SSHP is consistent with site requirements for spill control. Specific roles and responsibilities will be reviewed for MK and Navy personnel. The Base Fire Department will be notified of any spills classified above operational and will assist in spill containment. The Base Fire Department will provide overall command and control of the clean-up activity for spills classified above operational until relieved by a higher authority.

16.3 SPILL AND FIRE CONTROL MATERIALS AND EQUIPMENT

When planning to move or handle drums (or other containers) containing hazardous or special waste materials, the following shall be kept available in areas where spills, leaks or ruptures may occur: 1) salvage drums and container overpacks (approved by the U.S. Department of Transportation); 2) suitable quantities of proper absorbent materials; 3) portable containing material; 4) neutralizing agents; 5) fire extinguisher(s); 6) emergency eyewash station; and 7) spill pallets or platforms for secondary containment.

Drums and containers used during a clean-up will be appropriate to the hazardous substances they are meant to contain, and will meet the regulations promulgated by DOT, 49 CFR Parts 171-179, OSHA 29 CFR 1910.120, and EPA 40 CFR 262. Drums and containers will be inspected for defects and their integrity assured prior to being filled with any non-solid hazardous or special waste substance.

A spill of material can be contained with porous or absorbent barriers. Absorbent materials can take several configurations (pillows, sheets, booms, loose chips, particle beads, and fibers) that may be set in place, or scattered by hand. Preferred sorbents are inert nonreactive clay minerals (neutralizing agents may be added), or specific formulations which provide automatic neutralization or vapor control.

16.4 SPILL CONTROL MEASURES

Stopping the leak or spill at its source may involve turning off pumps or closing valves. Returning a container to an upright position, transferring wastes to other containers, or moving containers to less dangerous locations may, in some circumstances, be possible, but should not be attempted if the identification of the substance is not known unless Level B Protection is worn and decontamination stations have been established. Similarly, the patching of an active leak is not advised until an initial "Size-Up" of the situation is made and guidance established in Section 16.6 has been followed.

16.5 DRUM, CONTAINER, AND TANK HANDLING AND MOVING PROCEDURES

Drums, containers, and/or tanks of hazardous or special waste substances will not be moved until the requirements for preparation have been completed (i.e., all required equipment and materials are at the work site ready for use, and the employees have been familiarized with their responsibilities, the emergency response procedures, and the potential hazards associated with the contents of the drums and containers).

Work site operations will be organized to minimize the amount of drum or container movement. Each drum or container will be inspected before it is moved to ensure that it can be handled without suffering a rupture or puncture, and relocated without having the contents spill or leak.

Unlabeled or unmarked drums and containers will be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled. Drums and containers under pressure, as evidenced by bulging or swelling, will not be moved until such time as the cause for excess pressure is determined and appropriate containment procedures have been implemented to protect employees from explosion.

Equipment used to handle the drums and containers will be selected, positioned, operated, and maintained to minimize any contact that could rupture, puncture, dent, or drop drums and containers holding hazardous or special waste substances, and the potential for equipment ignition sources to ignite vapors released from ruptured drums or containers shall be controlled.

Drums and containers that cannot be moved without rupture, leakage or spillage will be transferred to a sound container using a device specified for the material being transferred. During liquid transfer of flammable or combustible liquids, bonding and grounding equipment shall be utilized.

16.6 INITIAL REPORTING AND MANAGEMENT OF INCIDENTS

All spill emergencies initially classified above an operational level spill shall be promptly reported to the FIRE DEPARTMENT AT X-3333.

Operational Level Spill (defined) - a minor spill that can be handled safely by MK and Subcontractor personnel, without help from the on site fire department. The size of the spill shall be less than approximately four feet in diameter on a non-penetrable surface which cannot reach storm or sanitary sewers, and is not an acutely hazardous substance.

The MK SSHO and the MK General Superintendent shall be notified immediately. The MK SSHO will assure that the Navy's Technical Representative (NTR) or ROICC is notified promptly. The MK SSHO, the MK General Superintendent and the Subcontractor Job Supervisor(s) are responsible for directing initial emergency response actions until the arrival of the NAS Corpus Christi designated authority. The designated authority can include the officer in charge of security, fire department and/or ambulance services. The following contains the initial response actions to be taken by MK personnel and subcontractors at the work site for spill and release emergencies.

Response Actions:

1. Classify spill as Operational or Non-Operational.

2. If operational (as defined above): 1) notify immediate supervisor; 2) assess hazard potential, establish precautions and PPE requirements; 3) begin clean-up of spill.

3. If Non-Operational, initiate response action in accordance with the following steps:

   a. Quickly assess probability of safely stopping spill. If physical, chemical, or biological health hazards exist, immediate evacuate the area to a safe distance upwind and upgrade from the spill.

   b. Notify the FIRE DEPARTMENT at X-3333 and provide the following information:

      1. Name and phone number of person calling;
      2. Location of incident;
      3. Type of incident;
      4. Is anyone injured or trapped and estimated volume of material released.

   c. MK SSHO, MK General Superintendent or Subcontractor Job Supervisor(s) designates one person to meet the emergency response units at the nearest road where the units will be approaching.

   d. MK SSHO, MK General Superintendent or Subcontractor Job Supervisor(s) assumes initial command of the situation and directs personnel to do one of the following:

      1. Emergency shutdown of process equipment or mobile equipment, evacuate the work zone or immediate area to a safe place of refuge and meet the incoming response units and provide all available information.

      2. Initiate initial spill response using available spill response equipment only for small operational spills where personnel are trained to mitigate. Evacuate the work zone or immediate area if there are any health threats or risks to personnel.

17.0 CONFINED SPACES

Not anticipated on this project.

TABLES

Table 1. Potential Contaminants				
Potential Contaminants	Description	Exposure Limits	Signs and Symptoms	First Aid
Benzene	Colorless to light-yellow liquid with an aromatic odor. Class 1B Flammable liquid.	OSHA PEL 1 ppm as 8 Hr. TWA OSHA STEL 5 ppm in 15 minute period	Irritant to eyes, nose, and respiratory system. Giddiness, headache, nausea, and staggered gait. Fatigue, anorexia and lassitude. Dermatitis. Bone marrow depression.	Irrigate eyes immediately with water. Soap wash skin promptly. Provide respiratory support. Seek medical attention immediately.
Cresols	Crystalline or white solid with a sweet, tarry odor.	OSHA PEL 5 ppm	Irritation to eyes, skin and mucous membranes; CNS depressant; respiratory failure; weakness; and dermatitis	Irrigate eyes immediately with water. Soap wash skin promptly. Provide respiratory support. Seek medical attention immediately.
Ethylbenzene	Colorless liquid with an aromatic odor. Class 1B Flammable Liquid.	OSHA PEL 100 ppm as 8 Hr. TWA	Irritant to eyes, nose and respiratory system. Headache, dermatitis and narcosis.	Irrigate eyes immediately with water. Soap wash skin. Provide respiratory support. Seek medical attention immediately.
Gasoline	Water white or pale yellow in color, may be dyed other colors, petroleum odor. Flammable, volatile liquid. Common components include benzene, toluene and xylene.	ACGIH TLV of 300 ppm as 8 hr TWA.	Irritant to eyes, nose and respiratory system. Headache and dizziness. May cause dermatitis or rash upon skin.	Irrigate eyes immediately with water. Soap wash skin promptly. Provide respiratory support. Seek medical attention immediately.
Tetraethyl Lead (TEL)	Colorless liquid unless dyed red, orange, or blue with a pleasant, sweet odor. Class 3B Combustible liquid.	OSHA PEL 75 ug/m^3 as 8 Hr. TWA.	Insomnia, lassitude and anxiety by inhalation. Tremor, hyper-reflexia, spastic and bradycardia. Irritant to eyes.	Irrigate eyes immediately with water. Soap wash skin promptly. Provide respiratory support. Seek medical attention immediately.

Table 1. Potential Contaminants				
Potential Contaminants	Description	Exposure Limits	Signs and Symptoms	First Aid
Manganese	Metal: a lustrous brittle, silvery solid.	OSHA Ceiling 5 mg/m^3	Parkinson's; insomnia; dry throat, cough, tight chest, dyspnea, V, flue like fever, low back pain, vomiting and fatigued	Irrigate eyes immediately with water. Soap wash skin promptly. Provide respiratory support. Seek medical attention immediately.
Naphthalene	Colorless to brown solid with an odor of mothballs	PEL 10 ppm	Irritation to eyes; headache, confusion, excitement, malaise; nausea, vomiting, abdominal pain; irritation bladder; profuse sweating, jaundice, renal shutdown, dermatitis.	Irrigate eyes immediately with water. Soap wash skin promptly. Provide respiratory support. Seek medical attention immediately.
Phenol	Colorless to light pink, crystalline solid with a sweet, acrid odor	PEL 5 ppm	Irritation to eyes, nose, throat, anorexia, weakness, muscle ache, pain; dark urine; cyanosis; liver, kidney damage; skin burns; dermatitis; tremor, convulsions, twitching.	Irrigate eyes immediately with water. Soap wash skin promptly. Provide respiratory support. Seek medical attention immediately.
Octane	Colorless liquid with a gasoline like odor.	PEL 500 ppm	Irritant to eyes and nose; drowsiness; dermatitis; chemical pneumonia	Irrigate eyes immediately with water. Soap wash skin promptly. Provide respiratory support. Seek medical attention immediately.
Triorthocresyl phosphate (TOCP)	Colorless to pale yellow, odorless liquid or solid	OSHA PEL 0.1 mg/m^3	Cramps in calves, tingling in feet and hands, weak feet, wrist drop, paralysis and gastrointestinal disorder.	Irrigate eyes immediately with water. Soap wash skin promptly. Provide respiratory support. Seek medical attention immediately.

Table 1. Potential Contaminants				
Potential Contaminants	Description	Exposure Limits	Signs and Symptoms	First Aid
Toluene	Colorless liquid with a sweet, pungent, benzene like odor. Class 1B Flammable liquid.	OSHA PEL 200 ppm as 8 Hr. TWA OSHA Ceiling of 300 ppm. ACGIH TLV of 50 ppm as 8 Hr. TWA.	Fatigue and weakness. Confusion, euphoria, dizziness, and headache. Dilated pupils and water eyes.	Irrigate eyes immediately with water. Soap wash skin promptly. Provide respiratory support. Seek medical attention immediately.
Xylene	Colorless liquid with aromatic odor.	OSHA PEL 100 ppm as 8 Hr. TWA OSHA STEL 150 ppm in a 15 minute period.	Dizziness, excitement, drowsiness, incoherence, and staggering gait. Irritant eyes, nose, and throat. Corneal vacuolization. Anorexia, nausea, vomiting, and abdominal pain. Dermatitis.	Irrigate eyes immediately with water. Soap wash skin promptly. Provide respiratory support. Seek medical attention immediately.

NOTE: In contrast to naphthalene, the only reported effects of methylated naphthalene in man are skin irritation and skin photosensitization. N-nitrosodi n-propylamine is from the class of chemicals classified as N-nitrosamines which are associated with numerous carcinogenic effects in laboratory animals. Human exposure data is limited. Since it levels reported in the ground water are extremely low, occupational exposure of any significance is considered highly unlikely.

Table 2 Personnel Names and Telephone Numbers

Contact	Person or Agency	Telephone
Robert Hlavacek	MK Program Manager	(803) 554-9367
Scott Newman	MK Senior Project Manager	(803) 554-9369
tbd	Site Project Manager	Office: (612) xxx-xxxx
tbd	MK Site Safety and Health Officer	Office:(612) xxx-xxxx
Mike Jackman tbd tbd tbd	MK Project Engineer MK Project Controls onsite MK Quality Control onsite MK General Superintendent	Office:(216) 523-3786
William Piispanen	MK Health and Safety Program Manager	(208) 386-5930
John Young	Public Works Department	tbd
Cmd R.A. Wall Jesse Duarte	ROICC REICC	tbd 512-939-8608
Andy Hutto	SOUTHNAVFACENGCOM	(803) 743-0542
John Young	Public Works, Environmental	(512) 939-3776
Law Enforcement	Security	x 2376
Fire Dept	Fire Dept	x 3333
Ambulance Service	Ambulance	x 2424
Poison Control Center	National Poison Control Center	1 800 764-7661
CHEMTRAC	Chemical spill or leak emergencies	1 800 424-9300
National Response Center	National Response Center	1 800 424-8802
Regional USEPA	USEPA Region VI, USEPA	214 767-2600
RCRA Hotline	USEPA	1-800-424-9346
Hospital	(1) NAS Hospital (2) Spohn Hospital	(1) (512) 939-2994 (2) (512) 881-3000
Utility Locate Service	NAS CC Public Works	tbd

Table 3. Training Requirements

Identifier	Location	40 Hr. Haz. Waste	Haz. Waste Annual Ref.	Haz. Waste Supervisor	Safety Mtg.	Haz. Com.	CPR First Aid	Respiratory Protection	Site Specific	POD, Pre & Post Entry Brief	Other
Well Modification and Installation	Fuel Farm 216 Area	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Piping and Mechanical	Fuel Farm Area	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Transport and Disposal (Hazardous Material)	Fuel Farm 216 Area					Y			Y		Y[2]

Y = Yes, N = No

Notes:

1 - Training requirements for the operations and maintenance phase will be delineated in the safety and health section of the MK prepared Operations and Maintenance (O&M) Manual.

2 - 49 CFR Part 172 Subpart H for personnel required to classify, mark, select packaging, inspect, load and transport hazardous materials.

Table 4 Selection of Personal Protective Equipment

PPE	Level D	Modified Level D	Level C	Level B
Coveralls or other approved working apparel	Yes	Optional*	Optional	Optional
Chemical-resistant clothing (coveralls; hooded, one- or two-piece chemical-resistant coveralls)		Yes		
Chemical-resistant clothing (coveralls; hooded one- or two-piece chemical splash suit; chemical-resistant hood and apron; disposal chemical-resistant coveralls)			Yes	
Chemical-resistant clothing (coveralls and long-sleeved jacket; one- or two-piece chemical splash suit; disposal chemical-resistant one-piece suit)				Yes
Boots, leather or chemical resistant, steel protective toe (29 CFR 1926.28, 1910.136 and ANSI Z41-1991).	Yes			
Boots (inner), chemical resistant, steel protective (29 CFR 1926.28, 1910.136 and ANSI Z41-1991).		Yes	Yes	Yes
Boot covers (outer), chemical resistant (disposable)		Optional	Optional	Optional
Safety glasses or chemical splash goggles (29 CFR 1910.133, ANSI Z87.1-1989, and 1926.102)	Yes	Yes	Yes *1	
Face shield (29 CFR 1910.133, ANSI Z87.1-1989, and 1926.102)	Optional	Optional	Optional	Optional
Gloves (cotton/leather)	Optional			
Gloves (inner), chemical resistant or liners		Optional	Yes	Yes
Gloves (outer), chemical resistant		Yes	Yes	Yes
Long underwear		Optional	Optional	Optional
Hardhat (29!CFR 1926.100, 1910.135, ANSI Z89.1-1969 and ANSI Z89.2-1971)	Yes	Yes	Yes	Yes
Positive pressure, full-facepiece with nose cup, self-contained breathing apparatus (SCBA) or positive pressure, supplied-air respirator with escape SCBA (MSHA or NIOSH approved) (Note: escape SCBA may not be required)				Yes
Air-purifying respirator, half-face or full face with suitable cartridge (MSHA or NIOSH approved)			Yes	

* Optional requirements to be determined by MK SSHO based on Activity Hazard Analysis (AHA).

*1 - not required with full face APR

Table 5 Minimum Personal Protective Equipment Requirements by Task

Site	Activity	PPE
Fuel Farm 216	1. Configure and set up work areas.	1. Level D, modify where necessary.
	2. Hydropunching using Geoprobe.	2. Modified Level D, modify where necessary.
	3. Modify existing wells.	3. Modified Level D, modify where necessary.
	4. Install new recovery wells.	4. Modified Level D, modify where necessary.
	5. Excavate and install underground process piping and utilities.	5. Modified Level D, modify where necessary.
	6. Construct utility building and install ancillary equipment.	6. Level D, modify where necessary.
	7. Waste Management activities including any sampling activities.	7. Modified Level D, modify where necessary.
	8. Site Restoration	8. Level D, modify where necessary.

Table 6 Airborne Contaminant Response Criteria

Contaminant or Chemical	Level	PPE	Monitoring Frequency	Actions Taken
Volatile organic compounds	No more than 5 ppm above background, no benzene detected above 0.5 ppm (Action Level).	Level D or Modified Level D. See Table 5 for PPE requirements by task.	Prior to each shift and reentry following 30 minute vacancy or as described in Section 7 of this plan.	Continue periodic monitoring or maintain continuous monitoring dependent on task.
	Greater than 5 ppm above background but less than 10 ppm above background. No benzene detected above 0.5 ppm (Action Level).	Level D or Modified Level D. See Table 5 for PPE requirements by task.	At least once every hour, when change in operation occurs or as described in Section 7 of this plan.	Monitor for benzene and vinyl chloride, continue periodic monitoring or maintain continuous monitoring dependent on task.
	Greater than 10 ppm above background or benzene detected greater than 0.5 ppm or action level exceeded for any organic.	Level C or B PPE as specified by MK SSHO. See Table 5 for PPE requirements by task.	Continuous.	Stop work, evacuate exclusion zone and notify MK SSHO. Size up situation and re-evaluate re-entry requirements.

Table 6. Airborne Contaminant Response Criteria (continued)

Contaminant or Chemical	Level	PPE	Monitoring Frequency	Actions Taken
Oxygen	Less than 19.5% or greater than 22%	Level B per concurrence by MK SSHO.	Prior to each shift and reentry following 30 minute vacancy or as described in Section 7 of this plan.	Stop work, evacuate exclusion zone and notify MK SSHO. Size up situation and re-evaluate re-entry requirements.
% LEL	Equal to or greater than 10%.	Level B PPE per concurrence by MK SSHO.	Prior to each shift and reentry following 30 minute vacancy or as described in Section 7 of this plan.	Stop work, evacuate exclusion zone and notify MK SSHO. Size up situation and re-evaluate re-entry requirements.

Table 7 Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers

ADJUSTED TEMPERATURE[b]	IMPERMEABLE ENSEMBLE
90°F (32.2°C) or above	After each 15 minutes of work
87.5°-90°F (30.8°-32.2°C)	After each 30 minutes of work
82.5°-87.5°F (28.1°-30.8°C)	After each 60 minutes of work
77.5°-82.5°F (25.3°-28.1°C)	After each 90 minutes of work
72.5°-77.5°F (22.5°-25.3°C)	After each 120 minutes of work

[a] For work levels of 250 kilocalories/hour.

[b] Calculate the adjusted air temperature (ta adj) by using this equation:
ta adj °F = ta°F + (13 x % sunshine).

Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow.

(100 percent sunshine = no cloud cover and a sharp, distinct shadow: 0 percent sunshine = no shadows.)

Table 8. Air Monitoring and Sampling Requirements

Site	Activity	Monitor					Sample
		VOC	Oxygen and, % LEL	Perimeter (VOCs)	Noise	Heat Stress	VOC
Fuel Farm 216 Facility	1. Configure and set up work areas.	1.0	1.N	1.N	1.N	1.0	1.N
	2. Hydropunching using Geoprobe.	2.O	2.O	2.O	2.O	2.O	2.O
	3. Modify existing wells.	3.Y	3.Y	3.Y	3.O	3.O	3.O
	4. Install new recovery wells.	4.Y	4.Y	4.Y	4.O	4.O	4.O
	5. Excavate and install underground process piping and utilities.	5.Y	5.Y	5.Y	5.O	5.O	5.O
	6. Construct utility building and install ancillary equipment.	6.N	6.N	6.N	6.N	6.O	6.N
	7. Waste Management activities including any sampling activities	7.O	7.N	7.N	7.N	7.O	7.N
	8. Site Restoration	8.N	8.N	8.N	8.N	8.O	8.O

Y = Yes; O = Optional at discretion of MK SSHO; N = Not required

FIGURES

Figure 4 Safety Meeting Report

Type of Meeting:

Topic:

The following personnel were present for meeting conducted at _____ (time) on _____ (date) at _____ (location).

NAME	SIGNATURE	ORGANIZATION

Printed Name of Meeting Chairman Signature Date

Figure 5 Pre-Entry Briefing Signature Sheet

Work area(s) to be entered _____

The following personnel have had a pre-site entry briefing conducted at _____ (time) on _____ (date) at _____ (location), and are familiar with this plan's provisions, and are willing to meet the requirements of this plan.

NAME	SIGNATURE	ORGANIZATION

Printed Name of Supervisor Signature Date

Figure 6. SSHO Daily Logbook Report

Page ___ of ___

Date _____ Report Number _____

'ion(s) Work Activity and # Employees: _____

Weather: Wind speed _____ Wind direction _____

Temp. & Pressure _____ Precipitation _____

Amount sun _____

Monitoring conducted:

Location	Sampled for	Instrument used	Results	Sampled By/Time

Levels of Protection: _____

Problems or Unusual Situations: _____

Correspondence: _____

Other Comments: _____

SSHO Printed Name: _____ Signature _____ Date _____

Figure 7 SSHP Weekly Inspection Checklist **Surveillance No. _____**

SURVEILLANCE NO.:		ACTIVITY:				PROJECT NO.:	
DATE:		LOCATION:				SURVEYED ORGANIZATION:	
		SITE/AREA CONTACT:		RESPONSIBLE MANAGER		PRIME: SUBTIER:	
ITEM NO.	DESCRIPTION OF SURVEYED ITEMS	N/A SAT UNSAT	DESCRIPTION OF DISCREPANCY/ NON-COMPLIANCE	ACT OR COND	CAT	REQUIRED ABATEMENT DATE	CORRECTIVE ACTION TAKEN AND DATE ABATEMENT COMPLETED
	Section 1						
1	Scope of work and site contaminants accurately described?						
	Section 2						
2	Activity hazard analysis prepared for each major work phase? (EM 385-1-1, Section 01.A.09)						
3	All hazards including chemical and physical adequately described?						
	Section 3						
4	Roles and responsibilities described and personnel roster up-to-date?						
	Section 4						
5	All site personnel completed required training?						
6	Training documented and records on site?						
	Section 5						
7	All site personnel completed initial medial qualification?						
	Section 6						
8	PPE available and in good condition?						
9	PPE work per SSHP and/or SSHO direction?						

Figure 7 SSHP Weekly Inspection Checklist **Surveillance No. _____**

SURVEILLANCE NO.:		ACTIVITY:				PROJECT NO.:	
DATE:		LOCATION: SITE/AREA CONTACT:		RESPONSIBLE MANAGER		SURVEYED ORGANIZATION: PRIME: SUBTIER:	
10	Personnel trained in proper use, limitations, and inspection of PPE?						
11	PPE inspected per SSHP?						
12	PPE donning/doffing procedures in place?						
13	Written SOP available describing respirator selection and use?						
	Section 7						
14	Air monitoring conducted per SSHP?						
15	Monitoring equipment properly maintained and calibrated?						
16	Employees notified of monitoring results?						
17	Chain of custody prepared and maintained for all samples?						
	Section 4 and 8						
18	Weekly safety meeting held?						
19	Pre entry briefs held? and signature sheet completed?						
20	Haz Com programs in place?						
21	Competent person evaluates excavation?						
22	Personnel responsible for work maintain control of area?						
	Section 9						
23	Work zone maps prepared and updated?						
24	Maps posted near work area and stored in field master copy of SSHP						
25	Traffic patterns established and rules observed?						

Figure 7 SSHP Weekly Inspection Checklist **Surveillance No. _____**

SURVEILLANCE NO.:		ACTIVITY:				PROJECT NO.:	
DATE:		LOCATION:				SURVEYED ORGANIZATION:	
		SITE/AREA CONTACT:		RESPONSIBLE MANAGER		PRIME: SUBTIER:	
	Section 10						
26	Inspections performed of all personnel, clothing and equipment leaving exclusion zone?						
27	All materials decontaminated prior to existing contamination reduction zone?						
28	Decon stations properly established?						
29	Proper personal hygiene practices observed?						
30	Decon solutions collected and properly disposed of?						
	Section 4 and 11						
31	At least two employees on each shift trained in CPR and first aid and bloodborne pathogens?						
32	First aid kit, biohazards control kit and eyewash/drench at each work site?						
33	All first aid and medical cases promptly reported to MK SSHO?						
	Section 12						
34	All personnel trained on Emergency Response Plan and Contingency Procedures?						
35	Emergency pre-planning addressed in safety meeting?						
36	List of emergency services/contact is up to date and posted?						
37	Assembly points identified and communicated to employees?						
38	Evacuation routes established and communicated to employees?						
39	Communication methods are adequate						

Figure 7 SSHP Weekly Inspection Checklist **Surveillance No. _____**

SURVEILLANCE NO.:		ACTIVITY:				PROJECT NO.:	
DATE:		LOCATION:				SURVEYED ORGANIZATION:	
		SITE/AREA CONTACT:		RESPONSIBLE MANAGER		PRIME:	
						SUBTIER:	
40	All drills, exercises, and emergencies critiqued?						
41	All emergencies promptly reported to MK SSHO?						
	Section 13						
42	MK SSHO maintains project log book?						
43	Daily reports completed by SSHO?						
44	Daily inspections completed by SSHO?						
45	Weekly reports prepared by SSHO?						
46	Records of all injuries and illnesses maintained by SSHO?						
	Section 14						
47	Work plans available and up to date?						
48	SOPs developed as needed?						
	Section 15						
49	Two-way radios available per SSHP?						
50	Cellular telephone available as needed?						
51	Emergency alarms available and personnel trained on what actions to take?						
52	Drills and exercises conducted to test communication methods?						
	Section 16						
53	Spill response measures reviewed with personnel?						
54	Suitable quantities of spill supplies available?						

Figure 7 SSHP Weekly Inspection Checklist **Surveillance No. _____**

SURVEILLANCE NO.:		ACTIVITY:				PROJECT NO.:	
DATE:		LOCATION:				SURVEYED ORGANIZATION: PRIME: SUBTIER:	
		SITE/AREA CONTACT:		RESPONSIBLE MANAGER			
55	Spills promptly reported to SSHO?						
56	Operations arranged to minimize spills?						
	Section 17						
57	Confined space requirements of 385-1-1, Section 06.0.01 followed? Personnel trained?						

Inspection Performed By: Date:

Abatement Accepted By: Date:

APPENDIX A

ACTIVITY HAZARD ANALYSIS (AHA)

ACTIVITY HAZARD ANALYSIS (AHA)

Activity: Configure and set up work areas.	Analyzed By/Date: Frank J. Petrik 10/6/95	Reviewed By/Date: William Simpson 12/18/95

1.0 Principal Steps	Potential Hazards	Recommended Controls
1.1 Walk area down, establish work zone and laydown areas.	1.1a.Struck by and struck against physical objects during loading and unloading operations and setup. 1.1b.Biological; weeds, snakes, spider's; other plant life. 1.1c.Contact by inhalation, direct contact or ingestion of chemical contaminants.	1.1a.Preplan work layout (Work Zone Map completed and posted by Subcontractor, also emergency numbers and hospital map). Backup alarms on all motorized heavy equipment. Use correct hand and power tools for job. Maintain good housekeeping and storage practices. 1.1b. MK SSHO to assess Work Zone for any specific biological hazards and communicate findings at POD and/or Pre Entry Briefs. 1.1c. Level D PPE expected. MK SSHO to visually inspect area for evidence of chemical contaminants and conduct general area scans for VOCs using PID.
1.3 Equipment to be Used	**Inspection Requirements**	**Training Requirements**
1.4 Heavy equipment for loading and hauling. Hand and power tools.	Daily, prior to use per manufacturer's recommendation.	OSHA 1910.120 40-Hour Training, 3 day OJT, 8 hours Supervisory, 8 hour Refresher, Site Safety and Health Plan (Project Kickoff), POD, Pre and Post Entry Briefs and OSHA Hazard Communication.

ACTIVITY HAZARD ANALYSIS (AHA)			
Activity: Hydropunching using Geo Probe or equivalent.		Analyzed By/Date: Frank J. Petrik 10/6/95	Reviewed By/Date: William Runyan 12/8/95
2.0 Principal Steps	Potential Hazards	Recommended Controls	
2.1. Establish locations and make penetrations. Manage any potentially contaminated soil or other waste.	Contact with underground utilities and/or process piping. Inhalation, direct contact or ingestion of chemical, biological and physical agents. Struck by and struck against physical objects during penetrations.	MK Excavation and Trenching permit required. Confirm location of underground utilities in penetration areas. Emergency procedures and equipment checked and in place. Modified Level D during initial penetrations, upgrade per MK SSHO direction. Review manufacturer's recommendation for face shields on operators. MK SSHO and Subcontractor to conduct periodic air monitoring for VOCs, combustible gas and oxygen. Maintain clear area around hydropunching equipment, barricade if necessary. Maintain good housekeeping and storage practices; load any potentially contaminated soil in approved containers and stage appropriately.	
2.4 Equipment to be Used	Inspection Requirements	Training Requirements	
2.5 Hydro punch, heavy equipment and handtools.	Daily, prior to use per manufacturer's recommendation to include structural damage; loose nuts and bolts; proper tension in drives; loose and/or missing guards and covers; fluid leaks; and damages hoses, pressure gauge and/or relief valves. Check and test all safety devises including proper function of gauges, indicator lights and control levers.	OSHA 1910.120 40-Hour Training, 3 day OJT, 8 hours Supervisory, 8 hour Refresher, Site Safety and Health Plan (Project Kickoff), POD, Pre and Post Entry Briefs, and OSHA Hazard Communication. Operators shall be trained and certified on hydropunch equipment.	

ACTIVITY HAZARD ANALYSIS (AHA)			
Activity: Modify existing wells by overdrilling; drill and construct new recovery wells.		Analyzed By/Date: Frank J. Petrik 10/6/95	Reviewed By/Date: William Pangan 12/8/95
3.0 Principal Steps	Potential Hazards	Recommended Controls	
3.1 Establish locations, set up equipment and make penetrations. Construct new wells. Manage any potentially contaminated soil or other waste.	Contact with underground utilities and/or process piping. Inhalation, direct contact or ingestion of chemical, biological and physical agents. Struck by and struck against physical objects during penetrations.	MK Excavation and Trenching permit required. Confirm location of underground utilities in penetration areas. Emergency procedures and equipment checked and in place. Modified Level D during initial penetrations, upgrade per MK SSHO direction. Review manufacturer's recommendation for face shields on operators. MK SSHO and Subcontractor to conduct periodic air monitoring for VOCs and combustible gas and oxygen. Assess noise hazards, and airborne potential of nuisance mineral dusts such as silica sand and cement/bentonite mixtures. Maintain clear area around drill rig equipment, barricade if necessary. Install indicator flag(s) on elevated mast per base procedure. Level and stabilize unit per manufacturer's recommendation. Maintain good housekeeping and storage practices; load any potentially contaminated soil in approved containers and stage appropriately. Establish energy control program specific to drill rigs and new utility connections, and establish hoisting and rigging program for casing and pump installation.	
3.3 Equipment to be Used	Inspection Requirements	Training Requirements	
3.4 Drill rig, heavy equipment and hand tools.	Daily, prior to use per manufacturer's recommendation to include structural damage; loose nuts and bolts; proper tension in drives; loose and/or missing guards and covers; fluid leaks; and damages hoses, pressure gauge and/or relief valves. Check and test all safety devises including proper function of gauges, indicator lights and control levers.	OSHA 1910.120 40-Hour Training, 3 day OJT, 8 hours Supervisory, 8 hour Refresher, Site Safety and Health Plan (Project Kickoff), POD, Pre and Post Entry Briefs and OSHA Hazard Communication. Operators shall be trained and certified on drill rig equipment.	

ACTIVITY HAZARD ANALYSIS (AHA)			
Activity: Excavate trenches and install underground process piping and utilities.		Analyzed By/Date: Frank J. Petrik 10/5/95	Reviewed By/Date: William Simpson 12/18/95
4.0 Principal Steps	**Potential Hazards**	**Recommended Controls**	
4.1. Establish locations and make trench penetrations. Install fluid recovery lines, air lines and vaulted sumps. Manage any potentially contaminated soil or other waste. Note: trenches will approximate 2 feet in depth.	Contact with underground utilities and/or process piping. Inhalation, direct contact or ingestion of chemical, biological and physical agents. Struck by and struck against physical objects during penetrations.	MK Excavation and Trenching permit required. Confirm location of underground utilities in penetration areas. Emergency procedures and equipment checked and in place. Modified Level D during initial penetrations, modify per MK SSHO direction. MK SSHO and Subcontractor to conduct periodic air monitoring for VOCs and combustible gas and oxygen. Maintain clear area around trenches, barricade where necessary. Maintain good housekeeping and storage practices; load any potentially contaminated soil in approved containers and stage appropriately. MSDS(s) for any chemicals used in process equipment preparation shall be reviewed by Subcontractor Supervisors with personnel, one copy shall be delivered to MK SSHO for review.	
4.3 Equipment to be Used	**Inspection Requirements**	**Training Requirements**	
4.4 Heavy equipment and handtools. Pipe cutters and sealants.	Daily, prior to use per manufacturer's recommendation.	OSHA 1910.120 40-Hour Training, 3 day OJT, 8 hours Supervisory. 8 hour Refresher, Site Safety and Health Plan (Project Kickoff), POD, Pre and Post Entry Briefs, and OSHA Hazard Communication. Heavy Equipment operator(s) trained and certified.	

ACTIVITY HAZARD ANALYSIS (AHA)			
Activity: Construct Utility Building, construct and install bermed area for ancillary equipment (oil/water separator, water and product storage tanks).		Analyzed By/Date: Frank J. Petrik 10/6/95	Reviewed By/Date: William Pierpoint 12/18/95
5.0 Principal Steps	Potential Hazards	Recommended Controls	
5.1 Prepare foundation; complete structure; install air compressor unit; and install control hardware. 5.2 Construct berm, install liner, install separator and tank hardware, and make all process connections.	Struck by and struck against. Material handling, including ergonomic type injuries. Mechanical and electrical energies. Chemical agent exposure (from contaminants unlikely, from specialty support chemicals, more likely)	Sub Supervisors shall verify utility clearances before any ground penetrations. Sub Supervisors and MK SSHO shall review mechanical and material handling practices to insure use of approved equipment and practices. MK SSHO shall verify competent person assigned for hoisting and rigging. MK General Superintendent coordinates and verifies with Sub the energy control plan is in place for all utility and process subsystems. Permit required for any Hot Work, coordinated by MK SSHO. Sub Supervisors shall review MSDS(s) for support chemicals with workers, one copy shall be delivered to MK SSHO for review.	
5.3 Equipment to be Used	Inspection Requirements	Training Requirements	
5.4 Material handling equipment, handtools, power tools, excavating equipment, specialty chemicals such as glues and solvents (limited application).	Before use per manufacturers recommendation.	OSHA 1910.120 40-Hour Training, 3 day OJT, 8 hours Supervisory. 8 hour Refresher, Site Safety and Health Plan (Project Kickoff), POD, Pre and Post Entry Briefs, and OSHA Hazard Communication.	

ACTIVITY HAZARD ANALYSIS (AHA)			
Activity: Site Restoration.		Analyzed By/Date: Frank J. Petrik 10/6/95	Reviewed By/Date: William Piispanen 12/18/95
6.0 Principal Steps	Potential Hazards	Recommended Controls	
6.1 Offload, spread, compact and reseed area (if required).	6.1a. Contact with airborne material, may present a biological hazard. 6.1b. Struck by and struck against physical objects during off-loading and spreading material.	6.1a. Dust Controls required to include wetting fill material. Level D PPE expected, upgrade if necessary. Dust controls and respirator (dust mask) may be necessary during spreading and covering with cover material (spray on straw or other material) 6.1b. Preplan work layout. Backup alarms on all motorized equipment. Keep clear area around heavy equipment.	
6.2 Equipment to be Used	Inspection Requirements	Training Requirements	
6.3 Heavy equipment, handtools, sodding equipment if applicable, and straw spreader.	Daily, prior to use per manufacturer's recommendation.	OSHA 1910.120 40-Hour Training, 3 day OJT, 8 hours Supervisory. 8 hour Refresher, Site Safety and Health Plan (Project Kickoff), POD, Pre and Post Entry Briefs, and OSHA Hazard Communication.	

ACTIVITY HAZARD ANALYSIS (AHA)			
Activity: Field Sampling Activities for Soil.		Analyzed By/Date: Frank J. Petrik 10/6/95	Reviewed By/Date: William Simpson 12/18/95
7.0. Principal Steps	Potential Hazards	Recommended Controls	
7.1. Hand auguring (in excavations and trenches)	7.1. Collapse of excavation, entrance and egress, contaminated soil contact, contact with underground utility or piping/ mechanical system.	7.1. Modified Level D PPE expected, upgrade per MK SSHO assessment. Analyze for potential contact with any underground utility or mechanical service. Note: Excavation Permit must be valid. Review Field Sampling Kit MSDSs if applicable. Note: Sampler requires approval from competent person to enter excavation if deeper than 5 foot. Atmospheric conditions in excavation checked prior to and during sampling.	
7.2. Hand auguring (non excavated areas)	7.2. Contaminated soil contact, contact with utility or piping/ mechanical system.	7.2. Analyze for potential contact with any underground utilities or mechanical services. Modified Level D PPE expected, upgrade per SSHO review. Review Field Sampling Kit MSDSs if applicable.	
7.3. Containerized Liquids Sampling (known contents)	7.3. Contaminated liquid contact.	7.3. Modified Level D PPE or as appropriate for contents hazards.	
7.4. Sampling Equipment Decontamination	7.4. Contact with contaminated material, also direct contact with decontamination solutions (weak nitric acid and acetone)	7.4. Modified Level D PPE with chemical goggles and gloves.	
7.5 Equipment to be Used	Inspection Requirements	Training Requirements	
7.6. Soil auger, stainless steel spoons, buckets, field sampling kits and decontamination solutions.	Per manufacturers recommendation. Core drilling equipment if used must be inspected daily. Preplan waste handling.	OSHA 1910.120 40-Hour Training, 3 day OJT, 8 hours Supervisory. 8 hour Refresher, Site Safety and Health Plan (Project Kickoff), POD, Pre and Post Entry Briefs, and OSHA Hazard Communication. DOT 181 certification for person supervising the preparation of contaminated materials for offsite shipment.	

APPENDIX B

WORK ZONE MAPS

Note: Work Zone Maps are field prepared by each Subcontractor and approved by the MK SSHO. The Excavation Subcontractor will deliver one set of the Work Zone Maps to the MK SSHO who will insert copies of the map(s) into the field master copy of this SSHP.

QUALITY CONTROL PLAN

NAS CORPUS CHRISTI FREE PRODUCT REMOVAL PROJECT
CORPUS CHRISTI, TEXAS

CONTRACT #N62467-93-D-1106
DELIVERY ORDER #0016
STATEMENT OF WORK #24

REVISION 0
DECEMBER 6, 1995

Prepared For:

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TABLE OF CONTENTS

0.1 INTRODUCTION

The Quality Control for the remedial action activities associated with NAS Corpus Christi Delivery Order No. 0016, Statement of Work No. 024, Table 1 is presented in two primary areas:

- The physical construction/Remediation Activities covered under this Quality Control Plan (QCP);
- Sampling and analysis quality requirements covered under the Chemical Data Acquisition Plan (CDAP), Section III, Quality Assurance Project Plan.

0.1.1 Quality Control Plan

The QCP presented herein is structured to implement the procedures necessary to achieve and maintain a consistently high level of quality in construction of the free product recovery system and sampling activities performed for the U. S. Navy, Naval Facilities Engineering Command Southern Division. This consistency will be accomplished through the standardization and thorough documentation of field techniques and activities for each Definable Feature of Work. This QCP is presented in a format specified by the Navy, and is intended to be a working document that provides the structure for achieving a high level of confidence in the quality of Delivery Order work activities

Definable Features of Work

The definable features of work identified for the remediation work under Statement of Work #24, are presented here. They include:

- Site preparatory work;
- Geoprobe site;
- Removing old recovery wells;
- Installing new recovery wells;
- Install transfer piping;
- Install concrete pad and storage building;
- Install oil/water separator and auxiliary equipment;
- Install storage tanks and control equipment;
- System start-up; and
- Site restoration.

The Site Quality Control Supervisor (SQCS) will perform the Three Phases of Control inspections for each definable feature of work. The Testing Plan and Log, presented in Section 7.0 of this QCP, is structured to ensure that preparatory, initial and follow-up inspections are completed for each definable feature as it is performed in an area.

Quality Records

Records generated as a result of analytical sampling activities are Quality Records and will be processed in accordance with the requirements of this QCP. Documents such as Chain of Custody Records, analytical testing results, and other required laboratory deliverables are essential documents necessary to ensure the integrity and defensibility of data used to make decisions in the remediation process. Further, Quality Records provide the documented evidence of events that have occurred for all features of the work and their adequate generation, review, protection, and submittal is essential to the success of the project.

0.1.2 Sampling and Analysis Plan

Section III of the CDAP, Quality Assurance Project Plan, is structured to establish the precision, accuracy, representativeness, completeness and the comparability requirements of environmental monitoring and measurement data associated with sampling and analysis quality requirements.

Data Quality Objectives

All samples will be classified as CLP Level QC or Level D. This classification is made to establish the objectives of field sampling and laboratory analytical procedures to obtain defensible data that meets data quality for precision, accuracy, representativeness, completeness and comparability which have been outlined in Section III of the CDAP. All other analytical sampling at NAS Corpus Christi (waste sample characterization, etc.) will be classified as Level E.

The parameters to be analyzed and associated detection limits are outlined in the CDAP. The CDAP also provides requirements for field sampling and testing, and provides the details for decontamination of sampling equipment, sample packaging and preservation, transportation, sample numbering, chain of custody, and documentation requirements. Samples will be collected in the field and submitted to laboratories to perform the required analyses. SW-846 Methods will be used for this project. Duplicate samples will be used to develop estimates of the accuracy and precision of the analytical data. Field surveillance of sampling, field measurements, and chain of custody procedures will be used to verify that proper techniques are being followed.

Three Phases of Control

This QCP integrates the Navy's Quality Control system of the *Three Phases of Control.* These phases, Preparatory, Initial, and Follow-up, represent a logical and systematic approach to assuring the control and the quality of the remediation work processes. Integration of the Three Phases of Control is accomplished by the performance of Preparatory, Initial, and Follow-up inspections at representative points in the remediation work process. Details of these inspections are contained in the Field Inspection

Checklist, found in Section 9 of this QCP.

At each phase, Quality Control verification activities may be supplemented by the performance of detailed inspections of a particular activity. In these cases, Field Inspection Checklists have been generated to assure a thorough verification of the work process. The use of Field Inspection Checklists is detailed in the Testing Plan and Log, Section 7 of this QCP. Copies of the specified Field Inspection Checklists are provided in Attachment A of this QCP. When utilized, the completed Field Inspection Checklist is attached to the combined *Contractor Production Report/Contractor Quality Control Report (Form 01400-1).*

Preconstruction/Quality Control Meetings

To ensure that all parties performing work at NAS Corpus Christi fully understand the Quality requirements established for this Delivery Order, a Coordination and Mutual Understanding Meeting will be held prior to the start of construction/remediation activities. Attendees at the meeting include the Contracting Officer, or designee, the MK Project Manager, the MK Construction Superintendent, and the MK SQCS. Any and all "Navy/Base" representatives that wish to attend will be afforded the opportunity to do so. Minutes of the meeting shall be prepared by the MK SQCS and signed by all meeting attendees. A copy of the meeting minutes are then provided to the Navy and MK Charleston Project Management Office (PMO).

After construction/remediation activities commence, the MK SQCS will conduct *QC Meetings* at least once every week or more frequently if appropriate. QC Meetings will be held with the MK Project Manager and superintendents, foreman, or managers responsible for upcoming work.

This QC meeting may be held concurrently with the weekly construction meeting. The purpose of the QC Meeting is to review the minutes of the previous meeting, review the schedule, review the status of submittals, review the work to be accomplished in the next two weeks, plan any testing and documentation required, resolve any QC and production problems, and address any items that may require revising the QC Plan. QC Meetings will be documented, and a copy of the minutes of the meeting will be provided to the Contracting Officer within two working days after the meeting.

1.0 QUALITY CONTROL PERSONNEL

This section of the Quality Control Plan sets forth the duties, responsibilities, and authorities of Quality Control Personnel executing tests and inspections in support of Delivery Order No. 0016, Statement of Work #24, Corpus Christi, Corpus Christi, Texas.

The Quality Control organization supporting Delivery Order work at Corpus Christi will consist of the following positions:

A QC Organization Chart is provided in Section 2 of this QCP. The organization chart identifies the structure and areas of responsibility of the project team and line of reporting authority within the project management organization. Personnel with Quality Control responsibilities are distinct from personnel with project management responsibilities in that the oversight performed for quality control will be independent of the oversight performed for physical drum removal/disposal activities. Corrective measures necessitated by the results of inspection and testing will be implemented through the site project management personnel.

Site Quality Control Supervisor

The Site Quality Control Supervisor (SQCS) appointed for the execution of Delivery Order 0016, Statement of Work 24, NAS Corpus Christi has not been determined. The name and qualification of the SQCS will be submitted under separate cover to the Contracting Officer. The SQCS is responsible for overall implementation of this QCP at the project site, and has the authority to act independently in all Quality Control matters. The SQCS will report to the MK Program Quality Control Manager (PQCM) based in the MK Project Management Office in Charleston, SC. The SQCS reports directly to the MK PQCM, and interfaces on a day-to-day basis with the site Project Manager. The SQCS has the authority to halt work if it is found to be nonconforming and further processing may result in an inability to resolve the identified condition. The SQCS is responsible for the following activities:

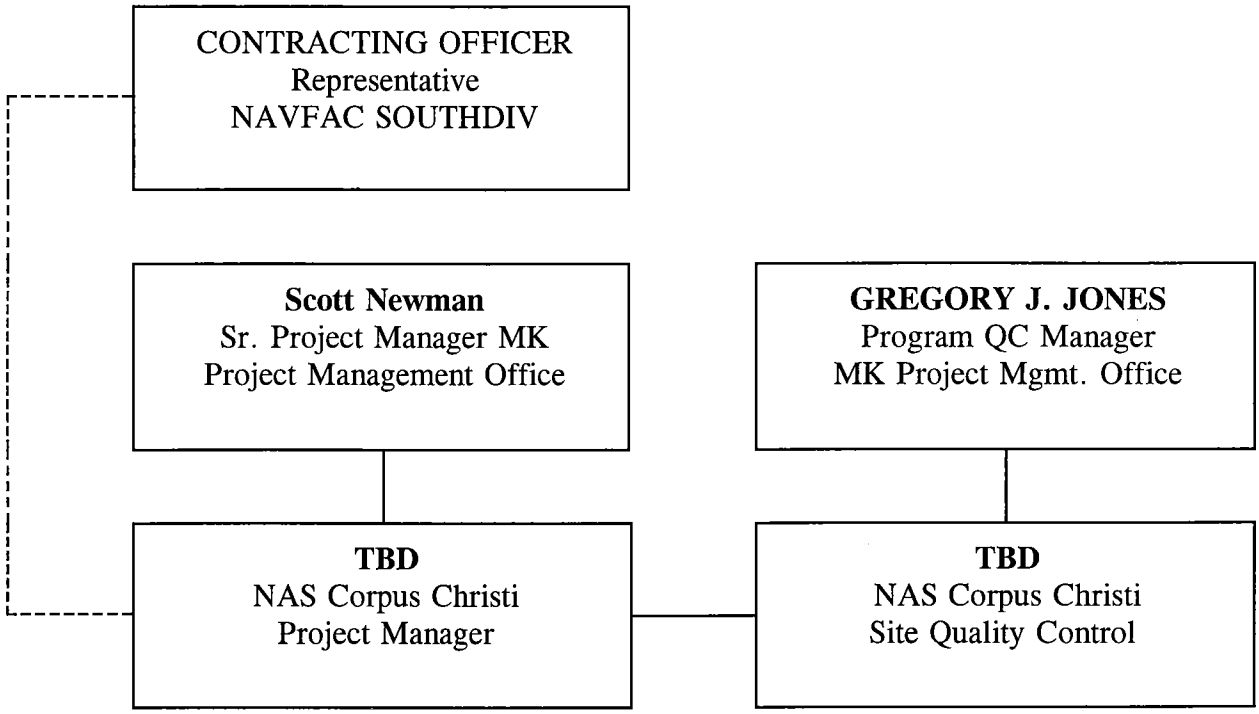
- Implementation of the Delivery Order Quality Control Plan (QCP);
- Performance of required tests and inspections, as specifically assigned in the QCP according to the Three Phases of control;
- Site supervision of the Quality staff, as applicable;
- Assist the PQCM in the submittals process;
- Regular and timely reporting of inspection/test results;
- Certification of completed work, invoices, and reports as may be designated in writing;
- Stoppage of work that does not comply with requirements established contractually;
- Manage the performance of all on-site and off-site inspections and testing;
- Evaluate the results of the inspections and testing;

- Maintain the Testing Plan and Log status provided in Section 6 of this QC Plan;
- Perform Preparatory, Initial, and Follow-Up Inspections per the schedule provided in Section 8 of this plan;
- Document results of inspection and testing activities on the Contractor Quality Control Report provided in Section 8 of this QC Plan;
- Maintenance of the status of the Rework Items List per Section 7 of this QC Plan;
- Ensure that sample custody requirements are maintained.

Laboratory Quality Control Personnel

Laboratory Quality Control personnel will perform the laboratory tests as specified to generate the QC analytical data. Laboratory QC personnel will be qualified by training and experience is accordance with the selected laboratory's Quality Assurance/Quality Control Manuals.

2.0 QUALITY CONTROL ORGANIZATION



3.0 SUPPORTING/OUTSIDE ORGANIZATIONS

Scope of Work	Organization
Old Recovery Well Removal	by Subcontractor
New Recovery Well Installation	by Subcontractor
Oil/Water Separator	by Subcontractor
Material Testing/Geotechnical	by Subcontractor
Laboratory Analyses	by Subcontractor
Waste Transport and Disposal	by Subcontractors
Waste Characterization Sampling	by Subcontractor
Data Review	by MK
Data Validation	by MK

4.0 SUBMITTALS

Submittals relating to this Delivery Order are processed in accordance with this section of the QC Plan. There are two primary areas of submittal activity that are discussed in this section. The first submittal of the Remedial Action Plan and related documents, including supporting plans such as the QCP, to Southern Division in North Charleston, SC. The second area of submittal activity involves subcontractor submittals review and approval.

N. Charleston Submittals

The MK PQCM, based in N. Charleston, SC, is responsible for review and approval of Delivery Order planning document submittals such as Work Plans, Safety and Health Plans , Quality Control Plans, and related plans. The submittal status for these documents will be maintained at the Project Management Office (PMO) in N. Charleston, SC.

Subcontractor Submittals

The SQCS will develop and maintain submittal registers for each subcontractor selected to support the remediation work at NAS Corpus Christi. The submittal register will list the contractually required submittals based on the Vendor Data Schedule developed in the subcontract package, and indicate submittal approval authorities. These authorities will always include the MK Project Engineer and the SQCS. Other submittals may require review by the Southern Division Resident Officer in Charge of Construction (ROICC). Once the submittal register is developed, the QC submits it to the ROICC at Corpus, who will indicate which submittals require Navy review and approval.

Submittal Types

Submittals are shop drawings, product data, samples, and administrative documents that require review, approval, and distribution. Submittal types include:

Shop Drawings. As used in this section, drawings, schedules, diagrams, and other data prepared specifically for this contract, by the Contractor or through the Contractor by way of a subcontractor, manufacturer, supplier, distributor, or other lower tier Contractor, to illustrate a portion of the work.

Product Data. Pre-printed material such as illustrations, standard schedules, performance charts, instructions, brochures, diagrams, manufacturer's descriptive literature, catalog data, and other data to illustrate a portion of the work, but not prepared exclusively for this contract.

Samples. Physical examples of products, materials, equipment, assemblies, or workmanship, physically identical to a portion of the work, illustrating a portion of the work or establishing standards for evaluating the appearance of the finished work or both.

Administrative Submittals. Submittals of data for which reviews and approval will be required to ensure that the administrative requirements of the project are adequately met but not to ensure directly that the work is in accordance with the design concept and in compliance with the contract documents.

Submittal Categories

SD-01, Data

Submittals which provide calculations, descriptions, or other documentation regarding the work.

SD-02, Manufacturer's Catalog Data

Data composed of catalog cuts, brochures, circulares, specifications, and product data, and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. A type of product data.

SD-03, Manufacturer's Standard Color Charts

Pre-printed illustrations displaying choices of color and finish for a material or product. A type of product data.

SD-04, Drawings

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, detail of fabrications, layout of particular elements, connections, and other relational aspects of the work. A type of shop drawing.

SD-05, Design Data

Design calculations, mix designs, analyses, or other data, written in nature and pertaining to a part of the work. A type of shop drawing.

SD-06, Instructions

Pre-printed material describing installation of a product, system, or material, including special notices and material safety data sheets, if any, concerning impedances, hazards, and safety precautions. A type of product data.

SD-07, Schedules

A tabular list of data or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work. A type of shop drawing.

SD-08, Statements

A document, required of the Contractor, or through the Contractor by way of a supplier, installer, manufacturer, or other lower tier Contractor, the purpose of which is to further the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verification of quality. A type of shop drawing.

SD-09, Reports

Reports of inspection and laboratory test, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-10, Test Reports

A report signed by an authorized official of a testing laboratory that a material product, or system identical to the material, product, or system to be provided has been tested in accordance with requirements specified by naming the test method and material. The test report must state the test was performed in accordance with the test requirements; state the test results; and indicate whether the material, product, or system has passed or failed the test. Testing must have been within 3 years of the effective date of award of the delivery order. Analytical laboratory testing must have been completed within established sample holding times. A type of product data.

SD-11, Factory Test Reports

A written report which includes the findings of a test made at the job site, in the vicinity of the job site, or on a sample taken from the job site, or on a portion of the work, during or after installation. The report must be signed by an authorized official of a testing laboratory or agency and must state the test was performed in accordance with the test requirements; state the test results; and indicate whether the material, product, or system has passed or failed the test. A type of shop drawing.

SD-13, Certificates

Statements signed by responsible officials of a manufacturer of a product, system, or material attesting that the product, system, or material meets specified requirements. The

statements must be dated after the award of this contract, name the project, and list the specific requirements which it is intended to address. A type of shop drawing.

SD-14, Samples

Samples, including both fabricated and unfabricated physical examples of materials, products, and units of work as complete units or as portions of units of work. A type of sample.

SD-15, Color Selection Samples

Samples of the available choice of colors, textures, and finishes of a product or material, presented over substrates identical in texture to that proposed for the work. A type of sample.

SD-16, Sample Panels

An assembly constructed at the product site in a location acceptable to the Contracting Officer and using materials and methods to be employed in the work; completely finished; maintained during construction; and removed at the conclusion of the work or when authorized by Contracting Officer. A type of sample.

SD-17, Sample Installations

A portion of an assembly or material constructed where directed and, if approved, retained as a part of the work. A type of sample.

SD-18, Records

Documentation to ensure compliance with an administrative requirement or to establish an administrative mechanism. A type of administrative and closeout submittal.

SD-19, Operation and Maintenance Manuals

Data intended to be incorporated in an operations and maintenance manual. A type of administrative and closeout submittal.

Submittal Register

A Submittal Register will be used to track progress of submittals as they are processed. Examples of Submittal Registers are provided in this section of this QCP.

Submittal Status

The status of submittals shall be maintained on the submittal register using the following status designators:

"Approved" or "Approved as Submitted" - Use of this document is unrestricted;

"Approved as Noted" - Use of document is unrestricted provided exception is not taken to noted comments.

"Disapproved" or "Revise and Resubmit"- A status of submittals that indicates the submittal is incomplete or does not comply with the design concept or contract documents and requires resubmittal after appropriate changes.

"Not Reviewed"- A status of submittals that indicates that the submittal has been previously reviewed and approved, is not required as a submittal, lacks review and approval by Mk, or is not complete. Submittals returned by the Navy marked "Not Reviewed" because of lack of review by MK or because of incompleteness shall be resubmitted to the Navy with appropriate action, change, or coordination.

"Preliminary Release for Information"- A document status that indicates the document is in the process of being finalized but is being released for use in preliminary planning efforts. This status may also be used for documents that are routed internally for review, comment, or approval.

"Information Only"-A document status that indicates the document may only be used for informational purposes and are not of controlled status. Information Only documents are not to be used as a source of design basis information or used as a reference in the completion or inspection of work.

SUBMITTAL REGISTER (PART A)		Morrison Knudsen Corporation N. Charleston, SC					SUBMITTAL REGISTER (PART B)							Page 1 of 1
Contract No.: N62467-93-D-1106		Project Title: U.S. Navy SOUTHDIV ERAC - Region II												
Delivery Order	Submittal No.	Sequence No.	Submittal Type	WBS No.	Submittal Description:									
0016	SD-08	001	SD	33.01.03.14	Remedial Action Plan - **NAS Corpus Christi**		s:\submital do0016.xls							
Spec. Section No. (a)	Material or Product (b)	Spec. Para. No. (c)	Classif/ Appr by CO (d)	Govt or A/E Reviewer (e)	Trans. Control No. (f)	Planned Submittal Date (g)	(h)	(i)	Date Submitted To PQM (j)	Date Submitted To CO (k)	Date Received By CO (l)	Action By CO (m)	Date Action by CO (n)	Date Received by MK (o)
Delivery Order 016 SOW 024	Site Safety & Health Plan, Rev.0	Delivery Order 016	G	CO	94-4324-713	12/19/95			12/15/95	12/19/95	12/19/95	Approve		
Delivery Order 016 SOW 024	Site Quality Control Plan, Rev.0	Delivery Order 016	G	CO	94-4324-713	12/19/95			12/15/95	12/19/95	12/19/95	Approve		
Delivery Order 016 SOW 024	Waste Mgmt. Plan, Rev.0	Delivery Order 016	G	CO	94-4324-713	12/19/95			12/15/95	12/19/95	12/19/95	Approve		
Delivery Order 016 SOW 024	Chemical Data Acq. Plan, Rev.0	Delivery Order 016	G	CO	94-4324-713	12/19/95			12/15/95	12/19/95	12/19/95	Approve		

5.0 INSPECTION SYSTEM

QC Personnel

QC Personnel are responsible for conducting assigned inspections in accordance with the technical requirements provided in the applicable specifications and drawings, and for documenting the results of these inspections, tests, and observations in accordance with this QCP.

Inspection/Test Point

An Inspection or Test Point is that point in a work process where an inspection or test is to be performed. Inspection and Test Points are designated in Section 6, Testing Plan and Log contained in this QCP.

Conduct of Inspections

Specific types and frequencies of tests are detailed in the Testing Plan and Log contained within Section 6 of this QCP. Inspections will be performed utilizing inspection checklists as specified in the Testing Plan and Log.

Preparatory Inspection

The Contracting Officer (CO) or the CO's designated representative will be notified at least two working days in advance of each preparatory phase. The preparatory phase inspection will be conducted with the superintendent and the foreman responsible for the definable feature of work. The results of the preparatory phase actions will be documented in the daily Contractor Quality Control Report. Prior to beginning work on each definable feature of work, the following will be performed:

- Review each paragraph of the applicable specification sections;
- Review the contract drawings;
- Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required;
- Review the testing plan and ensure that provisions have been made to provide the required QC testing;
- Verify that the appropriate disposal analysis requirements have been submitted to determine waste characterization analysis;
- Examine the work area, including the decontamination facility, to ensure that the required preliminary work has been completed and safety precautions have been taken;
- Examine the required materials and equipment, and sample work to ensure that materials and equipment are on hand and conform to the approved shop drawings and submitted data;

- Review the Health and Safety Plan and appropriate activity hazard analysis to ensure that applicable safety requirements are met, and that required Material Safety Data Sheets (MSDS) are submitted; and,
- Discuss construction methods.

Initial Inspection

At the initiation of a representative sample of the given features of work, the SQCS will verify that the work meets the applicable quality requirements. The following items will be verified during Initial Inspection:

- The workmanship meets the established quality requirements;
- Configuration and construction methods, equipment, and tools appear to be effective;
- Calibration of measurement and test equipment;
- Materials and articles used are as specified;
- Adequacy of inspection/testing methods;
- Adequacy of applicable drawings; and
- Adequacy of safety and environmental precautions.

Follow-Up Inspection and Surveillance

The following will be performed for ongoing work daily, or more frequently as necessary until the completion of each definable feature of work and documented in the daily Contractor quality control report:

- Ensure the work is in compliance with contract requirements;
- Maintain the quality of workmanship required;
- Ensure that testing is performed;
- Ensure that rework items are being corrected;
- Ensure that the decontamination facility is in sound working order.

QC Plan Inspections

The SQCS will perform follow-up inspections based on the Inspection Plan and Log in Section 6 of this QCP. The SQCS will document the results of each day's inspection on the Contractor Quality Control Report. Completed Contractor Quality Control Reports shall be submitted to the MK PQCM as a record.

Documentation

Contractor Quality Control Reports are required to be completed for each day that work is performed and for every seven consecutive calendar days of no-work, on the last day of that no-work period. Each calendar day will be accounted for throughout the life of the project. The reporting of work shall be identified by terminology consistent with the

construction schedule. Contractor quality control reports are to be prepared, signed, and dated by the MK SQCS and shall contain the following information:

a) Identify the control phase and the definable feature of work.
b) Results of the preparatory phase meetings held, including the location of the definable feature of work and a list of personnel present at the meeting. Verify in the report that for this definable feature of work, the drawings and specifications have been reviewed, and work methods and schedule have been discussed.
c) Results of the initial phase meetings held, including the location of the definable feature of work and a list of personnel present at the meeting. Verify in the report that for this definable feature of work the preliminary work was done correctly, samples have been prepared and approved, the workmanship is satisfactory, test results are acceptable, work is in compliance with the contract, and the required testing has been performed, and include a list of who performed the tests.
d) Results of the follow-up phase inspections held, including the location of the definable feature of work. Verify in the report for this definable feature of work that the work complies with the contract as approved in the initial phase, and that required testing has been performed, and include a list of who performed the tests.
e) Results of the three phases of control for off-site work, if applicable, including actions taken.
f) List rework items identified, but not corrected by close of business.
g) As rework items are corrected, provide a revised rework items list along with the corrective action taken.
h) Include a "Remarks" section in this report which will contain pertinent information including directions received, QC problem areas, deviations from the QC plan, construction deficiencies encountered, QC meetings held, acknowledgment that as-built drawings have been updated, corrective direction given by the QC manager, and corrective action taken by the Contractor.
i) Contractor quality control report certification.

Testing Plan and Log

As tests are performed, the SQCS shall record on the testing plan and log the date the test was conducted, the date the test results were forwarded to the Contracting Officer, and any remarks and acknowledgment that an accredited or Contracting Officer approved testing laboratory was used. The SQCS will attach a copy of the updated testing plan and log to the last daily Contractor Quality Control Report of each week. This log may be maintained as a computer file for ease of update, which will allow it's use as a final testing summary report.

Rework Items List

The MK SQCS shall maintain a list of work that does not comply with the contract, identifying what items need to be reworked, the date the item was originally discovered, and the date the item was corrected. There is no requirement to report a rework item that is corrected the same day it is discovered. The SQCS will attach a copy of the MK rework items list to the last daily Contractor Quality Control Report of each week. The SQCS shall be responsible for including on this list items needing rework including those identified by the Contracting Officer. This log may be maintained as a computer file for ease of update, which will allow it's use as a final testing summary report.

As-Built Records

The SQCS is required to review the as-built records required by contract to ensure that as-built records are kept current on a daily basis and marked to show deviations which have been made from the contract drawings. The SQCS shall initial each deviation or revision. Upon completion of work, the SQCS shall submit a certificate attesting to the accuracy of the as-built records prior to submission to the Contracting Officer.

Report Forms

Inspection and test results will be summarized daily on the "Contractor Quality Control Report", and supported by completed inspection/test checklists for the activity. Completed checklists are included in the Closure Report at project completion.

Reports shall be submitted daily to the Contracting Officer, with a copy sent to the PQCM in the PMO.

SUMMARY OF INSPECTION APPROACH: CORPUS CHRISTI DELIVERY ORDER 0016					
Project Component	Required Inspection/Test	Applicable Procedure	Preparatory Inspection	Initial Inspection	Follow-up Inspection
Install Recovery Wells	• Removal of old wells • Sampling and Analysis • Waste Disposal and Manifests	QEP 8.1 CDAP QEP 8.1	Document on CQCR Form 1400-1	Document all Initial Inspections on CQCR Form 1400-1	Document on CQCR Form 1400-1
Install System Piping	• Hydrostatic test of transfer piping • Sampling and Analyses • Waste Disposal and Manifests	QEP 8.1 CDAP	Document on CQCR Form 1400-1	Document all Initial Inspections on CQCR Form 1400-1	Document on CQCR Form 1400-1
Install Oil/Water Separator and Air System	•Inspect the connection of electricity and air system to pumps	QEP 8.1	Document on CQCR Form 1400-1	Document all Initial Inspections on CQCR Form 1400-1	Document on CQCR Form 1400-1
Perform System Start-up	• Removal of old wells • Sampling and Analysis • Waste Disposal and Manifests	QEP 8.1 CDAP	Document on CQCR Form 1400-1	Document all Initial Inspections on CQCR Form 1400-1	Document on CQCR Form 1400-1

6.0 TESTING PLAN AND LOG

A Testing Plan and Log has been prepared and included in this section of the QCP, and delineates the required tests and inspections applicable to a definable feature of work. The Testing Plan and Log identifies the project component, the specific inspection or test to be performed, the frequency of such testing or inspection, and lists the governing standard which governs the methodology to be employed. Qualitative and quantitative acceptance criteria is provided, either through an actual listing of the criteria or by reference to a supporting checklist, work plan element, or a governing regulation or standard.

The Testing Plan and Log is intended to serve as a living document to be utilized to record, in the field, the status of sampling and inspection performed in support of the Delivery Order work. The Log contains sections for the entry of work to be performed as specified in the Remedial Action Plan, inspection, testing activities, and relevant comments.

The Testing Plan and Log reflects the application of the Three Phases of Control to the definable features of work for each area. Where multiple areas will be worked at one time, the preparatory, initial and follow-up inspections may be combined. It is not necessary to generate a separate checklist for each area; however, it is necessary to perform the three phases of control for each activity in each area. As inspections are completed, the SQCS will record the date that the inspections occurred in the appropriate sections of the Testing Plan and Log. Results of the inspections will also be maintained.

TESTING PLAN AND LOG

CONTRACT NO./TITLE: MK SOUTHDIV ERAC
DELIVERY ORDER NO: 0016 NAS Corpus Christi
Statement of Work #24

Definable Feature of Work	Inspection Checklist	Three Phases of Control (Enter Dates that Inspections are Performed)			Test or Inspection Results	Comments
		Preparatory	Initial	Follow-up		
Product Recovery System Installation						
Site Preparatory Work	SC-01					
Recovery Well Installation	RWELL					
Piping Well Installation Underground Piping	PI-01					
Mechanical Installation of Recovery System	ME-01					
Electrical System Installation	EL-01					
Field Analytical Sampling Overview	SA-01					

Definable Feature of Work	Inspection Checklist	Three Phases of Control (Enter Dates that Inspections are Performed)			Test or Inspection Results	Comments
		Preparatory	Initial	Follow-up		
Decontamination Actions	DE-01					
Run on/Run off Control	ER-01					
Backfill Placement	SO-01					
Site Restoration	SR-01					

ATTACHMENT A

INSPECTION DOCUMENTATION

MORRISON KNUDSEN CORPORATION
Engineering, Construction, & Environmental

FIELD INSPECTION CHECKLIST

Checklist Title	Checklist Number	Revision Date	Checklist
SITE PREPARATORY WORK	**SC-01**	**June 95**	**Page 1 of 2**

ITEM NO.	ITEM CHECKED	Accept/ Reject	REMARKS	VERIFIED BY/ DATE
	Preparatory Inspection			
1	Schedule preparatory phase meeting prior to initiating work items for site clearing.			
2	Verify Work Zone is clearly delineated.			
3	Verify digging permits have been obtained.			
4	Verify site screening has been performed.			
5	Ensure that a **Stockpiling Plan** has been developed and approved by the Project Manager.			
6	Ensure that a **Decontamination Plan** has been developed and approved by the Project Manager.			
7	Ensure that a **Spill Control Plan** has been developed and approved by the Project Manager.			
8	Verify completion of any initial surveys.			
9	Verify that a review of safety requirements is performed as a part of the preparatory inspection. **(Briefing by Site Safety & Health Officer)**			
10	Ensure that an **Equipment Plan** is developed and approved by the Project Manager.			
11	Ensure that a **Housekeeping and Maintenance Plan** is developed and approved by the Project Manager.			
	Initial Inspection			
1	Confirm work areas have been located within the limits of established stakes, lines, or monuments.			
2	Conduct an examination of areas to be cleared and identify items to remain or existing features, including plant life, that is not to be disturbed. Resolve discrepancies prior to continuance of work.			
3	Ensure compliance with the plans identified in the Preparatory Phase.			
4	Verify that dust control measures are available and effective.			

MORRISON KNUDSEN CORPORATION Engineering, Construction, & Environmental			FIELD INSPECTION CHECKLIST	
Checklist Title **SITE PREPARATORY WORK**		Checklist Number **SC-01**	Revision Date **JUNE 95**	Checklist **Page 2 of 2**
ITEM NO.	ITEM CHECKED	Accept/ Reject	REMARKS	VERIFIED BY/ DATE
	Follow-up Inspections			
1	Ensure removal of ground surface vegetation from the construction area.			
2	Verify removal from the construction area of stumps, roots, debris, and other deleterious materials not suitable for subsequent grading or reuse and compaction.			
3	Verify final removal and off-site disposal of cleared and grubbed wastes in an approved manner.			
4	Verify continuing compliance with the approved plans identified during the Preparatory Phase Inspection.			
5	Ensure that needed revisions to the plans identified during the Preparatory Phase Inspection are documented and approved by the Project Manager and the Resident Officer in Charge of Construction.			
6	Verify completion of site clearing activities is complete and in accordance with the approved work plan.			

ADDITIONAL NOTES OR COMMENTS

Specific Item Identification or Location, as applicable:

MORRISON KNUDSEN CORPORATION
Engineering, Construction, & Environmental

Procedure Type

FIELD INSPECTION CHECKLIST

Checklist Title	Inspection Code	Revision Date	Checklist
AOC RECOVERY WELL INSTALLATION	**WELL**	**SEPT 95**	**Page 1 of 1**

ITEM NO.	ITEM CHECKED	Accept/ Reject A/R	REMARKS	VERIFIED BY DATE
1	Total depth of boring measured to the nearest 0.10-foot.			
2	Ten foot layer of 10/20 environmental filter pack placed in bottom of boring.			
3	Two foot layer of 50/60			
4	Well string, consisting of end cap, PVC Type well screen and casing, centralizers, and screw cap installed in boring. Length of each component measured and recorded. Location of stainless steel centralizers measured and recorded.			
5	Sand pack (100 % pass through No. 50 sieve) installed in annular space to one foot above screen. Confirmed by measuring tape and recorded. If water used during installation, record volume added.			
6	Bentonite pellets installed by use of tremie pipe to one foot above screen. Hydrated per manufacturer's specifications using potable water. Grout after bentonite seal has thickened. Grout proportion - 6 gal H2O to 4 - 5 lb bentonite per bag of Type I or II portland cement.			
7	Well development complete based on the following criteria: -Specific conductance, pH, and temperature stabilized over three consecutive measurements. -Water is free of visible sand, silt and turbidity.			
8	Surface closure complete. Protective casings and locking caps in place.			

Specific Item Identification or Location, as applicable:

MORRISON KNUDSEN CORPORATION
Engineering, Construction, & Environmental

Procedure Type

FIELD INSPECTION CHECKLIST

Checklist Title	Inspection Code	Revision Date	Checklist
AOC 1: PIPING WELL DISCHARGE/UNDERGROUND INSTALLATION	**PI-01**	**MAR 95**	**Page 1 of 3**

ITEM NO.	ITEM CHECKED	Accept/ Reject (A/R)	REMARKS	VERIFIED BY DATE
1	Trench excavation meets minimum requirements and guidelines in standard practice ASTM-2321.			
2	Concrete, cement and other materials used in construction of pipe trench meets all applicable ASTM standards.			
3	Proper temperature maintained during curing. Concrete protected from weather through the expiration of the curing period.			
4	Observe that pipe, fittings, and accessories are handled in such a manner as to avoid damage by impact, abrasions, or other causes.			
5	Check mechanical or finished ends for damage and pipe interior for dirt and foreign material, where accessible.			
6	Assure gaskets, lubricants, compounds, and other mechanical joint materials are handled and stored in accordance with manufacturer's recommendations.			
7	Assure all piping and fitting are schedule 80 wall thickness CPVC. Assure all miscellaneous components meet appropriate ASTM and ANSI specifications.			

REMARKS:

Specific Item Identification or Location, as applicable:

ITEM NO.	ITEM CHECKED	Accept/ Reject A/R	REMARKS	VERIFIED BY DATE
8	Assure all piping is laid in straight lines to alignment shown on drawings and to uniform grades between elevations shown on drawings at terminal structures, change of direction, and other locations.			
9	Assure joints are in accordance with manufacturer's recommendations.			
10	Assure piping is placed correctly in trench.			
11	Assure end surfaces are clean when joints are made.			
12	Assure trenches are free of standing water.			
13	Assure all required inspections, tests, hydrostatic/pneumatic tests, and/or NDE work for the piping has been performed.			
14	Assure all inspectors with jurisdictional authority of the applicable codes have witnessed the required inspections and tests, or have waived the witness/hold point.			
16	Back fill complete/reused.			
17	Verify that all tests, inspections, and NDE have been documented and the reports filed.			

Specific Item Identification or Location, as applicable:

ITEM NO.	ITEM CHECKED	Accept/ Reject A/R	REMARKS	VERIFIED BY DATE

PROVIDE DETAILED SKETCH:

Specific Item Identification or Location, as applicable:

MORRISON KNUDSEN CORPORATION Engineering, Construction, & Environmental	Procedure Type FIELD INSPECTION CHECKLIST

Checklist Title	Inspection Code	Revision Date	Checklist
AOC 1: MECHANICAL INSTALLATION OF GROUNDWATER TREATMENT EQUIPMENT	**ME-01**	**MAR 95**	**Page 1 of 2**

ITEM NO.	ITEM CHECKED	Accept/ Reject A/R	REMARKS	VERIFIED BY DATE
1	Verify that installation location is correct prior to and after concrete placement.			
2	Verify that concrete surfaces are properly prepared (clean, roughened, as necessary)			
3	Process flow diagrams and instrumentation diagrams show all major pieces of process equipment with controls. Detail drawings show proposed layout and mounting and relationship to other parts of the work.			
4	Check that equipment is handled in accordance with manufacturer's instructions, including protection of mechanical equipment from the weather during storage.			
5	Effluent sump alarm, pump lights and control valve in place.			
6	All electrical equipment conforms to the requirements of Section 16011 Electrical General Requirements.			

REMARKS:

Specific Item Identification or Location, as applicable:

Checklist Title
AOC 1: MECHANICAL INSTALLATION OF GROUNDWATER TREATMENT EQUIPMENT

Inspection Code	Revision Date	Checklist
ME-01	**MAR 95**	**Page 2 of 2**

ITEM NO.	ITEM CHECKED	Accept/ Reject A/R	REMARKS	VERIFIED BY DATE
12	Lockout/tagout procedures have been implemented as required.			
13	Equipment inspected for alignment and connections by a factory representative prior to startup.			
14	Fence installed to enclose treatment system per Technical Specification 02830.			

PROVIDE DETAILED SKETCHES:

Specific Item Identification or Location, as applicable:

MORRISON KNUDSEN CORPORATION
Engineering, Construction, & Environmental

Procedure Type
FIELD INSPECTION CHECKLIST

Checklist Title	Inspection Code	Revision Date	Checklist
AOC 1: ELECTRICAL EQUIPMENT INSTALLATION	**EL-01**	**MAR 95**	**Page 1 of 2**

ITEM NO.	ITEM CHECKED	Accept/Reject A/R	REMARKS	VERIFIED BY DATE
1	Verify correct equipment is installed (check nameplate) in accordance with manufacturers' instructions and that wiring devices are heavy duty.			
2	Verify the equipment is installed in the correct location with the correct orientation.			
3	Verify that equipment is properly mounted and aligned and clearances are correct.			
4	Verify incoming conduit is properly supported, free of corrosion and rust, and coated with a conductive galvanizing material.			
5	Verify the electrical equipment is clean, in good condition and free from moisture.			
6	Verify that electrical motors are of premium-efficiency and are installed properly.			
7	Verify that all sources and outlets are identified and that colors of nameplates and conductor tags conform to color codes specified in Work Plan.			
8	Verify that protective devices such as spray shields, drip shields and gaskets are properly installed to provide enclosure integrity.			
9	Verify that ventilation openings are not obstructed.			
10	Verify that hand operated switches, breakers and controls are functional.			
11	Verify internal connecting cable is of the correct type, that the wires are properly identified and the cable is terminated properly.			

Specific Item Identification or Location, as applicable:

Checklist Title
AOC 1: ELECTRICAL EQUIPMENT INSTALLATION

Inspection Code	Revision Date	Checklist
EL-01	**MAR 95**	**Page 2 of 2**

ITEM NO.	ITEM CHECKED	Accept/ Reject A/R	REMARKS	VERIFIED BY DATE
12	Verify that proper grounding is accomplished			
13	Verify that label plates and fuse rating nameplates are correct.			
14	Verify that connections and all power wiring have been checked for tightness, and that other field tests have been performed according to O/M Manual requirements.			
15	Verify that all systems and equipment are in satisfactory working order and ready for normal service.			
16	Confirm that all materials installed out of doors are approved for outdoor use.			
17	Confirm that the installation complies with applicable rules, codes and standards.			

Specific Item Identification or Location, as applicable:

MORRISON KNUDSEN CORPORATION
Engineering, Construction, & Environmental

FIELD INSPECTION CHECKLIST

Checklist Title	Checklist Number	Revision Date	Checklist
FIELD ANALYTICAL SAMPLING OVERVIEW	**SA-01**	**JUNE 95**	**Page 1 of 2**

ITEM NO.	ITEM CHECKED	Accept/ Reject	REMARKS	VERIFIED BY/ DATE
	Preparatory Inspection			
1	Schedule preparatory phase meeting prior to initiating field analytical sampling activities.			
2	Verify that analytical laboratory services have been procured by the PMO.			
3	Verify that sample containers, coolers, chain-of-custody records, labels, seals, and all necessary sampling equipment is present.			
4	Verify that field sampling personnel have completed training as required by the Chemical Data Acquisition Plan.			
5	Ensure that the requirements of the Sampling and Analysis Plan have been reviewed with the Project Team.			
	Initial and Follow-Up Inspections			
1	Ensure that sampling locations are properly selected per the CDAP.			
2	Ensure that sampling locations are adequately documented in a field log book. Drums have been properly numbered and recorded.			
3	Verify that any field instruments utilized are properly calibrated, and that calibrations are recorded in a field log book.			
4	Verify that sampling equipment is properly protected from possible contamination prior to sample collection.			

ADDITIONAL NOTES OR COMMENTS:

Specific Item Identification or Location, as applicable:

ITEM NO.	ITEM CHECKED	Accept/ Reject	REMARKS	VERIFIED BY/ DATE
	Initial and Follow-Up Inspections (continued)			
5	Verify that the sampling technician wears clean, disposable latex or vinyl gloves during sample collection.			
6	Verify that the sampling technician changes gloves for each sample location.			
7	Verify that proper field sampling equipment cleaning procedures are used, per the CDAP.			
8	Verify the collection of equipment rinsate blanks after field cleaning, per the CDAP.			
9	Verify that correct sample containers were used for the collection of samples.			
10	Ensure that the correct frequency of duplicate samples is collected, per the CDAP.			
11	Verify that samples are properly field preserved, per the CDAP.			
12	Ensure that field and/or trip blanks are utilized, per the CDAP.			
13	Ensure that sample containers are properly identified with labels.			
14	Verify proper security measures are taken to ensure custody of the samples after collection, per the sample custody procedures contained in the CDAP.			
15	Ensure that chain-of-custody and receipt for samples forms are properly completed.			
16	Verify correct frequency of collection and preparation of matrix spike/matrix spike duplicates (MS/MSD) per the CDAP.			
17	Verify that three times the necessary sample volume for the field duplicate sample identified for QC sampling is collected for MS/MSD sample aliquot.			
18	Verify that no homogenization of samples collected for Volatile Organic Compounds occurs.			

Specific Item Identification or Location, as applicable:

MORRISON KNUDSEN CORPORATION
Engineering, Construction, & Environmental

FIELD INSPECTION CHECKLIST

Checklist Title	Inspection Code	Revision Date	Checklist
SITE CLEARING	**CLR-01**	**JUNE 1995**	**Page 1 of 1**

ITEM NO.	ITEM CHECKED	Accept/ Reject	REMARKS	VERIFIED BY DATE
	Preparatory Inspection			
1	Conduct preparatory phase meeting prior to initiating work items for site clearing and topsoil stripping. Verify items in demolition task are complete or do not conflict with clearing.			
2	Confirm work areas have been located with the limits of work clearly established (stakes, lines, monuments).			
3	Conduct on-ground examination of areas to be cleared and identify items to remain or existing features, including plant life, not to be disturbed and protected. Resolve discrepancies prior to commencement of work.			
	Initial Inspection			
4	Protection of items not to be removed or disturbed has been provided, as necessary.			
5	Verify that dust control measures are available and effective.			
	Follow-up Inspection			
6	Cut to within 6" of ground surface vegetation indicated for removal and remove from construction limits.			
7	Conduct grubbing to remove stumps, roots, debris, or other deleterious materials not suitable for subsequent grading or reuse and compaction and removal from construction limits.			
8	Final removal and off-site disposal of cleared and grubbed wastes in an approved manner.			
9	Removal of excessive grass and other vegetation from topsoil.			
10	Topsoil materials are stockpiled, shaped and managed according to the specifications to promote drainage and for measurement purposes.			
11	Verify final removal and disposal of demolition debris and other items not to be salvaged or retained by owner in an approved manner.			
12	See that corrective action measures have been performed where required, verified, and documented.			

ADDITIONAL NOTES OR SKETCHES:

Specific Item Identification or Location, as applicable:

MK Project	Delivery Order No.	Checklist Title	Inspection Report
NAS CORPUS CHRISTI	**0016.SOW #24**	**Site Clearing CLR-01**	**Sheet 1 of 1**

MORRISON KNUDSEN CORPORATION

Engineering, Construction, & Environmental

FIELD INSPECTION CHECKLIST

Checklist Title	Inspection Code	Revision Date	Checklist
DECONTAMINATION ACTIONS	**DE-01**	**JUNE 1995**	**Page 1 of 2**

ITEM NO.	ITEM CHECKED	Accept/Reject	REMARKS	VERIFIED BY/ DATE
	Preparatory Inspection			
1	Schedule a preparatory phase inspection of decontamination preparedness prior to initiating decontamination actions.			
2	Review the requirements of the Work Plan regarding establishment of the Decontamination Facility.			
3	Review the requirement for Quality Control to perform visual inspection of the decontamination facility on a daily basis.			
4	Verify that the decontamination facility is constructed of materials as specified in the Work Plan, and in an area approved by the Project Manager.			
5	Review decontamination procedures for the external surfaces of debris and construction and field equipment as contained in the **Work Plan.**			
6	Review **Site Safety & Health Plan** requirements for the Personnel Decontamination Facility. **(Briefing by the Site Safety & Health Officer)**			
	Initial Inspection			
1	Verify that decontamination facilities are delineated with orange fencing and appropriate signage as part of the contamination reduction zone.			
2	Perform an initial inspection of the decontamination facility liner for the following attributes: evidence of tears and holes; evidence of seepage; that the sheeting is adequately fastened to the side walls; that the liner adequately covers the straw bales at the end sections and is secured by sandbags; that expected quantities of generated liquids can be contained until collected for disposal.			
3	Verify that records are established that specify decontamination facility construction materials and methods, disposition of liquids, and any repairs and/or breaches of liner integrity.			
4	Verify decontamination activities are performed in accordance with the procedures contained in the Work Plan.			

MORRISON KNUDSEN CORPORATION Engineering, Construction, & Environmental		FIELD INSPECTION CHECKLIST	
Checklist Title **DECONTAMINATION ACTIONS**	**Inspection Code** **DE-01**	Revision Date **JUNE 1995**	**Checklist** **Page 2 of 2**

ITEM NO.	ITEM CHECKED	Accept/ Reject	REMARKS	VERIFIED BY/ DATE
	Follow-up Inspection			
1	Monitor on-going decontamination operations to verify compliance with the Work Plan.			
2	Perform daily inspections of the decontamination facility liner for the following attributes: evidence of tears and holes; evidence of seepage; that the sheeting is adequately fastened to the side walls; that the liner adequately covers the straw bales at the end sections and is secured by sandbags; that expected quantities of generated liquids can be contained until collected for disposal. **Note:** Document on Contractor Quality Control Report.			
3	Verify that records of any breaches and/or repairs to the liner are documented.			
4	Verify, upon dismantlement of the decontamination facility, that underlying material is not contaminated. Potentially contaminated soil will be sampled by MK and analyzed prior to removal and managed per the Sampling and Analysis Plan.			

Specific Item Identification or Location, as applicable:

7.0 REWORK PROCEDURES

The SQCS is responsible for ensuring that deviating items are reported, tracked, and resolved. *MK Quality Execution Procedure (QEP) 13.1* establishes the requirements and responsibilities associated with the identification, reporting, and correction of deviating items. A deviating item is a departure from established requirements, and may be corrected through rework of the item or may result in a more formally documented solution requiring engineering evaluation. Deviations are usually identified by inspectors during routine inspections or tests; however, deviations may be identified at any time by anyone involved with the work and reported to the applicable inspector or Quality Control Supervisor.

Identified deviations shall be identified on the Rework Items List. The Rework Items List is provided in Attachment B of this QCP, and shall be maintained current throughout the work process.

8.0 REQUIRED QC DOCUMENTATION

This section of the QCP delineates the required Quality Control documentation that is to be completed to support the Corpus Christi Delivery Order work. Table 8-1 provides a listing of the required checklists to be completed when performing inspections, and specific forms to be used for activities such as sample chain of custody. Samples of these forms are included in Attachment B of this QCP.

TABLE 8-1: *Required Documentation*

Document Name	*Document Number*	*Completed By*
Contractor Production Report	*Form 01400-1*	*MK Production Supervision*
Contractor Quality Control Report	*Form 01400-1*	*MK Quality Control*
Chain of Custody Form	*Form 1799a/88*	*MK Sampling Technician/Project Eng.*
Rework Items List	*N/A*	*MK Quality Control*
Field Inspection Checklist: Site preparatory work	*SC-01*	*MK Quality Control*
Field Inspection Checklist: Recovery well installation	*RWELL*	*MK Quality Control*
Field Inspection Checklist: Piping well installation/Underground Piping	*PI-01*	*MK Quality Control*
Field Inspection Checklist: Mechanical Installation of Recovery System	*ME-01*	*MK Quality Control*
Field Inspection Checklist: Electrical System Installation	*EL-01*	*MK Quality Control*
Field Inspection Checklist: Sampling	*SA-01*	*MK Quality Control*
Field Inspection Checklist: Decontamination Action	*DE-01*	*MK Quality Control*
Field Inspection Checklist: Run On/Run Off Control	*ER-01*	*MK Quality Control*
Field Inspection Checklist: Backfill Placement	*SO-01*	*MK Quality Control*
Field Inspection Checklist: Site Restoration	*SR-01*	*MK Quality Control*
Daily Decontamination Facility Checklist	*N/A*	*MK Quality Control*
Subcontractor Submittal Register	*N/A*	*MK Quality Control*

9.0 LABORATORY QUALIFICATION PACKAGE

Analytical testing will be performed on waste soils prior to disposal. Sample integrity will be maintained from collection to disposal through chain of custody procedures. Samples will be identified as discussed in the CDAP. Custody seals will be affixed to all shipping containers. Completed chain-of-custody documents are retained as quality assurance records and maintained in accordance with the Quality Assurance Program. Records generated as a result of analytical sampling activities are Quality Assurance Records and will be processed in accordance with the requirements of this QCP.

At the time of generation of this QCP, the analytical laboratory has not been selected for the testing to be performed at NAS Corpus Christi. Laboratory services will be procured on a competitive basis, after pre-qualifying and work awarded only to those laboratories that meet the qualification requirements.

For analytical sample testing, the selected laboratory must meet, as a minimum, NEESA 20.2-047B requirements and shall have obtained NEESA or equivalent approval as detailed in the subject document. The selected laboratory will be required to submit their laboratory QAPjP to MK.

The following listing provides a general list of requirements that must be considered when procuring the services of an analytical laboratory.

(1) Laboratory shall provide the following items:

- sample jars (preserved as necessary)
- labels for sample jars
- coolers for shipping samples
- blue ice coolant for shipping samples
- packing material for jars/coolers
- deionized water for equipment rinse blank samples
- trip blank samples
- lab grade isopropanol or appropriate decontaminant (MK shall specify the quantity of decontamination fluid)

(2) Turn-around time for samples will begin upon receipt of samples by laboratory, as established by the chain-of-custody form.

(3) Laboratory shall provide a contact, alternate contact, and an after hours/weekend contact.

(4) Laboratory shall provide the name of the laboratory quality assurance (QA) manager.

(5) Laboratory shall submit a copy of their QA management plan and procedures to MK.

(6) Laboratory shall specify preservation requirements and quantity of sample material required to perform analyses to meet data quality objectives.

(7) Laboratory shall specify maximum daily capacity for each analytical method requested.

(8) Laboratory shall provide price quotes for various turn-around times (i.e. 48-hour and one week).

(9) Laboratory shall ensure capability to perform analyses in accordance with approved EPA methods and ability to meet detection limits required for the project.

(10) Laboratory shall perform analyses within method holding times. If holding times are exceeded, the laboratory shall incur the cost associated with re-sampling and analysis.

(11) Laboratory shall report preliminary analytical results by facsimile and final results by overnight mail.

(12) MK shall provide a contact and alternate contact to interface with the laboratory.

(13) MK will identify the sample matrix submitted for analysis (i.e. soil, water, unknown liquid, sludge).

(14) Additional samples and analyses may be required depending on conditions encountered in the field. MK shall advise laboratory upon discovery of conditions requiring additional samples and/or analyses.

(15) MK shall provide a brief description of the work task and samples collected using the sampling and analysis plan.

(16) MK shall specify the reporting format, level of detail, and presentation. Laboratory shall provide information in electronic format, hard copy, or both.

(17) MK shall reiterate the general requirements of NEESA 20.2-047B, *Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program*, in the RFP. The requirements may be presented as a bulleted list or paraphrased.

Geotechnical Testing Laboratories

Independent geotechnical testing laboratories shall be evaluated by MK in accordance with this plan to ensure that the laboratory is qualified to perform testing in support of SOUTHDIV ERAC program requirements.

Independent testing laboratories that are accredited shall comply with the following accreditation programs, as applicable:

- **National Institute of Standards and Technology (NIST)**
- **National Voluntary Laboratory Accreditation Program (NVLAP)**
- **American Association of State Highway and Transportation Officials (AASHTO) Program**
- **American Association for Laboratory Accreditation (AALA) Program**

A copy of the independent testing laboratory certificate of accreditation, the scope of accreditation, and the latest directory of the accrediting organization for accredited laboratories shall be furnished to MK for subsequent submittal to the Navy Contracting Officer. The scope of an independent laboratory's accreditation shall include the test methods required by contract and specification requirements.

Independent testing laboratories that are not accredited per the above, shall prepare certified statements, signed by an official of the testing laboratory, and shall be submitted to the Navy Contracting Officer for approval and attest that the proposed laboratory meets or conforms to the following requirements:

Sampling and testing shall be under the technical direction of a registered professional engineer (P.E.) with at least 5 years of experience in sampling and testing;

- Laboratories engaged in testing of concrete and concrete aggregates shall meet the requirements of ASTM C 1077, 1990;
- Laboratories engaged in testing of bituminous paving materials shall meet the requirements of ASTM D 3666, 1990 (Rev.A);
- Laboratories engaged in testing of soil and rock, as used in engineering design and construction,shall meet the requirements of ASTM D 3740, 1988; and
- Laboratories engaged in nondestructive testing (NDT) shall meet the requirements of ASTM E 543, 1989 (Rev.A).

Prior to utilization of any non-accredited testing laboratory, the Contracting Officer shall be notified by MK and afforded the opportunity to inspect the proposed testing laboratory's facilities and records. Records subject to inspection include equipment inventory, equipment calibration dates and procedures, library of test procedures, audit and inspection reports by agencies conducting laboratory evaluations and certifications, testing and management personnel qualifications, test report forms, and the laboratory's internal QC procedures.

MK and the Navy Contracting Officer have the right of access to testing laboratories performing work in support of the SOUTHDIV ERAC. This includes the right to check laboratory equipment in the laboratory and the laboratory technician's testing procedures,

techniques, and other items pertinent to testing, for the purpose of ensuring compliance to testing requirements established in the contract.

Test Results

Test results shall be signed by a testing laboratory representative authorized to sign certified test results. The laboratory shall furnish all test results to the MK Quality Control Manager. All test results shall contain the following, as a minimum:

- A reference to applicable contract requirements, tests, or analytical procedures used;
- Actual test results; and,
- A statement that the item tested or analyzed conforms or fails to conform to specified requirements. The cover sheet for each report shall be stamped in large red letters **"CONFORMS"** or **"DOES NOT CONFORM"** to the specification requirements, whichever is applicable.

10.0 INSPECTION/PROGRESS SCHEDULE

The inspections outlined in the Testing Plan and Log follow the definable features of work outlined in Section 0.1, Introduction, to this QC Plan. Each definable feature of work is subject to preparatory, initial, and follow-up inspections of the work activity. Therefore, the schedule of inspections to be performed will mirror the Recovery Well installation schedule for Delivery Order 0016, SOW 24.

11.0 REFERENCED PROCEDURES

To support the action required by the Quality Control Plan, the following standardized procedures are to be utilized:

- **QEP 8.1** Conduct and Control of Inspections
- **QEP 13.1** Identification and Control of Deviations

QEP 8.1 provides detailed instructions for the Three Phases of Control, including Preparatory, Initial and Follow-up Inspections. Additionally, Final Inspection requirements are described.

QEP 13.1 provides detailed instructions for the methodology involved in identifying, dispositioning, controlling, and resolving deviations from established quality requirements. Use of the Rework Items List is described, as well as the processing requirements for formal Nonconformance Reports.

WASTE MANAGEMENT PLAN

NAS CORPUS CHRISTI FREE PRODUCT REMOVAL PROJECT
CORPUS CHRISTI, TEXAS

CONTRACT #N62467-93-D-1106
DELIVERY ORDER #0016
STATEMENT OF WORK #24

REVISION 0
DECEMBER 6, 1995

Prepared For:

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1.0
INTRODUCTION

This plan describes methods to manage and dispose the various waste streams generated during the life of this project as executed at Naval Air Station (NAS) Corpus Christi, Corpus Christi Texas. All waste shall be collected and stored on-site in appropriate containers or piles, characterized, and disposed of according to federal, state and local regulations described in the ensuing sections.

Morrison Knudsen is responsible for:

- ensuring that all waste streams are managed in accordance with the procedures in this plan,
- providing field oversight and ensuring subcontractor compliance with the procedures in this plan,
- ensuring that appropriate waste containers and secondary containment are provided,
- preparing for NAS Corpus Christi signature all required paperwork and documentation, including manifests, for all wastes generated during interim removal activities within the designated notification time,
- ensuring all waste containers are properly managed in accordance with state and federal laws and regulations,
- maintaining waste records for the field effort.

1.1 BACKGROUND

NAS Corpus Christi - Is located adjacent to Corpus Christi Bay. A survey of the site using soil borings and monitoring well indicate that a plume of free product exists below Fuel Farm 216. The product probably came from underground storage tanks used to fuel land and sea planes. The following material may be in the plume;

- ***Aviation gasoline***
- ***Diesel fuel***

The scope of work includes:

- Perform Hydro-punches of the site to determine if additional recovery wells are needed,

- Overdrill three existing monitoring wells and transform them into recovery wells,
- Install two new recovery wells, if necessary,
- Install oil/water separator and auxiliary equipment,
- Sampling and laboratory analyses, transportation and disposal of excavated soils, and
- Backfilling and restoration of the excavated area.

2.0
DEFINITIONS/ACRONYMS

2.1 DEFINITIONS

Generator: Any person, by site, whose act or process produces hazardous waste identified or listed in 40 CFR part 261 or whose act first causes a hazardous waste to become subject to regulation.

Disposal Coordinator: The individual who performs one or more of the following functions for a waste generator:

a) Arranges for transportation of the waste;
b) Collects and/or consolidates shipments of waste; and/or,
c) Manages waste in some manner.

This definition shall not apply to a carrier whose sole function is to transport waste.

Hazmat Employee: A person who in the course of employment directly affects hazardous materials transportation safety, including one who:

a) Loads, unloads, or handles hazardous materials:
b) Tests, reconditions, repairs, modifies, marks, or otherwise represents containers, drums, or packagings as qualified for use in the transportation of hazardous materials;
c) Prepares hazardous materials for transportation;
d) Is responsible for safety of transporting hazardous materials;
e) Operates a vehicle used to transport hazardous materials;
f) Prepares transportation documents;
g) Offers materials for transport; or is
h) Specifically trained as a Hazmat Employee per 49 CFR 172.700.

Solid Waste: Any discarded material defined as such by the Texas Regulations which adopts federal regulation 40 CFR 260.

Non-hazardous Waste: Any solid waste which is not defined as hazardous waste or otherwise regulated.

Hazardous Waste: Any refuse, sludge, or other waste material or combinations of refuse, sludge or other waste materials in solid, semisolid, liquid, or contained gaseous form which because of its quantity, concentration, or chemical, physical, or infectious characteristics may (a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed. Categories

of hazardous waste material include, but are not limited to: explosives, flammable, oxidizers, poisons, irritants, and corrosives. Hazardous waste does not include source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended. For details, refer to Texas Administrative Code (TAC), Title 30, Environmental Quality, Chapter 335 Industrial Solid Waste and Municipal Hazardous Waste Section 504.

Class 1 Waste: A non-hazardous industrial solid waste is a Class 1 waste if;

1) it contains specific constituents which equal or exceed the levels in 335.521(a)(1). A non-hazardous waste is a Class 1 waste if, using the test methods described in 40 CFR 261 Appendix II, the extract from a representative sample of the waste contains any of the contaminants listed in 335.521(a)(1) equal to or greater than the Maximum Concentrations given in that table where matrix interferences of the waste cause the Practical Quantitation Limit (PQL) of the specific analysis to be greater than the Maximum Concentration listed in 335.521(a)(1), then the achievable PQL becomes the Maximum Concentration, provided that the generator maintain documentation which would demonstrate that lower levels of quantitation of a sample are not possible,
2) it is Class 1 if it is ignitable at a flash point less than 65.6 degrees Celsius,
3) it is Class 1 if it is corrosive,
4) it contains amenable cyanide equal to or greater than 20 mg/l,
5) there is absence of analytical data and/or documented process knowledge which proves a waste is Class 2 or 3,
6) it is identified as a Class I waste in 335.505, and
7) it is not a hazardous waste per 335.504.

Class 2 Waste: An industrial solid waste is Class 2 if;

1) it is not a hazardous waste per 335.504,
2) It is not a Class 1 waste,
3) it is not a Class 3 waste or the generator chooses not to classify the waste as Class 3 waste, and
4) any waste classified as Class 2 per 335.506.

Class 3 Waste: As industrial solid waste is a Class 3 waste if;

1) it is inert and essentially insoluble, and poses no threat to human health and/or the environment. Class 3 wastes include, but not limited to, materials such as rock, brick, glass, dirt, and certain plastics and rubber, which are not readily decomposable,
2) it is not a hazardous waste per 335.504,
3) it is not a Class 1 waste, and
4) it is inert.

TSD Facility: A Treatment, Storage, or Disposal Facility as defined by the USEPA for hazardous waste in 40 CFR 260.10 and 270.2.

Toxic Substance Control Act (TSCA) Waste: Any waste which is not RCRA listed or is not a characteristic hazardous waste but is a regulated substance as listed in 40 CFR 700

et seq.

Resource Conservation Recovery Act (RCRA) Waste: For the purposes of this procedure, RCRA wastes are material that may be solid, liquid, semisolid, and gaseous that are classified as a hazardous waste per 40 CFR 261.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): For the purposes of this procedure, CERCLA wastes or "hazardous substances" are defined by reference to substances that are listed or designated under other environmental statutes including:

RCRA;	hazardous wastes and characteristic hazardous wastes,
CWA;	hazardous substance,
CAA;	hazardous air pollutants,
CERCLA;	...substances which may present substantial danger to the public health or welfare or the environment,...
TSCA;	hazardous chemical substances or mixtures.

2.2 ACRONYMS

NAS	Naval Air Station
RCRA	Resource Conservation Recovery Act
CWA	Clean Water Act
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
TSCA	Toxic Substance Control Act
LDR	Land Disposal Restrictions
PCBs	Polychlorinated Biphenyls
USDOT	United States Department of Transportation
TNRCC	Texas Natural Resources Conservation Commission
TAC	Texas Administrative Code
UST	Underground Storage Tank

3.0
RESPONSIBILITIES AND TRAINING REQUIREMENTS

3.1 PERSONNEL RESPONSIBILITIES

Disposal Coordinator: The disposal coordinator is responsible for arranging and coordinating the safe and proper completion of the tasks required for disposal of a hazardous waste. These tasks include but are not limited to:

- insuring proper handling, packaging, and labeling of hazardous wastes,
- coordinating all hazardous waste documentation including Texas waste number, including all shipping papers and manifests to include approval signature, chain-of-custody, LDR forms and variances, sample and waste inventory tracking, etc..

Project Manager: The project managers responsibilities includes; coordination of the project resources to assure compliance with the appropriate plans, procedures, and regulatory requirements for hazardous waste handling, packaging, labeling, etc..

3.2 TRAINING REQUIREMENTS

Disposal Coordinator: The disposal coordinator performing the shipment shall be trained as described in the Site Safety and Health Plan and as a minimum in accordance with the following criteria:

- 49 CFR 172.700 (Subpart H) - Hazmat Employee Training

- 29 CFR 1910.120 - OSHA 40 Hour Health and Safety Training

Field Personnel: All personnel performing any activity which may cause exposure to hazardous materials shall be trained as described in the Site Safety and Health Plan and as a minimum in accordance with the following criteria:

- 29 CFR 1910.120 - OSHA 40 Hour Health and Safety Training

4.0
WASTE STREAMS

Waste streams expected to be generated during the life of the project include:

- soil,
- produced ground water,
- general debris,
- decontamination water,
- disposable personnel protective equipment and clothing, and
- inert wastes (wood, HDPE, etc.).

Solid Waste

Work will be performed in such a way as to minimize the amount of solid waste generated by activities performed. Solid waste will be characterized as hazardous or non-hazardous as described in Section 5.0 and the Texas Administrative Code.

Hazardous Waste

Every effort shall be made to eliminate and minimize the generation of hazardous waste. This goal will be achieved by implementing remediation techniques, technologies, and approaches that yield the least amount, and the lowest concentration of hazardous waste. All potentially hazardous waste will be identified and classified per the requirements of RCRA, codified at 40 CFR 261 and 30 TAC 335.504. Hazardous waste shall be characterized and managed as described in Sections 5.0 and 6.0 of this Plan.

4.1 EXCAVATED SOIL

Potentially contaminated soil will be encountered during excavation and well drilling activities described in the Remedial Action Plan (RAC). Excavated soils will be stockpiled on 6 mil polyethylene to prevent leaching of any potential contaminants once drill of a specific well is complete cuttings will be placed in 55-gallon drums. Characterization of soils will occur according to the procedures found in the RAP. The soil from the trench excavation will be sampled and used as backfill if not contaminated.

4.2 PRODUCED GROUND WATER

Ground water encountered during excavation of soil may be pumped from the excavation. Potentially contaminated produced ground water will be collected, sampled, and

analyzed. If found contaminated, the ground water will be transported to an on-site treatment facility for further processing.

4.3 DEBRIS

Preliminary screening of debris shall be performed throughout the excavation or remediation area. Preliminary screening shall consist of; visual inspection of the entire area, bulk construction debris and other debris; screening sampling if necessary; and sorting of debris. These items will then be removed and placed in a storage area.

The debris encountered during the remediation activities shall be collected, sorted, triple rinsed and dispositioned as non-hazardous waste and disposed of accordingly. All non-hazardous bulk construction debris dispositioned for off-site disposal in a Subtitle D landfill.

4.4 DECONTAMINATION WATER

Decontamination water is generated during steam cleaning or high pressure wash of debris, excavation equipment and during manual decontamination of sampling equipment. All water used in decontamination is collected in 55-gallon drums or portable storage tanks.

Since the decontamination water is expected to contain low concentrations of the contaminants potentially found at the site, it will be collected and treated on-site.

4.5 DISPOSABLE PERSONAL PROTECTIVE EQUIPMENT

Waste personal protective equipment (PPE) includes disposable Tyvek suits, gloves, boots, and visquene. The quantity of PPE generated depends upon the schedule and number of times PPE is discarded daily. Contaminated PPE will be placed in a plastic lined 55-gallon drum immediately after use. Drums will be transported to a municipal landfill for ultimate disposal.

4.6 SPILL PREVENTION AND CONTROL

If a spill or release of hazardous materials occurs in the work area, the Contracting Officer's representative will be notified. MK will meet with the Navy and NAS Corpus Christi prior to starting work and will discuss the facility's procedures for handling spills. MK will follow the base's instruction for mitigating spills and packaging and disposing of clean-up materials. If a spill occurs, the Site Fire Department will be notified and MK will assist in initial spill containment. The Site Spill Response Team handles all command and control and initiates clean-up activities. The Site Safety and Health Plan, contains a list of safety and spill control equipment available on site in the event of an emergency.

5.0
IDENTIFICATION AND LISTING OF HAZARDOUS WASTE

Use the flowcharts in Figures E-1 and E-2 to determine if a waste is hazardous and what codes apply. This approach methodically evaluates the type of waste and if a waste code or group of codes may apply to a waste. It is mandatory that the reader continue through the entire flowchart from beginning to end. Skipping around may cause an incorrect identification of a waste stream.

Samples will be taken and analyzed to determine if the waste will be classified as RCRA hazardous waste or Class 1 non-hazardous waste. If the waste is determined to be RCRA hazardous waste it will be sent to an off-site disposal facility or if available disposed of through the on-site DRMO activity. If the waste is determined to be Class 1 non-hazardous waste it will be disposed of off-site in an approved landfill.

6.0
HAZARDOUS WASTE

6.1 PREPARATION

The following prerequisites must be met prior to any individual shipping or assisting in the shipment of Hazardous Materials by any conveyance on the public highway, by vessel or rail, or by air.

6.1.2 The individual performing the shipment shall ensure that the following administrative requirements have been met prior to shipment of materials:

- The material must be identified by the most appropriate Proper Shipping Name in accordance with the Hazardous Materials Tables of 49 CFR 172.

- If the material is a Hazardous or Mixed Waste, the material must be identified by the most appropriate USEPA Waste Code in accordance with 40 CFR 261.

- The generator, transporter, and disposer of Hazardous Waste shall have valid EPA Identification Numbers and all EPA Permits (Generator Permits, Transporter Permits, TSD Permits, etc.), as appropriate. The generator shall also provide evidence that the waste stream(s) being shipped is acceptable at the receiving facility in accordance with all permit requirements.

- The Generator of Hazardous Waste (or his representative) shall have completed all notifications and certifications for the waste material subject to the Land Disposal Restrictions (LDR) in accordance with 40 CFR 268 and the latest rules, specifically Final Rule Land Disposal Restrictions Phase II-Universal Treatment Standards and Treatment Standards for Organic Toxicity Characteristic Wastes and newly Listed Wastes effective December 19, 1994. The following certification forms shall be prepared for Navy signature as applicable:

  > Notification From Generator to Treatment Facility That Wastes Do Not Meet Treatment Standards
  > Generator Notification and Certification To TSD Facility for Wastes Meeting The Treatment Standards
  > Generator Notification and Certification To TSD Facility for Restricted Wastes with Variances, Extensions, or Exemptions
  > Treatment Facility Notification To TSD Facility That Treated Waste Meets Treatment Standards.

- Hazardous Materials not shipped as waste shall be shipped in such a manner as to conform to all federal, state and local ordinances. The generator offering the material for transport shall make available the Material Safety Data Sheets.

- Prior to shipment of waste to a hazardous or waste disposal facility, the receiving facility must be approved by MK and the Navy.

- The Disposal Coordinator shall complete the Manifest Signee Certification Checklist, provided in Attachment A, for each shipment of hazardous materials.

- The Disposal Coordinator shall obtain Manifest Numbers, Manifest and shipping documentation, and signatures from the Navy (the waste owner) for all hazardous waste shipments.

6.2 STORAGE AND CONTROL OF HAZARDOUS WASTE

6.2.1 Containers

If a container holding hazardous waste is not in good condition per 49 CFR 173.24, or if it begins to leak, MK (or its representative) shall transfer the hazardous waste from the leaking container to a container that is in good condition or manage the waste in some other way.

The generator must use a container made of or lined with material which will not react with, and are otherwise compatible with, the hazardous waste to be stored, so that the ability of the container to contain the waste is not impaired.

The container holding hazardous waste must always be closed during storage, except when it is necessary to add or remove waste. A container holding hazardous waste must not be opened, handled, or stored in a manner which may rupture the container or cause it to leak. The container holding hazardous waste must always display the proper marking and labeling per 49 CFR 172.

Incompatible wastes, or incompatible wastes and materials, must not be placed in the same container, unless the requirements of 40 CFR 265.17(b) are complied with.

Hazardous waste must not be placed in an unwashed container that previously held an incompatible waste or material unless the requirements of 40 CFR 265.17(b) are complied with.

6.2.2 Inspections

The waste generator is required to inspect the waste stored at the hazardous waste

storage area on project sites on a weekly basis to the requirements of a RCRA temporary accumulation area (per 40 CFR 265.174). All accumulation, transfer, and storage areas will be identified in the site specific Work Zone Maps and designed and constructed in accordance with the requirements of 40 CFR 265. The wastes generated by MK on behalf of the US Navy are limited to a 90 day RCRA storage time for a temporary accumulation area (per 40 CFR 262.34).

6.2.3 Storage Area

Containers storing ignitable or reactive waste must be located at least 50 feet from the facility's property line.

A storage container holding a hazardous waste that is incompatible with any waste or other materials stored nearby in other containers, piles, open tanks, or surface impoundments must be separated from the other materials or protected from them by means of a dike, berm, wall, or other device.

All waste containers will be assigned an inventory number from the waste tracking log. Each container will be inventoried on a monthly basis. Waste will be stored on site for no more than 90 days.

6.3 TOOLS, MATERIALS, AND EQUIPMENT

Unless provided by the US Navy, the Hazardous Waste Disposal Coordinator will be required to provide all tools, administrative forms, survey instruments, labels, markings, and placards for each shipment of materials. Special care must be taken by the Disposal coordinator to ensure that an adequate supply of such materials is maintained. A Field Kit Materials List is provided as Appendix B of this procedure.

7.0
DETAILED INSTRUCTIONS

7.1 PROCEDURE FOR MATERIAL PREPARATION

All hazardous materials or waste shipped by MK or it's subcontractors shall be in strict adherence to the requirements of 49 CFR, Texas Regulations for hazardous waste management, and all other applicable federal, state, and local regulations.

7.1.1 Materials shall be packaged and the packaging inspected in accordance with the requirements of 49 CFR 173 for the Proper Shipping Name and USDOT Subtype of the material being offered for transport.

7.1.2 All packages offered for transport shall be properly marked and labeled in accordance with the requirements of 49 CFR 172 prior to shipment. Any old, worn, torn, or otherwise illegible labels and/or marks shall be replaced as soon as practical after they are discovered. Labels shall not be modified or corrected once they are affixed to drums.

7.1.3 Shipping Papers will be prepared for shipments as follows:

- All hazardous materials (unless otherwise excepted) shall have USDOT hazardous materials shipping papers prepared in accordance with 49 CFR 172.200 - 172.205.

- All hazardous waste shall, in addition to USDOT hazardous materials shipping papers, shall have a Uniform Hazardous Waste Manifest selected and prepared in accordance with 49 CFR 262.20 or the appropriate state specific hazardous waste manifest form.

- Additional forms shall be prepared as may be required by Federal, State, and Local ordinance, and by receiving site license or acceptance criteria.

7.2 PROCEDURE FOR MATERIAL LOADING

With the exception of common carrier shipments of hazardous materials, the following procedure shall be followed when loading material for transportation:

NOTE: Notify the NAS Corpus Christi Personnel for inspection and manifest signature prior to loading transport vehicle.

7.2.1 Conduct and document a visual inspection of the conveyance and ensure any discrepancies are repaired prior to loading.

7.2.2 If the vehicle floor shows evidence of moisture, the floor shall be wiped as dry as possible and the condition of the floor and action taken noted on the shipping

papers. The consignee shall also be notified prior to shipment.

7.2.3 The Disposal Coordinator and the NAS Corpus Christi representative shall inspect all packages as they are loaded to ensure that the packages are in full compliance with all the requirements set forth in this procedure. Incompatible materials shall be segregated as required by 49 CFR.

NOTE: SPECIAL CARE SHALL BE TAKEN TO ENSURE THAT ALL STRONG TIGHT CONTAINERS USED FOR TRANSPORT ARE COMPLETELY SEALED TO THE MAXIMUM EXTENT PRACTICAL. THIS INCLUDES THE USE OF SEALANT ON SEAMS OF METAL BOXES. SPECIAL CARE SHALL ALSO BE TAKEN TO ENSURE THAT ALL SPECIFICATION PACKAGES ARE PROPERLY PREPARED FOR TRANSPORT AND IN PRISTINE CONDITION PRIOR TO TRANSPORT. CONTACT THE DISPOSAL COORDINATOR OR THE PROJECT MANAGER FOR ALL QUESTIONABLE PACKAGES.

7.2.4 Upon completion of loading, visually verify that all packages are loaded.

7.2.5 Verify the proper use of blocking, bracing, dunnage, and tie-down, as appropriate.

7.2.6 Verify the conveyance is properly placarded, as applicable.

7.2.7 Seal the vehicle/conveyance if required.

7.2.8 Obtain NAS Corpus Christi authorized representative signature on the waste shipping manifest.

7.3 POST LOADING REQUIREMENTS

7.3.1 Have the driver (or transporter's representative) and shipper (or shipper's agent) sign all required forms.

7.3.2 Review all paperwork to ensure legibility.

7.3.3 Copy and Distribute all paperwork. Uniform Hazardous Waste Manifests (Form 8700-22 and 87-22A if necessary) shall be distributed in accordance with 40 CFR 262 and the Texas Administrative Code as indicated in the Distribution Checklist provided in Appendix A.

7.3.4 Verify that the driver (transporter's representative) understands all special instructions such as the maintenance of exclusive use and prior notification requirements. The shipment may now be released for transport.

7.3.5 Notify the Project Manager of a shipment in progress.

8.0
RECORDS

8.1 DISPOSAL COORDINATOR

The Disposal coordinator shall retain copies of records, forms, and shipping papers generated as a result of this procedure until written acknowledgement is received from the consignee for all waste shipments or telephone acknowledge is received for all non-waste shipments.

8.2 PROJECT RECORDS

All shipping papers shall be retained as part of a permanent project file for each project.

8.3 GENERATOR

The generator of waste shall be provided with a copy of all shipping papers.

9.0
REFERENCES

1. **Draft Contamination Assessment Report** EnSafe/Allen & Hoshall, June 9,1995

2. **Title 49**, Code of Federal Regulations, Transportation *et seq.*

3. **Title 40**, Code of Federal Regulations, Protection of Environment, *et seq.*

4. **Texas Administrative Code**, effective January 1, 1995.

Source Removal Activities Flow Diagram

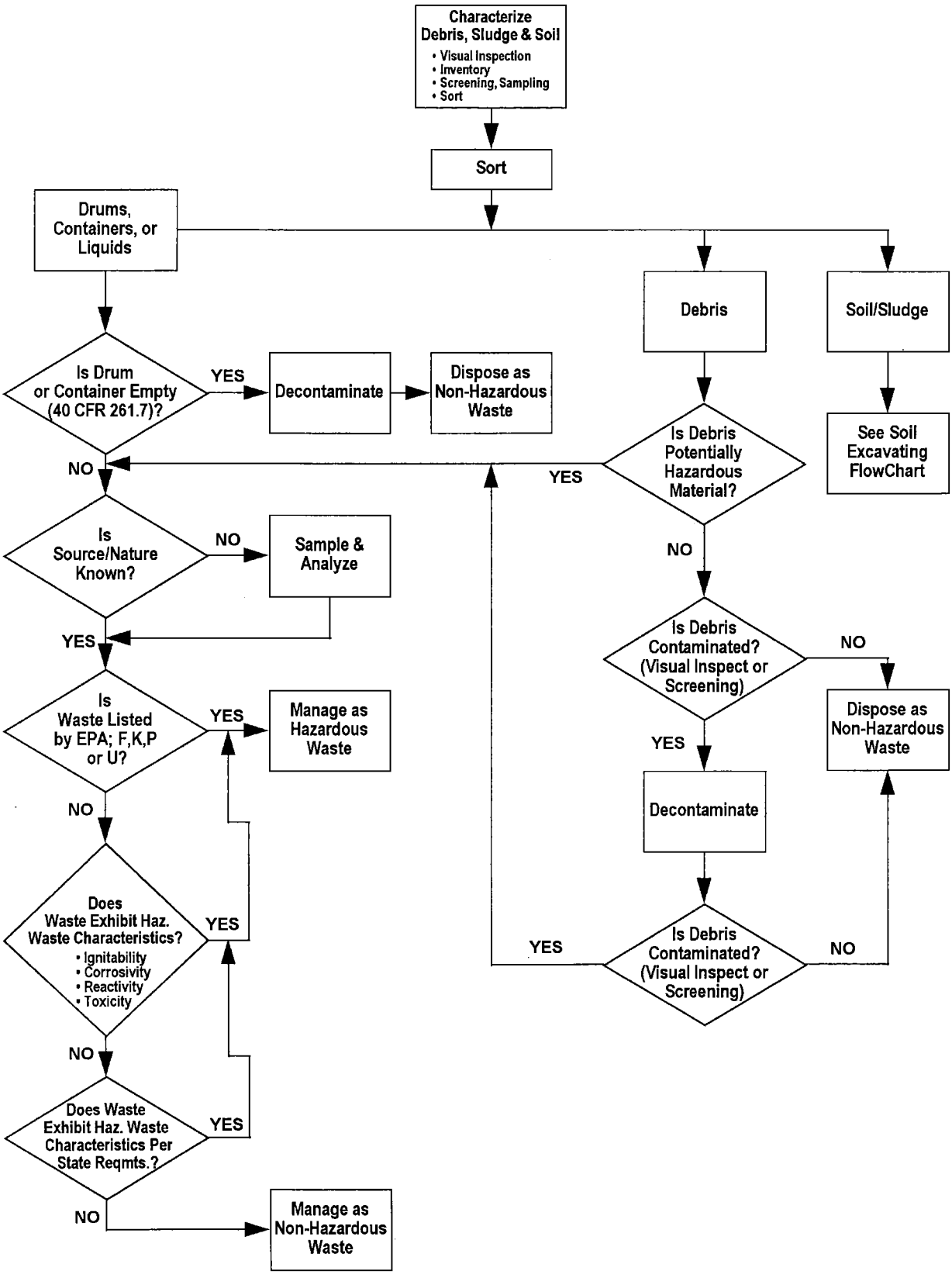

FIGURE E-1
SOURCE REMOVAL ACTIVITIES FLOW DIAGRAM

Soil Excavating Flow Diagram

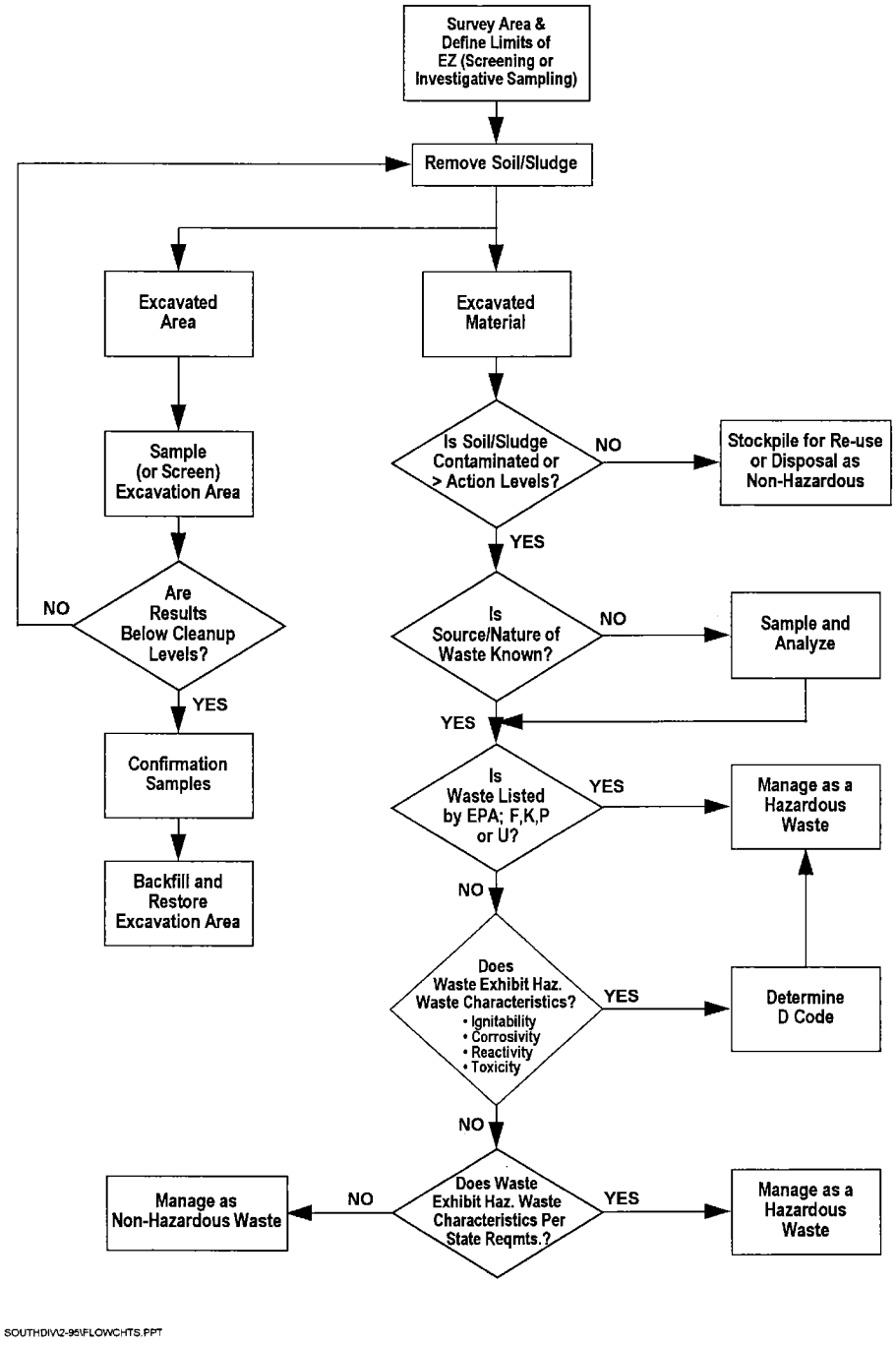

FIGURE E-2
SOIL EXCAVATING FLOW DIAGRAM

ATTACHMENT A
WASTE MANAGEMENT CHECKLISTS

COPY DISTRIBUTION CHECKLIST
HAZARDOUS WASTE

	Disposal Site	Shipper	Carrier	Van Copy*	Pro. Mgr.	Disp. Coord.	Mail *
UHWM**	orig	orig	orig	copy	copy	copy	N/A
Land Ban (LDR) Certification	orig	copy	copy	copy	copy	copy	N/A
Bill of Lading	copy	copy	orig	copy	copy	copy	N/A
Driver Instruction*	copy	copy	orig	copy	copy	copy	N/A
Inventory Sheet	N/A	copy	N/A	copy	copy	orig	N/A
Admin. Info	N/A	N/A	N/A	N/A	copy	orig	N/A
Coordinator Checklist	N/A	N/A	N/A	N/A	copy	orig	N/A
Emergency Action	copy	copy	orig	copy	copy	copy	N/A

* IF APPLICABLE

** ADDITIONAL DISTRIBUTION AS REQUIRED BY STATE (FOLLOW FORM INSTRUCTIONS)

ORIG - 1st Original
2 ORIG - 2nd Original
3 ORIG - 3rd Original
4 ORIG - 4th Original Procedure

NOTE: Items 1 thru 16 and Items A thru K correspond to Uniform Hazardous Waste Manifest Blocks with the same designations. Items A thru K are optional on Federal and some State Forms.

RESPONSIBILITY/INITIALS

Before Pickup:

1.	YES	NO	Is the Federal Uniform Hazardous Waste Manifest being used? (Or the State form if the State has one)(More than one manifest may be required if the waste is transported thru other States(s) having their own manifest).
	YES	NO	Has the generator's ID Number been identified?
	YES	NO	Has a Manifest Number been established by the generator?
2.	YES	NO	Is each page of the Manifest numbered?
3.	YES	NO	Has the name and address of the generator been used? (This should be the location which will manage the returned Manifest forms).
4.	YES	NO	Has the phone number of the generator been used? (This should again be the location which will manage the returned Manifest forms).
5.	YES	NO	Is the transporter's name on the Manifest?
6.	YES	NO	Is the transporter's EPA Id Number on the Manifest?
7.	YES	NO	If a second or alternate transporter has been arranged for, is this second/alternate transporter's name on the Manifest?
8.	YES	NO	Is the second or alternate transporter's EPA ID Number on the Manifest?
9.	YES	NO	Is the treatment/storage /disposal facility's (TSDF) name and address on the Manifest?
10.	YES	NO	Is the TSDF's EPA Id Number on the Manifest?
A.	YES	NO	Is the State Manifest Document Number preprinted on the Manifest?
B.	YES	NO	Is the generator's State ID Number on the Manifest?
C.	YES	NO	Is the Transporter's State ID Number on the Manifest?
D.	YES	NO	Is the transporter's phone number on the Manifest?
E.	YES	NO	If a second or alternate transporter has been arranged for, is this second/alternate transporter's State ID Number on the Manifest?
F.	YES	NO	Is the second/alternate transporter's phone number on the Manifest?
G.	YES	NO	Is the TSDF's State ID Number on the Manifest?
H.	YES	NO	Is the TSDF's phone number on the Manifest?
11.	YES	NO	Does the Manifest include for each waste stream the Department of Transportation (DOT) proper Shipping Name, Hazard Class, ID Number, Packaging Group, and EPA Waste Codes? Does it also include "RQ" for wastes having CERCLA Reportable Quantities (RQ's)?

RESPONSIBILITY/INITIALS

Before Pickup:

2.	YES	NO	Does the manifest include the number and type of container for each waste stream? (Abbreviations for container type are listed on the Manifest Instructions).
13.	YES	NO	For each waste stream, does the Manifest include a numerical quantity for that waste?
14.	YES	NO	For each waste stream, does the Manifest include the units associated with the quantity given above? (Abbreviations for units are listed on the Manifest Instructions).
I.	YES	NO	If that State issues one, does the Manifest include a State Waste Code Number for each waste stream?
J.	YES	NO	Are any additional descriptions for the waste streams included on the Manifest as necessary?
K.	YES	NO	Are handling codes for the waste streams included on the Manifest as necessary?
15.	YES	NO	Are special handling instructions and additional information (If Any) included on the Manifest?
16.	YES	NO	Has the generator's signee printed, signed and dated the generator's Certification Statement essentially attesting to the full and accurate manifest form completion, regulatory compliant preparation of waste for transport and to having a programming place to reduce the volume and toxicity of waste generated to the degree economically practicable, and to selecting the practicable method of the treatment storage or disposal which minimizes threat to human health and the environment.
17.	YES	NO	Has the hazmat employee (The manifest signee would qualify as such here) completed original and refresher DOT oriented courses required by DOT regulations? (OSHA 1910.120 training would suffice).
18.	YES	NO	Has the compliance status of the transporter and the TSDF been verified?
19.	YES	NO	Is there adequate 40 CFR 262.11 documentation of the waste's hazardous characteristics/listings (with hazardous constituent concentrations)?
20.	YES	NO	Have the appropriate Land Disposal Restriction (LDR) Notification/Certification forms been prepared and included with the Manifest? Does the form agree with the waste stream documentation?
21.	YES	NO	Have wastes been packaged in accordance with Department of Transportation (DOT) requirements; placed in containers compatible with the waste and dated/identified/labeled RCRA?
22.	YES	NO	Are there hazardous Waste Profile Sheets for each of the wastes (IF required by the TSDF) in the format specified by the TSDF?
23.	YES	NO	Is all back-up information available for review? (Work Plans, Test Results, RCRA regs, DOT Regs, etc.)

RESPONSIBILITY/INITIALS

Before Pickup:

24.	YES	NO	Is the generator's signee aware of what parties are involved with signing the Manifest and keeping copies?
25.	YES	NO	Is the TSDF permitted to accept your specific type waste(s)?
26.	YES	NO	Are emergency contacts and procedures in place to deal with an emergency in the event of one?
27.	YES	NO	Has the waste been staged at the agreed pick-up location?
28.	YES	NO	Does the generator's signee have on hand a letter which authorizes signature on the Manifest as the generator?

During Pick-Up:

29.	YES	NO	Is transport truck placarded per DOT requirements?
30.	YES	NO	Are Manifest signatures legible on all copies of the Manifest?
31.	YES	NO	Is the appropriate copy of the Manifest retained prior to letting the transporter leave the site?
32.	YES	NO	Is the generator's signee on-site (waste location) when signing the Manifest?
33.	YES	NO	Did the transporter sign the Manifest at the time of pick-up?

After Pick-UP:

34.	YES	NO	Is the generator's signee aware of the procedure for return of the Manifest copy to the generator? (Generator to start tracking if not returned in 35 days, exception reporting by day 45, etc.)

RCRA Compliance Issues:

35.	YES	NO	Is the generator status known? (Federal status could be large quantity [HW > 1,000 KG/Month], small quantity [100 KG/month < QTY < 1,000/month], or conditionally exempt small quantity [QTY < 100 KG/Month]; State definition may be different entirely)
36.	YES	NO	Is the date of hazardous waste generation noted on the waste container/tank unless the waste is at a 55 gallon or less satellite accumulation area?
37.	YES	NO	Is the waste being managed in accordance with applicable regulations while on site? (RCRA regulations will be applicable in many cases).
38.	YES	NO	Are 40 CFR 265.16 training records (going back 3 years) available for personnel managing hazardous wastes at 90-Day Accumulation and Permitted Hazardous Waste Storage areas?

RESPONSIBILITY/INITIALS

Before Pickup:

39.	YES	NO	Are recordkeeping requirements being satisfied? (Training, Manifest # tally, outstanding and returned manifests, LDR forms, Exception Reports. Disposal Certificates, HW generated Annual Reports). Is signee aware of the process by which each will be created and executed as well as the location of the records?

ATTACHMENT B
DISPOSAL COORDINATOR FIELD KIT MATERIAL LIST

DISPOSAL COORDINATOR FIELD KIT MATERIAL LIST

I. REFERENCES

1) 49 CFR, PARTS 100-177;

2) TEXAS HAZARDOUS WASTE MANAGEMENT REGULATIONS;

3) 40 CFR, PARTS 260-299;

4) ALL APPLICABLE PROJECT SPECIFIC RULES, REGULATIONS, AND LICENSES (STATE HAZARDOUS MATERIAL REGULATIONS, ETC.);

II. PAPERWORK

1) BLANK BILLS OF LADING;

2) BLANK US EPA UNIFORM HAZARDOUS WASTE MANIFESTS AND STATE MANIFESTS AS APPLICABLE;

3) ALL PROJECT SPECIFIC PAPERWORK (STATE OF TEXAS HAZARDOUS WASTE MANIFESTS, WASTE CERTIFICATION FORMS, PRIOR NOTIFICATION FORMS, ETC.).

III. LABELS AND MARKINGS

1) WASTE CLASS AND STABILITY STICKERS;

2) ITEM NO. AND WEIGHT STICKERS;

3) HAZARDOUS MATERIALS LABELS;

4) "7A TYPE A" STICKERS;

5) HAZARDOUS WASTE CONTAINER LABELS;

6) PERMANENT MARKERS (2) AND PENS (2);

7) HAZARDOUS MATERIALS PLACARDS;

8) PROJECT SPECIFIC MARKINGS AND LABELS AS REQUIRED.

IV. TOOLS AND MATERIALS

1) 12" CRESCENT WRENCH (1);

2) 15/16" COMBINATION WRENCH (2);

3) HALF ROUND NEOPRENE GASKETS AND SILICONE GREASE (IF SHIPPING DRUMS);

4) OTHER TOOLS, MATERIALS, AND INSTRUMENTATION AS REQUIRED BY PROJECT.

CHEMICAL DATA ACQUISITION PLAN

NAS CORPUS CHRISTI FREE PRODUCT REMOVAL PROJECT
CORPUS CHRISTI, TEXAS

CONTRACT #N62467-93-D-1106
DELIVERY ORDER #0016
STATEMENT OF WORK #24

REVISION 0
DECEMBER 6, 1995

Prepared For:

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
2155 Eagle Drive
P.O. Box 190010
North Charleston, South Carolina 29419-9010

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PART I INTRODUCTION AND OBJECTIVES

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

1.1.1 Site Location

NAS Corpus Christi is located on the south side of Corpus Christi Bay, to the southeast of Corpus Christi, Texas (Figure 1). Fuel Farm 216 is located to the north of the air strip and is adjacent to the north gate and the NAS Corpus Christi wastewater treatment plan. The USTs comprising Fuel Farm 216 are shown on Figure 2.

A water-driven displacement system or "aqua drive system" was used to transfer petroleum products within the fuel farm. Water required for the "aqua drive system: was stored in a 200,000-gallon UST located in the northwest corner of the fuel farm. Two fuel loading areas and an assortment of pipelines were also present.

A concrete seawall was constructed along the northern edge of the fuel farm, separating it from Corpus Christi Bay. The seawall reportedly extends at least 15 feet below mean sea level. Expansion joints within the concrete have been caulked with a black rubberized material to prevent leakage. Dredgings from the bay side of the seawall were deposited on the land side resulting in a nearly level land surface approximately 10 to 15 feet above Corpus Christi Bay.

1.1.2 Project History

Site records document that product was lost to the subsurface during the 40-year operational life of Fuel Farm 216. No records indicate which of the 36 USTs leaked, which were subsequently repaired, or where specific product leaks occurred. Free petroleum product was discovered floating on groundwater during closure of the fuel farm in the early 1980's. The free-floating product consisted of 60% JP-4 and 40% high octane gasoline.

An investigation was performed by Geraghty and Miller, Inc. at Fuel Farm 216 including the installation of 15 monitoring wells. It was concluded in a 1983 report that approximately 77,000 gallons of free product could be present within the underlying sediments and that less than 20,000 gallons could be recovered.

The NAS Public Works Department constructed a recovery well consisting of perforated 55-gallon metal drums welded together and extending to a depth of 15 feet. Records show the well was successful in recovering free product and reducing the free product thickness. Additional recovery wells were constructed at a later date, presumably because product thickness in the NAS Public Works well reached a level which was too low for

efficient recovery. No records were available regarding the operational history of these new wells. Recovery also ceased from the new wells apparently due to low product thickness. Product has not been reported to occur in any of the recovery wells since 1994. Free product has been recovered from several monitoring wells by pumping or bailing since 1994.

EnSafe/Allen and Hoshall (E/A & H) conducted a site assessment at Fuel Farm 216 in 1995. The assessment included the drilling of 24 exploration boreholes, twelve of which were converted to monitoring wells. E/A & H also sampled 11 of the 15 monitoring wells constructed by Geraghty and Miller, Inc. Free product was present in some of the site wells during the 1995 assessment.

The U.S. Navy Southern Division and the Texas Natural Resources Conservation Commission (TNRCC) have agreed that recovery activities should be conducted at Fuel Farm 216 until product removal is no longer possible. MK-Environmental Services and E/A & H have evaluated site hydrogeologic conditions and decided that wells appear the most efficient method of recovering available free product.

1.1.3 Geology

The coastal plain of the Corpus Christi area is underlain by Pleistocene delta and shoreline sediments deposited during inter-glacial periods. The Beaumont Formation, which immediately underlies the Corpus Christi area, is typically 60 feet thick and consists of mostly fine-grained sand and shells formed in a beach and barrier island environment (E/A & H, 1995).

The fuel farm is constructed upon manmade fill material dredged from Corpus Christi Bay. The upper foot of the fill generally consists of sandy top soil. The underlying fill material is very fine, poorly graded, dry, loose sand to depths of 1 to 8 feet.

The natural sediments consist of a gray-green sand to silty clay which underlies the fill to a depth of 12 feet. A gray-green stiff to hard, caliche-rich clay is present at depths from 4 to 18 feet. A highly saturated silty clay is sometimes encountered between depths of 12 to 15 feet. Intermixed caliche, silt, and clay are encountered below depths of 18 feet. The individual deposits are discontinuous with uneven contact between units.

1.1.4 Hydrogeology

Groundwater occurs under unconfined (water table) conditions within the sediments of the Beaumont Formation. Wells greater than 200 feet in depth typically are screened in a confined water-bearing zone (E/A & H, 1995).

The general direction of groundwater flow in the Beaumont Formation beneath the site is northward toward Corpus Christi Bay. Shallow groundwater flows in a westerly direction beneath the northern half of the fuel farm apparently in response to the barrier formed by the sea wall (Geraghty and Miller, Inc. 1983 and E/A & H, 1995).

Groundwater occurs at a depth of 8 to 10 feet.

No wells providing a potable drinking water supply are located within a 0.5 mile radius of the fuel farm. Groundwater sampled from wells located in the immediate vicinity of the fuel farm contained total dissolved solids (TDS) concentrations in the range of 350 to 24,000 mg/L. Seven wells had TDS values less than 3,000 mg/L, and the concentration of TDS in two wells exceeded 10,000 mg/L (E/A & H, 1995).

Groundwater samples collected in 1995 showed detectable concentrations of BTEX and/or TPH in wells MW-03, MW-18 and MW-19. Naphthalene was detected in well MW-18, and 2-methylnaphthalene, n-nitrosodi-n-propylamine, and naphthalene were detected in well MW-19. Phenol was detected in wells MW-05, MW-16 and MW-18.

1.2 ORGANIZATION OF DOCUMENT

The Chemical Data Acquisition Plan is divided into three parts:

I. Introduction and Objectives
II. Sampling and Analysis Plan
III. Quality Assurance Requirements

Part II includes all procedures to be used in the field, including sampling, documentation, decontamination, maintenance and calibration of equipment. Part III includes a discussion of data quality objectives (DQOs), aspects of data validation and quality control in the laboratory.

2.0
OBJECTIVES

The overall objective of this sampling event is to complement work previous completed to characterize the extent of the free product plume and complete initial stages of remediation. Individual tasks to be completed during this event include:

- Measure water levels and, if present, product thicknesses in site wells.
- Collect geologic data, visual data and samples for offsite analysis from seventeen borings installed in the vicinity of existing wells, to help place any additional recovery wells needed to recover free product from the soils. (Geoprobe Investigation)
- Oversee monitoring well overdrilling, new well installation, development and testing
- Collect effluent water samples and composite samples of drill cuttings or debris for analysis by an offsite laboratory.
- Support health and safety requirements.

Data collection objectives are summarized in Table 1.

PART II. SAMPLING AND ANALYSIS PLAN

The objective of any sampling event is to collect a representative sample, from which data can be used to make management decisions regarding, at a minimum, extent of contamination, chemical nature of the contaminant, source area delineation, plume extent, and waste soil and water characterization. The procedures below and in Part III. are designed to collect and analyze soil samples for the purpose of strengthening the database for beginning a remedial action phase.

1.0
PREPARATION FOR SAMPLING

Prior to sample collection, the following tasks will be completed:

1. Review any information (such as previous waste analysis, drum inventories, etc.) to gain general knowledge of the potential materials to be encountered. This information may be provided in the Remedial Action Plan (RAP) and the Site Safety and Health Plan. A site visit may be necessary to complete tasks two through four below. Locate nearest Federal Express office for shipment of samples (in coolers).

2. Ensure that appropriate staging areas, decontamination pads and holding areas have been properly constructed. Sufficient room should be allowed for exclusion zones, contaminant reduction zones and support zones around drilling locations. Access to support vehicles, office trailers, etc. should not be affected by drilling activities. Preliminary locations for these areas are provided on Figure 2.

3. Mark preliminary locations for the Geoprobe Investigation. Provide locations to the Public Works Department, Base or City utility personnel to have utilities (gas, buried electric, stormwater lines, sewer mains, forced water main, phone, former fuel lines, etc.) cleared for the proposed locations. Check for overhead power lines in the areas chosen. Move locations as necessary to minimize or avoid encounter with underground and aboveground utilities.

4. Arrange use of power (i.e. if special lines need to be run) and water. Discuss with Public Works the most accessible source of potable water for drilling. Arrange invoicing for water and power use prior to drilling. Complete special drilling permits if required by the Base or the State of Texas.

5. Determine if clean, undamaged equipment is available from previous work at the site. Inventory this equipment and determine equipment needs. A general list is provided in Table 2. Purchase or rent equipment as necessary to fill equipment gaps. Equipment will include, at a minimum:

    a. Health and Safety equipment, not limited to, a combustible gas indicator (CGI) and organic vapor monitor (OVM). Sampling will be conducted in modified Level D (hardhat, safety glasses, Tyvek, steel-toed boots) protective clothing.

b. Decontamination supplies such as analyte-free water, alconox, nitric acid and isopropanol solutions, may be provided by the offsite analytical laboratory. Decontamination procedures are included in Section 7.0 of this document.

6. Set up site facilities (office trailer, decon or storage trailer, restrooms) unless otherwise available on base.

7. Obtain all necessary documentation materials, including field data logging forms for geoprobe and water level data, health and safety logbook, general field logbooks, sample labels and chain-of-custody forms.

8. Carefully review the Site Safety and Health Plan. All field personnel will attend a Health and Safety training meeting at the beginning of each task. Field personnel will be asked to document that training was completed, and that they will abide with the provisions stated in the Plan.

2.0
SUMMARY OF SAMPLING ACTIVITIES AND LOCATIONS

Sampling activities are summarized in Table 1 and include the following:

- Water level and product thickness will be measured at each existing site well (total of 28 wells). Measurements will be made to the nearest hundredth of a foot.

- The Geoprobe Investigation will include installation of 17 borings in areas previously uncharacterized for plume extent. The results of the Geoprobe will be used to help place any additional recovery wells needed to recover free product from the soils. Samples of water-bearing formation soils will be collected for sieve analysis to confirm well design.

- Three existing 2-inch diameter monitoring wells (MW-21, MW-20 and MW-26) will be removed and overdrilled to permit installation of 6-inch recovery wells (design details are provided in the RAP). The wells will be developed using combinations of surge block, bailing, jetting and pumping, if possible. Estimates of well production rates will be recorded as well.

- Composite and discrete waste disposal samples will be collected from soil and debris (cuttings) removed during well overdrilling and boring installation.

- Water collected from decontamination, development activities and removed from recovery wells will be passed through the oil/water separator and sampled. Results will be reviewed to determine if the water being sent to the WWTP meets pretreatment standards.

Sample locations are provided in Figure 3.

3.0
RESPONSIBILITIES OF CONTRACTORS

3.1 MORRISON KNUDSEN (MK) - PRIME CONTRACTOR

- Oversight of all investigation and remedial activities including collecting water level and product thickness measurements, soil sampling during the Geoprobe investigation, debris and containerized soil sampling, packaging and shipping of samples for offsite analysis, well installation, well development and well testing
- Project Controls and Contracting
- Site Safety and Health Management
- Program and Project Management

3.2 DRILLING SUBCONTRACTOR

- Construct decontamination pad (provide plastic and other materials)
- Provide steam cleaner and tank for decontamination of equipment
- Install temporary soil borings (approximately 17) using Geoprobe equipment
- Provide drums for cuttings (estimate 1 drum per soil boring and 2 per well overdrilling)
- Provide transportation of drums around the site (forklift) and to a final staging area
- Provide all materials and equipment (mud rotary) to overdrill three existing monitoring wells and install new 6-inch diameter recovery wells
- Develop new wells, using combinations of bailing, jetting, surge block and overpumping as directed by the Contractor.
- Disposal offsite of inert or solid waste (i.e. cardboard containers, empty bags, uncontaminated trash)

4.0
HEALTH AND SAFETY

4.1 HEALTH AND SAFETY ACTIVITIES PRIOR TO SAMPLING

Prior to work beginning and after driller mobilization, a 1-hour health and safety meeting will be conducted by the Site Safety and Health Officer(SSHO) participants including the entire drilling crew will be required to document (by signature) that each has completed the pre-site entry briefing. Daily or weekly safety meetings will be conducted, depending on the length of the sampling event, between the field geologist and the drilling crew.

Measurements that affect the quality of an activity or operation will be taken only with instruments, tools, gauges, or other measuring devices that are controlled, calibrated, adjusted and maintained at predetermined intervals to a specified accuracy. The calibration and maintenance of field equipment and instrumentation will be in accordance with manufacturer's specifications or applicable test specifications, and shall be documented in the Daily Activity or Site Safety and Health Logbooks, as applicable. The calibration program described in the Contractor Quality Control Plan will be followed for all instruments requiring calibration. Air monitoring equipment used for personnel exposure monitoring will be calibrated daily, or after long periods of non-use during the day.

4.2 SAFETY REQUIREMENTS

- A minimum of two persons shall be present during any sampling activity.
- A portable eye wash, sprayer or safety shower shall be available in the immediate vicinity during any sampling activity.
- All sample containers shall be placed into secondary containment (compatible with the sample material) equipped with a sealable lid (such as a cooler) immediately after a sample is taken and prior to any on-site transportation activities.

5.0
DATA COLLECTION AND SAMPLING PROCEDURES

Procedures for the sampling activities listed in Section 2.0 are summarized below in tabular format. Objectives, equipment, methods, analysis, documentation and QA/QC are covered in each table:

- Procedure 1: Water Level and Product Thickness Measurements
- Procedure 2: Geoprobe Investigation - Soil Boring Logging and Sample Collection
- Procedure 3: Monitoring Well Overdrilling, Installation, Development and Testing
- Procedure 4: Water Sampling - Decontamination Fluids, Oil/water Separator Effluent
- Procedure 5: Waste Sampling - Soils/Solids

Five field datasheets are referenced in the procedures. These are included in Attachment A. Attachment B contains the soil boring logging guidelines (ASTM D 2488 - 90). Attachment C contains information on sieve testing. Attachment D provides the guidelines for borehole abandonment in the State of Texas.

PROCEDURE 1: WATER LEVEL AND PRODUCT THICKNESS Measurements

Objectives:

1. Update the database for groundwater elevations and product thickness for wells at the site.

2. Provide baseline information for recovery system to be installed.

Equipment:

-fifty or 100-foot Solinst (or equivalent) electronic water level meter (on reel).
-fifty-foot oil/water interface probe (ORS 1068 or equivalent)
-decontamination supplies (distilled water, methanol rinse, analyte-free water rinse)

Method:

1. Clean both probes with distilled water, methanol rinse and final analyte-free water rinse.
2. Lower the oil/water probe slowly down the well until the probe encounters oil or water. If oil is encountered (steady tone), record the depth below the top of the PVC well casing on the field datasheet.
3. Continue to lower the probe until water is encountered (rapid beeping), and record the depth to the nearest 0.01 foot.
4. To confirm the depth to product, slowly withdraw the probe until the steady tone ceases.
5. If oil or product is not encountered, record the depth to water and confirm the measurement using the water level meter.
6. Repeat Step 1.
7. Repeat this procedure for geoprobe borings left open overnight. Note that following the measurements, the borings must be properly abandoned per TNRCC guidelines.

Analysis: N/A

Documentation: Field Datasheet A (water levels, product thickness)

QA/QC: No equipment calibration required.

PROCEDURE 2: GEOPROBE INVESTIGATION - SOIL BORING LOGGING AND SAMPLE COLLECTION

Objectives:

1. To define the extent of the free product plume in soil in the vicinity of the tank farms.
2. To characterize the grain size distribution of the water-bearing zone(s) at the site.

Equipment:

-Three two-foot split spoons and geoprobe equipment (to be provided by driller)
-Large and small stainless steel spoons and bowl
-Sample jars (see Table 4)
-Organic Vapor Monitor (OVM)
-Sieve Test Assembly
-Decontamination supplies
-Water level indicator
-Oil/water interface probe

Method:

Steps 1-4 apply to each two-foot interval per Geoprobe location. Locations will be labeled beginning with SB-14. Consult Table 3 for number and depth of samples for analysis before proceeding.

1. After sample is collected from a selected interval, remove the split spoon from the Geoprobe rod assembly.

2. Remove the drive shoe and the top assembly from the sampler. Open the tub by removing one-half of the split barrel.

3. Immediately screen the contents of the sampler with an OVM. Record measurement on the boring log (Field Datasheet B). Record the time of the measurement. Crack the soil open with a decontaminated spoon or putty knife, divide the soil column and screen with an OVM. Record the measurement.

4. Collect soil into an 8-ounce jar, if one or more of the following criteria are met:

   - OVM reading over 100 ppm
   - strong hydrocarbon odor
   - petroleum discolored soil (oily, black)
   - interval is just above water table

Remove all large roots, coarse gravel and cobbles from soil prior to placing in jar.

PROCEDURE 2: GEOPROBE INVESTIGATION - SOIL BORING LOGGING AND SAMPLE COLLECTION

Method: (continued)

5. Do not collect more than two sets of samples per hole, unless directed by the Project Manager. One should be collected from just above the water table. The other will be collected from a shallower interval exhibiting the highest potential for hydrocarbon presence (use criteria above).

6. Using procedures in Attachment B (soil borehole logging procedures), describe the color, grain size, moisture content and presence of odor in the soil. Note changes in lithology or color. Note if trash or debris is present in the soil. Record information on Field Datasheet B.

7. Once water is encountered, collect a representative soil sample for sieve analysis, from the water-bearing formation. Note Figure 3 for the locations where these samples will be collected. If recovery of water-bearing zone samples is difficult, collect more than one sample until approximately 500 grams are collected.

8. Clean the exterior of the sample containers and ensure that the containers are tightly sealed prior to applying the sample container label. Complete sample bottle labels as described in Section 9.2. Document in the field logbook the date, time and sample identification numbers in the sample logbook.

9. Conduct sieve analysis (per QCP guidelines and per procedures provided as Attachment C) to confirm well design. This analysis may be done at an outside laboratory, if warranted by the Project Manager. Sieve data will be sent to the well construction materials supplier for interpretation of filterpack gradation and screen slot size.

10. When sampling is completed, leave holes open overnight. Provide sufficient surface protection/covers. Measure depth to water and thickness of product, if present, the next day. Record data on the second page of Field Datasheet A.

11. Abandon the hole per TNRCC guidelines. (Attachment D)

Documentation: Field Datasheet B (soil boring log); Field Datasheet A; sample labels (see Section 9.2); Field Activity Logbook (See Section 9.0)

QA/QC:

1. Decontaminate all split spoons and sampling equipment per guidelines in Section 7.0.

2. Following decontamination, collect one equipment rinsate blank per day and submit for the same set of analyses as the soil samples collected that day.

3. After each set of ten samples for lead analysis, collect a double volume for the eleventh sample (double the jar requirement). Process the first volume as usual. Label the second volume using a unique sample number (note the location of the sample in the logbook) and submit for the same analyses as the first volume.

4. If a field blank has not yet been collected, collect a sample of the potable water used during drilling equipment decontamination and a sample of the analyte-free water used during sampling equipment decontamination.

5. Collect additional sample volume, as directed by the laboratory, for MS/MSD samples (frequency: 1 for every 20 samples collected). Label as described in Section 9.2.

PROCEDURE 3: MONITORING WELL OVERDRILLING, INSTALLATION DEVELOPMENT AND TESTING

Objectives:

1. Remove existing 2-inch well and replace with 6-inch (product) recovery well.
2. Assure new wells are adequately installed and developed.
3. Estimate the production rate of each well. If necessary, determine the hydraulic conductivity of the water-bearing formation soils. Estimate production rates.

Equipment:

-pH and conductivity meters
-Organic Vapor Monitor
-Stainless steel spoons and putty knife
-(driller will provide all equipment for overdrilling well and installation of new wells)
-peristaltic pump and slug materials

Method:

1. Mud rotary will most likely be used for overdrilling and well installation.

2. Collect cuttings samples every 2 feet of drilling. Visually describe, as applicable, the following:
   -presence of coarse material (sandpack, bentonite)
   -color of drilling fluid (presence of oily sheen, changes in color)
   -presence of odor
   -native soil
3. Screen cuttings and headspace above and inside the borehole, as possible, with the OVM and record measurements in ppm. Break open clods extruded with the drilling fluid and screen for any fugitive vapors. Include data on the well construction log (Field Datasheet C).

4. Complete the well construction log as directed in the RAP.

5. Oversee development of new wells. Collect water samples every 5-10 gallons removed, and perform measurements of pH, temperature and conductivity. Estimate production rates of the well using the peristaltic pump. Record this data on Field Datasheet D.
6. Development will be considered complete if consecutive measurements of pH and conductivity are within 10% of one another, if turbidity in the well water no longer improves and the well capacity (gallons per minute per foot of drawdown, during pumping) no longer increases.
7. If necessary, complete a slug test to estimate the hydraulic conductivity of the water-bearing zone. Consult with the Project Manager to determine if this test will be completed. Procedures for calculating hydraulic conductivity using slug test data are provided in Kruseman and DeRidder (1991).
8. Water produced during well development and testing will be stored in 55-gallon drums and then pumped into the oil/water separator for treatment.

Documentation: Well construction logsheets (Field Datasheets C); Well Development logsheet (Field Datasheet D); field logbook

QA/QC: No samples will be collected from the three overdrilled boreholes for offsite laboratory analysis. Follow manufacturer-specified calibration procedures for the OVM. Record calibration results daily and note any mechanical problems.

PROCEDURE 4: WATER SAMPLING - DECONTAMINATION FLUIDS, OIL/WATER SEPARATOR EFFLUENT

Objective:

1. To determine if the effluent water from the oil/water separator and residual decontamination fluid meet pre-treatment standards, prior to treatment at the WWTP. Water will be sampled when storage tank is three-fourths full, tank will be recirculated for four hours prior to sampling.

Equipment:

-sample jars (see Table 4 for list)
-weighted bottle sampler or peristaltic pump with tubing (sampling directly from Baker tank, unless sampling port is available)
-clear plastic cups
-pH meter

Method:

1. Following decontamination activities, decontamination fluids will be passed through the oil/water separator and stored in the Baker tank. Water extracted from the three recovery wells will be also be stored in the tank following passage through the separator. Water produced during well development and testing will also be passed through the separator.

2. Calibrate the pH meter per manufacturer specifications. Record data in the field logbook.

3. Shut off valve to oil/water separator. Recirculate water through the tank and piping.

4. Attach tubing to sampling port. Shut off circulating pump, and allow level in tank to stabilize. Using the head of the water in the tank, bleed water through the valve and tubing.

5. Slowly fill a plastic cup approximately 2/3 full. Following the operator's manual, measure pH and temperature of the water sample. Record data in the field logbook.

6. Bleed water from the sampling port at a very low rate (approximately 200 m2L/min). Carefully fill each of three 40 mL glass VOA vials slowly. Do not overfill. Top off the vial by adding a few milliliters of water using the vial cap. Form a meniscus at the top of the vial and cap the bottle tightly. Check for air bubbles by inverting the bottle and tapping the sides. If air bubbles are present in the vial, discard the sample and recollect using a new vial. (go to next page for step 7)

PROCEDURE 4: WATER SAMPLING - DECONTAMINATION FLUIDS, OIL/WATER SEPARATOR EFFLUENT

Method: (continued)

7. Fill the remaining containers 1/4 full with water from the first quadrant. Remove the tubing and replace with fresh tubing. Lower new tubing into quadrant two and pump water to the containers, filling them to the half full mark. Repeat the procedure for the remaining quadrants. Do not completely fill bottles. Remaining analyses include TPH, total PAHs, total lead, TSS and BOD.

8. Repeat Step 5 after all sample bottles have been filled.

9. Complete sample bottle labels as described in Section 9.2. Document in the field logbook the date, time and sample identification numbers in the sample logbook. Also record any unusual observations of the water stored in the tank or being pumped such as color, turbidity, odor, presence of sheen, etc.

Documentation: Field logbook (pH measurements, observations, field activities, sample documentation)

QA/QC:

1. Because all sampling equipment is dedicated or disposable, no decontamination is required.

2. Label the trip blank with date, time and sample number (see Section 9.2) and place in cooler with BTEX samples. This sample will be analyzed for BTEX only.

3. If more than one sampling event occurs, collect a field duplicate sample.

PROCEDURE 5: WASTE SAMPLING - SOIL/SOLIDS

Objective: To characterize soil cuttings and solid debris removed during overdrilling and the geoprobe investigation for offsite disposal.

Equipment:
-hand auger and sampling bucket
-stainless steel spoons and bowls
-sample jars (see Table 4 for sizes)
-decontamination supplies

Method:

1. Approximately six cubic yards of soil and debris will be sent offsite for disposal. This material will be temporarily stored in drums (approximately 20 drums). Each drum will be labeled as described in Section 9.0.

2. OVM, visual data and chemical data, if available, will be reviewed to determine which drum contains the most potentially contaminated material. This drum will be sampled for BTEX. Insert the hand auger and decontaminated bucket into the drum contents approximately midway to the bottom of the drum. Immediately place the contents of the bucket into a certified clean 4-ounce glass jar. Do not collect coarse gravel, roots or cobbles with the soil. Completely fill the jar, leaving no headspace. Label the jar as described in Section 9.2.

3. Following hand auger and bucket decontamination, collect a small volume of soil/solids from each drum and composite these "grab" samples in a stainless steel bowl.

4. Fill remaining containers in the order shown in Table 4, and label the jars as described in Section 9.2. The remaining analyses include TPH and TCLP-inorganics. This list must be finalized prior to sample collection by the Project Manager, following discussion with the disposal agency.

5. Clean the exterior of the sample containers and ensure that the containers are tightly sealed prior to applying the sample container label. Document in the field logbook the date, time and sample identification numbers.

6. Package and ship samples to offsite laboratory as described in Section 10.0.

Documentation: Sample logbook; discussion with disposal agency including finalized sampling parameter list; manifest documents (see Waste Management Plan)

QA/QC:

1. Decontaminate hand auger, sampling bucket and other tools using procedures described in Section 7.0.

2. Label the trip blank with date, time and sample number (see Section 9.0) and place in cooler with BTEX samples. This sample will be analyzed for BTEX only.

6.0
QA/QC SAMPLES

Quality control samples will be collected in the field to enable identification of field and/or laboratory conditions that may affect the data quality and data usability. Field quality control samples to be collected as part of the Corpus Christi sampling activities include trip blanks, equipment rinsate blanks, field blanks, and field duplicates. These blanks are often referenced in the procedure tables above and are explained in more detail below.

6.1 TRIP BLANKS

Trip blanks consist of two 40-mL glass volatile organic analysis (VOA) vials containing analyte-free water taken from the laboratory, shipped to the sampling site with the sample containers and returned to the laboratory with the VOC samples. One trip blank will accompany each cooler containing samples for VOC analysis throughout the field storage, shipping, laboratory storage and analytical process. Trip blanks are only analyzed for VOCs and indicate when cross-contamination may occur due to atmospheric conditions within the cooler or within the laboratory.

6.2 EQUIPMENT RINSATE BLANK

An equipment rinsate blank will be collected to ensure that sampling equipment is clean and that the potential for cross contamination has been minimized by the equipment decontamination procedures. This blank will be collected following the first sample equipment decontamination activity of the day. Analyte-free water will be poured over cleaned sampling equipment and collected in appropriate sample containers. An equipment rinsate blank will be collected once daily following completion of decontamination. The equipment rinsate blank will be analyzed for identical parameters as the environmental samples collected that day.

6.3 FIELD BLANKS

Field blanks will consist of the source water used in decontamination and steam cleaning. One sample of the analyte-free water and one sample of the potable water used during steam cleaning will be collected, at a minimum. Both of these samples will be collected during the geoprobe investigation phase. However, the samples will be analyzed for lead, BTEX and TPH.

6.4 DUPLICATE SAMPLES

Duplicate samples will be collected to allow determination of analytical and sampling precision. One duplicate sample in every ten (10) environmental samples will be collected and submitted for the identical parameters as the regular samples.

6.5 MATRIX SPIKE/MATRIX SPIKE DUPLICATES

Matrix spike/matrix spike duplicates (MS/MSD) samples will also be submitted as further QC checks. These samples will be spiked at the laboratory. These will be collected at the frequency of one MS and MSD for every twenty (20) field samples (including trip blanks, field blanks and blind duplicates). These will allow accuracy to be determined by the recovery rates of compounds (the matrix spike and/or surrogate spike compounds defined in the analytical methods). Precision will also be assessed by comparison of matrix spike duplicate recoveries. The purpose of these laboratory spikes is to monitor any possible matrix effects specific to samples collected from the site. The addition of known concentrations of compounds/constituents to the sample also monitors extraction/digestion efficiency.

Matrix spike/matrix spike duplicate sample aliquots will be acquired by providing triple the necessary sample volume for the location identified for these QC samples. Matrix spike/matrix spike duplicate sample aliquots for solid/soil analyses will be split from the designated sample location at the laboratory. The laboratory will select aliquots that are as homogeneous with respect to one another as possible to avoid precision problems related to sample homogeneity. The specific sample location which will be used for matrix spikes and blind duplicates will be chosen by the Project Manager with direction from the Quality Assurance Manager. Homogenizing is discouraged prior to splitting duplicates to avoid the loss of volatile organic compounds.

The use of MS/MSD samples will be finalized by the Project Manager prior to the geoprobe investigation. It is anticipated that an MS/MSD will be done for lead only.

7.0
DECONTAMINATION PROCEDURES

A decontamination facility will be provided at each site, as possible. The station will have containment for the collection of washwater and be protected from the rain. The decon facility will be adequate in size to decontaminate all drilling and sampling equipment. The station will be located as close as practically possible to the contamination reduction zone.

All non-disposable equipment (*i.e.*, split spoons, hand augers, sampling buckets, spoons and stainless steel bowls) will be decontaminated according to procedures summarized below:

- Wash with Alconox™ solution
- Tap water rinse
- Methanol or isopropanol rinse
- Analyte-free water rinse
- Nitric Acid (<10%) rinse (metals)
- Analyte-free water rinse

The drilling rig (including Geoprobe equipment) will be decontaminated using high-pressure steam or water wash. Equipment such as small tools, water level probes and split spoons should be decontaminated using the six-step procedure above.

8.0
MAINTENANCE OF FIELD INSTRUMENTS

Preventive maintenance programs will, as a minimum, be established for equipment that would otherwise be subject to breakdown, when the breakdown could lead to safety hazards, environmental contamination, or loss of completeness and accuracy in data. The program will include a schedule of the important preventative maintenance tasks that will be carried out to minimize downtime of measurement systems, and a list of any critical spare parts that need to be on hand to minimize downtime.

9.0
FIELD DOCUMENTATION AND CHAIN-OF-CUSTODY PROCEDURES

9.1 GENERAL

The following field datasheets and logbooks will be used during this project:

- Field Activity Logbook (or "field logbook")
- Field Datasheet A (water level measurements)
- Field Datasheet B (soil boring log)
- Field Datasheet C (well construction log)
- Field Datasheet D (well development log)
- Sample Label
- Drum Label
- Chain-of-custody form

Items to include in each of these documents are summarized in a checklist (Table 5).

The designated field team leader will maintain a Field Activity Logbook in a bound notebook. In this log, the field team leader will record the on-site activities in real time, including all individuals on-site and sampling information, such as sample location, sample number, number of bottles collected, etc. If multiple activities are taking place at one time, the field team leader will record this in the Field Activity Logbook and the other field team will use a second bound notebook to record their activities.

9.2 SAMPLE DOCUMENTATION

Samples will be labeled, preserved, and properly packaged for shipment to the offsite analytical laboratory. Information on the sample label is included in Table 5.

Sample identification numbers will provide for a tracking procedure allowing information on a particular sample location to be easily and accurately retrieved. This system also ensures that each sample is unique identified and not confused with any other sample. The Project Manager and Field Sampling Manager will maintain a complete list of sample numbers. The sample identification number consists of alpha/numeric characters that represent the following information:

- Site Name
- Sample Matrix
- QC sample type (when applicable)
- Sample interval or depth (when applicable)
- Sampling date

The project will utilize a specific prefix, COR, separated from the sample identification number with a backslash (e.g., COR\123-45-678).

The first three digits indicate the sample origin. These digits are alphanumeric and are created with some mnemonic device for the true name of the site. The first digit is an alphabetical character in order to facilitate data processing. Sample origin abbreviations are developed according to specific project requirements. Examples are given below:

- Geoprobe boring SB-14 - S14
- Tank 1 (water) - WT1
- Drum sample (cuttings) - DS1

The sampling depth or number is represented by digits 4 and 5. Designations may include the following:

- 3.5 - depth of soil sample (in half-foot increments)
- 01 - sample number one

The sixth digit and seventh and eighth digits are separated by a forward slash (/) and indicate the sample date. Duplicate samples will be "blind labeled." For example:

- COR\S14-3.5-1/15 represents the sample collected from soil boring 14 (geoprobe) at a depth of 3.5 feet below ground surface on January 15.
- COR\S40-D1-1/15 represents a duplicate sample collected from a fictitious soil boring number 40 on January 15. The actual location and depth must be recorded in the field logbook.
- COR\WT1-01-1/25 represents the first water tank sample, collected January 25.
- COR\DS1-01-1/30 represents a drum sample (cuttings) collected on January 30.

Additional QA/QC samples are numbered by replacing digit 4 with the proper QC sample code, listed below, followed by the number of the sample (digit 5) and the month and day it was collected as digits 6, 7, 8 and 9. For example, August 14 would appear in the last four digits of the sample identification number as 0814. QC sample codes used during the project are:

- F - field blank
- E - equipment rinsate
- T - trip blank

An example sample label for a trip blank to be sent with Drum Sample 1, BTEX samples on January 15, 1996 would be COR\DS1-T1-1/15.

The sample number is entered on sample labels, chain-of-custody forms, and in the appropriate section of the Testing Plan and Log found in the QC Plan. All sample identification information will also be documented in the field logbook, including pertinent information not incorporated in the sample number.

Samples will be placed in shipping containers that are locked or sealed for shipment to the laboratory. Custody seals will be affixed to the sealed shipping container and/or

individual sample containers. Information on the custody seal will include the date when the container was sealed and the signature of the sampler or relinquisher. Broken custody seals will be noted in the remarks section of the chain-of-custody record.

9.3 CHAIN-OF-CUSTODY FORMS

All sample shipments will be accompanied by a chain-of-custody record, which will include information in Table 5.

The chain-of-custody record will be completed with information and wording consistent with information and wording reported on sample labels and seals.

When transferring custody the sampler will record the time and date and sign the chain-of-custody form in the "relinquished by" block. The receiver will sign "received by" block upon sample receipt. The original chain-of-custody record will accompany the shipment, and a copy will be retained by the Project Manager or designee. A signed chain-of-custody record will obtained from the laboratory custodian after the samples have been received and their condition checked.

10.0
SAMPLE PREPARATION, PRESERVATION AND PACKAGING AND SHIPMENT

Immediately after collection, samples will be transferred to properly labeled sample containers with all necessary preservatives added. Table 4 lists the proper container material, volume requirements, and preservation needed for the sampling effort. Samples requiring refrigeration for preservation will be immediately transferred to coolers packed with ice or ice packs. Proper chain-of-custody documentation will be maintained as discussed in Section 9.0 - Field Documentation and Chain-of-Custody Procedures.

Packaging and shipping procedures will vary depending upon sample media, contaminant concentration, preservation technique, and sample container. A waterproof metal or equivalent strength ice chest or cooler is suitable for packaging and shipping samples not considered "Dangerous Goods" by the U.S. Department of Transportation (USDOT). The person packaging the samples is responsible for ensuring that the cooler is in suitable condition for shipping. In the event a concern arises regarding whether a sample shipment is a USDOT "Dangerous Good", the Project Engineer will be consulted.

Sample packaging should ensure that the chance of breakage is minimized and that, in the event a sample container breaks or leaks, it will not impact the integrity of other samples in the shipment. Also, samples should be protected from ice melt. Each sample container should be placed in a ziploc-type bag, and packing material such as bubble wrap, vermiculite, or comparable shock-absorbing materials should be used when shipping glass containers to avoid breakage. Adequate ice, contained in durable ziploc-type bags, or blue ice must be included with each cooler shipment so that the contents are maintained at four degrees celsius until receipt at the laboratory. A chain-of-custody record, protected from moisture by enclosure in a ziploc-type bag, must accompany each cooler shipped. The cooler lid should be secured using packing tape around the outside of the cooler.

All samples will be shipped to the analytical laboratory via Federal Express. Make sure the airbills have been completed accurately and copied. Place one airbill or copy of airbill into each envelope with each cooler to be shipped.

PART III. QUALITY ASSURANCE PROCEDURES

1.0
INTRODUCTION

This section of the SAP describes those activities necessary to generate a data set that is defensible, traceable, and usable for decision-making. Chemical data for the Corpus Christi project will be obtained from:

- Soil samples collected during the Geoprobe investigation;
- Water samples collected from oil/water separator effluent (pretreatment analyses)
- Soil/solids samples collected for disposal characterization (drill cuttings)
- QA/QC samples, as described in the Part II, Sampling and Analysis Plan.

2.0
DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of the data required to support decisions concerning remediation. DQOs are determined based on the end uses of the data and are established prior to data collection. DQOs help to ensure that all data collected are legally and scientifically defensible.

2.1 DATA QUALITY OBJECTIVES PROCESS

The data quality objectives (DQO) process consists of three stages:

- Stage 1: Identify Decision Types
- Stage 2: Identify Data Uses/Needs
- Stage 3: Design Data Collection Program

Stage 1 of the DQO process defines the types of decision that will be made by identifying data users, evaluating available data, developing a conceptual model, and specifying objectives for the project. Identified data users include federal, state and local (if applicable) regulatory agencies, and SOUTHDIV representatives for this project. Evaluation of available data include summarizing the existing data for input to the site conceptual model and using the existing data for design of the additional work envisioned for this facility. The site conceptual model will be developed by utilizing the existing data to formulate hypotheses regarding the nature and extent of contamination, the site-specific fate and transport mechanisms as well as available remedial alternatives. From the developed site conceptual model and the available remedial alternatives, specific objectives (*i.e.*, performance goals) will be developed for this facility.

Stage 2 of the DQO process identifies the data uses and data needs for this project. The data uses center around several concepts. The first is to update the current database of water level and product thickness measurement to determine if product distribution in site wells has varied with time. The second data use is confirmation sampling at borings installed using a Geoprobe for the purpose of evaluating lead concentrations in soils and defining the characteristics of the principal water-bearing zone at the site. The third data use is waste characterization for disposal of soils and to determine if pretreatment criteria for wastewater are met for WWTP disposal.

Stage 3 of the DQO process involves design of the data collection program. This stage results in analytical method specification, as well as determinations of the quality and quantity of data necessary in order to make the appropriate decisions.

2.2 CHEMICAL DATA QUALITY OBJECTIVES

The analytical laboratory selected for this project will analyze samples in compliance with

NEESA 20.2-047 B requirements, or equivalent, before samples are submitted for chemical analyses. Table 4 details the analytical program for this project. In order to establish the uses for which the laboratory data are suitable, all samples will be collected and analyzed using NEESA Level C. The objectives of the chemical data are to, within the defined uncertainties of the data set, enable decisions regarding contamination extent and satisfy disposal requirements.

2.3 PHYSICAL DATA QUALITY OBJECTIVES

Physical features of the site will be verified (if mapped during previous studies) or determined in the field. Soil sampling locations will be documented on the site map. Locations will be measured from a permanent feature (i.e. buildings, fences).

Instruments used at the site, including the OVM, conductivity meter, and pH meter, will be calibrated per manufacture instructions. Calibration information will be documented daily.

2.4 ANALYTICAL DATA QUALITY OBJECTIVES

DQOs for analytical data will be defined through assessment of the following:

- Precision - the degree to which a measurement is reproducible, determined by comparison of sample duplicates. Typically precision of 20% is acceptable for laboratory generated duplicates of either matrix.

- Accuracy - expressed as the percent recovery of a compound from a sample spiked with known concentrations of target compounds for each analytical method. Accuracy for metals analysis typically lies between 75 and 125%, while values for organic are compound specific.

- Completeness - a measure of the amount of valid data obtained from an analytical data set compared with the amount that would be expected to be obtained under normal sampling and analytical conditions. Completeness goals for this project have been established at 95%.

- Comparability - the confidence with which one data set can be compared to another.

- Representativeness - the degree to which data represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition.

Analytical quality assurance objectives are established to ensure the quality of the analytical data produced by the laboratory.

3.0
DATA VALIDATION/VERIFICATION

Data validation is a systematic procedure of reviewing a body of data against a set of established criteria to provide a specified level of assurance of its validity prior to use. Data resulting from offsite chemical analysis will be reviewed at NEESA Analytical Level C. Evaluation of data consistency will involve review of:

- Duplicate field sample analysis
- Instrument calibrations
- Detection limits
- Holding times
- Database entry accuracy
- Data outliers

The laboratory will review the data prior to submittal, and provide internal data validation, per internal QA/QC guidelines. MK will review the data submitted and provide validation as defined in **Sampling and Chemical Quality Assurance Requirements for the Navy Installation Restoration Program** (NEESA 20.2-047B).

4.0
LABORATORY ANALYTICAL PROCEDURES

The most current version of "Test Methods for Evaluating Solid Waste Physical/Chemical Methods" (SW-846) and/or "Methods for the Chemical Analyses of Water and Waste, EPA 600.1982" will be used for field screening and waste characterization. "Statement of Work for Organic Analysis" will be used by the off-site laboratory for BTEX analysis of water samples.

4.1 ANALYTICAL METHODOLOGY

The analytical methodology for this project is largely based on utilization of an off-site laboratory. The off-site laboratory will conduct analyses for organic and inorganic parameters as listed in Table 4. The off-site laboratory is expected to produce NEESA Level C analytical data for all samples analyzed. The analytical data will be used for characterizing the subsurface soils and disposal characterization of soil and water samples.

4.2 SAMPLE CONTAINERS, PRESERVATION AND HOLDING TIMES

All sample containers will be provided by the analytical laboratories. The containers will be cleaned according to EPA protocol and either pre-preserved or the necessary amount of preservative will be provided by the laboratory in a separate container.

All samples collected during the field investigation and submitted to laboratories for chemical analyses will be preserved according to EPA standards. Sample preservation and temperature shall be checked immediately upon receipt of samples at the laboratory. The results of these checks will be recorded on the corresponding chain-of-custody form.

4.3 QUALITY CONTROL SAMPLES

Field blank, field duplicate, equipment rinsate blanks and trip blank samples will be collected in the field as specified in the SAP. Laboratory QC samples will be analyzed, where appropriate, and will include method blanks and sample duplicates. These will be analyzed concurrently with the analytical batch to which they are assigned.

The laboratory method blank is carried through each step of the analytical method to examine the potential for cross-contamination. The laboratory method blank will be analyzed at a rate of 1 per 20 samples or one per analytical batch, whichever is the greater frequency, for all methods.

4.4 METHOD SPECIFIC DATA QUALITY OBJECTIVES

The method specific data quality objectives will be provided in the Quality Assurance Plan submitted by the approved laboratory performing the chemical analyses on the sample collected for this project.

5.0
QUALITY CONTROL CHECKS

5.1 SAMPLE HANDLING IN THE LABORATORY

Upon receipt, all samples will proceed through an orderly processing sequence (as defined in the laboratory QA/QC Plan) specifically designed to ensure continuous integrity of both the sample and other pertinent information to the analysis.

All samples will be carefully checked and verified for proper chain-of-custody (COC) records, preservation, broken or leaking sample containers, proper label identification, and any associated discrepancies. These items will be documented by use of a laboratory receipt form. If any samples arrive leaking or broken, or the custody seal on the shipment coolers is not intact, the Project Manager and QA/QC Coordinator will be notified of the problem(s) immediately.

If no discrepancies are identified, the sample COC record will be signed, and the samples will subsequently be assigned a unique laboratory identification number by the laboratory for tracking and filing. The laboratory QA system and the use of an internal COC procedure will ensure that the samples are appropriately tracked from storage through the laboratory until the analytical process is complete.

Analytical and procedural information and activities will be documented with the use of Standard Operating Procedures (SOPs), a laboratory data management system, laboratory benchsheets, laboratory notebooks, and orderly project files containing any information pertinent to the analysis or integrity of the results.

The contracted laboratory will provide a written QA/QC program which discusses rules and guidelines to ensure the reliability and validity of all analytical work conducted in their laboratory. Compliance with the QA/QC program is coordinated and monitored by designated laboratory quality assurance personnel.

The laboratory will document, in each data package provided, that both initial and ongoing instrument and analytical QC functions have been met. Corrective action will be initiated on any samples analyzed in non-conformance with the QC criteria.

5.2 METHOD SPECIFIC QUALITY CONTROL

Method quality control checks will be analyzed as outlined in the individual methods for each analysis performed.

6.0
DATA REDUCTION, VALIDATION AND REPORTING

6.1 DATA REDUCTION

The laboratory will perform in-house analytical data reduction and review of chemical analyses under the direction of the laboratory's technical staff, QA Officer, and Project Manager for this project. These individuals are responsible for evaluating the quality of the data and indicating which, if any, data may be listed as "unacceptable" and/or which should be considered potentially unreliable. A report by the personnel assessing data quality will be submitted to the Laboratory Project Manager or designee with every data package prior to transmittal to the client.

Data reduction, review, and reporting by the laboratory will include the following:

- Raw data produced by the analyst are reduced and checked by the analyst following laboratory SOPs and the analytical methodology.

- A data review specialist will independently review the data to check that quality control criteria have been attained.

- Upon acceptance of the data package by the independent reviewer, a report is generated and sent to the Laboratory Project Manager.

- The laboratory QA/QC director or his/her designee randomly reviews, at a minimum, five percent of all project reports produced by the laboratory.

- Data packages will be prepared and submitted to the MK Project Manager on an ongoing basis by the laboratory. Level C deliverable requirements are included in Table 7.6 of NEESA.

Complete data reduction and reporting procedures will be those specified by the laboratory Quality Assurance Project Plan.

6.2 DATA REPORTING

The specific data items in each analytical data set submitted to MK will include, but will not be limited to, the following items:

- Cover sheet listing the samples included in the report and narrative comments describing problems encountered during analysis;

- Copies of signed COC records;

- Tabulated results of the compounds identified and quantified;

- Analytical results for field blanks, method blanks, surrogate recoveries, initial and continuing calibration forms, verifications of standards and blanks, internal standard data, ICP Interference Check Samples, ICP Serial Dilutions, Method of Standard Additions, and laboratory control samples;

- Calculations of reporting limits;

- Photocopies of laboratory notebooks relevant to the analytical data set.

7.0
PREVENTIVE MAINTENANCE AND CALIBRATION

The approved laboratory will be responsible for the maintenance of laboratory instruments and equipment. Instruments and measurements made as part of the analytical methodology will be as specified in the method, without modification. The laboratory's QA program ensures that only trained personnel perform routine maintenance on all major instruments and that repairs are performed by trained laboratory personnel or service technicians employed by the instrument manufacturer or representative. Instrument maintenance will be appropriately documented through the use of instrument logs which will be included in the laboratory project file.

8.0
CORRECTIVE MEASURES

When errors, deficiencies or out-of-control situations exist, the laboratory QA program provides systematic procedures, called corrective actions, to resolve problems and restore proper functioning to the analytical system.

The Laboratory Operations Manager or designee will review the data generated to ensure that all quality control samples have been analyzed as specified in the protocol. Where sample results fall outside of the acceptable ranges for accuracy and precision, deficiencies will be reported to MK's QA/QC Coordinator, who will immediately report the discrepancies to the Project Manager. Corrective actions will be defined by the MK Project Quality Manager in conjunction with the Project Manager and documented appropriately.

The laboratory will follow the procedures in the respective method for performing corrective action and reporting the data with qualifiers, if appropriate. MK will evaluate the effect of any deviations in relation to the project Data Quality Objectives. Corrective action may include, but is not necessarily limited to:

- Re-analyzing suspect samples
- Re-sampling and analyzing
- Evaluating and amending sampling and/or analytical procedures
- Accepting data with an acknowledged level of uncertainty
- Discarding the data

9.0
LABORATORY DATA REPORT

Laboratory data reports will be issued for each work order generated by the laboratory. A work order is generated for a single client's samples, received by the laboratory on the same day. The deliverable components of the data report are listed below:

- Case Narrative/Data Flags
- Data Package Checklist
- Sample Delivery Group Worksheet
- Data Report (analyte, method, detection limit, date and time of analysis and results for each sample)
- Method Blank Summary
- Surrogate Recovery Information
- Field and Laboratory Blank Summaries
- Deficient Incident Report
- Dilution Factors
- Chain-of-Custody Records
- Cooler Receipt Forms
- Laboratory Sample Preparation Data Sheets
- Extraction/Digestion Logs

As appropriate, each of these deliverable components are given for each of the types of analyses that are conducted.

10.0
QUALITY ASSURANCE PROGRAM

10.1 SYSTEM AUDITS

System audit(s) may be performed by the MK Project Chemist (PC) or designee during the course of the field activities. Evaluations will be made of ongoing field work, as well as any other activity affecting the quality. The primary purpose of the system audit is to verify and document that field activities are being performed efficiently and in conformance with approved standards and procedures, federal and state regulatory requirements, sound engineering and environmental practices, and contract requirements.

The audits will include: an objective examination of work areas, activities, and processes; review of documents and records; interviews with project personnel; and review of procedures associated with the project. Audit results will be documented and the audit report submitted to the Project Manager for action. The Project Manager will investigate any adverse audit findings, determine the root cause (if necessary), schedule corrective action, and respond in writing to the report as requested. The Project Manager will report periodically on the status of corrective actions taken, until all required actions are completed.

10.2 SURVEILLANCES

Quality assurance surveillances will be performed as necessary, using performance-based concepts for monitoring and/or observing activities, to verify conformance to specified program requirements. Surveillances are considered to be snap-shots of compliance during a given time and generally focus on one specific area of review, rather than entire program effectiveness. Surveillances will be conducted at the discretion of the PQM and may be initiated when the quality of an activity appears to be in jeopardy due to noncompliance with the applicable project plans; an overview less formal than an audit is desirable; or formal audits of an activity, project subcontractor, etc., may not be required.

10.3 LABORATORY EVALUATION

Any laboratory performing chemical analysis will provide a list of certifications and approvals for review. MK will utilize a laboratory which has previously performed or are currently performing work in support of the Navy's Installation Restoration Program (IRP) per NEESA. As an alternate to previous NEESA approval, MK may utilize a laboratory which has undergone successful reviews by other DOD agencies, including: AFCEE (Air Force Center for Environmental Excellence) Installation Restoration Program U.S. Air Force; DERP (Defense Environmental Restoration Program) U.S. Army Corps of Engineers; and/or MRD (Missouri River Division) U.S. Army Corps of Engineers. Other relevant federal agency reviews or approvals other than those listed may be considered, but require Contracting Officer approval.

The PC will assure that the laboratory has a current validation for all analyses and matrices specific to this project. MK will obtain a copy of the laboratory's Quality Assurance Plan and evaluate its experience, capability, and adequacy prior to sending of samples. This evaluation will be conducted and retained in project files.

10.4 CORRECTIVE ACTION PROGRAM

A corrective action program will be implemented to ensure that conditions adverse to quality are identified promptly and corrected as soon as practical. In the case of significant conditions adverse to quality, the root cause of the condition will be determined, and corrective action taken to preclude reoccurrence. These actions will be documented and reported to appropriate levels of management.

Corrective actions may be the result of internal audits and surveillances or when laboratory analytical results appear unusual, questionable, or quality control criteria are exceeded. When quality control criteria are exceeded, information justifying poor recovery or precision will be requested from the laboratory and documented. Follow-up action will be taken to verify implementation of all corrective actions.

10.4.1 Reporting and Resolution of Quality Problems

Significant quality problems and conditions will be identified, reported and corrected in accordance with the following requirements:

- Existing, developing, or potentially out-of-control quality conditions will be promptly reported to the Project Manager for evaluation and action. These reports will include identification of the problems and corrective actions taken.

- Reports documenting quality problems and their resolution, including lessons learned from significant quality problems and adverse conditions, will be routinely disseminated to all affected project personnel.

10.4.2 Laboratory Corrective Action

The MK PC or designee will review the data generated to ensure that all quality control samples have been analyzed as specified in the methods. This review will include calibration procedures, frequency, and results. Instrument maintenance logs also may be checked. Recoveries of laboratory matrix spike/matrix spike duplicate samples and surrogates will be checked for consistency with method accuracy. RPDs of laboratory matrix spike/matrix spike duplicates will be checked for consistency with method precision. Where sample results fall outside of the acceptable ranges for accuracy and precision as given in individual methods, discrepancies will be reported immediately to the Project Manager. Corrective actions will be defined by the PC in conjunction with the Project Manager and documented appropriately.

The contracted laboratory will have an internal quality assurance corrective action program which includes verification that QC data are not outside acceptable windows for precision and accuracy, blanks or control samples do not contain contaminants above acceptable levels, undesirable trends detected in spike recoveries or RPDs between duplicates are corrected, there are no unusual changes in detection limits, and holding times have not been exceeded. If deficiencies are identified by the laboratory QA department during internal or external audits, or from results of performance evaluation samples, actions will be taken as previously described in Section 8.0

10.4.3 Recurring Conditions Adverse to Quality

For recurring quality problems where corrective actions have not been effective, the Project Manager, as needed, will do the following:

- Determine the events leading to the occurrence of the quality problems
- Develop an understanding of the technical and work activities associated with the quality problems
- Ascertain the implications of the quality problem
- Determine the extent to which similar quality problems (or precursors to the problems) have been recognized by the responsible task manager, the effectiveness of any corrective actions that were taken, and impacts on completed work
- Consider stopping work associated with the applicable activity
- Recommend actions that can be taken by the responsible task manager to preclude recurrence.

TABLE 1. SUMMARY OF DATA COLLECTION ACTIVITIES.

Activity	Methods/Equipment Used	Data Collected	Data Use/Quality Objectives
Water Level Measurement and Determination of Product Thickness	-water level indicator -oil/water interface probe -distilled water	-depth to water below top of PVC -depth to top of product -product thickness	-update database for groundwater elevations and product thickness -provide baseline information for recovery system -field level data quality
Geoprobe Investigation (install approximately 17 soil borings)	-Geoprobe equipment and split spoons -Organic Vapor Monitor (OVM) -stainless steel spoons, bowl -Sieve test equipment -decon supplies -sample jars (see Table 4) -water level indicator -oil/water interface probe	-soil description -presence and concentration of organic vapors downhole and in soil samples -depth of water-bearing zone -presence of product -grain size distribution -depth of water and thickness of product, if present	-Health and Safety Monitoring -lead samples (Level C QA/QC) -confirmation of well screen and filter-pack design for recovery wells -confirm the extent of the free product plume
Monitoring Well Overdrilling, new well installation and development	-OVM -pH, conductivity meters -stainless steel spoons/ putty knife -stopwatch	-description of cuttings -presence and concentration of organic vapors downhole and in cuttings -well development data (volume removed, pH and conductivity measurements)	-assure wells are adequately developed prior to installation of pump and equipment for product recovery -assure previous well materials have been completely removed
Water Sampling - Decon water and water extracted from recovery wells	-weighted bottle sampler or peristaltic pump with tubing -pH meter -sample jars (offsite analysis)	-offsite analysis of BOD, TSS, lead, PAHs, BTEX and TPH -field observations and pH data	-Level C QA/QC for pretreatment data -field level data quality for pH -determine if pretreatment criteria are met (combine with guidance from WWTP)
Waste Soil Sampling (disposal)	-hand auger and sampling bucket -stainless steel bowls, spoons, trowels for compositing -decontamination supplies -sample jars (offsite analysis)	-offsite analysis for TPH, BTEX and TCLP-metals	-Level C QA/QC for disposal sample data -Meet requirements of disposal/receiving facility -Proper documentation of drum contents and labeling -Proper naming and disposition of waste as defined by RCRA

Table 2. Field Equipment Checklist (page 1 of 2)

Soil Sampling	Quantity	Collected	Drum/tank Contents	Quantity	Collected
small stainless steel spoons			coliwasa		
large stainless steel spoons			stainless steel bailer		
stainless steel bowls			pinpoint sampler		
brass sleeves and endcaps			drum thief		
teflon tape					
folding table for split spoons			**Miscellaneous**		
hefty bags (table covers)			sample containers from lab		
grey tape			paper towels		
shovel			clear plastic cups		
hand auger and attachments			large garbage bags		
drive sampler			ziploc bags (gallon and quart)		
drums for cuttings			scissors		
			tools (pliers, wrenches)		
Water Sampling			steel tape/measuring tape		
well keys			ruler		
wrench for bolted well covers			stopwatch		
water level probe			5.5 gallon bucket		
pH meter and buffer solutions			camera and film		
conductivity meter			surveyor tape		
conductivity standard			cellular phone/2-way radio		
DO meter			extra batteries for meters		
turbidimeter			aluminum foil		
disposable bailers					
fishing line (30+ pound test)			**Decontamination**		
cord reel			distilled water		
submerisble pump and tubing			analyte free water (from lab)		
generator (compatible with pump)			nitric acid solution (from lab)		
peristaltic pump and tubing			isopropanol solution (from lab)		
car battery			___ gallon tubs		
garden hose ____ feet			brushes		
flow regulator (valve)			pipe cleaner brushes		
purge water storage container			alconox		
VOC glass 40 mL vial fill tubes			spray bottles		
pump tubing			chemical rinse tub		
extra bottle preservative					
pH paper			**Sample Shipping**		
			coolers from lab		
S.Water/Sediment			ice		
0.45 micron in-line filter			ziploc bags		
water filtration system			vermiculite/bubble wrap		
Ponar dredge			strapping tape		
			fed ex airbills and envelopes		
			thermometer, if requestedl		

Table 2. Field Equipment Checklist (page 2 of 2)

Documentation	Quantity	Collected	Health and Safety	Quantity	Collected
field logbook or diary			(consumables)		
sharpies			CPR Pocket Masks		
sample labels			Dual station/eyewash station		
sample seals (CLP)			Moist towelettes		
custody seals			UL listed hazardous locations		
sample logbook			Smoke Alarms		
soil logging guidelines			(support documents)		
Sampling and Analysis Plan			copy of MK Safety manual		
map of sampling locations			(SouthDiv specific)		
Site Safety and Health Plan			Copy of MK Industrial Hy-		
digging permits			giene Procedures Manual		
			Copy of MK Safety and		
Health and Safety			Health Program Desc. for		
(rentals)			Haz. Waste Site Operations		
OVM or PID			Copy of MK Accident Prev.		
Combustible Gas Indicator (CGI)			Plan for SouthDiv Contract		
Flame Ionization Detector (FID)			OSHA posters/ 2 OSHA		
Isobutylene or other cal gas (PID)			200 forms		
Methane (FID, CGI)			Tool Box Talks (orange book)		
regulator (ask rental place)			EM 85-1-1 Corps Safety Man.		
Sound Level Meter			Signed off SSHP/Work Plan		
Dust Monitor (mini-ram)			MK Accident Data Report		
Draeger tubes and handpump			Form # 678/91		
(consumables)			MK Supervisor Accident In-		
Kimwipes (medium/large)			vestigation Report Form #		
Respirators (note size)			CAS 24/77		
Chemical cartridges			MK Daily Logbook Report		
HEPA cartridges			from SSHP		
Cleaner/sanitizer for respirators			MK Weekly Inspection		
PPE covering (note size, type)			Checklist forms from SSHP		
PPE gloves (note size, type)			PMO project procedures:		
PPE foot protection (note size)			PHSP 001.1, 002.1, 003.1,		
Foam earplugs			004.1, 005.1		
Safety Glasses			Hardhats		
Silver cloth duct tape			29 CFR 1910, 29 CFR 1926		
Personal first aid kit					
Reflective safety vests					
Yellow "Caution" tape					
PID Lamp Cleaner bottles					
Two 10-foot tygon tubing:					
10 feet - 0.25 inch I.D.					
10 feet - 0.125 inch I.D.					
Two 20lb. ABC dry chemical fire					
extinguishers					
Bloodborne pathogen kits					

TABLE 3. DATA COLLECTION LOCATIONS

Medium	Test Parameters	Number of Samples or Locations	QA/QC Samples[1]				Purpose
			TB[2]	ERB[3]	FD[4]	FB	
Field Measurements							
Water	depth to water	all wells and borings	N/A	N/A	N/A	N/A	Update database for water levels
Product	product thickness, depth to product	all wells and borings	N/A	N/A	N/A	N/A	Update database for product thicknesses
Effluent from oil/water separator	pH	1 sample per tank; or 1 sample per batch sent to WWTP	N/A	N/A	N/A	N/A	Determine if pH of effluent falls within acceptable pH range
Development water	pH, conductivity, temperature	1 per 5-10 gallons of water removed	N/A	N/A	N/A	N/A	Determine if development is complete
Water-bearing zone soils	grain-size distribution	minimum of 3 (near locations of new wells)	N/A	N/A	N/A	N/A	Confirm well design
Analytical (offsite) laboratory testing							
Soil	Waste characterization	17 borings (1-2 samples each)	0	1	2	2	Characterization of lead content in soil in product plume vicinity
Soil/solids	BTEX, TPH, TCLP - inorganics	4 comp, 4 grab	1	0	0	0	Disposal characterization[5], determine if soil excavated for piping may be used as backfill
Water	BTEX, PAHs, TPH, lead, TSS, BOD	1 comp, 1 grab	1	0	0	0	Determine if pretreatment criteria are met for effluent

[1]QA/QC samples include trip blank (TB), equipment rinsate blanks (ERB), field duplicate (FD) and field blank (FB)
[2]Trip blanks will be analyzed for BTEX.
[3]Rinsate blanks will be collected once daily, following completion of decontamination procedures. Blanks will be analyzed for associated parameters sampled for that day. N/A = not applicable
[4]Field duplicates will be collected at a rate of 1 per 10 (or less) samples collected.
[5]Disposal parameters will be finalized pending discussion with the disposal facility.

TABLE 4. SUMMARY OF ANALYTICAL METHODS

Analyte[1]	Analytical Method	Sample Container	Preservative	Holding Time
Water Samples - Decon Fluids, Oil/Water Separator Effluent				
BTEX	CLP SOW for volatile organics	3 40 mL VOA glass vials	HCL to pH < 2, ice to 4°C	10 days
TPH	EPA Method 418.1	3 40 mL VOA glass vials	ice to 4°C	28 days
PAHs	8310	2 1-liter amber glass jars	ice to 4°C	7 days until extraction, 40 days until analysis
Lead	6010A	1 500-mL plastic	H_2SO_4 to pH < 2, ice to 4°C	180 days
TSS	EPA Method 160.2	1 500-mL plastic	Ice to 4°C	7 days
BOD	EPA Method 405.1	1 1-liter plastic	Ice to 4°C	48 hours
Soil/Solids Samples (disposal characterization)[2]				
BTEX	CLP TCL[3]	1 4-ounce glass jar	Ice to 4°C	10 days
TPH	EPA Method 418.1	1 8-ounce glass jar	Ice to 4°C	28 days
TCLP - inorganics	Method 1311 (non-volatile extraction); 6010A; 7470A (mercury)	1 8-ounce glass jar	Ice to 4°C	28 days (mercury); 180 days for other metals

[1] Samples should be collected in the order shown in the table.
[2] This list for offsite disposal characterization will be finalized per discussions with the disposal agency.
[3] CLP SOW = Contract Laboratory Program Statement of Work (for Organic Analyses) OLM03.1, U.S. EPA, August 1994 (NEESA Requirement); deliverables should be submitted on CLP-like forms for Level C QA/QC

TABLE 5. SUMMARY OF FIELD DOCUMENTATION REQUIREMENTS		
Field Document	**Field Activity**	**Contents**
Field Activity Logbook	All	-date, site name and crew initials (top of every page) -daily tasks and objectives -location and description of sampling locations (if different from map) -weather conditions -names, titles and purpose of visit for all site visitors -sample identification numbers, analysis, and time collected -location and depths of duplicate samples -pH measurements -health and safety measurements (breathing zone, downhole) -calibration data (pH meter, OVM) -drum inventory (last pages of logbook) -deviations from this CDAP and rationale -other observations, as required by specific tasks
Field Datasheet A (water levels and product thickness)	Water Level Measurement	-depth to water in each well (to nearest 0.01 foot) below surveyed top of PVC casing -thickness of floating product present in well -visual observations of product or water, if visible in the well
Field Datasheet B (soil boring log)	Geoprobe Investigation	-Geoprobe location (SB-14 through SB-30) -OVM measurements -soil description: color, grain size, USCS classification, moisture content, odor, facies changes, etc. as required by the procedures in Attachment B -depth to water-bearing zone(s) -depths product is encountered, if possible -sample identification numbers, date and time -attach data from sieve test
Field Datasheet C (well construction log)	Well Overdrilling and new well installation	-OVM measurements -cuttings description (presence of sandpack material, color of drilling fluid, odor) -unusual observations (i.e. change in drilling fluid color)
Field Datasheet D (well development)	Well Overdrilling and new well installation	-development data (pH, conductivity, volume removed)

TABLE 5. SUMMARY OF FIELD DOCUMENTATION REQUIREMENTS		
Field Document	**Field Activity**	**Contents**
Drum Label	Geoprobe Investigation, Waste Sampling	-date drum was filled -name of COTR -Contractor's name -contact phone number -term "pending analysis" -source of drum contents (i.e. geoprobe boring number) -other requirements as stated in 40 CFR Subpart C
Sample Label	Geoprobe Investigation, Water Sampling, Waste Sampling	-sampler's initials -full sample identification number -date and time -analysis requested -preservative -site name
Chain-of-Custody Form	Geoprobe Investigation, Water Sampling, Waste Sampling	-full sample identification numbers -date and time sample collected -analysis requested (method number and description) -site name -project manager/contact phone number -chain-of-custody number -preservative -bottle quantity per analysis -turnaround time (very critical) -signatures for transfer of custody -FedEx airbill tracking number -reference number (project number) -indicator if potentially "high" level of contamination is present

REFERENCES

EnSafe/Allen & Hoshall (1995). Final Contamination Assessment Plan, CTO-102, NAS Corpus Christi, Texas

Geraghty and Miller (1983). Assessment of Fugitive Oil Contamination at the Naval Air Station Corpus Christi, Texas. (March 1983).

Naval Energy and Environmental Support Activity (1988). Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program, NEESA 20.2-047B.

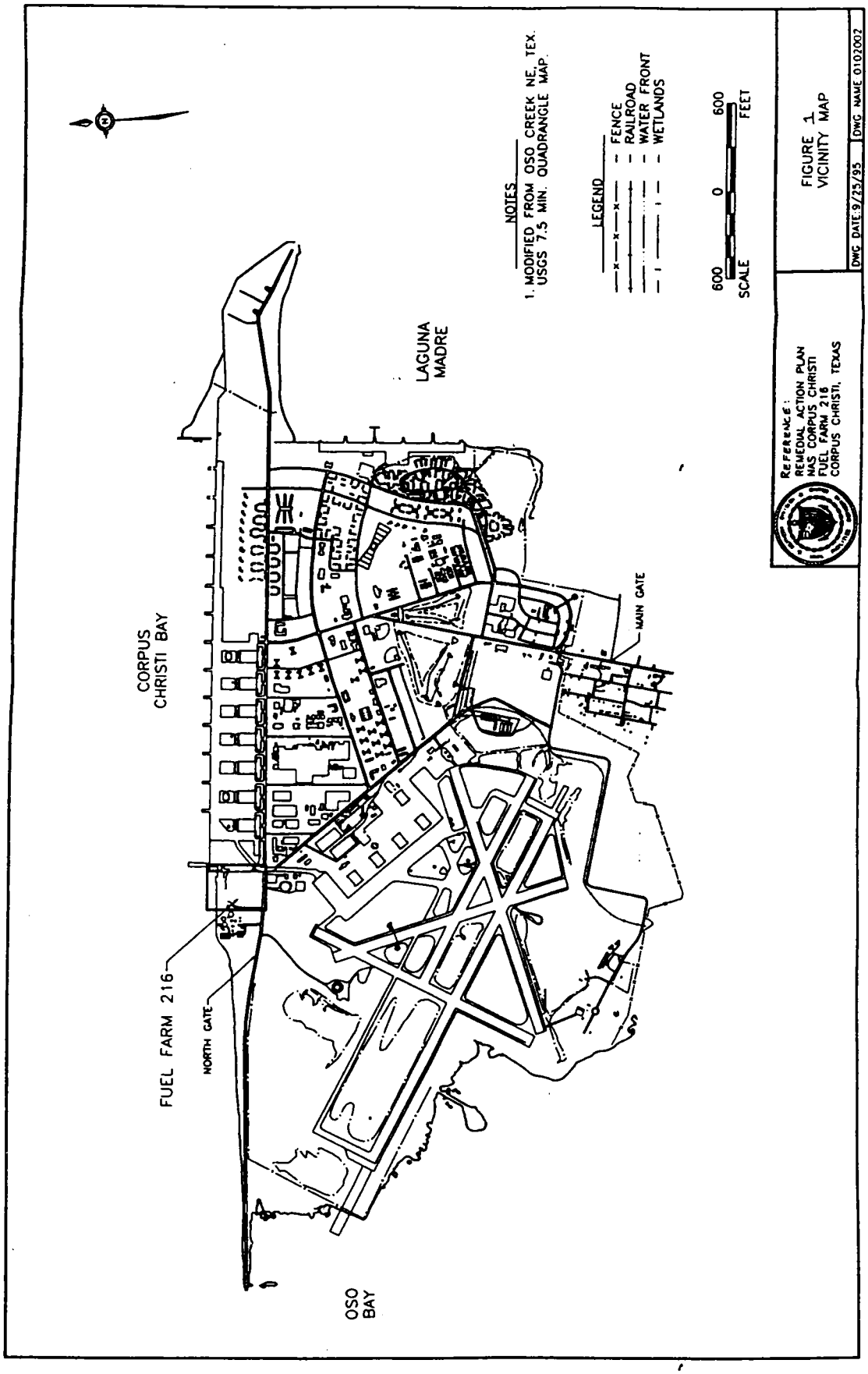


Figure 1
Vicinity Map

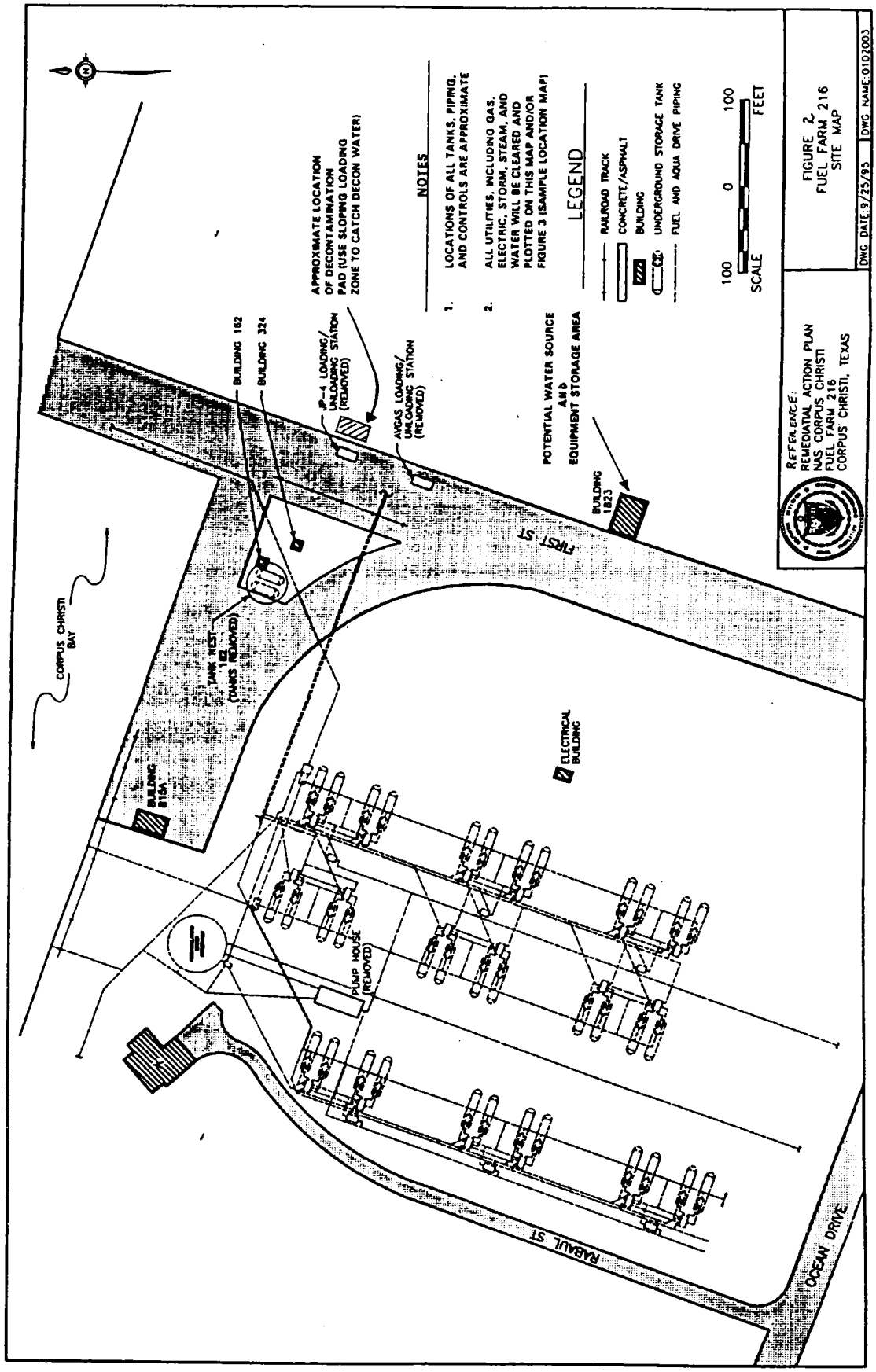


Figure 2
Fuel Farm 216 Site Map

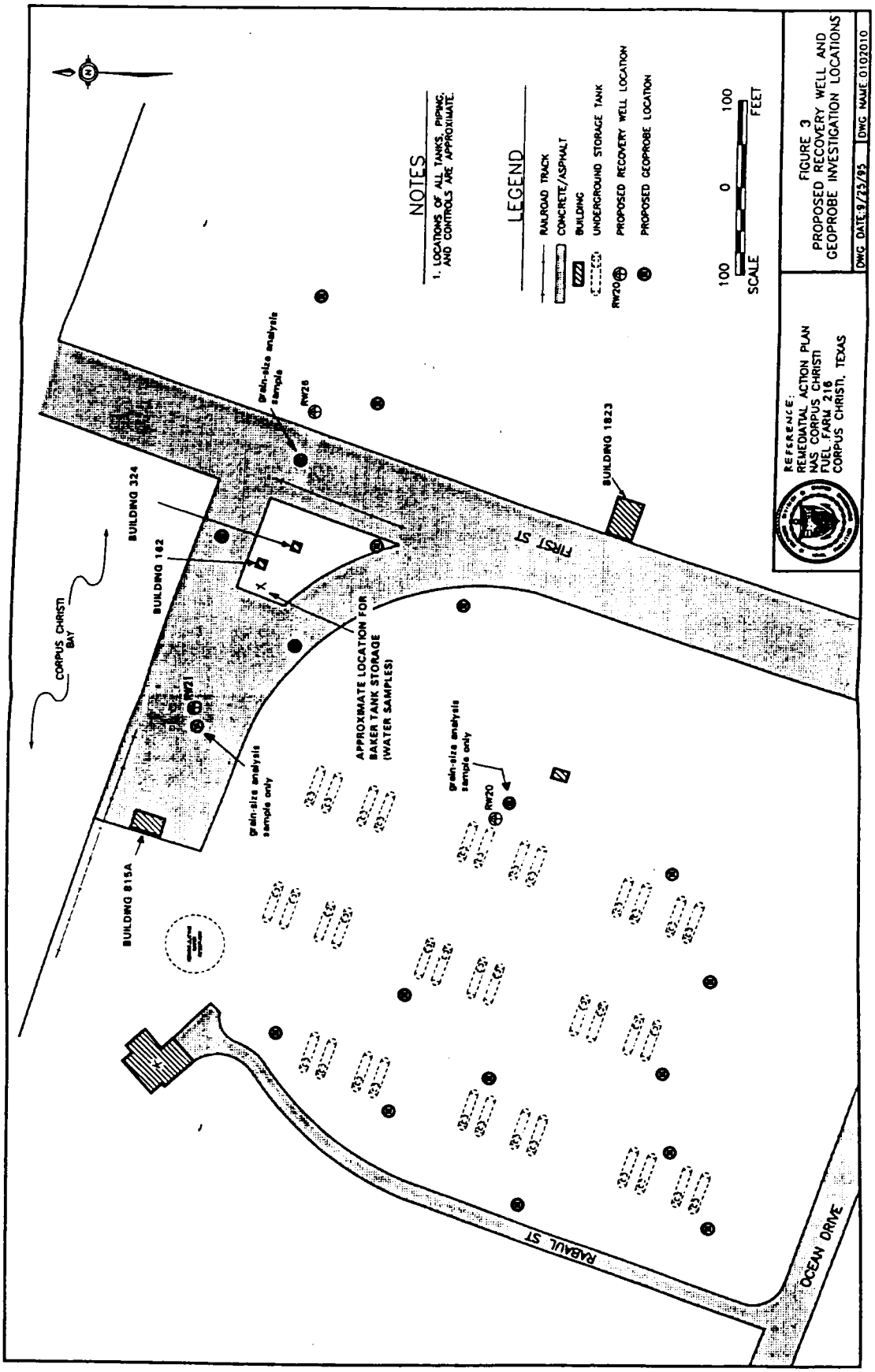


Figure 3
Proposed Recovery Well and Geoprobe Investigation Locations

ATTACHMENT A

FIELD DATASHEETS

A. Water Level Measurement and Product Thickness
B. Soil Boring Log
C. Well Construction Log
D. Well Development Data

Field Datasheet A -- Water Level Measurement and Product Thickness
NAS Corpus Christi
(page 1 of 2)

Date:	
Weather Conditions:	
Field Crew initials:	

Well	Time	Depth to Water (feet below top of PVC)	Depth to Product (feet below top of PVC)	Product Thickness (inches)	Elevation of Top of PVC (ft MSL)	Groundwater Elevation (ft MSL)
MW-2						
MW-3						
MW-4						
MW-5						
MW-7						
MW-8						
MW-9						
MW-10						
MW-12						
MW-13						
MW-14						
MW-16						
MW-18						
MW-19						
MW-20						
MW-21						
MW-22						
MW-23						
MW-24						
MW-25						
MW-26						
MW-27						
MW-28						
MW-29						
RW-1						
RW-2						
RW-3						
RW-13						

Notes:

Field Datasheet A -- Water Level Measurement and Product Thickness
NAS Corpus Christi
(page 2 of 2)

Date:	
Weather Conditions:	
Field Crew initials:	

Boring	Time	Depth to Water (feet below ground surface)	Depth to Product (feet below ground surface)	Product Thickness (inches)	Estimated Ground Elevation (ft MSL)	Notes
SB-14						
SB-15						
SB-16						
SB-17						
SB-18						
SB-19						
SB-20						
SB-21						
SB-22						
SB-23						
SB-24						
SB-25						
SB-26						
SB-27						
SB-28						
SB-29						
SB-30						

Notes:

FIELD DATASHEET B

MK-FERGUSON COMPANY
A MORRISON KNUDSEN CO.

SOIL BOREHOLE LOG

Sheet 1 of

Borehole number:

Project: CORPUS CHRISTI NAS

Location:

Excavation authorization no.:

Drilling sub-con:

Rig model:

Date start:

Finished:

Geologist:

Total depth:

Elevation:

Coordinates:

Boring method and equipment:

Groundwater level	Depth below Surface (feet)	Sample: Interval (LAB SAMPLE)	Sample: Method	Sample: Recovery (inches)	Sample: Retained (inches)	Sample: OVA/hnu screening (ppm)	SPT: 6"-6"-6" / N	Graphic	USCS Classification	Soil Description
	5									name, gradation, percent gravel, color, moisture content, relative density or consistency, soil structure, mineralogy, staining. MKF sample I.D. code AQMS sample I.D. code
	10									
	15									
	20									

BOREHOLE WATER LEVELS (non-static conditions)

While Sampling: ft. | Casing Depth: ft.		While Drilling: ft. | Casing Depth: ft.	
Before Removing Casing: ft. | Total Casing Depth: ft.		Immediately After Removing Casing: ft.	
After Completion : ft. day/time		After Completion: ft. day/time	

KPSTIP 5/18/90

Well Completion Record, Above Ground Completion

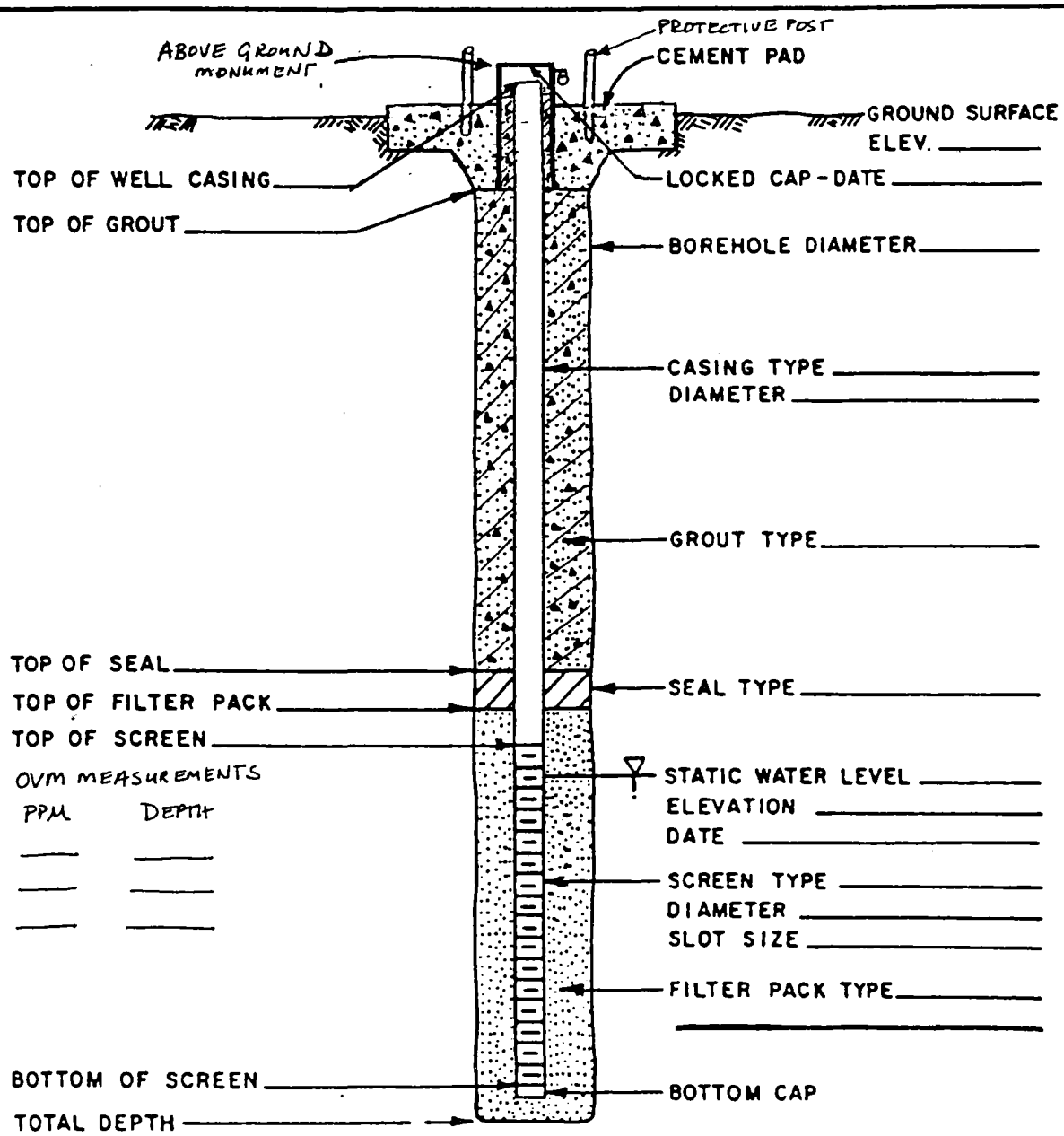
FIELD DATASHEET C

WELL COMPLETION RECORD

PROJECT NAS CORPUS CHRISTI — LOCATION _____

WELL NUMBER _____ — DATE INSTALLED _____

MKE REPRESENTATIVE _____ — DRILLER _____



MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

FIGURE

Field Datasheet D -- Well Development Data
NAS Corpus Christi

Well:	
Date Development Started:	
Date Development Complete:	
Total Volume Removed:	
Development Method(s):	
Field Crew Initials:	

Time	Cumulative Gallons Removed	pH (units)	Conductivity (micromhos/ cm)	Temperature (deg. Celcius)	Appearance

Notes on development:

ATTACHMENT B

SOIL BORING LOGGING GUIDELINES

Designation: D 2488 – 90

Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)[1]

This standard is issued under the fixed designation D 2488; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

1. Scope

1.1 This practice covers procedures for the description of soils for engineering purposes.

1.2 This practice also describes a procedure for identifying soils, at the option of the user, based on the classification system described in Test Method D 2487. The identification is based on visual examination and manual tests. It must be clearly stated in reporting an identification that it is based on visual-manual procedures.

1.2.1 When precise classification of soils for engineering purposes is required, the procedures prescribed in Test Method D 2487 shall be used.

1.2.2 In this practice, the identification portion assigning a group symbol and name is limited to soil particles smaller than 3 in. (75 mm).

1.2.3 The identification portion of this practice is limited to naturally occurring soils (disturbed and undisturbed).

NOTE 1—This practice may be used as a descriptive system applied to such materials as shale, claystone, shells, crushed rock, etc. (See Appendix X2).

1.3 The descriptive information in this practice may be used with other soil classification systems or for materials other than naturally occurring soils.

1.4 *This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For specific precautionary statements see Section 8.

1.5 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[2]

D 1452 Practice for Soil Investigation and Sampling by Auger Borings[2]

D 1586 Method for Penetration Test and Split-Barrel Sampling of Soils[2]

D 1587 Practice for Thin-Walled Tube Sampling of Soils[2]

D 2113 Practice for Diamond Core Drilling for Site Investigation[2]

D 2487 Test Method for Classification of Soils for Engineering Purposes[2]

D 4083 Practice for Description of Frozen Soils (Visual-Manual Procedure)[2]

3. Terminology

3.1 *Definitions:*

3.1.1 Except as listed below, all definitions are in accordance with Terminology D 653.

NOTE 2—For particles retained on a 3-in. (75-mm) US standard sieve, the following definitions are suggested:

Cobbles—particles of rock that will pass a 12-in. (300-mm) square opening and be retained on a 3-in. (75-mm) sieve, and

Boulders—particles of rock that will not pass a 12-in. (300-mm) square opening.

3.1.1.2 *clay*—soil passing a No. 200 (75-μm) sieve that can be made to exhibit plasticity (putty-like properties) within a range of water contents, and that exhibits considerable strength when air-dry. For classification, a clay is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index equal to or greater than 4, and the plot of plasticity index versus liquid limit falls on or above the "A" line (see Fig. 3 of Test Method D 2487).

3.1.1.3 *gravel*—particles of rock that will pass a 3-in. (75-mm) sieve and be retained on a No. 4 (4.75-mm) sieve with the following subdivisions:

coarse—passes a 3-in. (75-mm) sieve and is retained on a ¾-in. (19-mm) sieve.

fine—passes a ¾-in. (19-mm) sieve and is retained on a No. 4 (4.75-mm) sieve.

3.1.1.4 *organic clay*—a clay with sufficient organic content to influence the soil properties. For classification, an organic clay is a soil that would be classified as a clay, except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

3.1.1.5 *organic silt*—a silt with sufficient organic content to influence the soil properties. For classification, an organic silt is a soil that would be classified as a silt except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

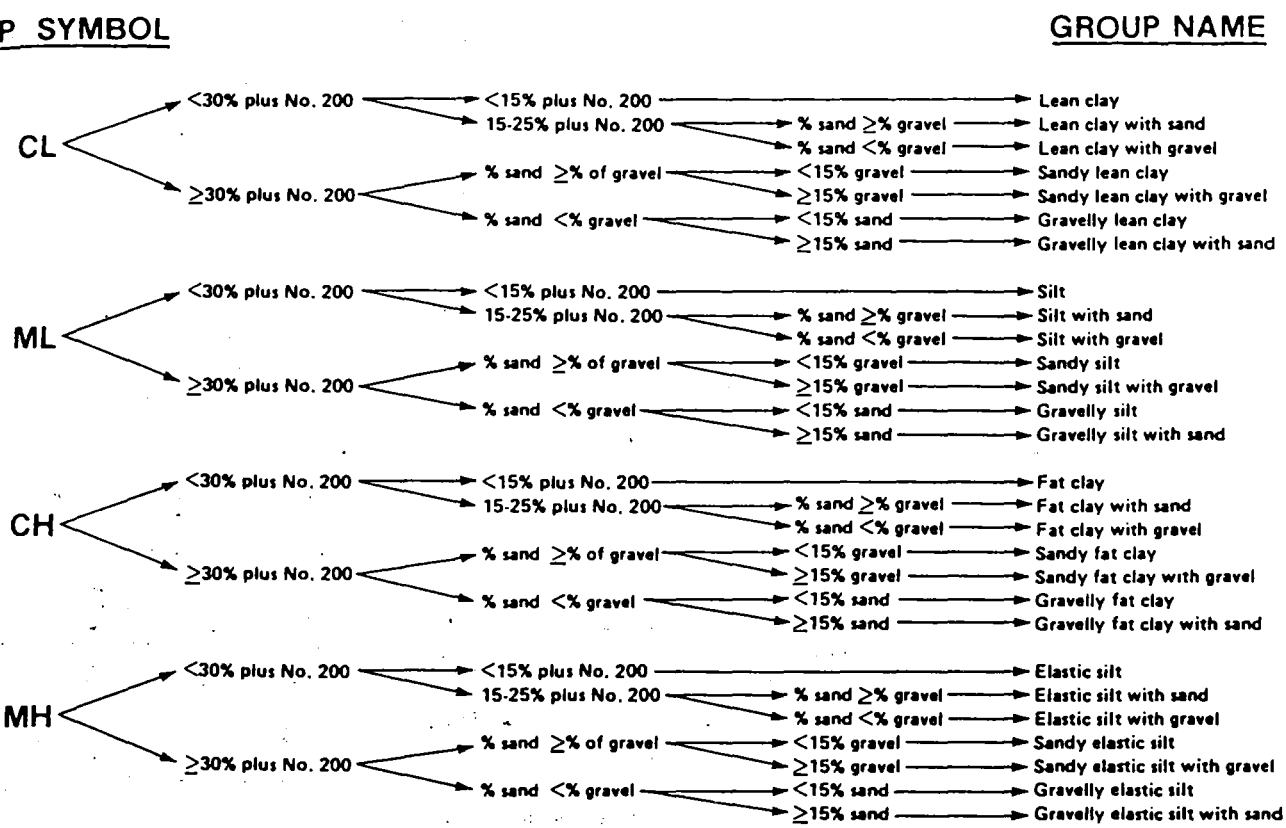
3.1.1.6 *peat*—a soil composed primarily of vegetable tissue in various stages of decomposition usually with an organic odor, a dark brown to black color, a spongy consistency, and a texture ranging from fibrous to amorphous.

3.1.1.7 *sand*—particles of rock that will pass a No.

[1] This practice is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.07 on Identification and Classification of Soils.

Current edition approved June 29, 1990. Published August 1990. Originally published as D 2488 – 66 T. Last previous edition D 2488 – 84[ε1].

[2] *Annual Book of ASTM Standards*, Vol 04.08.



NOTE—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 1a Flow Chart for Identifying Inorganic Fine-Grained Soil (50 % or more fines)

(4.75-mm) sieve and be retained on a No. 200 (75-μm) sieve with the following subdivisions:

coarse—passes a No. 4 (4.75-mm) sieve and is retained on a No. 10 (2.00-mm) sieve.

medium—passes a No. 10 (2.00-mm) sieve and is retained on a No. 40 (425-μm) sieve.

fine—passes a No. 40 (425-μm) sieve and is retained on a No. 200 (75-μm) sieve.

3.1.1.8 *silt*—soil passing a No. 200 (75-μm) sieve that is nonplastic or very slightly plastic and that exhibits little or no strength when air dry. For classification, a silt is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index less than 4, or the plot of plasticity index versus liquid limit falls below the "A" line (see Fig. 3 of Test Method D 2487).

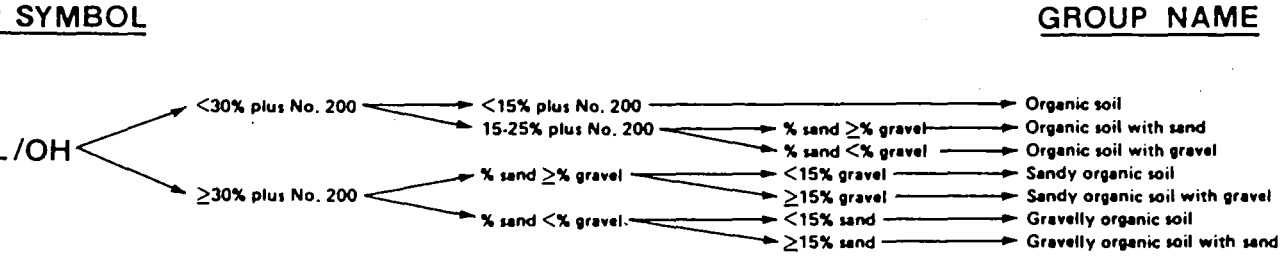
4. Summary of Practice

4.1 Using visual examination and simple manual tests, this practice gives standardized criteria and procedures for describing and identifying soils.

4.2 The soil can be given an identification by assigning a group symbol(s) and name. The flow charts, Figs. 1a and 1b for fine-grained soils, and Fig. 2, for coarse-grained soils, can be used to assign the appropriate group symbol(s) and name. If the soil has properties which do not distinctly place it into a specific group, borderline symbols may be used, see Appendix X3.

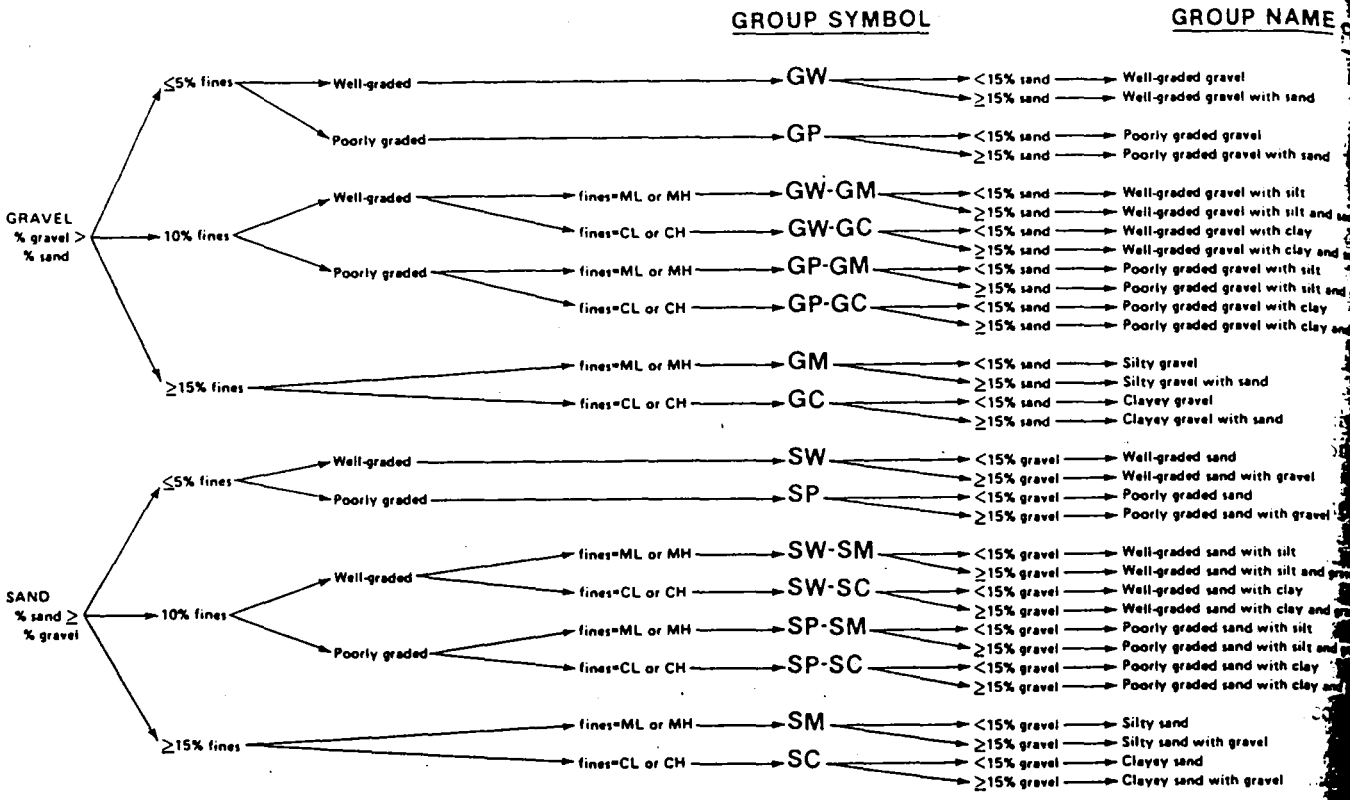
NOTE 3—It is suggested that a distinction be made between *dual symbols* and *borderline symbols*.

Dual Symbol—A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC, CL-ML used to indicate that the soil has been identified as having the properties of a classification in accordance with Test Method D 2487 where two symbols are required. Two symbols are required when the soil has between 5 and 12 % fines or



NOTE—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 1b Flow Chart for Identifying Organic Fine-Grained Soil (50 % or more fines)



NOTE—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 2 Flow Chart for Identifying Coarse-Grained Soils (less than 50 % fines)

when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart.

Borderline Symbol—A borderline symbol is two symbols separated by a slash, for example, CL/CH, GM/SM, CL/ML. A borderline symbol should be used to indicate that the soil has been identified as having properties that do not distinctly place the soil into a specific group (see Appendix X3).

5. Significance and Use

5.1 The descriptive information required in this practice can be used to describe a soil to aid in the evaluation of its significant properties for engineering use.

5.2 The descriptive information required in this practice should be used to supplement the classification of a soil as determined by Test Method D 2487.

5.3 This practice may be used in identifying soils using the classification group symbols and names as prescribed in Test Method D 2487. Since the names and symbols used in this practice to identify the soils are the same as those used in Test Method D 2487, it shall be clearly stated in reports and all other appropriate documents, that the classification symbol and name are based on visual-manual procedures.

5.4 This practice is to be used not only for identification of soils in the field, but also in the office, laboratory, or wherever soil samples are inspected and described.

5.5 This practice has particular value in grouping similar soil samples so that only a minimum number of laboratory tests need be run for positive soil classification.

NOTE 4—The ability to describe and identify soils correctly is learned more readily under the guidance of experienced personnel, but it may also be acquired systematically by comparing numerical laboratory test results for typical soils of each type with their visual and ma characteristics.

5.6 When describing and identifying soil samples fro given boring, test pit, or group of borings or pits, it is necessary to follow all of the procedures in this practic every sample. Soils which appear to be similar ca grouped together; one sample completely described identified with the others referred to as similar base performing only a few of the descriptive and identifica procedures described in this practice.

5.7 This practice may be used in combination Practice D 4083 when working with frozen soils.

6. Apparatus

6.1 *Required Apparatus:*

6.1.1 *Pocket Knife or Small Spatula.*

6.2 *Useful Auxiliary Apparatus:*

6.2.1 *Small Test Tube and Stopper* (or jar with a lid)

6.2.2 *Small Hand Lens.*

7. Reagents

7.1 *Purity of Water*—Unless otherwise indicated, r ences to water shall be understood to mean water from a water supply or natural source, including non-potable

7.2 *Hydrochloric Acid*—A small bottle of dilute h chloric acid, HCl, one part HCl (10 *N*) to three parts (This reagent is optional for use with this practice Section 8.

(a) Rounded (b) Angular

(c) Subrounded (d) Subangular

FIG. 3 Typical Angularity of Bulky Grains

8. Safety Precautions

8.1 When preparing the dilute HCl solution of one part concentrated hydrochloric acid (10 *N*) to three parts of distilled water, slowly add acid into water following necessary safety precautions. Handle with caution and store safely. If solution comes into contact with the skin, rinse thoroughly with water.

8.2 **Caution**—Do not add water to acid.

9. Sampling

9.1 The sample shall be considered to be representative of the stratum from which it was obtained by an appropriate, accepted, or standard procedure.

NOTE 5—Preferably, the sampling procedure should be identified as having been conducted in accordance with Practices D 1452, D 1587, or D 2113, or Method D 1586.

9.2 The sample shall be carefully identified as to origin.

NOTE 6—Remarks as to the origin may take the form of a boring number and sample number in conjunction with a job number, a pedologic stratum, a pedologic horizon or a location description with respect to a permanent monument, a grid system or a station number and offset with respect to a stated centerline and a depth or elevation.

9.3 For accurate description and identification, the minimum amount of the specimen to be examined shall be in accordance with the following schedule:

Maximum Particle Size, Sieve Opening	Minimum Specimen Size, Dry Weight
4.75 mm (No. 4)	100 g (0..5 lb)
9.5 mm (⅜ in.)	200 g (0.5 lb)
19.0 mm (¾ in.)	1.0 kg (2.2 lb)
38.1 mm (1½ in.)	8.0 kg (18 lb)
75.0 mm (3 in.)	60.0 kg (132 lb)

NOTE 7—If random isolated particles are encountered that are significantly larger than the particles in the soil matrix, the soil matrix can be accurately described and identified in accordance with the preceeding schedule.

9.4 If the field sample or specimen being examined is smaller than the minimum recommended amount, the report shall include an appropriate remark.

TABLE 1 Criteria for Describing Angularity of Coarse-Grained Particles (see Fig. 3)

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

10. Descriptive Information for Soils

10.1 *Angularity*—Describe the angularity of the sand (coarse sizes only), gravel, cobbles, and boulders, as angular, subangular, subrounded, or rounded in accordance with the criteria in Table 1 and Fig. 3. A range of angularity may be stated, such as: subrounded to rounded.

10.2 *Shape*—Describe the shape of the gravel, cobbles, and boulders as flat, elongated, or flat and elongated if they meet the criteria in Table 2 and Fig. 4. Otherwise, do not mention the shape. Indicate the fraction of the particles that have the shape, such as: one-third of the gravel particles are flat.

10.3 *Color*—Describe the color. Color is an important property in identifying organic soils, and within a given

TABLE 2 Criteria for Describing Particle Shape (see Fig. 4)

The particle shape shall be described as follows where length, width, and thickness refer to the greatest, intermediate, and least dimensions of a particle, respectively.

Flat	Particles with width/thickness > 3
Elongated	Particles with length/width > 3
Flat and elongated	Particles meet criteria for both flat and elongated

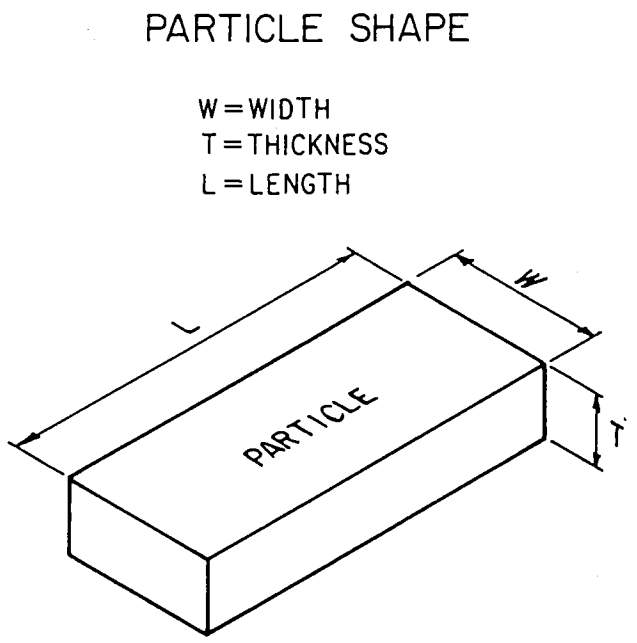


FIG. 4 Criteria for Particle Shape

TABLE 3 Criteria for Describing Moisture Condition

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

locality it may also be useful in identifying materials of similar geologic origin. If the sample contains layers or patches of varying colors, this shall be noted and all representative colors shall be described. The color shall be described for moist samples. If the color represents a dry condition, this shall be stated in the report.

10.4 *Odor*—Describe the odor if organic or unusual. Soils containing a significant amount of organic material usually have a distinctive odor of decaying vegetation. This is especially apparent in fresh samples, but if the samples are dried, the odor may often be revived by heating a moistened sample. If the odor is unusual (petroleum product, chemical, and the like), it shall be described.

10.5 *Moisture Condition*—Describe the moisture condition as dry, moist, or wet, in accordance with the criteria in Table 3.

10.6 *HCl Reaction*—Describe the reaction with HCl as none, weak, or strong, in accordance with the critera in Table 4. Since calcium carbonate is a common cementing agent, a report of its presence on the basis of the reaction with dilute hydrochloric acid is important.

TABLE 4 Criteria for Describing the Reaction With HCl

Description	Criteria
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immed

TABLE 5 Criteria for Describing Consistency

Description	Criteria
Very soft	Thumb will penetrate soil more than 1 in. (25 mm)
Soft	Thumb will penetrate soil about 1 in. (25 mm)
Firm	Thumb will indent soil about ¼ in. (6 mm)
Hard	Thumb will not indent soil but readily indented with thum
Very hard	Thumbnail will not indent soil

10.7 *Consistency*—For intact fine-grained soil, des the consistency as very soft, soft, firm, hard, or very har accordance with the criteria in Table 5. This observati inappropriate for soils with significant amounts of grav

10.8 *Cementation*—Describe the cementation of in coarse-grained soils as weak, moderate, or strong, in acc ance with the criteria in Table 6.

10.9 *Structure*—Describe the structure of intact soi accordance with the criteria in Table 7.

10.10 *Range of Particle Sizes*—For gravel and sand ponents, describe the range of particle sizes within component as defined in 3.1.2 and 3.1.6. For example, a 20 % fine to coarse gravel, about 40 % fine to coarse sa

10.11 *Maximum Particle Size*—Describe the maxim particle size found in the sample in accordance with following information:

10.11.1 *Sand Size*—If the maximum particle size sand size, describe as fine, medium, or coarse as define 3.1.6. For example: maximum particle size, medium sa

10.11.2 *Gravel Size*—If the maximum particle size gravel size, describe the maximum particle size as smallest sieve opening that the particle will pass. example, maximum particle size, 1½ in. (will pass a square opening but not a ¾-in. square opening).

10.11.3 *Cobble or Boulder Size*—If the maximum pa size is a cobble or boulder size, describe the maxim dimension of the largest particle. For example: maxim dimension, 18 in. (450 mm).

10.12 *Hardness*—Describe the hardness of coarse and larger particles as hard, or state what happens whe particles are hit by a hammer, for example, grave particles fracture with considerable hammer blow, gravel-size particles crumble with hammer blow. "H means particles do not crack, fracture, or crumble un hammer blow.

10.13 Additional comments shall be noted, such a presence of roots or root holes, difficulty in drillin augering hole, caving of trench or hole, or the presen mica.

10.14 A local or commercial name or a geologic int

TABLE 6 Criteria for Describing Cementation

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pres
Moderate	Crumbles or breaks with considerable finger pressu
Strong	Will not crumble or break with finger pressure

TABLE 7 Criteria for Describing Structure

Description	Criteria
[illegible]	Alternating layers of varying material or color with layers at least 6 mm thick; note thickness
[illegible]	Alternating layers of varying material or color with the layers less than 6 mm thick; note thickness
[illegible]	Breaks along definite planes of fracture with little resistance to fracturing
[illegible]sided	Fracture planes appear polished or glossy, sometimes striated
[illegible]ky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
[illegible]	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness
[illegible]mogeneous	Same color and appearance throughout

[illegible]ion of the soil, or both, may be added if identified as such.

10.15 A classification or identification of the soil in accordance with other classification systems may be added if identified as such.

11. Identification of Peat

11.1 A sample composed primarily of vegetable tissue in various stages of decomposition that has a fibrous to amorphous texture, usually a dark brown to black color, and an organic odor, shall be designated as a highly organic soil and shall be identified as peat, PT, and not subjected to the identification procedures described hereafter.

12. Preparation for Identification

12.1 The soil identification portion of this practice is based on the portion of the soil sample that will pass a 3-in. (75-mm) sieve. The larger than 3-in. (75-mm) particles must be removed, manually, for a loose sample, or mentally, for an intact sample before classifying the soil.

12.2 Estimate and note the percentage of cobbles and the percentage of boulders. Performed visually, these estimates shall be on the basis of volume percentage.

NOTE 8—Since the percentages of the particle-size distribution in Test Method D 2487 are by dry weight, and the estimates of percentages of gravel, sand, and fines in this practice are by dry weight, it is recommended that the report state that the percentages of cobbles and boulders are by volume.

12.3 Of the fraction of the soil smaller than 3 in. (75 mm), estimate and note the percentage, by dry weight, of the gravel, sand, and fines (see Appendix X4 for suggested procedures).

NOTE 9—Since the particle-size components appear visually on the basis of volume, considerable experience is required to estimate the percentages on the basis of dry weight. Frequent comparisons with laboratory particle-size analyses should be made.

12.3.1 The percentages shall be estimated to the closest 5 %. The percentages of gravel, sand, and fines must add up to 100 %.

12.3.2 If one of the components is present but not in sufficient quantity to be considered 5 % of the smaller than 3-in. (75-mm) portion, indicate its presence by the term trace, for example, trace of fines. A trace is not to be considered in the total of 100 % for the components.

13. Preliminary Identification

13.1 The soil is *fine grained* if it contains 50 % or more fines. Follow the procedures for identifying fine-grained soils of Section 14.

13.2 The soil is *coarse grained* if it contains less than 50 % fines. Follow the procedures for identifying coarse-grained soils of Section 15.

14. Procedure for Identifying Fine-Grained Soils

14.1 Select a representative sample of the material for examination. Remove particles larger than the No. 40 sieve (medium sand and larger) until a specimen equivalent to about a handful of material is available. Use this specimen for performing the dry strength, dilatancy, and toughness tests.

14.2 *Dry Strength:*

14.2.1 From the specimen, select enough material to mold into a ball about 1 in. (25 mm) in diameter. Mold the material until it has the consistency of putty, adding water if necessary.

14.2.2 From the molded material, make at least three test specimens. A test specimen shall be a ball of material about ½ in. (12 mm) in diameter. Allow the test specimens to dry in air, or sun, or by artificial means, as long as the temperature does not exceed 60°C.

14.2.3 If the test specimen contains natural dry lumps, those that are about ½ in. (12 mm) in diameter may be used in place of the molded balls.

NOTE 10—The process of molding and drying usually produces higher strengths than are found in natural dry lumps of soil.

14.2.4 Test the strength of the dry balls or lumps by crushing between the fingers. Note the strength as none, low, medium, high, or very high in accorance with the criteria in Table 8. If natural dry lumps are used, do not use the results of any of the lumps that are found to contain particles of coarse sand.

14.2.5 The presence of high-strength water-soluble cementing materials, such as calcium carbonate, may cause exceptionally high dry strengths. The presence of calcium carbonate can usually be detected from the intensity of the reaction with dilute hydrochloric acid (see 10.6).

14.3 *Dilatancy:*

14.3.1 From the specimen, select enough material to mold into a ball about ½ in. (12 mm) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.

14.3.2 Smooth the soil ball in the palm of one hand with the blade of a knife or small spatula. Shake horizontally, striking the side of the hand vigorously against the other hand several times. Note the reaction of water appearing on

TABLE 8 Criteria for Describing Dry Strength

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling
Low	The dry specimen crumbles into powder with some finger pressure
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface
Very high	The dry specimen cannot be broken between the thumb and a hard surface

TABLE 9 Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing

TABLE 10 Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness

the surface of the soil. Squeeze the sample by closing the hand or pinching the soil between the fingers, and note the reaction as none, slow, or rapid in accordance with the criteria in Table 9. The reaction is the speed with which water appears while shaking, and disappears while squeezing.

14.4 *Toughness:*

14.4.1 Following the completion of the dilatancy test, the test specimen is shaped into an elongated pat and rolled by hand on a smooth surface or between the palms into a thread about ⅛ in. (3 mm) in diameter. (If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation.) Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about ⅛ in. The thread will crumble at a diameter of ⅛ in. when the soil is near the plastic limit. Note the pressure required to roll the thread near the plastic limit. Also, note the strength of the thread. After the thread crumbles, the pieces should be lumped together and kneaded until the lump crumbles. Note the toughness of the material during kneading.

14.4.2 Describe the toughness of the thread and lump as low, medium, or high in accordance with the criteria in Table 10.

14.5 *Plasticity*—On the basis of observations made during the toughness test, describe the plasticity of the material in accordance with the criteria given in Table 11.

14.6 Decide whether the soil is an *inorganic* or an *organic* fine-grained soil (see 14.8). If inorganic, follow the steps given in 14.7.

14.7 *Identification of Inorganic Fine-Grained Soils:*

TABLE 11 Criteria for Describing Plasticity

Description	Criteria
Nonplastic	A ⅛-in. (3-mm) thread cannot be rolled at any water content
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

14.7.1 Identify the soil as a *lean clay*, CL, if th... medium to high dry strength, no or slow dilat... medium toughness and plasticity (see Table 12).

14.7.2 Identify the soil as a *fat clay*, CH, if th... high to very high dry strength, no dilatancy, ... toughness and plasticity (see Table 12).

14.7.3 Identify the soil as a *silt*, ML, if the soil ... low dry strength, slow to rapid dilatancy, and low ... and plasticity, or is nonplastic (see Table 12).

14.7.4 Identify the soil as an *elastic silt*, MH, if th... low to medium dry strength, no to slow dilatancy, a... medium toughness and plasticity (see Table 12).

NOTE 11—These properties are similar to those for a... However, the silt will dry quickly on the hand and have a sm... feel when dry. Some soils that would classify as MH in accord... the criteria in Test Method D 2487 are visually difficult to ... from lean clays, CL. It may be necessary to perform laborat... for proper identification.

14.8 *Identification of Organic Fine-Grained Soils:*

14.8.1 Identify the soil as an *organic soil*, OL/OH, ... soil contains enough organic particles to influenc... properties. Organic soils usually have a dark brown ... color and may have an organic odor. Often, organic ... change color, for example, black to brown, when ex... the air. Some organic soils will lighten in color sign... when air dried. Organic soils normally will not ha... toughness or plasticity. The thread for the toughnes... be spongy.

NOTE 12—In some cases, through practice and experience ... possible to further identify the organic soils as organic silts ... clays, OL or OH. Correlations between the dilatancy, dry ... toughness tests, and laboratory tests can be made to identify or ... in certain deposits of similar materials of known geologic ori...

14.9 If the soil is estimated to have 15 to 25 ... gravel, or both, the words "with sand" or "with ... (whichever is more predominant) shall be added to th... name. For example: "lean clay with sand, CL" or ... gravel, ML" (see Figs. 1a and 1b). If the percentage of ... equal to the percentage of gravel, use "with sand."

14.10 If the soil is estimated to have 30 % or more ... gravel, or both, the words "sandy" or "gravelly" ... added to the group name. Add the word "sandy" ... appears to be more sand than gravel. Add ... "gravelly" if there appears to be more gravel than sa... example: "sandy lean clay, CL", "gravelly fat clay, ... "sandy silt, ML" (see Figs. 1a and 1b). If the percen... sand is equal to the percent of gravel, use "sandy."

15. Procedure for Identifying Coarse-Grained Soils (... tains less than 50 % fines)

15.1 The soil is a *gravel* if the percentage of g... estimated to be more than the percentage of sand.

TABLE 12 Identification of Inorganic Fine-Grained Soils ... Manual Tests

Soil Symbol	Dry Strength	Dilatancy	Toughn...
ML	None to low	Slow to rapid	Low or thread ... formed
CL	Medium to high	None to slow	Medium
MH	Low to medium	None to slow	Low to mediu...
CH	High to very high	None	High

15.2 The soil is a *sand* if the percentage of gravel is estimated to be equal to or less than the percentage of sand.

15.3 The soil is a *clean gravel* or *clean sand* if the percentage of fines is estimated to be 5 % or less.

15.3.1 Identify the soil as a *well-graded gravel*, GW, or as *well-graded sand*, SW, if it has a wide range of particle sizes and substantial amounts of the intermediate particle sizes.

15.3.2 Identify the soil as a *poorly graded gravel*, GP, or as *poorly graded sand*, SP, if it consists predominantly of one size (uniformly graded), or it has a wide range of sizes with some intermediate sizes obviously missing (gap or skip graded).

15.4 The soil is either a *gravel with fines* or a *sand with fines* if the percentage of fines is estimated to be 15 % or more.

15.4.1 Identify the soil as a *clayey gravel*, GC, or a *clayey sand*, SC, if the fines are clayey as determined by the procedures in Section 14.

15.4.2 Identify the soil as a *silty gravel*, GM, or a *silty sand*, SM, if the fines are silty as determined by the procedures in Section 14.

15.5 If the soil is estimated to contain 10 % fines, give the soil a dual identification using two group symbols.

15.5.1 The first group symbol shall correspond to a clean gravel or sand (GW, GP, SW, SP) and the second symbol shall correspond to a gravel or sand with fines (GC, GM, SC, SM), for example:

15.5.2 The group name shall correspond to the first group symbol plus the words "with clay" or "with silt" to indicate the plasticity characteristics of the fines. For example: "well-graded gravel with clay, GW-GC" or "poorly graded sand with silt, SP-SM" (see Fig. 2).

15.6 If the specimen is predominantly sand or gravel but contains an estimated 15 % or more of the other coarse-grained constituent, the words "with gravel" or "with sand" shall be added to the group name. For example: "poorly graded gravel with sand, GP" or "clayey sand with gravel, GC" (see Fig. 2).

15.7 If the field sample contains any cobbles or boulders, or both, the words "with cobbles" or "with cobbles and boulders" shall be added to the group name. For example: "silty gravel with cobbles, GM."

16. Report

16.1 The report shall include the information as to origin, and the items indicated in Table 13.

NOTE 13—*Example: Clayey Gravel with Sand and Cobbles, GC*—About 50 % fine to coarse, subrounded to subangular gravel; about 30 % fine to coarse, subrounded sand; about 20 % fines with medium plasticity, high dry strength, no dilatancy, medium toughness; weak reaction with HCl; original field sample had about 5 % (by volume) subrounded cobbles, maximum dimension, 150 mm.

In-Place Conditions—Firm, homogeneous, dry, brown

Geologic Interpretation—Alluvial fan

NOTE 14—Other examples of soil descriptions and identification are given in Appendixes X1 and X2.

NOTE 15—If desired, the percentages of gravel, sand, and fines may be stated in terms indicating a range of percentages, as follows:

Trace—Particles are present but estimated to be less than 5 %
Few—5 to 10 %
Little—15 to 25 %
Some—30 to 45 %
Mostly—50 to 100 %

16.2 If, in the soil description, the soil is identified using a classification group symbol and name as described in Test Method D 2487, it must be distinctly and clearly stated in log forms, summary tables, reports, and the like, that the symbol and name are based on visual-manual procedures.

TABLE 13 Checklist for Description of Soils

1. Group name
2. Group symbol
3. Percent of cobbles or boulders, or both (by volume)
4. Percent of gravel, sand, or fines, or all three (by dry weight)
5. Particle-size range:
   Gravel—fine, coarse
   Sand—fine, medium, coarse
6. Particle angularity: angular, subangular, subrounded, rounded
7. Particle shape: (if appropriate) flat, elongated, flat and elongated
8. Maximum particle size or dimension
9. Hardness of coarse sand and larger particles
10. Plasticity of fines: nonplastic, low, medium, high
11. Dry strength: none, low, medium, high, very high
12. Dilatancy: none, slow, rapid
13. Toughness: low, medium, high
14. Color (in moist condition)
15. Odor (mention only if organic or unusual)
16. Moisture: dry, moist, wet
17. Reaction with HCl: none, weak, strong

For intact samples:

18. Consistency (fine-grained soils only): very soft, soft, firm, hard, very hard
19. Structure: stratified, laminated, fissured, slickensided, lensed, homogeneous
20. Cementation: weak, moderate, strong
21. Local name
22. Geologic interpretation
23. Additional comments: presence of roots or root holes, presence of mica, gypsum, etc., surface coatings on coarse-grained particles, caving or sloughing of auger hole or trench sides, difficulty in augering or excavating, etc.

17. Precision and Bias

17.1 This practice provides qualitative information only, therefore, a precision and bias statement is not applicable.

18. Keywords

18.1 classification; clay; gravel; organic soils; sand; silt; soil classification; soil description; visual classification

ATTACHMENT C

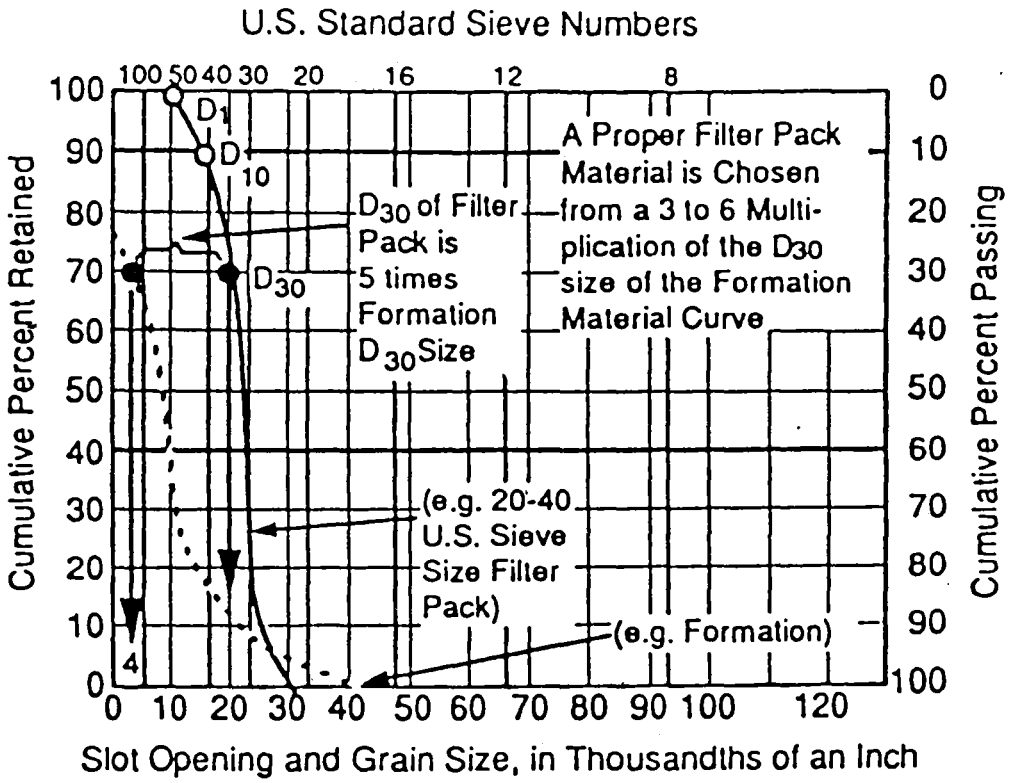
SIEVE ANALYSIS PROCEDURES

SIEVE ANALYSIS PROCEDURE

Basically the sieve analysis consists of the following steps:

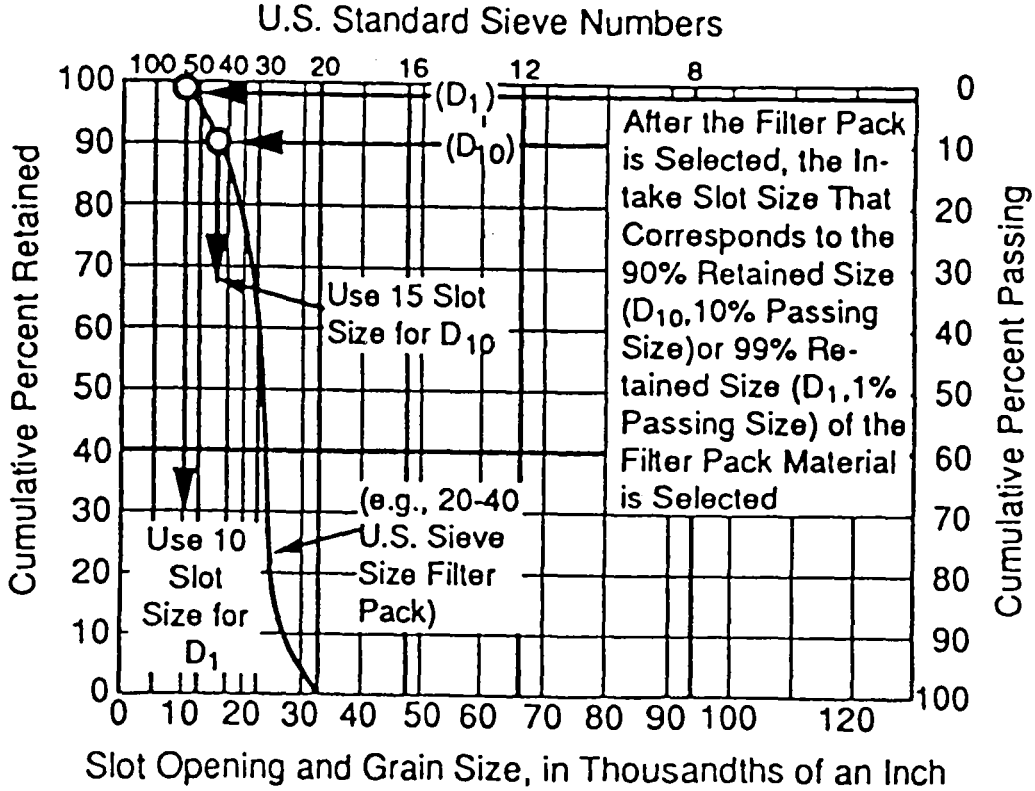
1. Obtain a representative sample of the water-bearing formation soils.
2. If the sample is wet or moist, allow the sample to air dry or dry the sample in an oven at a temperature not exceeding 140°F.
3. Break thoroughly any aggregates of particles using mortal and pestle or other suitable device. Weigh the dry sample.
4. Sieve the resulting sample through a representative stack of sieves and weighing the amount of soil retained on each sieve. Use standard sieve numbers 10 through 200 (primarily 10, 20, 40, 50, 60, 100 and 200). The sieve stack used should contain a sufficient number of sieve sizes to adequately define a curve.
5. Compute the percent retained by each sieve in the stack. Weigh the amount retained by each sieve and calculate the percent retained (or percent finer). Graph grain size (thousandths of an inch) vs. percent retained (y-value). Use the attached graph as a guide.
6. Once the grain-size distribution curve is completed, provide the results to the project manager for review. Following interpretation by the site staff or by an outside well component supplier, confirm the well design details (sandpack gradation and well slot size) proposed in the RAP.

The ASTM procedures for particle-size analysis of soils are also attached. This information is particularly useful if grain size information for particles passing the no. 200 sieve is required.



Artificial filter pack design criteria.

formation



Selecting well intake slot size based on filter pack grain size.

Designation: D 2217 – 85

Standard Practice for Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants[1]

This standard is issued under the fixed designation D 2217; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This practice has been approved for use by agencies of the Department of Defense and for listing in the DoD Index of Specifications and Standards.

1. Scope

1.1 This practice covers the wet preparation of soil samples as received from the field for particle-size analysis and determination of soil constants.

1.2 Procedure A provides for drying the field sample at a temperature not exceeding 140°F (60°C), making a wet separation on the No. 10 (2.00-mm) sieve, or No. 40 (425-μm) sieve, or both, as needed, and finally drying at a temperature not exceeding 140°F. Procedure B provides that the sample shall be kept at a moisture content equal to or greater than the natural water content. The procedure to be used should be indicated in the specification for the material being tested. If no procedure is specified, the provisions of Procedure B shall govern.

1.3 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 421 Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants[2]

D 422 Method for Particle-Size Analysis of Soils[2]

E 11 Specification for Wire-Cloth Sieves for Testing Purposes[3]

3. Significance and Use

3.1 Procedure A is used to prepare soil samples for plasticity tests and particle-size analysis when the coarse-grained particles of a sample are soft and pulverize readily, as in Practice D 421, or when the fine particles are very cohesive and tend to resist removal from the coarse particles.

3.2 Some soils never dry out in nature and may change their characteristics greatly when dried. If the true natural gradation and plasticity characteristics of such soils are desired, these soils should be shipped to the laborator sealed containers and processed in accordance with Pr dure B of this practice.

3.3 Liquid limit and plasticity index values derived f samples containing their natural moisture are usually not always, equal to or higher than values derived similar samples of the dried soil. In the case of fine-gra organic soil, there is a radical drop in plasticity due to drying.

4. Apparatus

4.1 *Balance*, sensitive to 0.1 g.

4.2 *Mortar and Rubber-Covered Pestle*, suitable breaking up the aggregations of soil particles.

4.3 *Sieves*, No. 10 (2.00-mm) and No. 40 (425-μm square mesh woven-wire cloth, conforming to Specific E 11.

4.4 *Sampler*—A riffle sampler or sample splitte quartering the samples.

4.5 *Drying Apparatus*—Thermostatically cont drying oven for use at 140°F (60°C) or below and at (110°C), infrared lamps; air drier; or other suitable devi drying samples.

4.6 *Filter Funnels or Candles*—Büchner funnels (254 mm) in diameter and filter paper or filter candles

4.7 *Miscellaneous Equipment*—Pans 12 in. (304.8 m diameter and 3 in. (76.2 mm) in depth; a suitable con that will prevent loss of moisture during storage of the test sample prepared in Procedure B.

PROCEDURE A

5. Sampling

5.1 Dry the soil sample as received from the field one of the following methods: (*1*) in air at room tem ture, (*2*) in a drying oven at a temperature not exc 140°F (60°C), or (*3*) using any warming device that w raise the temperature of the sample above 140°F. Br thoroughly any aggregations of particles using the and rubber-covered pestle or other suitable device (N Select a representative portion by the method of qua or by use of the sampler. This portion must be suffic provide samples for particle-size analyses of mate tained on and passing the No. 10 (2.00-mm) sieve provide an adequate amount of material passing the (425-μm) sieve for the tests to determine soil constan amounts of material required to perform the individu are as follows:

[1] This practice is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.03 on Texture, Plasticity, and Density Characteristics of Soils.

Current edition approved July 26, 1985. Published September 1985. Originally published as D 2217 – 63 T. Last previous edition D 2217 – 66 (1978)[ε1].

[2] *Annual Book of ASTM Standards*, Vol 04.08.

[3] *Annual Book of ASTM Standards*, Vol 14.02.

Particle-Size Analysis of Material Retained on No. 10 (2.00-mm) Sieve:	
Gravelly soils, g	4 000 to 10 000
Sandy soils, g	1 500
Silty or clayey soils, g	400
Particle-Size Analysis of Material Passing No. 10 (2.00-mm) Sieve:	
Sandy soils, g	115
Silty or clayey soils, g	65
Tests for Determination of Soil Constants:	
Liquid limit, g	100
Plastic limit, g	15
Centrifuge moisture equivalent, g	10
Shrinkage factors, g	30
Check tests, g	65

NOTE 1—When the sample contains particles of soft shale or sandstone or similar weak material, proper care must be exercised to avoid excessive reduction in the size of the particles.

6. Preparation of Test Samples

6.1 *For Particle-Size Analysis:*

6.1.1 Weigh the portion of the test sample selected for particle-size analysis and record as the weight of test sample uncorrected for hygroscopic moisture. Separate this material into two portions using the No. 10 (2.00-mm) sieve. Set aside the portion passing for later recombination with additional material washed from the portion retained on the No. 10 (2.00-mm) sieve.

6.1.2 Place the material retained on the No. 10 (2.00-mm) sieve in a pan, cover with water, and allow to soak until the particle aggregations become soft. After soaking, wash the material on a No. 10 (2.00-mm) sieve in the following manner: Place an empty No. 10 (2.00-mm) sieve on the bottom of a clean pan and pour the water from the soaked sample into the sieve. Add sufficient water to bring the level approximately ½ in. (12.7 mm) above the mesh of the sieve. Transfer the soaked material to the sieve in increments not exceeding 1 lb (0.45 kg), stirring each increment with the fingers while agitating the sieve up and down. Crumble or mash any lumps that have not slaked, using the thumb and fingers. Raise the sieve above the water in the pan and complete the washing operation using a small amount of clean water. Transfer the washed material on the sieve to a clean pan before placing another increment of soaked material on the sieve.

6.1.3 Dry the material retained on the No. 10 (2.00-mm) sieve at a temperature of 230 ± 9°F (110 ± 5°C), sieve on the No. 10 (2.00-mm) sieve, and add the material passing the sieve to similar material obtained in 6.1.1. Set aside the material retained on the sieve for use in the particle-size analysis.

6.1.4 Set aside the pan containing the washings for a period of several hours or until the water above the particles is clear. Decant, pipet, or siphon off as much of the clear water as possible (Note 2). Dry the soil remaining in the pan at a temperature not exceeding 140°F (60°C). Grind the dried soil in the mortar with the rubber-covered pestle or other suitable device, and combine with similar material obtained in 6.1.1.

6.1.5 Alternatively, after all the soaked material has been washed, remove most of the water by filtering the wash water on one or more Büchner funnels fitted with filter paper or by using filter candles. Remove the moist soil from the filter paper or filter candles, combine with any sediment remaining in the pan, and dry at a temperature not exceeding 140°F (60°C). Grind the dried soil in the mortar with a rubber-covered pestle or other suitable device and combine with similar material obtained in 6.1.1.

NOTE 2—In some instances, the wash water will not become clear in a reasonable length of time; in this case the entire volume must be evaporated.

6.2 *For Determination of Soil Constants*—Proceed in accordance with 6.1, substituting a No. 40 (425-μm) sieve for the No. 10 (2.00-mm) sieve.

NOTE 3—In some areas it is possible that the cations of salts present in the tap water may exchange with the natural cations in the soil and alter significantly the values of the soil constants should tap water be used in the soaking and washing operations. Unless it is known that such cations are not present in the tap water, distilled or demineralized water should be used. The soaking and washing operation will remove soluble salts contained in the soil. When soluble salts are present in the soil, the wash water should be saved and evaporated, and the salts returned to the soil sample.

7. Test Samples

7.1 Keeping each portion separate from the other portion, mix thoroughly the portions of the soil sample passing the No. 10 (2.00-mm) sieve and the No. 40 (425-μm) sieve. By the method of quartering or by the use of the sampler, select and weigh out test samples of the weights indicated in Section 5, as may be needed to make the required tests.

PROCEDURE B

8. Samples

8.1 Samples prepared in accordance with this procedure must be shipped from the field to the laboratory in sealed containers and must contain all their natural moisture. Samples obviously containing only particles passing the No. 10 (2.00-mm) sieve may be tested in the particle-size analysis without first washing on the No. 10 (2.00-mm) sieve. Samples obviously containing only particles passing the No. 40 (425-μm) sieve may be used in the tests to determine soil constants without first washing on the No. 40 (425-μm) sieve.

9. Preparation of Test Samples

9.1 *For Particle-Size Analysis:*

9.1.1 Select and weigh a representative portion of the moist sample estimated to contain 50 g of particles passing the No. 10 (2.00-mm) sieve for silty and clayey soil, or 100 g for sandy soil. For samples containing particles not passing the No. 10 (2.00-mm) sieve for which a particle-size analysis is required, select and weigh a representative sample estimated to contain the required amounts of particles both passing and not passing the No. 10 (2.00-mm) sieve. Determine the moisture content at 230 ± 9°F (110 ± 5°C) using an auxiliary sample, for use in Method D 422.

9.1.2 Soak the moist sample and wash on a No. 10 (2.00-mm) sieve as described in 6.1.2. After washing, dry the material retained on the No. 10 (2.00-mm) sieve in an oven at a temperature of 230 ± 9°F (110 ± 5°C), weigh, and retain for the particle-size analysis. If the volume of the wash water and soil is too large for use in the sedimentation procedure of the test for particle-size analysis, evaporate excess water by exposure to air at room temperature, by heating in an oven

at a temperature not exceeding 230°F (110°C), or by boiling. Regardless of the method of evaporation used, the following precautions must be taken: (*1*) stir the slurry from time to time to prevent a dry soil ring from forming on the walls of the evaporation vessel, and (*2*) return the temperature of the sample to room temperature before testing.

9.2 *For Determination of Soil Constants*—Select a representative portion of the moist sample estimated to contain sufficient particles passing the No. 40 (425-μm) sieve to make the required tests for determination of soil constants. Soak this selected portion of the moist sample and wash on the No. 40 (425-μm) sieve as described in 6.2 (Note 2). Reduce the moisture content of the material passing the No. 40 (425-μm) sieve until the mass reaches a putty-like consistency (such as 30 to 35 drops of the cup in the li limit test) but never below the natural moisture co Reduction of moisture content may be accomplish follows: by exposure to air at ordinary room temperatu heating in an oven at a temperature not exceeding (110°C), by boiling, by filtering on a Büchner funnel, o use of filter candles. During evaporation and cooling, st sample often enough to prevent overdrying of the fringe soil pinnacles on the surface. Cool the heated sample normal room temperature before testing. For soil sam containing soluble salts, use a method of water reduc that will not eliminate the soluble salts from the test sam Protect the prepared sample in a suitable container f further drying until all required tests have been perfor

Designation: D 421 – 85

Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants[1]

This standard is issued under the fixed designation D 421; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers the dry preparation of soil samples as received from the field for particle-size analysis and the determination of the soil constants.

1.2 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 2217 Practice for Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants[2]

E 11 Specification for Wire-Cloth Sieves for Testing Purposes[3]

3. Significance and Use

3.1 This practice can be used to prepare samples for particle-size and plasticity tests where it is desired to determine test values on air-dried samples, or where it is known that air drying does not have an effect on test results relative to samples prepared in accordance with Practice D 2217.

4. Apparatus

4.1 *Balance*, sensitive to 0.1 g.

4.2 *Mortar and Rubber-Covered Pestle*, suitable for breaking up the aggregations of soil particles.

4.3 *Sieves*—A series of sieves, of square mesh woven wire cloth, conforming to Specification E 11. The sieves required are as follows:

No. 4 (4.75-mm)
No. 10 (2.00-mm)
No. 40 (425-μm)

4.4 *Sampler*—A riffle sampler or sample splitter, for quartering the samples.

5. Sampling

5.1 Expose the soil sample as received from the field to the air at room temperature until dried thoroughly. Break aggregations thoroughly in the mortar with a rubber-co pestle. Select a representative sample of the amount re to perform the desired tests by the method of quarter by the use of a sampler. The amounts of material requi perform the individual tests are as follows:

5.1.1 *Particle-Size Analysis*—For the particle-size ysis, material passing a No. 10 (2.00-mm) sieve is requi amounts equal to 115 g of sandy soils and 65 g of eith or clay soils.

5.1.2 *Tests for Soil Constants*—For the tests fo constants, material passing the No. 40 (425-μm) si required in total amount of 220 g, allocated as follows

Test	Grams
Liquid limit	100
Plastic limit	15
Centrifuge moisture equivalent	10
Volumetric shrinkage	30
Check tests	65

6. Preparation of Test Sample

6.1 Select that portion of the air-dried sample select purpose of tests and record the mass as the mass of the test sample uncorrected for hygroscopic moisture. Se the test sample by sieving with a No. 10 (2.00-mm) Grind that fraction retained on the No. 10 sieve in a m with a rubber-covered pestle until the aggregations o particles are broken up into the separate grains separate the ground soil into two fractions by sieving No. 10 sieve.

6.2 Wash that fraction retained after the second si free of all fine material, dry, and weigh. Record this m the mass of coarse material. Sieve the coarse material being washed and dried, on the No. 4 (4.75-mm) sie record the mass retained on the No. 4 sieve.

7. Test Sample for Particle-Size Analysis

7.1 Thoroughly mix together the fractions passing th 10 (2.00-mm) sieve in both sieving operations, and b method of quartering or the use of a sampler, select a p weighing approximately 115 g for sandy soils and app mately 65 g for silt and clay soil for particle-size analy

8. Test Sample for Soil Constants

8.1 Separate the remaining portion of the material p the No. 10 (2.00-mm) sieve into two parts by means o 40 (425-μm) sieve. Discard the fraction retained on th 40 sieve. Use the fraction passing the No. 40 sieve fo determination of the soil constants.

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[1] This practice is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.03 on Texture, Plasticity, and Density Characteristics of Soils.

Current edition approved July 26, 1985. Published September 1985. Originally published as D 421 – 35 T. Last previous edition D 421 – 58 (1978)[ε1].

[2] *Annual Book of ASTM Standards*, Vol 04.08.

[3] *Annual Book of ASTM Standards*, Vol 14.02.

Designation: D 422 – 63 (Reapproved 1990)ε1

Standard Test Method for Particle-Size Analysis of Soils[1]

This standard is issued under the fixed designation D 422; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε1 NOTE—Section 19 was added editorially in September 1990.

1. Scope

1.1 This test method covers the quantitative determination of the distribution of particle sizes in soils. The distribution of particle sizes larger than 75 μm (retained on the No. 200 sieve) is determined by sieving, while the distribution of particle sizes smaller than 75 μm is determined by a sedimentation process, using a hydrometer to secure the necessary data (Notes 1 and 2).

NOTE 1—Separation may be made on the No. 4 (4.75-mm), No. 40 (425-μm), or No. 200 (75-μm) sieve instead of the No. 10. For whatever sieve used, the size shall be indicated in the report.

NOTE 2—Two types of dispersion devices are provided: (*1*) a high-speed mechanical stirrer, and (*2*) air dispersion. Extensive investigations indicate that air-dispersion devices produce a more positive dispersion of plastic soils below the 20-μm size and appreciably less degradation on all sizes when used with sandy soils. Because of the definite advantages favoring air dispersion, its use is recommended. The results from the two types of devices differ in magnitude, depending upon soil type, leading to marked differences in particle size distribution, especially for sizes finer than 20 μm.

2. Referenced Documents

2.1 *ASTM Standards:*

D 421 Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants[2]

E 11 Specification for Wire-Cloth Sieves for Testing Purposes[3]

E 100 Specification for ASTM Hydrometers[4]

3. Apparatus

3.1 *Balances*—A balance sensitive to 0.01 g for weighing the material passing a No. 10 (2.00-mm) sieve, and a balance sensitive to 0.1 % of the mass of the sample to be weighed for weighing the material retained on a No. 10 sieve.

3.2 *Stirring Apparatus*—Either apparatus A or B may be used.

3.2.1 Apparatus A shall consist of a mechanically operated stirring device in which a suitably mounted electric motor turns a vertical shaft at a speed of not less than 10 000 rpm without load. The shaft shall be equipped with a replaceable stirring paddle made of metal, plastic, or hard rubber, as shown in Fig. 1. The shaft shall be of such length that the stirring paddle will operate not less than ¾ in. (19.0 mm) nor more than 1½ in. (38.1 mm) above the bottom of the dispersion cup. A special dispersion cup conforming to either of the designs shown in Fig. 2 shall be provided to hold the sample while it is being dispersed.

3.2.2 Apparatus B shall consist of an air-jet dispersion cup[5] (Note 3) conforming to the general details shown in Fig. 3 (Notes 4 and 5).

NOTE 3—The amount of air required by an air-jet dispersion cup is of the order of 2 ft^3/min; some small air compressors are not capable of supplying sufficient air to operate a cup.

NOTE 4—Another air-type dispersion device, known as a dispersion tube, developed by Chu and Davidson at Iowa State College, has been shown to give results equivalent to those secured by the air-jet dispersion cups. When it is used, soaking of the sample can be done in the sedimentation cylinder, thus eliminating the need for transferring the slurry. When the air-dispersion tube is used, it shall be so indicated in the report.

NOTE 5—Water may condense in air lines when not in use. This water must be removed, either by using a water trap on the air line, or by blowing the water out of the line before using any of the air for dispersion purposes.

3.3 *Hydrometer*—An ASTM hydrometer, graduated to read in either specific gravity of the suspension or grams per litre of suspension, and conforming to the requirements for hydrometers 151H or 152H in Specifications E 100. Dimensions of both hydrometers are the same, the scale being the only item of difference.

3.4 *Sedimentation Cylinder*—A glass cylinder essentially 18 in. (457 mm) in height and 2½ in. (63.5 mm) in diameter, and marked for a volume of 1000 mL. The inside diameter shall be such that the 1000-mL mark is 36 ± 2 cm from the bottom on the inside.

3.5 *Thermometer*—A thermometer accurate to 1°F (0.5°C).

3.6 *Sieves*—A series of sieves, of square-mesh woven-wire cloth, conforming to the requirements of Specification E 11. A full set of sieves includes the following (Note 6):

[1] This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.03 on Texture, Plasticity, and Density Characteristics of Soils.

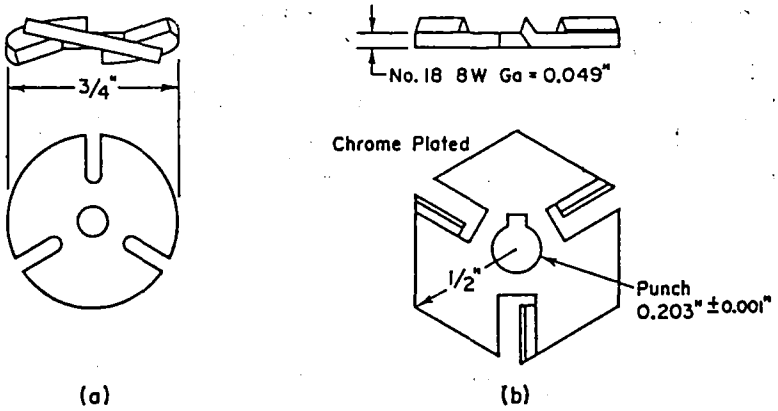
Current edition approved Nov. 21, 1963. Originally published 1935. Replaces D 422 – 62.

[2] *Annual Book of ASTM Standards*, Vol 04.08.

[3] *Annual Book of ASTM Standards*, Vol 14.02.

[4] *Annual Book of ASTM Standards*, Vol 14.03.

[5] Detailed working drawings for this cup are available at a nominal cost from the American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103. Order Adjunct No. 12-404220-00.



Metric Equivalents					
in.	0.001	0.049	0.203	½	¾
mm	0.03	1.24	5.16	12.7	19.0

FIG. 1 Detail of Stirring Paddles

3-in. (75-mm)	No. 10 (2.00-mm)
2-in. (50-mm)	No. 20 (850-μm)
1½-in. (37.5-mm)	No. 40 (425-μm)
1-in. (25.0-mm)	No. 60 (250-μm)
¾-in. (19.0-mm)	No. 140 (106-μm)
⅜-in. (9.5-mm)	No. 200 (75-μm)
No. 4 (4.75-mm)	

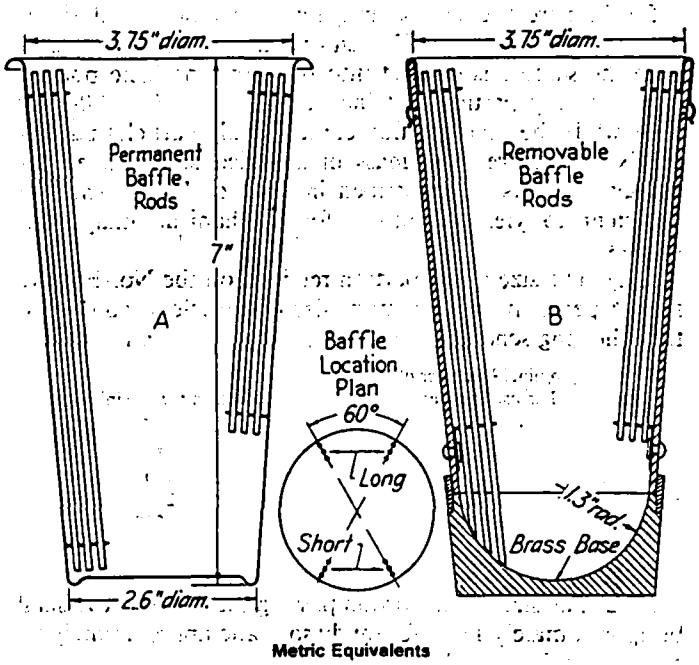
NOTE 6—A set of sieves giving uniform spacing of points for the graph, as required in Section 17, may be used if desired. This set consists of the following sieves:

3-in. (75-mm)	No. 16 (1.18-mm)
1½-in. (37.5-mm)	No. 30 (600-μm)
¾-in. (19.0-mm)	No. 50 (300-μm)
⅜-in. (9.5-mm)	No. 100 (150-μm)
No. 4 (4.75-mm)	No. 200 (75-μm)
No. 8 (2.36-mm)	

3.7 *Water Bath or Constant-Temperature Room*—A water bath or constant-temperature room for maintaining the soil suspension at a constant temperature during the hydrometer analysis. A satisfactory water tank is an insulated tank that maintains the temperature of the suspension at a convenient constant temperature at or near 68°F (20°C). Such a device is illustrated in Fig. 4. In cases where the work is performed in a room at an automatically controlled constant temperature, the water bath is not necessary.

3.8 *Beaker*—A beaker of 250-mL capacity.

3.9 *Timing Device*—A watch or clock with a second hand.



Metric Equivalents			
in.	1.3	2.6	3.75
mm	33	66	95.2

FIG. 2 Dispersion Cups of Apparatus

4. Dispersing Agent

4.1 A solution of sodium hexametaphosphate (sometimes called sodium metaphosphate) shall be used in distilled or demineralized water, at the rate of 40 g of sodium hexametaphosphate/litre of solution (Note 7).

NOTE 7—Solutions of this salt, if acidic, slowly revert or hydrolyze back to the orthophosphate form with a resultant decrease in dispersive action. Solutions should be prepared frequently (at least once a month) or adjusted to pH of 8 or 9 by means of sodium carbonate. Bottles containing solutions should have the date of preparation marked on them.

4.2 All water used shall be either distilled or demineralized water. The water for a hydrometer test shall be brought to the temperature that is expected to prevail during the hydrometer test. For example, if the sedimentation cylinder is to be placed in the water bath, the distilled or demineralized water to be used shall be brought to the temperature of the controlled water bath; or, if the sedimentation cylinder is used in a room with controlled temperature, the water for the test shall be at the temperature of the room. The basic temperature for the hydrometer test is 68°F (20°C). Small variations of temperature do not introduce differences that are of practical significance and do not prevent the use of corrections derived as prescribed.

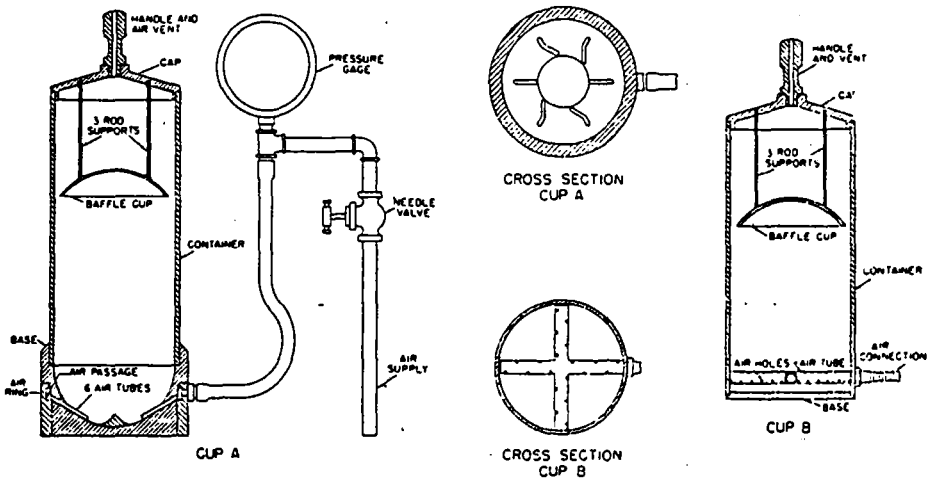


FIG. 3 Air-Jet Dispersion Cups of Apparatus B

5. Test Sample

5.1 Prepare the test sample for mechanical analysis as outlined in Practice D 421. During the preparation procedure the sample is divided into two portions. One portion contains only particles retained on the No. 10 (2.00-mm) sieve while the other portion contains only particles passing the No. 10 sieve. The mass of air-dried soil selected for purpose of tests, as prescribed in Practice D 421, shall be sufficient to yield quantities for mechanical analysis as follows:

5.1.1 The size of the portion retained on the No. 10 sieve shall depend on the maximum size of particle, according to the following schedule:

Nominal Diameter of Largest Particles, in. (mm)	Approximate Minimum Mass of Portion, g
⅜ (9.5)	500
¾ (19.0)	1000
1 (25.4)	2000
1½ (38.1)	3000
2 (50.8)	4000
3 (76.2)	5000

5.1.2 The size of the portion passing the No. 10 sieve shall be approximately 115 g for sandy soils and approximately 65 g for silt and clay soils.

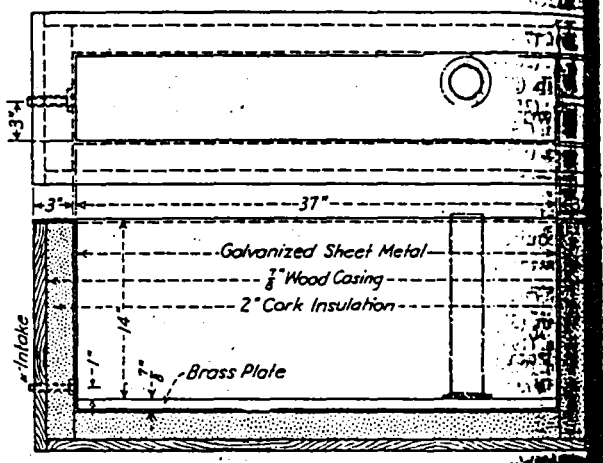
5.2 Provision is made in Section 5 of Practice D 421 for weighing of the air-dry soil selected for purpose of tests, the separation of the soil on the No. 10 sieve by dry-sieving and washing, and the weighing of the washed and dried fraction retained on the No. 10 sieve. From these two masses the percentages retained and passing the No. 10 sieve can be calculated in accordance with 12.1.

NOTE 8—A check on the mass values and the thoroughness of pulverization of the clods may be secured by weighing the portion passing the No. 10 sieve and adding this value to the mass of the washed and oven-dried portion retained on the No. 10 sieve.

SIEVE ANALYSIS OF PORTION RETAINED ON NO. 10 (2.00-mm) SIEVE

6. Procedure

6.1 Separate the portion retained on the No. 10 (2.00-mm) sieve into a series of fractions using the 3-in. (75-mm),



Metric Equivalents					
in.	⅞	1	3	6¼	14
mm	22.2	25.4	76.2	158.2	356

FIG. 4 Insulated Water Bath

2-in. (50-mm), 1½-in. (37.5-mm), 1-in. (25.0-mm), (19.0-mm), ⅜-in. (9.5-mm), No. 4 (4.75-mm), and sieves, or as many as may be needed depending o sample, or upon the specifications for the materia test.

6.2 Conduct the sieving operation by means of a and vertical motion of the sieve, accompanied by a action in order to keep the sample moving continuous the surface of the sieve. In no case turn or man fragments in the sample through the sieve by hand. C sieving until not more than 1 mass % of the residu sieve passes that sieve during 1 min of sieving mechanical sieving is used, test the thoroughness o by using the hand method of sieving as described ab

6.3 Determine the mass of each fraction on a conforming to the requirements of 3.1. At the weighing, the sum of the masses retained on all th used should equal closely the original mass of the sieved.

HYDROMETER AND SIEVE ANALYSIS OF PORTION PASSING THE NO. 10 (2.00-mm) SIEVE

7. Determination of Composite Correction for Hydrometer Reading

7.1 Equations for percentages of soil remaining in suspension, as given in 14.3, are based on the use of distilled or demineralized water. A dispersing agent is used in the water, however, and the specific gravity of the resulting liquid is appreciably greater than that of distilled or demineralized water.

7.1.1 Both soil hydrometers are calibrated at 68°F (20°C), and variations in temperature from this standard temperature produce inaccuracies in the actual hydrometer readings. The amount of the inaccuracy increases as the variation from the standard temperature increases.

7.1.2 Hydrometers are graduated by the manufacturer to be read at the bottom of the meniscus formed by the liquid on the stem. Since it is not possible to secure readings of soil suspensions at the bottom of the meniscus, readings must be taken at the top and a correction applied.

7.1.3 The net amount of the corrections for the three items enumerated is designated as the composite correction, and may be determined experimentally.

7.2 For convenience, a graph or table of composite corrections for a series of 1° temperature differences for the range of expected test temperatures may be prepared and used as needed. Measurement of the composite corrections may be made at two temperatures spanning the range of expected test temperatures, and corrections for the intermediate temperatures calculated assuming a straight-line relationship between the two observed values.

7.3 Prepare 1000 mL of liquid composed of distilled or demineralized water and dispersing agent in the same proportion as will prevail in the sedimentation (hydrometer) test. Place the liquid in a sedimentation cyclinder and the cylinder in the constant-temperature water bath, set for one of the two temperatures to be used. When the temperature of the liquid becomes constant, insert the hydrometer, and, after a short interval to permit the hydrometer to come to the temperature of the liquid, read the hydrometer at the top of the meniscus formed on the stem. For hydrometer 151H the composite correction is the difference between this reading and one; for hydrometer 152H it is the difference between the reading and zero. Bring the liquid and the hydrometer to the other temperature to be used, and secure the composite correction as before.

8. Hygroscopic Moisture

8.1 When the sample is weighed for the hydrometer test, weigh out an auxiliary portion of from 10 to 15 g in a small metal or glass container, dry the sample to a constant mass in an oven at 230 ± 9°F (110 ± 5°C), and weigh again. Record the masses.

9. Dispersion of Soil Sample

9.1 When the soil is mostly of the clay and silt sizes, weigh out a sample of air-dry soil of approximately 50 g. When the soil is mostly sand the sample should be approximately 100 g.

9.2 Place the sample in the 250-mL beaker and cover with 125 mL of sodium hexametaphosphate solution (40 g/L). Stir until the soil is thoroughly wetted. Allow to soak for at least 16 h.

9.3 At the end of the soaking period, disperse the sample further, using either stirring apparatus A or B. If stirring apparatus A is used, transfer the soil - water slurry from the beaker into the special dispersion cup shown in Fig. 2, washing any residue from the beaker into the cup with distilled or demineralized water (Note 9). Add distilled or demineralized water, if necessary, so that the cup is more than half full. Stir for a period of 1 min.

NOTE 9—A large size syringe is a convenient device for handling the water in the washing operation. Other devices include the wash-water bottle and a hose with nozzle connected to a pressurized distilled water tank.

9.4 If stirring apparatus B (Fig. 3) is used, remove the cover cap and connect the cup to a compressed air supply by means of a rubber hose. A air gage must be on the line between the cup and the control valve. Open the control valve so that the gage indicates 1 psi (7 kPa) pressure (Note 10). Transfer the soil - water slurry from the beaker to the air-jet dispersion cup by washing with distilled or demineralized water. Add distilled or demineralized water, if necessary, so that the total volume in the cup is 250 mL, but no more.

NOTE 10—The initial air pressure of 1 psi is required to prevent the soil - water mixture from entering the air-jet chamber when the mixture is transferred to the dispersion cup.

9.5 Place the cover cap on the cup and open the air control valve until the gage pressure is 20 psi (140 kPa). Disperse the soil according to the following schedule:

Plasticity Index	Dispersion Period, min
Under 5	5
6 to 20	10
Over 20	15

Soils containing large percentages of mica need be dispersed for only 1 min. After the dispersion period, reduce the gage pressure to 1 psi preparatory to transfer of soil - water slurry to the sedimentation cylinder.

10. Hydrometer Test

10.1 Immediately after dispersion, transfer the soil - water slurry to the glass sedimentation cylinder, and add distilled or demineralized water until the total volume is 1000 mL.

10.2 Using the palm of the hand over the open end of the cylinder (or a rubber stopper in the open end), turn the cylinder upside down and back for a period of 1 min to complete the agitation of the slurry (Note 11). At the end of 1 min set the cylinder in a convenient location and take hydrometer readings at the following intervals of time (measured from the beginning of sedimentation), or as many as may be needed, depending on the sample or the specification for the material under test: 2, 5, 15, 30, 60, 250, and 1440 min. If the controlled water bath is used, the sedimentation cylinder should be placed in the bath between the 2- and 5-min readings.

NOTE 11—The number of turns during this minute should be approximately 60, counting the turn upside down and back as two turns.

Any soil remaining in the bottom of the cylinder during the first few turns should be loosened by vigorous shaking of the cylinder while it is in the inverted position.

10.3 When it is desired to take a hydrometer reading, carefully insert the hydrometer about 20 to 25 s before the reading is due to approximately the depth it will have when the reading is taken. As soon as the reading is taken, carefully remove the hydrometer and place it with a spinning motion in a graduate of clean distilled or demineralized water.

NOTE 12—It is important to remove the hydrometer immediately after each reading. Readings shall be taken at the top of the meniscus formed by the suspension around the stem, since it is not possible to secure readings at the bottom of the meniscus.

10.4 After each reading, take the temperature of the suspension by inserting the thermometer into the suspension.

11. Sieve Analysis

11.1 After taking the final hydrometer reading, transfer the suspension to a No. 200 (75-μm) sieve and wash with tap water until the wash water is clear. Transfer the material on the No. 200 sieve to a suitable container, dry in an oven at 230 ± 9°F (110 ± 5°C) and make a sieve analysis of the portion retained, using as many sieves as desired, or required for the material, or upon the specification of the material under test.

CALCULATIONS AND REPORT

12. Sieve Analysis Values for the Portion Coarser than the No. 10 (2.00-mm) Sieve

12.1 Calculate the percentage passing the No. 10 sieve by dividing the mass passing the No. 10 sieve by the mass of soil originally split on the No. 10 sieve, and multiplying the result by 100. To obtain the mass passing the No. 10 sieve, subtract the mass retained on the No. 10 sieve from the original mass.

12.2 To secure the total mass of soil passing the No. 4 (4.75-mm) sieve, add to the mass of the material passing the No. 10 sieve the mass of the fraction passing the No. 4 sieve and retained on the No. 10 sieve. To secure the total mass of soil passing the ⅜-in. (9.5-mm) sieve, add to the total mass of soil passing the No. 4 sieve, the mass of the fraction passing the ⅜-in. sieve and retained on the No. 4 sieve. For the remaining sieves, continue the calculations in the same manner.

12.3 To determine the total percentage passing for each sieve, divide the total mass passing (see 12.2) by the total mass of sample and multiply the result by 100.

13. Hygroscopic Moisture Correction Factor

13.1 The hydroscopic moisture correction factor is the ratio between the mass of the oven-dried sample and the air-dry mass before drying. It is a number less than one, except when there is no hygroscopic moisture.

14. Percentages of Soil in Suspension

14.1 Calculate the oven-dry mass of soil used in the hydrometer analysis by multiplying the air-dry mass by the hygroscopic moisture correction factor.

14.2 Calculate the mass of a total sample represented by the mass of soil used in the hydrometer test, by dividing the oven-dry mass used by the percentage passing the No. 10 (2.00-mm) sieve, and multiplying the result by 100. This value is the weight W in the equation for percentage remaining in suspension.

TABLE 1 Values of Correction Factor, a, for Different Specific Gravities of Soil Particles[A]

Specific Gravity	Correction Factor, a
2.95	0.94
2.90	0.95
2.85	0.96
2.80	0.97
2.75	0.98
2.70	0.99
2.65	1.00
2.60	1.01
2.55	1.02
2.50	1.03
2.45	1.05

[A] For use in equation for percentage of soil remaining in suspension with Hydrometer 152H.

14.3 The percentage of soil remaining in suspension at the level at which the hydrometer is measuring the density of the suspension may be calculated as follows (Note 13) for hydrometer 151H:

$$P = [(100\,000/W) \times G/(G - G_1)](R - G_1)n$$

NOTE 13—The bracketed portion of the equation for hydrometer 151H is constant for a series of readings and may be calculated and then multiplied by the portion in the parentheses.

For hydrometer 152H:

$$P = (Ra/W) \times 100$$

where:

a = correction faction to be applied to the reading of hydrometer 152H. (Values shown on the scale are computed using a specific gravity of 2.65. Correction factors are given in Table 1),

P = percentage of soil remaining in suspension at the level at which the hydrometer measures the density of the suspension,

R = hydrometer reading with composite correction applied (Section 7),

W = oven-dry mass of soil in a total test sample represented by mass of soil dispersed (see 14.2), g,

G = specific gravity of the soil particles, and

G_1 = specific gravity of the liquid in which soil particles are suspended. Use numerical value of one in both instances in the equation. In the first instance the possible variation produces no significant effect; in the second instance, the composite correction is based on a value of one for G_1.

15. Diameter of Soil Particles

15.1 The diameter of a particle corresponding to the percentage indicated by a given hydrometer reading is calculated according to Stokes' law (Note 14), on the basis that a particle of this diameter was at the surface of the suspension at the beginning of sedimentation and has settled to the level at which the hydrometer is measuring the density of the suspension. According to Stokes' law:

$$D = \sqrt{[30n/980(G - G_1)] \times L/T}$$

where:

D = diameter of particle, mm,

η = coefficient of viscosity of the suspending medium (in this case water) in poises (varies with changes in temperature of the suspending medium),

L = distance from the surface of the suspension to the level at which the density of the suspension is being measured, cm. (For a given hydrometer and sedimentation cylinder, values vary according to the hydrometer readings. This distance is known as effective depth (Table 2)),

T = interval of time from beginning of sedimentation to the taking of the reading, min,

G = specific gravity of soil particles, and

G_1 = specific gravity (relative density) of suspending medium (value may be used as 1.000 for all practical purposes).

NOTE 14—Since Stokes' law considers the terminal velocity of a single sphere falling in an infinity of liquid, the sizes calculated represent the diameter of spheres that would fall at the same rate as the soil particles.

15.2 For convenience in calculations the above equation may be written as follows:

$$D = K\sqrt{L/T}$$

where:

K = constant depending on the temperature of the suspension and the specific gravity of the soil particles. Values of K for a range of temperatures and specific gravities are given in Table 3. The value of K does not change for a series of readings constituting a test, while values of L and T do vary.

15.3 Values of D may be computed with sufficient accuracy, using an ordinary 10-in. slide rule.

NOTE 15—The value of L is divided by T using the A- and B-scales, the square root being indicated on the D-scale. Without ascertaining the value of the square root it may be multiplied by K, using either the C- or CI-scale.

16. Sieve Analysis Values for Portion Finer than No. 10 (2.00-mm) Sieve

16.1 Calculation of percentages passing the various sieves used in sieving the portion of the sample from the hydrometer test involves several steps. The first step is to calculate the mass of the fraction that would have been retained on the No. 10 sieve had it not been removed. This mass is equal to the total percentage retained on the No. 10 sieve (100 minus total percentage passing) times the mass of the total sample represented by the mass of soil used (as calculated in 14.2), and the result divided by 100.

16.2 Calculate next the total mass passing the No. 200 sieve. Add together the fractional masses retained on all the sieves, including the No. 10 sieve, and subtract this sum from the mass of the total sample (as calculated in 14.2).

16.3 Calculate next the total masses passing each of the other sieves, in a manner similar to that given in 12.2.

16.4 Calculate last the total percentages passing by dividing the total mass passing (as calculated in 16.3) by the total mass of sample (as calculated in 14.2), and multiply the result by 100.

17. Graph

17.1 When the hydrometer analysis is performed, a graph of the test results shall be made, plotting the diameters of the particles on a logarithmic scale as the abscissa and the percentages smaller than the corresponding diameters to an

TABLE 2 Values of Effective Depth Based on Hydrometer and Sedimentation Cylinder of Specified Sizes[A]

Hydrometer 151H		Hydrometer 152H			
Actual Hydrometer Reading	Effective Depth, L, cm	Actual Hydrometer Reading	Effective Depth, L, cm	Actual Hydrometer Reading	Effective Depth, L, cm
1.000	16.3	0	16.3	31	11.2
1.001	16.0	1	16.1	32	11.1
1.002	15.8	2	16.0	33	10.9
1.003	15.5	3	15.8	34	10.7
1.004	15.2	4	15.6	35	10.6
1.005	15.0	5	15.5		
1.006	14.7	6	15.3	36	10.4
1.007	14.4	7	15.2	37	10.2
1.008	14.2	8	15.0	38	10.1
1.009	13.9	9	14.8	39	9.9
1.010	13.7	10	14.7	40	9.7
1.011	13.4	11	14.5	41	9.6
1.012	13.1	12	14.3	42	9.4
1.013	12.9	13	14.2	43	9.2
1.014	12.6	14	14.0	44	9.1
1.015	12.3	15	13.8	45	8.9
1.016	12.1	16	13.7	46	8.8
1.017	11.8	17	13.5	47	8.6
1.018	11.5	18	13.3	48	8.4
1.019	11.3	19	13.2	49	8.3
1.020	11.0	20	13.0	50	8.1
1.021	10.7	21	12.9	51	7.9
1.022	10.5	22	12.7	52	7.8
1.023	10.2	23	12.5	53	7.6
1.024	10.0	24	12.4	54	7.4
1.025	9.7	25	12.2	55	7.3
1.026	9.4	26	12.0	56	7.1
1.027	9.2	27	11.9	57	7.0
1.028	8.9	28	11.7	58	6.8
1.029	8.6	29	11.5	59	6.6
1.030	8.4	30	11.4	60	6.5
1.031	8.1				
1.032	7.8				
1.033	7.6				
1.034	7.3				
1.035	7.0				
1.036	6.8				
1.037	6.5				
1.038	6.2				

[A] Values of effective depth are calculated from the equation:

$$L = L_1 + \tfrac{1}{2}\,[L_2 - (V_B/A)]$$

where:

L = effective depth, cm,

L_1 = distance along the stem of the hydrometer from the top of the bulb to the mark for a hydrometer reading, cm,

L_2 = overall length of the hydrometer bulb, cm,

V_B = volume of hydrometer bulb, cm^3, and

A = cross-sectional area of sedimentation cylinder, cm^2

Values used in calculating the values in Table 2 are as follows:

For both hydrometers, 151H and 152H:

L_2 = 14.0 cm

V_B = 67.0 cm^3

A = 27.8 cm^2

For hydrometer 151H:

L_1 = 10.5 cm for a reading of 1.000

= 2.3 cm for a reading of 1.031

For hydrometer 152H:

L_1 = 10.5 cm for a reading of 0 g/litre

= 2.3 cm for a reading of 50 g/litre

TABLE 3 Values of K for Use in Equation for Computing Diameter of Particle in Hydrometer Analysis

Temperature, °C	Specific Gravity of Soil Particles								
	2.45	2.50	2.55	2.60	2.65	2.70	2.75	2.80	2.85
16	0.01510	0.01505	0.01481	0.01457	0.01435	0.01414	0.01394	0.01374	0.01356
17	0.01511	0.01486	0.01462	0.01439	0.01417	0.01396	0.01376	0.01356	0.01338
18	0.01492	0.01467	0.01443	0.01421	0.01399	0.01378	0.01359	0.01339	0.01321
19	0.01474	0.01449	0.01425	0.01403	0.01382	0.01361	0.01342	0.1323	0.01305
20	0.01456	0.01431	0.01408	0.01386	0.01365	0.01344	0.01325	0.01307	0.01289
21	0.01438	0.01414	0.01391	0.01369	0.01348	0.01328	0.01309	0.01291	0.01273
22	0.01421	0.01397	0.01374	0.01353	0.01332	0.01312	0.01294	0.01276	0.01258
23	0.01404	0.01381	0.01358	0.01337	0.01317	0.01297	0.01279	0.01261	0.01243
24	0.01388	0.01365	0.01342	0.01321	0.01301	0.01282	0.01264	0.01246	0.01229
25	0.01372	0.01349	0.01327	0.01306	0.01286	0.01267	0.01249	0.01232	0.01215
26	0.01357	0.01334	0.01312	0.01291	0.01272	0.01253	0.01235	0.01218	0.01201
27	0.01342	0.01319	0.01297	0.01277	0.01258	0.01239	0.01221	0.01204	0.01188
28	0.01327	0.01304	0.01283	0.01264	0.01244	0.01255	0.01208	0.01191	0.01175
29	0.01312	0.01290	0.01269	0.01249	0.01230	0.01212	0.01195	0.01178	0.01162
30	0.01298	0.01276	0.01256	0.01236	0.01217	0.01199	0.01182	0.01165	0.01149

arithmetic scale as the ordinate. When the hydrometer analysis is not made on a portion of the soil, the preparation of the graph is optional, since values may be secured directly from tabulated data.

18. Report

18.1 The report shall include the following:

18.1.1 Maximum size of particles,

18.1.2 Percentage passing (or retained on) each sieve, which may be tabulated or presented by plotting on a graph (Note 16),

18.1.3 Description of sand and gravel particles:

18.1.3.1 Shape—rounded or angular,

18.1.3.2 Hardness—hard and durable, soft, or weathered and friable,

18.1.4 Specific gravity, if unusually high or low,

18.1.5 Any difficulty in dispersing the fraction passing the No. 10 (2.00-mm) sieve, indicating any change in type and amount of dispersing agent, and

18.1.6 The dispersion device used and the length of the dispersion period.

NOTE 16—This tabulation of graph represents the gradation of the sample tested. If particles larger than those contained in the sample were removed before testing, the report shall so state giving the amount and maximum size.

18.2 For materials tested for compliance with definite specifications, the fractions called for in such specifications shall be reported. The fractions smaller than the No. 10 sieve shall be read from the graph.

18.3 For materials for which compliance with definite specifications is not indicated and when the soil is composed almost entirely of particles passing the No. 4 (4.75-mm) sieve, the results read from the graph may be reported as follows:

(*1*) Gravel, passing 3-in. and retained on No. 4 sieve .....
(*2*) Sand, passing No. 4 sieve and retained on No. 200 sieve .....
  (*a*) Coarse sand, passing No. 4 sieve and retained on No. 10 sieve .....
  (*b*) Medium sand, passing No. 10 sieve and retained on No. 40 sieve .....
  (*c*) Fine sand, passing No. 40 sieve and retained on No. 200 sieve .....
(*3*) Silt size, 0.074 to 0.005 mm .....
(*4*) Clay size, smaller than 0.005 mm .....
  Colloids, smaller than 0.001 mm .....

18.4 For materials for which compliance with definite specifications is not indicated and when the soil contains material retained on the No. 4 sieve sufficient to require sieve analysis on that portion, the results may be reported as follows (Note 17):

SIEVE ANALYSIS

Sieve Size	Percentage Passing
3-in.	.....
2-in.	.....
1½-in.	.....
1-in.	.....
¾-in.	.....
⅜-in.	.....
No. 4 (4.75-mm)	.....
No. 10 (2.00-mm)	.....
No. 40 (425-μm)	.....
No. 200 (75-μm)	.....

HYDROMETER ANALYSIS

0.074 mm	.....
0.005 mm	.....
0.001 mm	.....

NOTE 17—No. 8 (2.36-mm) and No. 50 (300-μm) sieves may be substituted for No. 10 and No. 40 sieves.

19. Keywords

19.1 grain-size; hydrometer analysis; hygroscopic moisture; particle-size; sieve analysis

ATTACHMENT D

TNRCC GUIDELINES FOR WELL/BOREHOLE ABANDONMENT

§330.242. Monitor-Well Construction Specifications.

TXRti30\ptI\ch330\shI\se330.242(a)
(a) The following specifications shall be used for the installation of groundwater monitoring wells at municipal solidwaste landfills. Equivalent alternatives to these specifications may be used if prior written approval is obtained in advance from the executive director.
TXRti30\ptI\ch330\shI\se330.242(a)(1)
(1) Drilling.
TXRti30\ptI\ch330\shI\se330.242(a)(1)(A)
(A) Monitoring wells shall be drilled by a Texas-licensed driller who is qualified to drill and install monitoring wells. The installation and development must be supervised by a qualified geologist or engineer who is familiar with the geology of the area.
TXRti30\ptI\ch330\shI\se330.242(a)(1)(B)
(B) The well shall be drilled by a method that will allow installation of the casing, screen, etc., and that will not introduce contaminants into the borehole or casing. Drilling techniques used for boring shall take into account the materials to be drilled, depth to ground water, total depth of the hole, adequate soil sampling, and other such factors that affect the selection of the drilling method. If any fluids are necessary in drilling or installation, then clean, treated city water shall be used; other fluids must be approved in writing by the executive director before use. If city water is used, a current chemical analysis of the city water shall be provided with the monitor-well report.
TXRti30\ptI\ch330\shI\se330.242(a)(1)(C)
(C) The diameter of the boring shall be at least four inches larger than the diameter of the casing. When the boring is in hard rock, a smaller annulus may be approved by the executive director.
TXRti30\ptI\ch330\shI\se330.242(a)(1)(D)
(D) During drilling of the monitoring well, a log of the boring shall be made by a qualified geologist or engineer who is familiar with the geology of the area.
TXRti30\ptI\ch330\shI\se330.242(a)(2)
(2) Casing, screen, filter pack, and seals.
TXRti30\ptI\ch330\shI\se330.242(a)(2)(A)
(A) The well casing shall be: two to four inches in diameter; NSF-certified PVC schedule 40 or 80 pipe, flushthread, screw joint (no glue or solvents); polytetrafluorethylene (PTFE, such as Teflon) tape or O-rings in the joints; no collar couplings. The top of the casing shall be at least two feet above ground level. Where high levels of volatile organic compounds or corrosive compounds are anticipated, stainless steel or PTFE casing and screen may be used, subject to approval by the executive director. Four-inch diameter casing is recommended because it allows larger volume samples to be obtained and provides easier access for development, pumps, and repairs. The casing shall be cleaned and packaged at the place of manufacture; the

packaging shall include a PVC wrapping on each section of casing to keep it from being contaminated prior to installation. The casing shall be free of ink, labels, or other markings. The casing (and screen) shall be centered in the hole to allow installation of a good filter pack and annular seal, using appropriately placed centralizers. The top of the casing shall be protected by a threaded or slip-on top cap or by a sealing cap or screw-plug seal inserted into the top of the casing. The cap shall be vented to prevent buildup of methane or other gases.

TXRti30\ptI\ch330\shI\se330.242(a)(2)(B)

(B) The screen shall be compatible with the casing and should generally be of the same material. The screen shall not involve the use of any glues or solvents for construction. A wire-wound screen is recommended to provide maximum inflow area. Field-cut slots are not permitted for well screen. Filter cloth shall not be used. A blank-pipe sediment trap, typically one to two feet, should be installed below the screen. A bottom cap is typically placed on the bottom of the sediment trap. The sediment trap shall not extend through the lower confining layer of the water-bearing zone being tested. Screen sterilization methods are the same as those for casing. Selection of the size of the screen opening should be done by a person experienced with such work and shall include consideration of the distribution of particle sizes both in the water-bearing zone and in the filter pack surrounding the screen. The screen opening shall not be larger than the smallest fraction of the filter pack.

TXRti30\ptI\ch330\shI\se330.242(a)(2)(C)

(C) The filter pack, placed between the screen and the well bore, shall consist of pre-packaged, inert, clean silica sand or glass beads; it shall extend from one to four feet above the top of the screen. Open stockpile sources of sand or gravel are not permitted. The filter pack usually has a 30% finer grain size that is about four to 10 times larger than the 30% finer grain size of the water-bearing zone; the filter pack should have a uniformity coefficient less than 2.5. The filter pack should be placed with a tremie pipe to ensure that the material completely surrounds the screen and casing without bridging. The tremie pipe shall be steam cleaned prior to the first well and before each subsequent well.

TXRti30\ptI\ch330\shI\se330.242(a)(2)(D)

(D) The annular seal shall be placed on top of the filter pack and shall be at least two feet thick. It should be placed in the zone of saturation to maintain hydration. The seal should be composed of, in order of preference, coarse-grain sodium bentonite, coarse-grit sodium bentonite, or bentonite grout. Special care should be taken to ensure that fine material or grout does not plug the underlying filter pack. Placement of a few inches of pre-packaged clean fine sand on top of the filter pack will help to prevent migration of the annular seal material into the filter pack. The seal should be placed on top of the filter pack with a steam-cleaned tremie pipe to ensure good distribution and should be tamped with a steam-cleaned rod to determine that the seal is thick enough. The bentonite shall be hydrated with clean water prior to any further activities on the well and left to stand until hydration is complete (eight to 12 hours, depending on the grain size of the bentonite). If a bentonite-grout (without cement) casing seal is used in the well bore, then it may replace the annular seal described above.

TXRti30\ptI\ch330\shI\se330.242(a)(2)(E)
(E) A casing seal shall be placed on top of the annular seal to prevent fluids and contaminants from entering the borehole from the surface. The casing seal shall consist of a commercial bentonite grout or a cement-bentonite mixture. Drilling spoil, cuttings, or other native materials are not permitted for use as a casing seal. Quick-setting cements are not permitted for use because contaminants may leach from them into the ground water. The top of the casing seal shall be between five and two feet from the surface.
TXRti30\ptI\ch330\shI\se330.242(a)(3)
(3) Concrete Pad. High-quality structural-type concrete shall be placed from the top of the casing seal (two to five feet below the surface) continuously to the top of the ground to form a pad at the surface. This formed surface pad shall be at least six inches thick and not less than four (preferably six) feet square or five (preferably six) feet in diameter. The pad shall contain sufficient reinforcing steel to ensure its structural integrity in the event that soil support is lost. The top of the pad shall slope away from the well bore to the edges to prevent ponding of water around the casing or collar.
TXRti30\ptI\ch330\shI\se330.242(a)(4)
(4) Protective Collar. A steel protective pipe collar shall be placed around the casing "stickup" to protect it from damage and unwanted entry. The collar shall be set at least one foot into the surface pad during its construction and should extend at least three inches above the top of the well casing (and top cap, if present). The top of the collar shall have a lockable hinged top flap or cover. A sturdy lock shall be installed, maintained in working order, and kept locked when the well is not being bailed/purged or sampled. The well number or other designation shall be marked permanently on the protective steel collar; it is useful to mark the total depth of the well and its elevation on the collar.
TXRti30\ptI\ch330\shI\se330.242(a)(5)
(5) Protective Barrier. Where monitoring wells are likely to be damaged by moving equipment or are located in heavily traveled areas, a protective barrier shall be installed. A typical barrier is three or four six-to 12-inch diameter pipes set in concrete just off the protective pad. The pipes can be joined by pipes welded between them, but consideration must be given to well access for sampling and other activities. Separation of such a pipe barrier from the pad means that the barrier can be damaged without risk to the pad and well. Other types of barriers may be approved by the executive director.
TXRti30\ptI\ch330\shI\se330.242(b)
(b) Unusual Conditions. Where monitoring wells are installed in unusual conditions, all aspects of the installation shall be approved in writing in advance by the executive director. Such aspects include, for example, the use of cellar-type enclosures for the top-well equipment or multiple completions in a single hole.
TXRti30\ptI\ch330\shI\se330.242(c)
(c) Development. After a monitoring well is installed, it shall be developed to remove artifacts of drilling (clay films, bentonite pellets in the casing, etc.) and to open the water-bearing zone for maximum flow into the well. Development should continue until all of the water used or affected during drilling activities has

been removed and field measurements of pH, specific conductance, and temperature have stabilized. Failure to develop a well properly may mean that it is not properly monitoring the water-bearing zone or may not yield adequate water for sampling even though the water-bearing zone is prolific.

TXRti30\ptI\ch330\shI\se330.242(d)

(d) Location and Elevation. Upon completion of a monitoring well, the location of the well and all appropriate elevations associated with the top-well equipment shall be surveyed by a registered professional surveyor. The elevation shall be surveyed to the nearest 0.01 foot above mean sea level (with year of the sea-level datum shown). The point on the well casing for which the elevation was determined shall be permanently marked on the casing. The location shall be given in terms of the latitude and longitude at least to the nearest tenth of a second or shall be accurately located with respect to the landfill grid system described in §330.55(a)(10)(F) of this title (relating to Site Development Plan).

TXRti30\ptI\ch330\shI\se330.242(e)

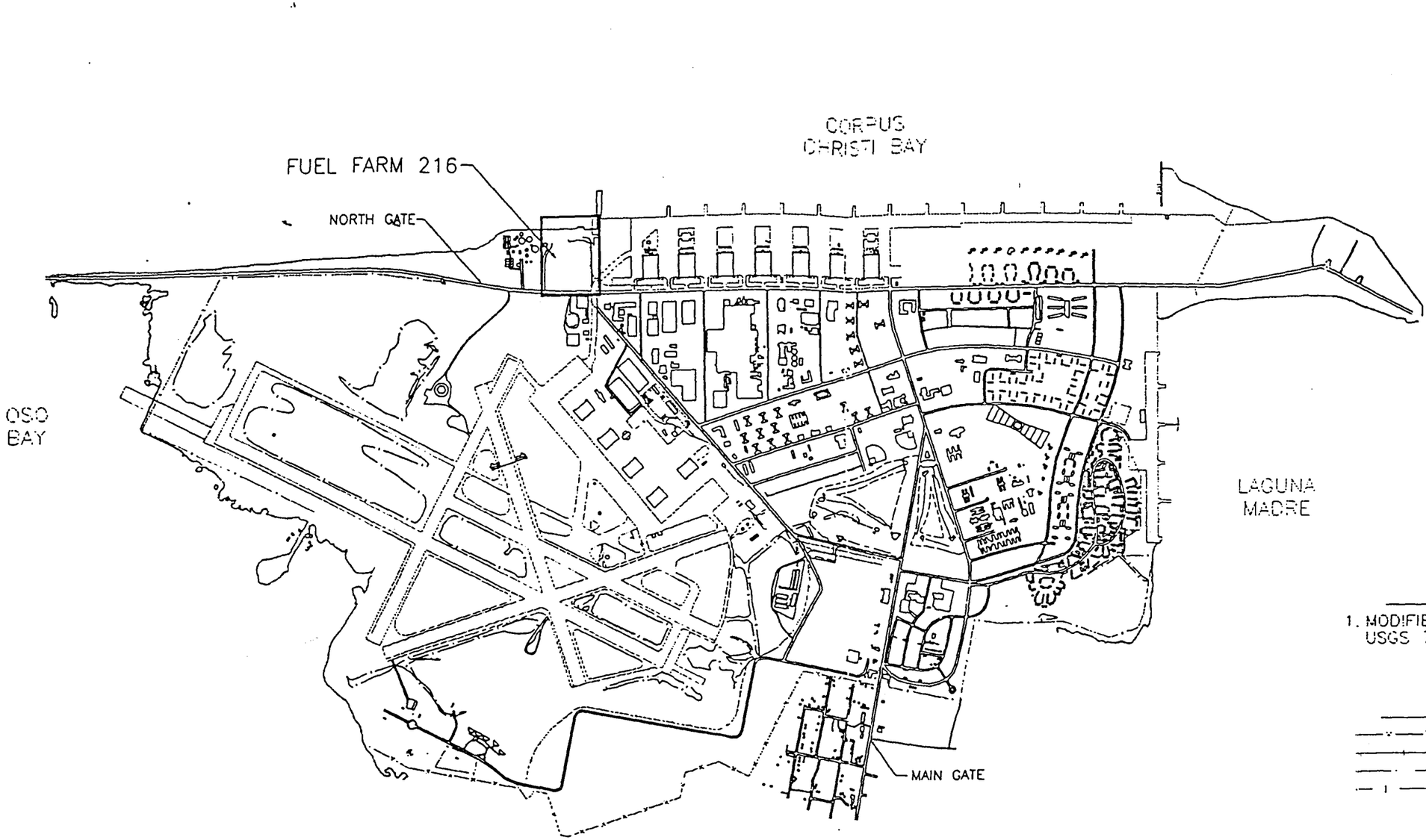
(e) Reporting. Monitoring well installation and construction details shall be submitted on forms available from the Commission and shall be completed and submitted within 30 days of well completion. A copy of the detailed geologic log of the boring, any particle size or other sample data from the well, and a site map drawn to scale showing the location of all monitoring wells shall be submitted to the executive director at the same time. The licensed driller should be familiar with the forms required by other agencies; a copy of those forms shall also be submitted to the Commission.

TXRti30\ptI\ch330\shI\se330.242(f)

(f) Damaged Wells. Any monitoring well that is damaged to the extent that it is no longer suitable for sampling shall be reported to the executive director who may make a determination about whether to repair or replace the well.

TXRti30\ptI\ch330\shI\se330.242(g)

(g) Plugging and Abandonment. Any monitoring well that is no longer used shall be properly abandoned and plugged in accordance with the rules of the Commission. No abandonment shall take place without prior authorization in writing by the executive director.



NOTES

1. MODIFIED FROM OSO CREEK NE, TEX. USGS 7.5 MIN. QUADRANGLE MAP.

LEGEND

- FENCE
- RAILROAD
- WATER FRONT
- WETLANDS

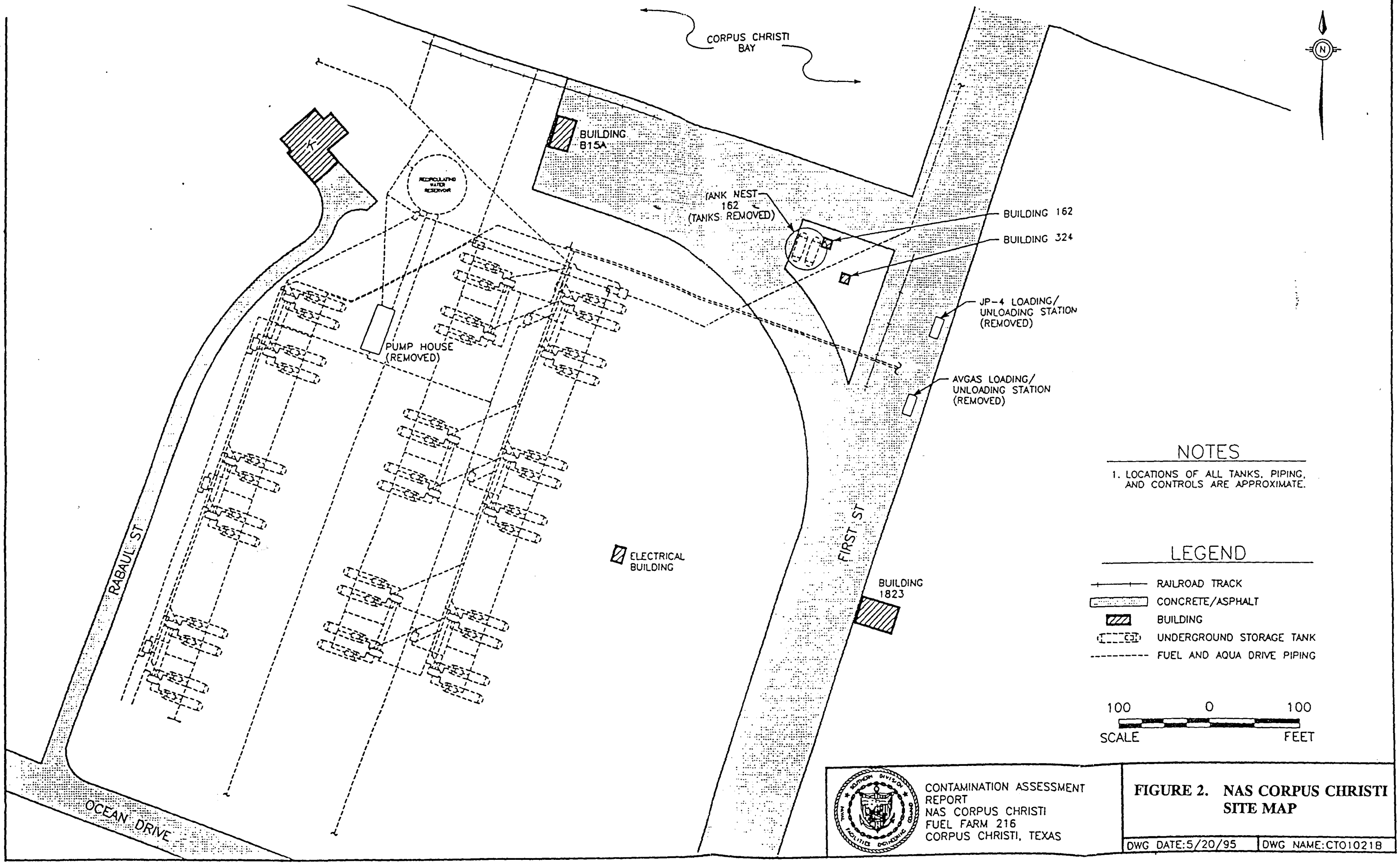
500 0 600

SCALE FEET

CONTAMINATION ASSESSMENT
REPORT
NAS CORPUS CHRISTI
FUEL FARM 216
CORPUS CHRISTI, TEXAS

FIGURE 1. NAS CORPUS CHRISTI VICINITY MAP

DWG DATE:5/20/95 | DWG NAME:CTO1021A



CONTAMINATION ASSESSMENT REPORT
NAS CORPUS CHRISTI
FUEL FARM 216
CORPUS CHRISTI, TEXAS

FIGURE 2. NAS CORPUS CHRISTI SITE MAP

DWG DATE:5/20/95 | DWG NAME:CT010218

Spohn Hospital
600 Elizabeth
Corpus Christi, TX 78404
Ph: 512-881-3103
800-247-6574

Fuel Farm 216
Work Site

North Gate

Main Gate

Naval Hospital
10651 E St
Corpus, Christi, TX
Ph: 512-939-2688

Connects Here

CORPUS CHRISTI BAY

CAYO DEL OSO

N

0 0.5 1.0 Mile
SCALE

FIGURE 3 -- HOSPITAL ROUTE MAP