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INTERIM REMEDIATION WORK PLAN SOIL AND FREE PRODUCT REMOVAL ACTIVITIES AT NORTH FUEL FARM NAS CECIL FIELD FL

7/1/1995

BECHTEL

INTERIM REMEDIATION WORK PLAN
SOIL AND FREE PRODUCT REMOVAL ACTIVITIES
AT NORTH FUEL FARM

FOR

NAVAL AIR STATION CECIL FIELD

JACKSONVILLE, FLORIDA

Prepared for

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

Under Contract No. N62467-93-D-0936

Prepared by

BECHTEL ENVIRONMENTAL, INC.
OAK RIDGE, TENNESSEE

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Revision 0

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PB0006

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ENGINEER'S CERTIFICATION

The engineering work described and professional opinions rendered in this document, *Interim Remediation Work Plan, Soil and Free Product Removal Activities at North Fuel Farm for Naval Air Station Cecil Field, Jacksonville, Florida*, dated July 1995, Revision 0, were conducted or developed using commonly accepted engineering practices and standards. The scope of engineering services described in this document was conducted under the supervision of the undersigned professional engineer, registered in the State of Florida.

This document represents a shop drawing submittal to the Engineer of Record for this project, specifically, Mike Dunaway, Florida PE #39451, regarding the Alternative Procedures Request for North Fuel Farm, Facility 76, Naval Air Station Cecil Field, Jacksonville, Florida, signed May 11, 1995. This action and process are being performed in accordance with the Florida Administrative Code FACs 61G15-30.005 and 61G15-30.006.

This document is a final document being submitted to Florida Department of Environmental Protection and other parties. Revisions from the draft document include clarification of recovery wells, addition of "wet" excavation and transport, reponses to comments (Appendix F), and reivision to preliminary construction drawings. In accordance with FAC 62-770, record set drawings will be submitted with the appropriate engineer's seal.

7/13/95

Frank B. Cater, PE
Project Engineer
Florida PE Number 42508
Expires February 28, 1997

Bechtel Environmental, Inc.

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ACRONYMS

ABB-ES	ABB Environmental Services, Inc.
APA	Alternative Procedures Agreement
ASL	analytical support level
ASTM	American Society for Testing and Materials
BCT	BRAC Cleanup Team
BEI	Bechtel Environmental, Inc.
BRAC	Base Realignment and Closure
CA	Corrective Action
CAR	Corrective Action Report
CCS	Contract Compliance Screen
CFR	Code of Federal Register
CLEAN	Comprehensive Long-Term Environmental Action - Navy
Dup	duplicate
EPA	Environmental Protection Agency
EPB	Environmental Protection Board
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FDER	Florida Department of Environmental Response
FFA	Federal Facilities Agreement
FID	flame ionization detector
FOTW	federally-owned treatment works
GAC	granulated activated carbon unit
HDPE	high density polyethylene
IRWP	Interim Remediation Work Plan
LET	liquid effluent tank
LTTD	low temperature thermal desorption
NAS	Naval Air Station
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFF	North Fuel Farm
NPL	National Priority List
OVA	organic vapor analyzer
OWS	oil/water separator
PAH	polynuclear aromatic hydrocarbon
PID	photoionization detector
PPE	personal protective equipment
PSHP	Program Safety and Health Plan
QC	Quality Control
QCPA	Quality Control Program Plan - Addendum
QCP	Quality Control Program Plan
RAC	Response Action Coordinator
RCRA	Resource Conservation and Recovery Act
ROICC	Resident Officer In Charge of Construction
SAP	Sampling and Analysis Plan
SOPs	Standard Operating Procedures
SSHP	Site Safely and Health Plan
SSHP	Site Specific Safety and Health Plan
SSHR	Site Safety and Health Representative

ACRONYMS (continued)

SVOC	semivolatile organic compound
TCLP	Toxicity Characteristic Leaching Procedure
TRPH	total recoverable petroleum hydrocarbons
TVOA	total volatile organic aromatics
UST	underground storage tank
VOA	volatile organic aromatics
VOC	volatile organic compound
VOH	volatile organic halocarbon

UNITS OF MEASURE

µg/kg	microgram/kilogram
bls	below land surface
cfm	cubic feet per minute
ft	feet/foot
ft^2	square feet
gal	gallon
h	horizontal
hr.	hours
in.	inch/inches
mg/kg	microgram per kilogram
ppb	parts per billion
ppm	parts per million
ssu	standard scientific units
v	vertical
yd	yard
yd^3	cubic yards

FOREWORD

This Interim Remediation Work Plan (IRWP) has been prepared to document the planning process performed by the U.S. Navy to support interim remedial action activities at the North Fuel Farm (NFF) located at the Naval Air Station (NAS) Cecil Field site in Jacksonville, Florida. This work plan is a shop drawing submittal to the Navy and the Navy's Engineer of Record for the action described herein. Review of this work plan by the Navy's Engineer of Record is required, in accordance with Florida Administrative Code (FAC) Chapter 61G15-30.005.

This Work Plan describes the activities necessary to implement the initial remedial actions associated with the removal of excessively contaminated soil, recovery of free product encountered during the soil removal, and free product recovery via bioslurping techniques. This interim remedial action is not intended to be a final solution, but complement the final remedy. This IRWP provides the background information and regulatory setting, describes the approach that will be used to conduct the interim remedial actions, and identifies Bechtel's management organization.

1.0 INTRODUCTION

The U.S. Department of Navy, Southern Division, Naval Facilities Engineering Command intends to conduct an interim remedial action at the Naval Air Station (NAS) Cecil Field North Fuel Farm, Jacksonville, Florida. This interim action is being conducted in accordance with the objectives of the NAS Cecil Field Base Realignment and Closure (BRAC) Cleanup Team (BCT) tank management strategy. Additionally, this interim remedial action is consistent with the Florida Administrative Code (FAC), Chapter 62-770. This Interim Remediation Work Plan (IRWP) addresses the interim remedial action activities that will be implemented by Bechtel Environmental, Inc. (Bechtel) as the Environmental Response Action Contractor (RAC) for Southern Division. The interim remedial action described in this IRWP is being executed as part of prime contract N62467-93-D-0936 under Delivery Order Number 0022.

The specific interim remedial action presented in the IRWP addresses the removal of excessively contaminated soils in an area west of the bermed fuel farm, recovery of free product in the area of the excavation, controls to prevent the future migration of free product into the excavated area, backfill of the excavated area with clean (mostly organic-free) soil, and free product recovery in the bermed fuel farm area. The intent of the interim remedial action is to abate excessively contaminated soil's ability to act as a continuing source of contamination, recover free product during this abatement, and to provide initial free product recovery actions that will complement final remedial actions that will be addressed at a later date. The documents that provide the basis for the initial remedial actions at North Fuel Farm are as follows:

- *Contamination Assessment Report, North Fuel Farm Sites, Naval Air Station Cecil Field, Jacksonville, Florida*, July 1994 (ABB-ES 1994a)
- Memorandum: *North Fuel Farm Cecil Field*, ABB Environmental Services, Inc., December 7, 1994 (ABB-ES 1994c)
- Memorandum: *North Fuel Farm, Cecil Field, Phase I, Task 1: Soil Removal*, ABB Environmental Services, Inc., March 17, 1995 (ABB-ES 1995a)
- Memorandum: *North Fuel Farm, Cecil Field, Phase I, Task 2; Alternate Procedures Request for Free Product Removal*, ABB Environmental, Inc. April 24, 1995 (ABB-ES 1995b)
- Memorandum: *Draft Meeting Minutes, 14 April 1995, North Fuel Farm, BCT/Partnering Team*, Southern Division Naval Facilities Command, April 20, 1995 (Navy 1995a)
- *Alternative Procedures Request*, ABB Environmental Services, Inc., Mike Dunaway, Florida PE 39451, May 11, 1995 (ABB-ES 1995c)

This IRWP presents instructions to the field for execution of the remedial action and provides necessary information for regulatory and Navy approval to proceed with the remedial action. Section 1.0 provides the background information, including site history, regulatory setting, and project objectives. Included in the project objectives are the remedial action objectives, site-specific objectives, and action-specific site cleanup criteria. Sections 2.0 and 3.0 present the actual activities associated with the remedial action and provide the primary field guidance for the remedial action. Section 4.0 presents the field sampling plan required during remedial action and the waste management sampling requirements. Section 5.0 describes the field approach to waste management for this specific action. Sections 6.0, 7.0, and 8.0 respectively address the project management plan, safety and health, and quality control.

Included in this work plan are typical Bechtel Navy RAC technical specifications (Appendix B) that are applicable to the remedial action described in this work plan. These specifications were developed as a cost

savings measure for the majority of the Bechtel Navy RAC projects or delivery orders awarded through Southern Division. They were also developed with the idea that Bechtel would be subcontracting the work. In the case of projects such as NFF where Bechtel is providing direct hire labor and equipment to execute the project, references to subcontractor interface to Bechtel are not applicable. These specifications are provided as general guidance to the field construction management team for the work involved in the remedial action. In the event of conflict, the order of precedence for the remedial action described in this IRWP would be (1) construction drawings, (2) the work plan, and (3) specifications.

Appendix C of this IRWP contains the preliminary construction drawing (90 percent) set. Final record set drawings will be issued to the appropriate parties at the completion of the project. Field copies of the current record sets (updated due to field conditions or approved revisions) will be maintained at the NAS Cecil Field office. All record copies submitted and copies maintained at the site will be sealed by a professional engineer, in accordance with Florida Statutes 471.

1.1 BACKGROUND INFORMATION

1.1.1 Site Description

NAS Cecil Field is located 14 miles southwest of Jacksonville in the northeastern part of Florida (Figure 1, Appendix A). Most of NAS Cecil Field is located within Duval County (including the NFF); however, part of the site is located in the northern part of Clay County. NAS Cecil Field was established in 1941 and provides facilities, services, and material support for the operation and maintenance of naval weapons, aircraft, and other units of the operating forces as designated by the Chief of Naval Operations. Some of the tasks required to accomplish this mission include operation of fuel storage facilities, performance of aircraft maintenance, maintenance and operation of engine repair facilities and test cells for turbo-jet engines, and support of special weapons systems.

NFF is located at the northeast corner of "A" Avenue and Loop Road (Figure 2, Appendix A and Drawing 227-DD000-001, Appendix C). The NFF site has a flat, grass-vegetated terrain. The bermed fuel farm area consists of six approximately 550,000-gal interior-lined, asphalt-coated steel, earth-mounded tanks that contain JP-5 jet fuel. The tanks were installed in 1952 and 1954. In 1987, each tank was relined and overfill protection (high level alarms) was installed. Each tank has impressed-current-type corrosion protection (ABB-ES 1994a).

1.1.2 Site History

In February 1991, an approximately 900,000-gal JP-5 fuel spill occurred at the site. The Navy submitted a report to the state that summarized the events and action regarding the recovery of the spilled fuel. In 1991, the Navy contracted for a contamination assessment (CA) to characterize and assess the vertical and horizontal extent of the contamination at NFF and submit a contamination assessment report (CAR). In June 1992, a CAR was submitted to the Florida Department of Environmental Protection (FDEP) for NFF (ABB-ES 1994a).

FDEP recommended that additional soil samples be taken and additional monitoring wells be installed to better delineate the extent of soil contamination and free product present at the site. In July 1994, a revised CAR was sent to FDEP. This report characterized and assessed the vertical and horizontal extent of contamination as it then existed.

As reported in the CAR, the petroleum contamination at the NFF was due to releases of JP-5 jet fuel. Excessively contaminated soil was detected in the area west of the bermed fuel farm area to "A" Avenue at depths ranging from 0 to 4.5 ft below land surface (bls). During the contamination assessment phase of the

project, groundwater was encountered at the site at a depth of between 2 to 4 ft bls. In the past it has been observed that seasonal rains have raised the groundwater in the area of concern to depths of 1 to 1.5 ft bls (ABB-ES 1994c).

Since the end of 1994, the Navy has been proactively pursuing an avenue for the removal of the excessively contaminated soil located between the bermed fuel farm area and "A" Avenue and the recovery of the free product in the area of the bermed fuel farm area. In April of 1995, the Navy and FDEP achieved consensus during the BCT/Partnering Team Meeting on the method and timing for the soil cleanup and free product removal. In general, soil excavation with subsequent thermal treatment at Site 3 Thermal Treatment Staging Area, which is also located on NAS Cecil Field property, was the selected remedy for remediation of the excessively contaminated soil located on the west side of the bermed fuel farm area. Free product recovery during the excavation activities and in situ free product removal through the use of bioslurping technology in the area on top of the bermed fuel farm area was approved for immediate implementation (Navy 1995).

1.2 REGULATORY SETTING

NAS Cecil Field was placed on the National Priority List (NPL) by the U.S. Environmental Protection Agency (EPA) and the Office of Management and Budget in December 1989. A Federal Facilities Agreement (FFA) for NAS Cecil Field was signed by the FDEP [formerly the Florida Department of Environmental Regulation (FDER)], US EPA, and the Navy, in 1990. In 1993 NAS Cecil Field was selected for closure by the BRAC Commission (ABB-ES 1994b). The underground storage tank (UST) program at NAS Cecil Field is being completed in accordance with the BCT tank management plan, and in accordance with the Navy's Installation Restoration Program, UST division.

In accordance with FAC 62-770, an interim remedial action is proposed for the excessively contaminated soils west of the bermed fuel farm area at NFF. Excessively contaminated soil means soil saturated with petroleum product which causes a total hydrocarbon reading above 50 parts per million (ppm) for the Kerosene Analytical Group (used for JP-5) in accordance with FAC 62-770.200. The amount of soils to be excavated exceeds the 1,500 yd^3 limit for removal of contaminated soils during an interim (or initial) remedial action, as stated in FAC 62-770.300 (7), without FDEP approval. Approval for this action is contained in an alternative procedure agreement (APA) filed and granted in December 1994 and January 1995, respectively. Excessively contaminated soil that is excavated will be thermally treated by a low temperature thermal desorption (LTTD) unit located at Site 3. Thermal treatment will be conducted in accordance with FAC 62-775. Since both NFF and Site 3 are within NAS Cecil Field boundaries, compliance with the requirements of FAC 62-775.710 concerning the operation of the mobile thermal treatment unit at the site with confirmed contaminated soil is satisfied.

1.3 PROJECT OBJECTIVES

1.3.1 Remedial Action Objectives

The remedial action objective of this interim action is to remove free product in the area west of the bermed fuel farm area, to the extent practicable, in accordance with FAC 62-770.300 (3); remove and treat the excessively contaminated soils located in this same area; provide a subsurface barrier to prevent free product from re-contaminating the excavated area after backfilling; and begin a free product recovery operation in the area of the tank farm. The objective of this IRWP is to describe the technologies, procedures, and methodology to implement the interim remedial action.

This interim remedial action is not intended to be a final solution, but to complement the final remedy.

1.3.2 Site Cleanup Criteria

In accordance with a BCT/Partnering Team Meeting, it was agreed by all members present, including FDEP, that the following criteria would be applied to the soil excavation (Navy 1995):

- Within the free product plume west of the existing fence located at the western toe of the bermed fuel farm area (Drawing 227-DD000-001), excavate the soil to 5 ft bls.
- In areas where free product is encountered during excavation, excavate the soil to 5 ft bls.
- Outside the area of the free product, soil contaminated greater than 50 ppm (headspace as described in FAC 62-770.200) will be removed to a depth of 1 ft below the encountered (existing) water table.
- The area to be excavated is defined as that area contaminated with greater than 50 ppm (as measured using headspace analysis in accordance with FAC 62-770.200) to the south of the new jet fuel bypass line, west of the fence of the bermed fuel farm area to Avenue A, and south to Loop Road.

Free product that is exposed in the open excavation will be recovered to the extent practicable. This will be accomplished using a floating free product recovery skimmer pump. The free product layer in the open excavation will need to be greater than 1/8 in. in thickness for the recovery pump to be effective.

Free product recovery (bioslurping) in the area of the tank farm will also begin during this interim action. Cleanup criteria for the free product recovery, or the point at which the free product recovery operation can cease, has not been addressed at this time. This will be included in a future report, technical memorandum, or discussed and documented in meeting minutes. Preliminary estimates regarding the recovery time of the free product is in the range of five years. While the actions described in this IRWP do not address groundwater contamination, the final Contamination Assessment Report that is currently under development by the Navy will address the groundwater associated with NFF.

Clean soil criteria for the thermally treated soil will be in compliance with FAC 62-775.400. Further discussion of the clean soil criteria after thermal treatment is presented in Section 3.1.13.

2.0 PRE-REMEDIATION ACTIVITIES

2.1 MOBILIZATION

Mobilization will include delivering to the jobsite and work areas all construction equipment, tools, materials, supplies, and miscellaneous articles and establishing a work force sufficient to commence and sustain construction activities as required. Prior to the commencement of the work, a preconstruction meeting will be held with the NAS Cecil Field Resident Officer In Charge of Construction (ROICC) to discuss execution of the work, access roads, transportation haul routes, and contact personnel for utilities, environmental, safety and health, and security.

2.1.1 Utility and Excavation Interference Identification

Prior to beginning excavation or intrusive work, the designated areas will be checked for existing utilities and other potential interferences. The Bechtel site superintendent or his designated representative will perform a walkdown of the areas to be excavated to visually observe locations of manholes, hydrants, valves, open cuts, overhead obstructions, curbs, buildings, etc. and other unusual conditions. NAS Cecil Field personnel will be consulted for as-built locations of underground utilities. In addition, the Public Works Center for NAS Cecil Field will be requested to survey and indicate all utilities within the

remediation site. These will be marked either through the use of flagging or colored paint. Any other excavation or intrusive work interference will be also identified at this time and options discussed with the ROICC. No excavation or intrusive work will be initiated until the subgrade interference survey is complete.

2.1.2 Temporary Facilities

A construction trailer(s) will be set up at the site for a field office and for storage of personal protective equipment (PPE) and monitoring equipment. To control access, a temporary construction fence will be installed around the construction site at NFF [Drawing 001 and Drawing 227-DD000-002 (Drawing 002), Appendix C].

Parking for construction crews will be in areas designated by Bechtel. These areas will be designated outside of the area of contamination and will be coordinated with the ROICC. The specific area for parking will be determined in the field.

A temporary vehicle and equipment decontamination facility will be constructed, including provisions to contain waters generated during decontamination activities. Water generated during decontamination will be controlled in accordance with Section 5.0, Waste Management.

The necessary temporary utilities will be provided at the site (e.g., power, water, etc.). Permanent utilities for the bioslurping facility are discussed in Section 3.0. The necessary temporary utilities associated with the mobilization of the LTTD unit at Site 3 have previously been provided.

2.1.3 Specialty Subcontractor Mobilization

A specialty subcontractor will be mobilized to the site to perform the installation of the vertical isolation subsurface barrier wall.

A State of Florida-permitted LTTD unit for treatment of petroleum hydrocarbon contaminated soils will be mobilized. Treatment of the soils will be provided at Site 3, located on NAS Cecil Field, by a specialty subcontractor. In addition to the area required for thermal desorption treatment equipment, sufficient area for contaminated and treated soil stockpiles will be provided. Discussion of the soil stockpile areas is provided in Section 3.0.

2.2 CLEARING AND GRUBBING

Clearing and grubbing shall consist of removing all designated vegetation and debris in the established limits of excavation, equipment laydown areas, facility areas, utility construction/re-routes, selected areas for thermal treatment unit, contaminated material stockpile laydown area, and treated material stockpile laydown area. Clearing and grubbing will be performed in accordance with the Bechtel Navy RAC Technical Specification for Clearing and Grubbing, 22567-001-SP000-002 (Appendix B). Typically included in these Bechtel technical specifications are references to subcontractors. This reference will not apply to the majority of the specification included in this work plan, since Bechtel will be performing the work using direct hire labor forces. In addition, Section 4.0, "Submittals," is deleted for this work. Clarification is provided to Section 5.0 in that all work will be coordinated with the ROICC. Clearing and grubbing may not be required, and shall only be performed if necessary.

2.3 INITIAL SURVEY

Bechtel will provide an initial survey to provide control points for the excavation activities if it is deemed necessary in the field. This survey will be used to identify site layout, compound construction, control point elevations, and establish grids for the excavation. Bechtel may choose to subcontract this survey to a local survey company.

2.4 MONITORING WELL ABANDONMENT

Monitoring wells that are located near the limits of the excavation will be marked indicating a potential for abandonment. These wells are indicated on Drawing 001, Demolition Plan, Appendix C. Guidance for the monitoring well abandonment is provided in Bechtel Navy RAC Technical Specification for Well Drilling, Installation and Abandonment, 22567-001-SP000-022 (Appendix B). The requirements of FAC 40C-3 (administered by the St. Johns River Water Management District) and any local requirements [e.g., Environmental Protection Board (EPB) Rule 8, Proposed Amendments, Groundwater Resource Management, City of Jacksonville, EPB, September 8., 1990] will also be followed. Notification of abandoned wells will be provided to the Navy and local authorities as directed. Replacement monitoring wells will be provided by the Navy or its designated contractors. Bechtel will provide the Navy with appropriate closure reports.

2.5 MISCELLANEOUS STRUCTURES

The existing valve house and other structures will be demolished as indicated on Drawing 001. Other structures that are identified for demolition during the site walkover, such as manholes, hydrants, valves, pull boxes, etc., will be demolished by Bechtel. Demolition of miscellaneous structures will be accomplished following the guidance provided by Bechtel's Navy RAC Technical Specification for Demolition of Structures, 22567-001-SP000-017 (Appendix B). Section 4.0 of this specification is not required for this work. This specification is provided for general guidance of demolition of structures. UST removal and demolition referenced in this specification shall also be performed in compliance with Section 3.16 of this IRWP. Materials removed from the valve house will be disposed as directed by the Navy, or in a Resource Conservation and Recovery Act (RCRA) Subtitle D landfill. Pipes, valves, or other appurtenances will be stockpiled and disposed as directed by the Navy. If these materials are deemed by visual inspection to be excessively contaminated by petroleum product, they will be decontaminated or disposed in an appropriately licensed landfill.

3.0 REMEDIATION ACTIVITIES

As discussed in Section 1.0, the NFF interim remedial action objective is to:

- excavate, stockpile, and thermally treat excessively contaminated soils located west of the bermed fuel farm area and to recover any free product encountered during this excavation activity
- begin in situ free product recovery operations in the area of the bermed fuel farm area through the use of bioslurping technology

To describe these objectives, discussion of the interim remediation activities has been divided into two stages. Stage 1 is defined as the remediation activities associated with the excavation and free product recovery in the area west of the bermed fuel farm area. Stage 2 is defined as the bioslurping free product recovery and evaluation of the system installed and achievement of remedial action goals. Either stage could begin first, or both could operate concurrently.

To accomplish these objectives, the following services will be performed:

Stage 1

- Vertical isolation barrier installation
- Existing utilities removal/reroute
- Contaminated soil stockpile construction
- UST closure
- Contaminated soil excavation
- Free product recovery in area of excavation
- Excavation backfill and compaction
- Low-temperature thermal desorption treatment of contaminated soil
- Site restoration/grading

Stage 2

- Treatment compound construction
- Installation of bioslurping system
- Startup of bioslurping system
- Completion of record set drawings of remedial activities (inclusive of Stages 1 and 2)
- Evaluation report regarding the effectiveness of the bioslurping system and the achievement of remedial action goals

3.1 STAGE 1 SOIL EXCAVATION AND INITIAL FREE PRODUCT RECOVERY

The first stage of the interim remedial action involves the removal of excessively contaminated soils from an area west of the bermed tank farm area. The excessively contaminated soils were defined as the 50 ppm limits indicated in the *North Fuel Farm Cecil Field* memorandum (ABB-ES 1994c), as based on the revised CA. The volume estimates of soil to be removed and treated are in the range of 11,000 yd^3 (assuming a density factory of 1,285 ton/yd^3 this yields 14,135 tons of soil to be treated), indicated as primary excavation limits on Drawing 002, Appendix C. This estimate was based on a 5 ft excavation depth within the excavation limits. If additional area is required to be excavated (marked potential excavation area on Drawing 002) due to headspace readings, this will be coordinated with the Navy and the NAS Cecil Field BCT.

Excavation under Avenue A will not be performed, nor is it planned to excavate under Loop Road. Traffic disruption is not expected, and therefore re-routing of traffic is not planned.

Prior to excavation, a vertical isolation barrier wall will be placed between the existing bermed fuel farm area and the excavation area to intercept free product migration during and after excavation activities. Additionally, all existing utilities will be located, removed, protected in-place, and/or re-routed as required.

Thermal treatment of the excavated contaminated soils will be used to reduce contamination levels consistent with FAC 62-775 (Soil Thermal Treatment Facilities). The treated soils that have been verified to be clean through the thermal treatment will be stockpiled for future use, or may be used in the backfilling of the excavation.

Excavation of the area of the existing retention area (Drawing 002) will not occur without concurrence by the Navy. If excavation of this retention area is required, it will be replaced with similar lined construction during site restoration activities. Typical excavation activities will maintain a 3-ft distance from the retention area.

3.1.1 Vertical Isolation Barrier

A vertical barrier will be installed along the NFF western fenceline, at least 4 ft from the western toe of the slope of the bermed fuel farm area. Actual location will be coordinated in the field and will be dependent on interferences. Proposed extent of the barrier wall is indicated on Drawing 002. The membrane will be installed to a depth of approximately 12 ft bls. The horizontal extent of the isolation barrier dissects the area of the free product plume and extends 75 ft north and 75 ft south. The purpose of the vertical isolation barrier is to minimize potential for the migration of existing free product from the bermed fuel farm area into the excavation area during and after the excavation remedial actions.

A specialty subcontractor will utilize a proprietary innovative technology allowing an 80-mil high-density polyethylene (HDPE) membrane to be installed simultaneous to trench excavation. This technology eliminates traditional open trench technology (i.e., shoring, trench boxes, etc.) and is not dependent on trench sidewall/soil stability. As the trenching progresses, the sheets of liner material are joined to provide a leak-resistant panel joint. The installation trench is closed as the liner is installed.

Sheets of HDPE 22 ft wide and a minimum of 50 ft long will be used for the barrier wall. The 10 ft of HDPE that is not subsurface will be folded over to the east and clean soil stockpiles will be placed on the folded portion. In this way, the HDPE will act as a stabilizing sidewall for the excavation. Excavation next to the HDPE wall is limited to no closer than 2 ft and no deeper than 5 ft bls.

3.1.2 Existing Utility Line Abandonment

The proposed excavation site contains sanitary sewer and potable water lines. Both of these utility services will be rerouted, if necessary, prior to contaminated soil excavation. Relocation of these utilities will be coordinated with the ROICC. The abandoned sanitary sewer line will be removed during contaminated soil excavation. The existing water line will be terminated at the southern end of the NFF, west of Avenue A and south of Loop Road. The abandoned water line will be removed during contaminated soil excavation. Any utilities not previously identified to Bechtel will be addressed as appropriate with the Navy.

3.1.3 Contaminated Soil Stockpile Construction

Contaminated soil excavated from NFF may be placed in an area that will be excavated later, to allow for drainage into the excavation area. After drainage, the contaminated soils will be transported to a stockpile area constructed at Site 3. If this option is used, berms and other stormwater controls will be provided to prevent the spread of contamination. The preferred option is the provision of lined or water-tight trucks. The soils will be loaded "wet" and transported to the Site 3 contaminated soil stockpile for treatment.

An area at Site 3 will be designated as the contaminated soil stockpile area and will be cleared as necessary. Once cleared, the site will be graded and bermed as required. A security fence, if required, with warning signs will be installed around the perimeter of the stockpile area. A 30-mil HDPE liner with a layer of protective drainage sand will be placed to contain the material. The contaminated soil stockpile will be protected daily with a temporary 10-mil (minimum) cover with nylon scrim. The cover will be provided to totally cover the contaminated soil stockpile and will be such that the effort to remove and apply the cover during daily activities is minimal. The cover will be secured in place at the end of daily operations, and removed prior to the start of activities the following day. Runoff and stormwater maintenance (inclusive of secondary containment) for this area will be provided to prevent release of contamination to the environment.

The contaminated soil stockpile site and liner will be constructed so that leachate and stormwater will be collected in an internal low point (sump) and removed for disposal in the wastewater treatment plant, or as

directed by the Navy. Sampling of the collected leachate is addressed in Section 4.0. A suction hose with inlet strainer will be provided at the sump for periodic pumping and removal of leachate. Runoff resulting from the stockpile cover will be directed to the existing land surface and distributed to minimize erosion. No stormwater that has been in contact with the contaminated soils will be allowed to drain to the surrounding area. This water (contact water) will be handled as leachate.

The contaminated soil stockpile will be sized to provide containment for 100 percent of the excavated soil. It is assumed that as material is being excavated, previously excavated soil will have been sampled; is undergoing treatment in the thermal unit; and is subsequently transferred to the clean soil stockpile. The contaminated material will be placed and managed in discrete units until pre thermal treatment analytical sampling is complete. The contaminated soil removed from the NFF will be sampled prior to thermal treatment in accordance with the frequency specified in Table 3-1, and as required by the LTTD unit subcontractor's permit requirements. This sampling is required to provide the necessary analytical information for compliance with permit requirements of a low temperature thermal treatment unit. Analytical requirements for contaminated soil prior to treatment are defined in Section 4.0 of this IRWP.

Prior to thermal treatment, the LTTD subcontractor will screen all excavated soil to remove particles 2 in. or greater in size, unless more stringent requirements are part of the LTTD subcontractor's permit. This will be performed to comply with material requirements of the low temperature thermal desorption treatment unit. Depending on the nature of the soils excavated, it may be necessary to blend various batches of excavated soil to provide appropriate material for the treatment unit. Any required blending of the soil material will be the responsibility of the thermal treatment subcontractor, and only in allowance with the permit or FAC 62-775.

All materials that are not thermally treated (screened material 2 in. or greater) will be containerized and disposed as indicated in Section 5.0. Due to the extensive characterization activities previously accomplished, all materials coming from the NFF site are anticipated to only be petroleum-contaminated soils.

3.1.4 Limit of Excavation

The limits of excavation for the NFF are indicated in Drawing 002. The limits have been defined by the BCT/Partnering Team during discussions on April 14, 1995. The following represents the excavation limits as discussed in the meeting.

- Within the free product plume west of the fence, excavate the soil to a depth of 5 ft. The objective is to remove the soil smeared with petroleum as a result of the rise and fall of the water table inside the area of free product (Navy 1995).

- Outside the area of the free product, soil contaminated greater than 50 ppm, as measured by headspace analysis, will be removed to a depth of 1 ft below the water table (Navy 1995). Horizontal limits of the contaminated soil will be determined in the field through the use of headspace analysis. The limits of the excavation will be defined when headspace readings are less than 50 ppm. Field sampling is further addressed in Section 4.0.

- The area to be excavated is defined as that area contaminated greater than 50 ppm, as measure by headspace analysis, which is located to the south of the new jet fuel bypass line, west of the fence to Avenue A, and south to Loop Road. The objective is to remove soil acting as a source of contamination and to create an open excavation exposing the groundwater to aid in skimming free product (Navy 1995).

Table 3-1
Composite Samples Quantities Prior to Thermal Treatment

Amount of Soil		
by Volume (cubic yards)	by Weight (tons)	Quantity of Composite Samples
Less than 100	Less than 140	1
100 to 500	140 to 700	3
500 to 1000	700 to 1400	5
For each additional 500	For each additional 700	1

Notes:

Source of the table is FAC 62-775.410, Table II

The initial limits of the excavation are indicated in Drawing 002. The area that is indicated as a potential excavation area is based on discussions held during previous meetings with the Navy. Actual horizontal extents of the excavation in the southern area along Loop Road will be determined in the field. Physical limitations along Avenue A and the refueling station will also limit the excavation. Soil excavation will not occur any closer than 5 ft from Avenue A and from other structures. Soil excavation will not occur any closer than 3 ft from the retention area unless otherwise directed by the Navy.

Remedial performance criteria is as follows:

- A headspace reading of 50 ppm will be used for determination of the extent of the excavation in accordance with the requirements of FAC 62-770.200(2). Should groundwater not be encountered during the vertical extents of excavation, the same 50 ppm criteria shall apply for determination of the limits of excavation.

- Confirmatory sampling on the side walls (and bottom of excavation if groundwater is not encountered) will be used. Confirmatory sampling requirements are discussed in Section 4.0. In general, the confirmatory sampling is ex-situ headspace analysis as required by FAC 62-770.200.

3.1.5 Method of Excavation

Excavation will generally be performed in accordance with the Bechtel Navy RAC Technical Specification for Contaminated Earthwork and Miscellaneous Demolition, 22567-001-SP000-005 (Appendix B). In general, this specification is intended as a generic Bechtel specification for all Navy RAC work. Revisions noted in the IRWP take precedence. Sections 1.5, 3.4.2, and 3.4.3 of this specification are not included as part of this work. Additionally, Bechtel is responsible for items noted in Sections 3.6.2, and 3.8.4. The last sentence of Section 3.6.2 is not applicable to this work, as Bechtel is responsible for contamination control.

All excavation will be by backhoe, hydraulic excavator, or dragline (dredge) equipment where practical. In areas where interferences that are not being removed are present and preclude use of mechanized equipment, excavation will be by hand, provided confined space entry is not required. No entry into an excavation area over 4 ft deep will be made without site safety and health representative and construction management/engineering approval. All interferences which are not otherwise rerouted or abandoned will be properly maintained as required while the excavation is in progress and remain protected until the excavation is backfilled. Side slopes of the excavation will be maintained at no greater than a 2v:1h slope. Heavy equipment and personnel will not be closer than 4 ft to the side of the excavation during heavy equipment operations. Sidewall sampling, if necessary, will be taken from the bucket of the backhoe or excavator.

Excavation will start in the area of the free product as indicated on Drawing 002. Beginning a minimum of 2 ft west of the barrier wall, the excavation shall continue down to a depth of 5 ft. The horizontal extent of the initial excavation shall be as indicated on Drawing 002, and visually marked in the field prior to beginning excavation. Once the free product recovery "lake" is excavated, the excavation process will move to the northern portion of the site. The free product recovery "lake" will be left open to begin free product recovery operations described in Section 3.1.9.

Materials that are excavated "dry" will be directly loaded into the haul trucks for transport to Site 3. Materials that are excavated wet may be staged in a manner that will allow for drainage back into the excavation as discussed earlier. If proper transport is provided to prevent leakage and spread of contamination, the material may be loaded "wet" for transport. Further discussion of loading and transportation of materials is provided in Section 3.1.7.

Dust controls will be implemented if deemed necessary during the excavation activities. Continual monitoring will occur downwind during excavation activities.

Once all material has been excavated and backfilled, a registered land surveyor shall provide the necessary survey information (coordinates, elevations, etc.) to prepare as-built drawings for the excavation. Depth of excavation shall be recorded in the field engineer's logbook.

3.1.6 UST 70 Closure

Near the existing valve house there is a UST identified as UST 70. This UST is located within the limits of excavation and will be demolished during the excavation activities. UST 70 is a concrete tank (approximately 6 ft. long, 3 ft. wide, and 4 ft. deep with metal cover) that contained valves and piping for petroleum product transfer; the tank (valve box) is no longer used. All resulting debris and rubble will be transported and disposed of at a location as determined by Navy personnel, or transported to a Subtitle D landfill, if this is deemed possible by the Navy.

Prior to removal or closure of UST 70, Bechtel will provide a minimum 36-hour notification to the Navy. The Navy will then provide the required notifications of closure to the City of Jacksonville and other appropriate authorities prior to removal of the UST. Other regulatory notifications regarding the closure of this UST, such as the 30-day closure notification, will be provided by the Navy. Closure of this UST shall be conducted in accordance with FAC 62-761, with the appropriate closure report being forwarded to the regulatory agency by the Navy. Bechtel will provide the Navy with the appropriate reporting documents to assist in the closure of this UST.

3.1.7 Material Loading and Transport

Loading and unloading operations will be conducted in a highly controlled manner to prevent contamination of transport vehicles. Bechtel will verify that transport trucks are free of contamination before release from the loading/unloading area. The transport trucks will be provided with drape curtains, etc., during the loading process to minimize migration of contaminated soil. Additionally, the transport truck beds will be made watertight either through the use of tailgate gaskets or material containment liners to prevent liquid leakage during transport of saturated material. Additional guidance for material loading, transportation, and off-loading can be found in the the Bechtel Navy RAC Technical Specification for Onsite Transportation of Contaminated Materials, 22567-201-SP007-001 (Appendix B). Section 3.0, "Submittals" of this specification is not applicable, since Bechtel will be performing the work.

During the preconstruction meeting, the Bechtel site superintendent and NAS Cecil Field personnel will decide on the haul route for the contaminated soils being transported from NFF to Site 3. For those areas of the transportation route which cross NAS roadways, a permanent flagman will be stationed, if necessary, at each individual location to direct traffic. This effort will be coordinated with the appropriate Navy personnel.

3.1.8 Stormwater, Erosion, and Sedimentation Controls

During construction activities, the excavation areas will be maintained to preclude erosion and sediment runoff and minimize stormwater runon. Silt fencing and berms will be provided where deemed necessary by the Bechtel site superintendent. Stormwater falling on the sidewalls or temporary contaminated soil stockpiles will be directed into the excavation area. Any temporary contaminated soil stockpiles in the area of the excavation will be covered during a storm event and at the end of each day.

Other controls that will be implemented will include the construction of a berm around the excavation area to control runon and runoff around the NFF excavation. A berm will also be constructed around the stockpile areas at Site 3. Additional storage of water collected in the sumps of the stockpile areas will be provided by temporary tanks.

3.1.9 Initial Free Product Recovery - Open Excavation

Prior to the start of the excavation process, a sample of the free product will be taken from one of the monitoring wells and analyzed for specific gravity and viscosity. These data will allow for the final sizing of the free product recovery system. Described below is a conceptual process, based on a viscosity of 50 ssu.

After all or part of the initial area indicated on Drawing 002 is excavated to groundwater, the open excavation will be allowed to accumulate free product. This free product will then be recovered using a floating free product recovery skimmer pump. The pump will be capable of retrieving the floating free product at a rate of 4 gpm. The system will be approved for use in Class 1, Division 1, Group D locations. A process and instrumentation diagram for this pump is provided in Drawing 227-DD000-004 (Drawing 004, Appendix C). A primary component of the system is a sensor switch for automatic shut off during filling of the recovered product tank.

Recovered product will be pumped to a 5,000- to 8,000-gal portable storage tank. Operations will be monitored to preclude any spills. Spill prevention planning is addressed in Section 5.4. Power to the unit can be supplied through the use of a portable generator. An example of acceptable product information, the ORS Environmental Systems Filter Scavenger™ System, is contained in Appendix D.

The initial excavation will be left open until Bechtel and the Navy have agreed that the free product in the area of the excavation has been recovered to the extent practicable. The estimated amount of free product in the area of the excavation is approximately 5,500 gal (ABB-ES 1995d).

Once the 5,000- to 8,000-gal portable storage tank is full, another portable storage tank will be staged to the site (if necessary) to continue recovery operations. The full storage tank will be sampled as described in Section 4.0. If the analytical data indicates that the recovered free product can be recycled, and the Navy concurs, the recovered free product will be transferred to the Navy's 10,000-gal tank (No. 136) for ultimate disposal. Waste management of the free product is further described in Section 5.0.

3.1.10 Backfill and Site Restoration

Backfill for NFF may be performed simultaneous to excavation, with the exception of the free product recovery area "lake." The backfill borrow source will be approved by Cecil Field as discussed in Section 3.1.11. Backfill will be in general accordance with Bechtel's Navy RAC Technical Specification for Uncontaminated Earthwork, 001-SP000-006 (Appendix B), or as specified in this IRWP. Sections 1.5, 3.1, 3.4.2, 3.4.3, 3.6.3, 3.8, and 3.9 of the specification are not applicable to this work. To minimize recontamination of the backfill soil by the groundwater, a minimum (i.e., <0.5 percent) organic material will be present in the material. Discussion of the borrow source is provided in Section 3.1.11. In areas requiring 85 percent compaction (currently all areas), as measured by Standard Proctor (ASTM D698), backfill material will be placed in 18 in. lifts. If Bechtel is directed by the Navy to provide areas with 90 percent to 95 percent Standard Proctor, backfill material will be placed in lifts no greater than 12 in. Testing requirements for the backfill compaction are only necessary in the areas where restoration involves roadways or structures, or as directed by the Navy. If excavation and backfill operations are performed simultaneously, a separation distance will be maintained between the toe of slope for excavation and the toe

of slope for backfill to prevent or minimize cross-contamination by direct contact with free product or excessively contaminated soil.

After all disturbed areas of excavation have been successfully backfilled, the sites will be graded to drain as indicated in Drawing 227-DD000-003 (Drawing 003), Site Restoration Plan (Appendix C), or as directed by the Navy. In general, the NFF excavation area will be graded such that runoff will flow away from it.

Prior to backfilling NFF, an appropriate amount of 1-1/2- to 2-in. diameter crushed stone may be provided as a bottom layer in order to stabilize saturated material resulting from groundwater encroachment within the open excavation. If required, this layer of crushed stone will provide the means to achieve the desired compaction. Backfilling with a layer of gravel will be at the discretion of the Bechtel site superintendent.

3.1.11 Borrow Source

An acceptable borrow source will be identified and subsequent samples provided to a geotechnical testing subcontractor, if required, for moisture content, organic carbon, and moisture-density relationships. All borrow source approval will be by Cecil Field personnel, not Bechtel. This revises Specification 22567-001-SP000-006, Section 3.11. Backfill material for NFF shall be well-graded granular soil, consisting of silica sand or other approved materials. Backfill shall contain less than 0.5 percent organic carbon as measured in accordance with ASTM D2074-87. Moisture-density testing shall be in accordance with ASTM D698-91. A minimum of three samples from the potential borrow source, representing the potential stockpile or excavation area for the project, shall be tested for moisture-density relationship and organic content prior to being used in construction. Backfill shall be supplied at a moisture content within plus/minus 4 percent of optimum moisture to facilitate compaction. Requirements of this paragraph take precedence over Technical Specification 22567-001-SP000-006.

If approved by the Navy, treated confirmed clean soils from the LTTD unit may be used as backfill. Test of the treated material may include organic content to verify appropriateness of placement of treated material in the area of the excavation.

3.1.12 Clean Soil Stockpile Construction

Contaminated soil which has been successfully treated in the thermal desorption unit will be placed in an area designated as the clean soil stockpile area. The area designated for the clean soil stockpile will be cleared as indicated in Section 2.2. Once cleared, the site will be graded as required. A 30-mil HDPE liner will be placed to contain the material. The clean soil stockpile area will be sized to provide containment for approximately 100 percent of the treated soil. Discrete units of thermally treated soil for which representative samples have been taken will be stockpiled and tracked. Requirements for sampling of treated soil are defined in Section 4.0.

Sampling results for thermally treated soil will be compared with those criteria listed in Table 3-2. If results indicate that a unit of soil does not meet the clean criteria as specified by FAC 62-775.400, the soil will be returned to the thermal treatment unit for additional treatment. Secondly, although preliminary indications are that metals will not be of concern, treated soil will be analyzed for total metals as required by FAC 62-775.400. Soil that fails the clean soil criteria for total metals will be analyzed using the toxicity characteristic leaching procedure (TCLP). Units of soil which fail to meet the clean soil criteria for total metals and/or TCLP metals will be segregated from the clean soil stockpile and will be controlled, inspected, and maintained as hazardous waste, as discussed in Section 5.0. Soil material which fails TCLP will be controlled and transported offsite to a licensed hazardous waste disposal facility or as directed by the Navy.

3.1.13 Low Temperature Thermal Desorption

Thermal treatment requires that the treatment of the soil reduces total petroleum hydrocarbon contamination to those parameters specified in FAC 62-775 which are shown in Table 3-2.

The thermal treatment subcontractor will be required to perform treatment operations in accordance with performance objectives listed in Section 3.1.12. The subcontractor is required to retrieve material from the contaminated soil stockpile, screen the soil as necessary, blend the soil as necessary and, only as allowed by FAC 62-775, load the soil into the thermal treatment unit's hopper, thermally treat the soil, sample the soil in accordance with FAC 62-775, and place the material in the clean soil stockpile. The primary estimated volume of soil from NFF requiring treatment is approximately 11,028 yd^3 or approximately 14,135 tons. This estimated volume includes a 12 percent swell factor.

Bechtel will perform post treatment confirmatory sampling of a minimum of 10 percent of subcontractor's samples. Sampling and analysis is further discussed in Section 4.0.

3.1.14 Transport Vehicle and Equipment Decontamination Facility

Transport vehicles and equipment determined to be contaminated will be directed to the temporary decontamination facility located at the existing truck rack. The decontamination facility will be temporary and provide a location to pressure wash and remove contaminated soil from vehicles and equipment. The facility will include a liner that covers the concrete slab of the existing truck rack. All water generated as a result of decontamination activities will be containerized in a temporary storage tank and disposed of in accordance with the provisions of Section 5.0.

3.1.15 Geotechnical Field Testing

During earthwork construction, an onsite soils technician will perform in-place soil density testing in areas where compaction requirements are greater than 85 percent Proctor to confirm compliance with the specified compaction parameters. Pre-determined moisture—density relationships established for the borrow source material will be used as a baseline for field density testing. Field density testing shall be performed in accordance with ASTM D1556-90 (Sand Cone Method) or ASTM D2922-91 and ASTM D3017-88 (1993) (Density of Soil and Water Content of Soil by Nuclear Method). Field density testing, if required, will be performed at a maximum frequency of one test per 100 yd^3 of material placed or a minimum of one test per lift while work is in progress. Testing shall only be performed on material that requires a compaction of 90 to 95 percent compaction, or as directed by the Navy. If field density testing is requested for 85 percent specified compaction areas, the frequency will be one test per 200 yd^3 of material placed or a minimum of one test per day while work is in progress.

3.2 FREE PRODUCT RECOVERY - BIOSLURPING SYSTEM

Bioslurping technology adapts and applies vacuum-enhanced dewatering technology to the remediation of petroleum contaminated sites. Bioslurping combines two remedial approaches: (1) bioventing to stimulate bioremediation of petroleum-contaminated soils in situ; and (2) vacuum-enhanced free-product recovery to extract light, nonaqueous-phase liquid (LNAPLS) from the capillary fringe and the water table.

Vacuum enhanced recovery is a modification of conventional free product recovery system design, in which a vacuum is applied to the well bore to increase the hydraulic gradient. Free product recovery and/or plume control is dependent on the cone of depression (or pumping radius of influence). An insufficient pumping

Table 3-2
Criteria for Thermally Treated Clean Soil

Parameter	Cleanup Level
Total Volatile Organic Aromatics	100 mg/kg
Total Recoverable Petroleum Hydrocarbons	10 mg/kg or if exceeded then go to *a* below

Metals	TCLP[b,c]	Total[c,d]
Arsenic	5 mg/l	10 mg/kg
Barium	100 mg/l	4940 mg/kg
Cadmium	1 mg/l	37 mg/kg
Chromium	5 mg/l	50 mg/kg
Lead	5 mg/l	108 mg/kg
Mercury	0.2 mg/l	23 mg/kg
Selenium	1 mg/l	389 mg/kg
Silver	5 mg/l	353 mg/kg

Notes:

Source of the table is FAC 62-775.

[a] If exceeded, then the Total Recoverable Petroleum Hydrocarbons will not exceed 50 mg/kg (EPA Draft Method 3540/9073) provided the total of the Polynuclear Aromatic Hydrocarbons does not exceed 1 mg/kg (EPA Method 8100, 8250, 8270, or 8310) and the total of the Volatile Organic Halocarbons does not exceed 50 mg/kg (EPA Method 5030/8021 or 5030/8010).

[b] Toxicity Characteristic Leaching Procedure (EPA Method 1311).

[c] TCLP analysis will be provided only if totals are exceeded.

[d] The acid digestion procedure by EPA Method 3050 will be used to prepare soil samples for total metal analyses except mercury.

rate may lead to inadequate plume control and a resultant increase in residual product in the soil. A high pumping or recovery rate may increase product yield; however, the mobile hydrocarbon may be smeared at residual saturation in the unsaturated zone.

Applying a vacuum to a recovery well enables the piezometric gradient for oil and water flow to be increased (by decreasing the air pressure above the oil/water table), without a corresponding reduction in the air-oil and oil-water tables. When a vacuum is applied in a well, liquids in the well and the soil will rise due to the reduced pressure above the fluid interfaces. This phenomenon, called upwelling, can be reversed by lowering the water pressure in the bore hole by increasing the pumping rate. The net effect is increase liquid extraction rates without lowering the liquid levels and thus without increasing the amount of residual product in the unsaturated smear zone.

Bioventing is the process of aerating subsurface soils to stimulate in situ biological activity and promote biodegredation of petroleum hydrocarbons. Forced introduction of air (oxygen) to the subsurface is utilized by the indigenous microbial population to aerobically degrade the petroleum hydrocarbon present, utilizing oxygen as the electron acceptor, and ultimately producing carbon dioxide and water as by products.

Bioslurping technology combines both vacuum enhanced recovery and bioventing by:

- reducing the ratio of groundwater extracted per gallon of fuel recovered
- reducing the smear zone by maintaining a relative horizontal flow path of free product into the recovery well
- exposing the capillary fringe and smear zone to aeration, thus increasing biological action in these zones

The bioslurping system can be converted to a total bioventing system once free product activities are completed.

This section provides the system description necessary to implement the process. Key components of the process include:

- alternative procedure approval
- bioslurping monitor wells
- bioslurping wells
- electrical requirements
- liquid/vapor flow system
- record set drawings
- site layout

3.2.1 Alternative Procedure Description

The proposed plan of action at the NFF is to utilize two existing monitoring wells, install a bioslurping system based on estimated parameters, and monitor the results. The key to the success of this system is the ability to approach the implementation of the system on a full scale pilot system basis. Estimates of radius of influence were based on the spacing of the monitoring wells (90 ft), coupled with an estimated hydraulic well gradient of 60 in. These assumptions will be carried forward in the finalization of the construction drawings and implementation of the system. Other initial assumptions, provided by the engineer of record, included sizing of the pump, air-liquid storage tank, and oil-water separator. This IRWP will present the proposed process to be implemented. A process and instrumentation diagram is provided on Drawing 004. An alternative procedure has been requested for the actions described herein (ABB 1995b).

3.2.2 Bioslurping Monitor Wells

Six 1-in. push probes or equivalent observation wells will be used to monitor the effectiveness of the bioslurping system. Placement of these wells will be based on estimated radius of influence and site conditions. At each of the bioslurping recovery wells, three monitor wells/probes will be used to triangulate information. Push probe technology offers the maximum versatility in field placement of the wells.

3.2.3 Bioslurping Recovery Wells

Two new recovery wells will be installed on the top of the bermed fuel farm area. The location of these new wells is indicated in Drawing 003 and detailed on Drawing 005 of Appendix C. The recovery wells will be constructed of 4-in. diameter PVC, installed to a depth of 27 ft, with 20 ft of 0.020-in. slotted PVC well screen. The screened interval will be placed between 5 and 25 ft bls (ABB-ES 1995e). A 2-ft sump will be provided. The proposed location of the recovery wells is as close as possible to existing monitoring wells CEF-076-15 and CEF-076-016.

3.2.4 Piping and Utilities

Conveyance piping located on the top of the tank mound can be placed above or underground, depending on Navy's preference. Underground piping will be placed in trenches 18 in. bls. Above ground piping will be supported 12 in. off the ground using wooden posts which are spaced every 5 ft. Conveyance piping material and sizing is provided on Drawing 005, Appendix C. Discharge piping from the oil/water separator to the sanitary sewer will be placed either above or underground, depending on the Navy's preference. Piping requirements are the same as identified above.

Electrical power can be supplied to the treatment compound by overhead lines or underground conduit, and will be in accordance with the National Electrical Code and local regulations. All electrical hookups will be performed by a Florida-licensed electrician.

3.2.5 Treatment Compound Layout

The treatment compound will consist primarily of skid mounted equipment and will be approximately 15 by 25 ft. If the treatment compound is located outside of the fenced, or secured area of NFF, or Bechtel is directed by the Navy to secure the area, it will be secured with an 8-ft high chain link fence with one personnel gate and one 12-ft. gate to permit easy access and removal of equipment. The proposed location is indicated on Drawing 003. The final location will be coordinated with the Navy in the field.

The equipment for the bioslurping process will be delivered as equipment skids. These could be provided as the vacuum pump skid, moisture separator skid, and oil/water separator skid. If individual skids are provided in lieu of a single skid, the skids will be laid out to minimize pipe runs yet permit easy access to each piece of equipment. Anchorage of the equipment will be into a 6-in. thick concrete compound pad. The equipment skids will contain all instrumentation and controls required for operations within each individual equipment skid, and will be pre-wired. Power will be connected to each individual skid. A main 150 amp disconnect and meter (if required) will be provided. Process piping and instrumentation controls will also be connected between equipment skids. The manufacturer will provide instrumentation and power connections for each piece of equipment as indicated on the process and instrumentation diagram, Drawing 227-DD000-004 (Drawing 004, Appendix C).

3.2.6 System Components

See Drawing 004.

Vacuum Pump

The vacuum pump shall be a liquid ring pump which will generate a vacuum of 22 in. of mercury at a flow rate of 125 cubic feet per minute (cfm). The liquid ring pump utilizes water to compress the air stream as it enters the pump. The water also acts as a coolant for the air stream.

The pump discharge is injected into a discharge separator where 99.9 percent of the water is recovered and passed through an air cooled heat exchanger prior to being injected back into the pump. The air will be discharged through the moisture separator, granulated activated carbon units, and 25-ft 4-in. stack.

Moisture Separator

The off-gas from the liquid ring pump will be routed into a moisture separator. The separator is configured with a high high level switch set at 40 gal, a high level switch set at 30 gal, and a low level switch set at 5 gal. The high and low level switches control an electric diaphragm pump which will discharge to an oil/water separator. The high high level switch is a safety switch which will shut down the vacuum pump and activate a local alarm: either sound, flashing beacon, or both.

The moisture separator will remove the entrained water/oil in the air stream by reducing the velocity to approximately 50 ft/min. The air is then passed through an impingement baffle. The final stage of the air stream process is the passage of the air through the granulated activated carbon units.

Oil Water Separator

The recovered liquid will be treated by an oil/water separator. The separator will be a gravity type separator utilizing an oil skimming weir which will discharge the oil by gravity to a 250-gal (minimum capacity) storage tank. The oil/water separator will also have a sludge collection chamber with sides sloped at 45 degrees for easy sludge removal. Treated water will be discharged by gravity systems to the sanitary sewer or the federally-owned treatment works (FOTW). Direct discharge of the water after treatment through the oil/ water separator is discussed in the Alternative Procedure Request and is in compliance with the engineer of record design (ABB 1995b).

The oil/water separator will be specified to remove all non-emulsified JP-5 from the wastewater stream and produce an effluent containing no more than 10 mg/L of JP-5 droplets 20 microns or larger. The separation process will be automatic and incorporate the use of a bank(s) of slant-rib sinusoidal, oelophillic, coalescing plate(s) arranged to induce oil droplet impingement on the plate surfaces. Solids will settle into a sludge chamber(s). The separator will efficiently process variable influent flows from 5 to 25 gpm.

Instrumentation and Controls

The bioslurping system will operate on 480 V, 3-phase power provided from existing transformers. Power will be fed below grade to a National Electrical Manufacturers Association (NEMA) 3R, 150 amp fused disconnect switch located 15 ft.(minimum) away from the main fuel storage tanks within the bermed fuel farm area, and 15 ft. (minimum) away from the oil/water separator. Due to the presence of explosive gases in pressurized lines, all motors, switches, disconnects, conduit, and wiring within 10 ft. of the pressurized

lines and 15 ft. from the oil/water separator shall comply with National Electric Code (NEC) Article 501 to permit operation in a Class I, Division 2, Group D hazardous area.

The system will operate 24-hr. per day, seven days per week, and will only shut down automatically due to the following occurrences:

1) The high high level switch is tripped in either of the moisture separators, or
2) Either of the high high level switches is tripped in the oil/water separator.

Upon automatic shut down, a local alarm on the control panel will light indicating the switch which caused shut-down and a beacon light will be activated providing a visual indication that the system has shut down.

Vapor Treatment

As noted in the APR, it was proposed that no treatment be provided. The TSCREEN model (EPA) was used to estimate the emission concentrate. The conclusion of this analysis was that no vapor treatment was required. However, FDEP Engineering Support Section (ESS) - 4, *Vacuum Extraction, Piolt Studies, Air Emissions Treatment and Monitoring Requirements,* requires that air emission controls be provided for the first two months. Initially, Bechtel will provide granulated activated carbon units to control air emissions. If concentration of the hydrocarbons result in inefficient usage of the carbon units, alternative methods of treatment will be analyzed. At the end of two months of operation, TSCREEN analysis as specified in ESS-4 will be provided and recommendations for permanent air emission control requirements will be provided.

3.2.7 Free Product (Oily Waste) Transfer

Free product that is contained in the 300-gal oil tank will be manually transferred to a 5,000- to 8,000-gal portable storage tank. Operations will be monitored to preclude any spills. Spill prevention planning is addressed in Section 5.4.

Once the 5,000- to 8,000-gal portable storage tank is full, another portable storage tank will be staged to the site, if necessary. The full tanker truck will be sampled as described in Section 4.0. If the analytical data indicates that the recovered free product can be recycled, and the Navy concurs, the recovered free product will be transferred to the Navy's 10,000-gal tank (No. 036) for ultimate disposal. Waste management of the free product is further described in Section 5.0.

3.2.8 Record Set Drawings

At the completion of the installation of the bioslurping system, record set drawings will be produced and submitted to the Navy and FDEP, in accordance with FAC 62-770.730 and 62-770.500.

3.2.9 Initial Operation Report and Operation and Maintenance Manual

Bechtel will complete an evaluation report of the system as installed. Included will be a record of the remedial activities completed during the actions described in this IRWP. The format and content of this report will be discussed with the Navy and clarified prior to commencement of the work.

The initial bioslurping operation report will be prepared after the system is installed and pertinent operational data is collected. The operation report may include:

- bioslurping well liquid pumping radius of influence

- bioslurping hydrocarbon/liquid recovery rates
- bioslurping well specific capacity
- measured VOC emission rates
- vapor flow and bioslurping well vacuum relationship
- bioslurping well vapor removal radius of influence
- estimated vadose zone permeability, based on measurements collected during operations
- saturated zone conductivity, based on measurements collected during operations

Final outline and responsibility of the report will be coordinated with the Navy. In addition, initial operational data obtained from the field will be compared to provide full scale design data, if necessary. Any adjustments made in the field during operations to meet the initial performance criteria will also be included.

4.0 SAMPLING AND ANALYSIS PLAN

Bechtel currently has an approved Florida Comprehensive Quality Assurance Program Plan, and performs all work in accordance with this plan.

This section describes the sampling and analysis for field screening, confirmatory soil sampling, free product recovery, and low temperature thermal treatment of contaminated soils at NFF. Sampling methodology and procedures described in this Sampling and Analysis Plan (SAP) are based on FDEP requirements as found in FDEP's *Standard Operating Procedures for Laboratory Operations and Sample Collection Activities* and *Quality Assurance Standard Operating Procedures for Petroleum Storage System Closure Assessments*. EPA ASL Level III data will be required for free product characterization sampling, thermal treatment sampling, and waste management sampling to determine that remediation and/or treatment goals have been achieved.

4.1 SAMPLING PROTOCOL

4.1.1 Decontamination

Sampling equipment will be decontaminated prior to collection of each sample. Decontamination will be completed in accordance with Section 4.1, "Decontamination," of FDEP's *Standard Operating Procedures for Laboratory Operations and Sample Collection Activities* and US EPA Region IV SOPs. Used decontamination fluids will be containerized, stored and discharged to the wastewater treatment plant as directed by the Navy as indicated in Section 5.0.

4.1.2 Collection

Sampling, with the exception of field screening, will be performed in accordance with Section 4, "Sampling Procedures," of FDEP's *Standard Operating Procedures for Laboratory Operations and Sample Collection Activities*. Field screening will be performed in accordance with Section IV, "Field Measurements," of FDEP's *Quality Assurance Standard Operating Procedures for Petroleum Storage System Closure Assessments*.

4.1.3 Sample Identification

Sample identification will be in accordance with Navy RAC Project Procedure 6003, "Sample Identification and Data Encoding."

4.1.4 Logbooks

BEI field logbooks will be used for recording all field activities. Entries will include sufficient detail to reconstruct all significant activities. Logbook entries will be completed in accordance with the minimum requirements for recordkeeping included in Section 5.0, "Sample Custody and Documentation," of FDEP's *Standard Operating Procedures for Laboratory Operations and Sample Collection Activities,* which includes the minimum requirements for recordkeeping, and Bechtel Project Procedure 6004, "Field Logbook Management."

4.1.5 Chain-of-Custody Records

In order to maintain sample traceability, each sample for offsite analysis will be properly documented on a chain-of-custody record. Chain-of-custody documentation will be completed in accordance with Section 5.3, "Custody Documentation Requirements for Field Operations," of the FDEP's *Standard Operating Procedures for Laboratory Operations and Sample Collection Activities* and Bechtel Project Procedure 6005, "Chain-of-Custody Record Procedure."

4.1.6 Packaging and Holding Times

Sample volume requirements, frequencies, preservation techniques, minimum holding times, and container material requirements for samples are given in Table 4-1.

The preparation of all sampling containers and the container types, preservatives, and holding times are specified in the FDEP's *Standard Operating Procedures for Laboratory Operations and Sample Collection Activities* and in Bechtel Project Procedure 6010, "Sample Container Preservation and Aliquot Requirement." Section 4.4, "Sample Handling," of the FDEP SOPs contains the recommended container, preservation, and holding times for water, wastewater, soil, and sediment samples. Sample containers will meet all specifications outlined in the above-mentioned procedures.

4.1.7 Contract Compliance Screening and Data Processing

Analytical laboratory results for all confirmatory analyses will be contract compliance screened (CCS) upon receipt. This screen will verify and document the completeness of the data deliverable, the adherence to nationally recognized holding time criteria, and the use of appropriate analytical methodology. All analytical data following the CCS will be forwarded to intended data recipient in hardcopy only.

4.2 FIELD SAMPLING AND ANALYSIS

Samples identified in this section will be collected in accordance with FDEP's SOPs as outlined in Section 4.3.4, "Soil Sampling Procedures." Analysis of these samples will be in accordance with FDEP *Standard Operating Procedures for Laboratory Operations and Sample Collection Activities*, Sections 5.0 through 10.0 and Bechtel Sampling Project Procedures. Table 4-1 provides a summary of the data requirements and analytical parameters for samples to be collected from NFF. All sampling discussed herein is provided by Bechtel, with the exception of thermal treatment sampling. Thermal treatment sampling is primarily provided by the thermal treatment subcontractor, with Bechtel collecting duplicate (split) samples.

4.2.1 Limits of Excavation Sampling

Screening of samples for the VOC component of TRPHs will be used to guide remediation activities, to the extent practical. Soil samples will be collected and analyzed using a flame ionization detector (FID) in

accordance with Section IV, "Field Measurements," of FDEP's *Quality Assurance Standard Operating Procedures for Petroleum Storage System Closure Assessments*. Each sample will be obtained in the vadose zone and screened with and without a carbon filter so a determination can be made whether naturally occurring organic (methane) vapors are having an effect on the FID levels detected.

The headspace samples for limits of excavation will be performed by collection of grab samples from the sidewalls and bottom of excavation if appropriate. Initially, the soil will be excavated in the areas identified as contaminated with over 50 ppm as discussed in Section 3.1.4, after which headspace analysis, to the extent practical, will be used to guide additional excavation activities. If necessary, additional field sampling may be completed in the field for stained soils. It is estimated that samples for headspace analyses will be collected from every grid as established in Section 4.2.2. Samples will be collected every 30 ft along the center of the sidewall and from the center of every 30- by 30-ft grid within the excavation area. Approximately 300 field screen samples will be collected. Sixteen oz. Mason jars will be provided for the headspace analyses.

4.2.2 Excavation Soil Sampling Grid Establishment

Soil sampling will be conducted to confirm that unsaturated (vadose zone) soils with headspace readings of less than 50 ppm remain following excavation of contaminated soils, as allowed in FAC 62-770.200, "Initial Remedial Action." The number and distribution of samples will be based on the *Guidance Document for Verification of Soil Remediation* (Michigan 1994, see Appendix E). At a point in the excavation process determined by the Bechtel site representative, soil samples will be collected for headspace analyses at the outer limits of the excavation (i.e., sidewalls and trench bottom) only from soil that lies above the water table. Samples will not be collected from the bottom of the excavation where the excavation was halted due to encountering groundwater (assumed to be approximately 75 percent of the excavated area). If this assumption is significantly different from the actual area excavated, the grid interval may be determined using the following equation for an area between 0.25 (10,890 ft^2) and 3.0 (130,680 ft^2) acres (actual NFF excavation area will fall within 1 acre +/- 0.5 acre) (Michigan 1994).

$$\text{Grid Interval} = (\sqrt{(\text{Area}/\pi)}) / 4.$$

Area in ft^2

The estimated area of the sidewall and bottom area above water table is 16,000 ft^2 and 26,000 ft^2, respectively. Assuming a total of 42,000 ft^2, the grid interval is 29 ft. Using this grid interval, superimpose the scaled grid on a map of the remediated area in a manner that best fits the area, typically by starting at a chosen corner. Grid adjustments may also be needed to accommodate a minimum of at least one sample from each sidewall. Initially, only a subset of the total grid nodes will be sampled in order to statistically evaluate the data, and if favorable, sampling will cease. A minimum of 10 samples, or 25 percent of the total grid nodes , whichever is larger, should be sampled and analyzed to allow a large enough data pool for statistical analysis. A couple of extra samples are recommended in the event that statistical analysis indicates the need for more samples.

Michigan Department of Natural Resources guidance on statistically-based sampling of a medium size site provides a 95 percent confidence level of determining any hot spot concentrations at NFF using unbiased sampling. The null hypothesis assumes that, following excavation, if a sample from the tested area contains any target analyte above the cleanup criteria, the area is still contaminated. Areas in question will be further remediated, followed by hot spot sampling (i.e., subquadrant confirmatory sampling) in order to show that the area is clean in accordance with the alternative hypothesis and that the null hypothesis is false. The alternative hypothesis assumes that sample results above the cleanup criteria indicate the site has been remediated to cleanup goals.

Table 4-1
Data Requirements for North Fuel Farm

Sample Event	Analytical Method	ASL Level	Sample Volume	Sample Container	Preservative	Holding Time	QC Samples Required[1]
UNSATURATED SOIL (VADOSE ZONE) SAMPLING							
Limit of Excavation Sampling							
TVOC[2]	Head Space FAC 62-770.200	I	fill jar ½ full	16-oz. canning jar	None	Analyze immediately following temperature equilibration	Dup: 1/10
THERMAL TREATMENT SAMPLING							
Pre-treatment Soil Sample							
TVOA[3]	EPA 5030/8020	III	10 g	Glass, 4-oz. widemouth w/Teflon/silicone septum	Cool @ 4°C	14 days	N/A
TRPH[4]	EPA 3540/9073 or EPA 9071	III	20 g	Glass, 4-oz. widemouth w/Teflon/silicone septum	Cool @ 4°C	14 days	N/A
TVOH[5]	EPA 5030/8010	III	10 g	Glass, 4-oz. widemouth w/Teflon/silicone septum	Cool @ 4°C	14 days	N/A
As, Ba, Cd, Cr, Pb, Hg, Se, Ag	EPA 6010 and 7471 (Hg only)	III	200 g	Glass or plastic, 8-oz. widemouth w/Teflon lined cap	Cool @ 4°C	6 months (28 days for Hg)	N/A

Table 4-1 (continued)

Sample Event	Analytical Method	ASL Level	Sample Volume	Sample Container	Preservative	Holding Time	QC Samples Required[1]
Post-treatment soil samples							
TRPH[6]	EPA 3540/9073 or EPA 9071	III	20 g	Glass, 4-oz. widemouth w/Teflon/silicone septum	Cool @ 4°C	14 days	Dup: 1/20 RB: 1/20 or weekly
TVOA	EPA 5030/8020	III	10 g	Glass, 4 oz. widemouth w/Teflon/silicone septum	Cool @ 4°C	14 days	TB: 1/cooler shipment Dup: 1/20 RB: 1/20 or weekly
As, Ba, Cd, Cr, Pb, Hg, Se, Ag	EPA 6010 and 7471 (Hg only)	III	200 g	Glass or plastic, 8-oz. widemouth w/Teflon lined cap	Cool @ 4°C	6 months (28 days for Hg)	RB: 1/20 or weekly Dup: 1/20
TCLP[7]	EPA 1311/8011 (metals)	III	100 g	2-L glass bottle w/teflon lined cap	Cool @ 4°C	14 days	N/A
LIQUID WASTE SAMPLING							
Decontamination water and oil/water separator water effluent[8]							
ICP Metals and Hg	EPA 6010 and 7471 (Hg only)	III	fill container	1-gal amber glass w/Teflon lined cap	Cool @ 4°C	6 months (28 days for Hg)	N/A
Halogenated VOCs[9]	EPA 601	III	fill container	3 40-mL vials w/Teflon septum seal	Cool @ 4°C	7 days until extraction, 40 days after extraction until analysis	N/A
Aromatic VOC	EPA 602	III	fill container	3 40-ml vials w/Teflon septum seal	Cool @ 4°C	14 days	N/A
TSS	EPA 160.2	III	fill container	16-oz. plastic	Cool @ 4°C	7 days	N/A
Chemical/ biological oxygen demand	Standard Method 507 [5210(BOD) and 5220 (COD)]	III	100 ml	16-oz. plastic (BOD) 4-oz. plastic (COD)	Cool @ 4°C H_2SO_4 (COD)	14 days (BOD) 28 days (COD)	N/A
pH	EPA 9041	III	100 ml	4 oz plastic	Cool @ 4°C	Analyze immediately	N/A

Table 4-1 (continued)

Sample Event	Analytical Method	ASL Level	Sample Volume	Sample Container	Preservative	Holding Time	QC Samples Required[1]
FREE PRODUCT SAMPLING (CHARACTERIZATION FOR RECYCLING)							
pH	EPA 9041	III	100 ml	4 oz plastic	Cool @ 4°C	Analyze immediately	1/20 RB 1/20 Dup
Flashpoint	EPA 1020	III	200 ml	8 oz amber glass	Cool @ 4°C	28 days	1/20 RB 1/20 Dup
Percent Solids	EPA 160.2	III	400 ml	16 oz plastic	Cool @ 4°C	7 days	1/20 RB 1/20 Dup
Total Halogens	ASTM D-808	II	200 ml	8 oz amber glass		7 days	1/20 RB 1/20 Dup
RCRA Metals TCLP	EPA 6010	III	400 ml	16 oz plastic	H_2SO_4 pH<2 Cool @ 4°C	6 months	1 TB 1/20 RB 1/20 Dup
VOC (including MEK)	EPA 8240	III	120 ml	(3) 4 ml VOA vial	HCL, pH<2 Cool @ 4°C	14 days	1/20 RB 1/20 Dup
SVOC	EPA 8270	III	(2) 1 liter	1 liter amber	Cool @ 4°C	7 days until extraction, 40 days after extraction until analysis	1/20 RB 1/20 Dup
Reactivity (Including CN and Sulfide)	SW 846	III	(2) 1 liter	1 liter amber	Cool @ 4°C	No specified holding time	1/20 RB 1/20 Dup

Table 4-1 (continued)

Sample Event	Analytical Method	ASL Level	Sample Volume	Sample Container	Preservative	Holding Time	QC Samples Required[1]
AIR SAMPLING DURING BIOSLURPING OPERATIONS							
TVOA	T014	III	fill canister	Suma canister	Cool @ 4°C	Not specified by method. 14 days maximum	None
DEBRIS SAMPLING							
TRPH[4]	EPA 3540/9073 or EPA 9071	III	20 g	Glass, 4 oz. widemouth w/Teflon/silicone septum	Cool @ 4°C	14 days	Dup: 1/20 RB: 1/20 or weekly
TVOA	EPA 5030/8020	III	10 g	Glass, 4 oz. widemouth w/Teflon/silicone septum	Cool @ 4°C	14 days	TB: 1/cooler shipment Dup: 1/20 RB: 1/20 or weekly
As, Ba, Cd, Cr, Pb, Hg, Se, Ag	EPA 6010 and 7471 (Hg only)	III	200 g	Glass or plastic, 8 oz. widemouth w/Teflon lined cap	Cool @ 4°C	6 months (28 days for Hg)	RB: 1/20 or weekly Dup: 1/20
TCLP[8]	EPA 1311/8011 (metals)	III	100 g	2 L glass bottle w/teflon lined cap	Cool @ 4°C	14 days	N/A

NOTE: Samples for volatile organic analyses shall not be homogenized (mixed) prior to containerization.

[1] Generic QC sample types will include the following: TB - Trip Blank, RB - Equipment Rinsate Blank, FB - Field Blank, Dup - Duplicate, MS/MSD - Matrix Spike/Matrix Spike Duplicate
[2] TVOC = Total volatile organic compounds
[3] TVOA = Total volatile organic aromatics
[4] TRPH = Total recoverable petroleum hydrocarbons
[5] TVOH = Total volatile organic halocarbons
[6] If TRPH values exceed 10 ppm, analyze for PAH (EPA Methods 8100, 8250, 8270, or 8310) and total VOHs (EPA Methods 5030/8021 or 5030/8010). Refer to FAC 62-775.400 (2).
[7] TCLP analysis required only if total metals results fail clean soil criteria for total metals
[8] Discharge limits set by FOTW
[9] VOC = Volatile Organic Compound

4.2.3 Field Sampling of Free Product

Field sampling will be performed on recovered free product generated from use of the skimmer within the trench and from the oil/water separator (part of bioslurping process). It is assumed that one portable storage tank will be available during free product recovery. Once full, a single sample will be collected from the tanker (grab sample), analyzed, and evaluated. Results of the analysis will be forwarded to NAS Cecil Field personnel for review. If necessary, temporary storage (e.g., 5 to 10 drums) will be available for backup storage during the characterization period. Samples will be collected and analyzed for waste oil characterization and metals parameters as provided in Table 4-1.

4.2.4 Thermal Treatment Soil Sampling

Thermal treatment sampling includes samples collected prior to and following thermal treatment. All sampling associated with the thermal treatment will be the responsibility of the thermal treatment subcontractor, with Bechtel providing field duplicate samples (splits). Sample collection will be performed in accordance with Section 4.3.4, "Soil Sampling Procedures," of the FDEP *Standard Operating Procedures for Laboratory Operations and Sample Collection Activities,* unless otherwise specified. Prior to thermal treatment, composite samples will be collected ex-situ as specified in the *Quality Assurance Standard Operating Procedures Manual for Soil Thermal Treatment Facilities*. Section 2.1.1.2 addresses stockpiled soil sampling. The frequency with which composite samples are to be collected is based on the quantity of material to be treated (see Table 4-1). The high estimate of the volume of soil is calculated from an estimated area of approximately 60,000 ft^2 multiplied by the expected depth of excavation (5 ft) to get approximately 11,000 yd^3. In accordance with FAC 62-775.410, five composite samples are required for the first 500 to 1,000 yd^3 of soil followed by one sample for each additional 500 yd^3 (approximately 700 tons). The total number of samples that will be collected by the subcontractor is estimated to be 40. Bechtel will monitor the frequency and sampling methodology used by the subcontractor and will perform a quality control check of the subcontractors laboratory via collection of 10 percent split samples (i.e., four in 40).

The composite samples will be analyzed for volatile organic aromatics, total recoverable petroleum hydrocarbons, volatile organic halocarbons, and metals according to the methods included in Table 4-1. Each composite sample will consist of soil samples collected from a minimum of four locations, with the exception of volatile organics for which composite samples will not be collected. Each sample shall be collected from at least four locations and three depths at each location: 2/3, 1/3 and 1/6 the height of the stockpile at the subsample location. This soil sampling and analyses procedure is in accordance with FAC 62-775.410(3).

During thermal treatment, a soil sample will be collected at least hourly and composited over an 8-operational-hour maximum time interval or at least once every 400 tons, whichever is less. Each composite sample will be analyzed for parameters listed in Table 4-1. This procedure and analyses are in accordance with FAC 62-775.410(5) and 62-775.400.

4.2.5 Sampling of Decontamination Water

Sample collection will be performed in accordance with Section 4.2, "Aqueous Sampling Procedures," of the FDEP *Standard Operating Procedures for Laboratory Operations and Sample Collection Activities*. Samples will be collected and analyzed to determine ability to dispose of the decontamination water through the FOTW. Samples will be analyzed for the parameters listed in Table 4-1. A single sample of the decontamination water will be collected from each storage tank staged to the site for containment of

decontamination fluids. Based on the results and Navy approval, the decontamination water will be released to the FOTW. Additional discussion of the decontamination fluids is contained in Section 5.0.

4.2.6 Air Sampling

During the initial operations of the bioslurping system, off-gas analysis of the vapors for the stack indicated on Drawing 004 will be collected and analyzed for TVOA. Suma canisters will be used for collection of the off gas. It is estimated that during the first two weeks of operations, six canisters will be collected. Additional canisters may be collected if deemed necessary by the Navy. Results of these analyses will be used in the evaluation report of the system.

4.2.7 Effluent Sampling

Water that has passed through the oil/water separator will be sampled initially for the parameters indicated in Table 4-1. These data will then be provided to the Navy for approval to discharge to the FOTW. Further analysis of discharge water from the oil/water separator will occur once a month, unless directed otherwise by the Navy.

5.0 WASTE MANAGEMENT

There are several waste management activities anticipated during this removal action, including disposal of:

- the soils and debris generated during the excavation that cannot be thermally treated
- thermally treated soils
- the free product (waste fuel) or oily liquids encountered in the excavation
- water recovered via the oil water separation used in conjunction with bioslurping
- water generated in the decontamination of equipment or dewatering of excavated areas
- PPE and other incidentally contaminated materials
- other non-hazardous solid wastes

5.1 WASTE MINIMIZATION

Waste materials to be disposed of during this removal action are not anticipated to be classified as "hazardous" waste. All previous investigations at this site have only encountered fuel and petroleum products resulting from site activities. The site is well characterized and contamination is well defined.

Construction activities at this site will be controlled to minimize the amount of materials that must eventually be disposed of. Waste minimization is an important goal and will be implemented during all site operations. These practices will include:

- limiting extraneous materials taken into contamination control areas
- decontamination and free release of equipment used to support onsite activities
- use of consumables that can be compacted or otherwise volume reduced

5.2 HAZARDOUS WASTE

Hazardous waste is not expected to be found associated with the removal actions at this site. Based on extensive previous site characterization data and the well known history of site operations, no hazardous wastes will be encountered. If any hazardous wastes are identified, they will be managed in accordance with RCRA, 40 CFR Parts 260, and related federal and state regulations.

5.3 WASTE DISPOSAL

5.3.1 Petroleum Contaminated Soil

Any non-hazardous petroleum contaminated soil excavated from this site will be loaded for transport as described in Section 3.1.7. Soil contaminated above cleanup guidelines or excessively contaminated soil (50 ppm as measured by headspace anaylsis) will be transported to the on-site thermal treatment facility (located at Site 3) for treatment. Sampling of the petroleum contaminated soils will be in accordance with FAC 62-770.200.

Soil that is determined to be non-contaminated or has petroleum contamination below approved guidelines will be disposed of in an approved non-hazardous landfill or used as common fill onsite only with Navy approval.

5.3.2 Disposal of Contaminated Debris

Debris screened from the thermal treatment process and other construction debris will be disposed of in a RCRA Subtitle D landfill. Debris will be containerized in 20 yd^3 rolloff bins. Representative composite samples will be collected from six locations in each rolloff and analyzed as indicated in Table 4-1. These data will be provided to the Navy prior to disposal of the debris, and only with Navy approval will the debris be disposed in a RCRA Subtitle D landfill.

5.3.3 Thermally Treated Soil

The thermally treated soils that are confirmed clean will be disposed in a construction landfill, used as backfill at the NFF site, or stockpiled for future use by the Navy. The location of the clean soil stockpile will be as directed by the Navy.

5.3.4 Free Product

Any free product that is encountered during the excavation will be recovered via a skimmer pump. The free product will be pumped directly to a portable storage tank prior to sampling. Subsequent disposal or transfer of free product will be to the Navy's Recovery Tank 136. Ultimate disposal of the waste oil and liquids will be handled by the Navy. Sampling prior to transfer to the Navy is discussed in Section 4.0.

5.3.5 Decontamination Water

Decontamination water that is generated as a part of these remedial actions will be containerized in storage tanks. A sample will be taken from each tank for analyses as described in Section 4.0. These data will be provided to the Navy for review and determination of ultimate disposal of the decontamination water. Typically, the decontamination water is expected to be discharged to the FOTW for secondary treatment. Decontamination water that is containerized in the area of NFF will be treated via the oil/water separator prior to discharge to the FOTW, if this is the approved method of disposal.

5.3.6 Effluent Water

Water that is the effluent of the oil/water separator process will be collected from the oil/water separator dry well, once the well is half full. This sample will be analyzed as indicated in Table 4-1. These data will be provided to the Navy for review. Based on Navy approval, the effluent will be discharge to the FOTW. No other sampling prior to discharge is proposed after the initial sampling event. Monthly samples will be

collected and analyzed (on a frequency agreed to by the Navy) as indicated in Table 4-1. These data will also be provided to the Navy for review.

5.3.7 Personal Protective Equipment

All PPE will be disposed of by placing the materials in double plastic garbage bags and disposing of it in a licensed Subtitle D landfill. Any other non-hazardous solid waste that is generated as a result of mobilization and construction activities at the site will be properly disposed of onsite or offsite as directed by the Navy.

5.3.8 Waste Management Practices - General

Waste management practices, as defined in the Navy RAC Programmatic Waste Management Plan, will be performed as described in the plan and coordinated with the Navy. The Waste Management Plan provides guidance for uniform practices in this area.

5.4 SPILL PREVENTION

Activities conducted in support of the free product recovery operations will be conducted in a manner to ensure that product or fuel is not released into the environment. When conducting operations which may result in a possible fuel release, Bechtel's work will provide best management practices to preclude a spill. Provisions for spill prevention and control that will be used during the transfer of free product will include:

- Performing level checks in free product recovery tank and the Navy's 10,000-gal tank (No. 136) prior to each transfer from the 5,000- to 8,000-gal portable storage tank.
- Manual transfer (with full-time attendant) of free product from free product recovery tank to the Navy's 10,000-gal tank.
- Continuous backup storage: A second free product storage tank will be available onsite as the first free product storage tank is filling.
- Surveillance monitoring: All free product tanks will be checked to ensure that overflow conditions do not occur.
- Use of process controls in the system where feasible.
- Immediate availabilty of spill mitigation equipment (e.g., absorbent materials).
- Notification: Immediate notification shall be made to the NAS Cecil Field Environmental personnel if spill occurs.

Other provisions and procedures will be discussed with the Navy prior to implementation of the transfer operation.

6.0 ORGANIZATION AND RESPONSIBILITIES

6.1 PROJECT ORGANIZATION

As the Environmental RAC for the Navy, Bechtel provides NAS Cecil Field management of remedial action field activities, which includes all activities necessary to implement field work delineated in work plans.

Typically, these activities include development and procurement of subcontract services; development, implementation, and overview of plans; collection and review of data, including sampling results, quality assurance/quality control submittals, and sample tracking and custody; technical guidance to onsite personnel; report preparation; cost management; and schedule control. Key leadership for the project is provided by the project manager, Hermann Bauer; the construction manager, Fred Seale; and the safety and health representative, Trent Rogers.

6.2 SCHEDULE

The schedule for the implementation of actions described in this IRWP is not completed. Upon completion of the schedule, a copy will be forwarded to the Navy for review.

7.0 SAFETY AND HEALTH

A Program Safety and Health Plan (PSHP) defines policies for work on the Navy RAC Project. A Site Safety and Health Plan (SSHP) has been prepared for Navy RAC bases. Addendum No. 18 to the SSHP, which is provided separately, defines task-specific requirements for interim remedial action activities at the NFF. Addendum 18 to the SSHP will be revised to include a hazard assessment for bioslurping and associated activities prior to its implementation.

8.0 QUALITY CONTROL PLAN

Appropriate Quality Control criteria is developed and included in the site-specific addendum to the Quality Control Program Plan (QCP). This site-specific plan, called the Quality Control Program PlanAddendum [QCPA]) is based on the Navy approved QCP for the basic contract. Bechtel will implement, maintain, and comply with the Navy approved basic contract QCP and the site-specific QCPA.

REFERENCES

ABB Environmental Services. Inc. (ABB-ES), 1994a. *Contamination Assessment Report, North Fuel Farm Sites, Naval Air Station Cecil Field, Jacksonville, Florida* (July).

ABB-ES 1994b. *Remedial Investigation Operable Unit 2, Naval Air Station Cecil Field, Jacksonville, Florida*, Draft (October).

ABB-ES 1994c. Memorandum: *North Fuel Farm Cecil Field*, (December).

ABB-ES 1995a. Memorandum: *North Fuel Farm, Cecil Field, Phase I, Task 1: Soil Removal* (March).

ABB-ES 1995b. Memorandum: *North Fuel Farm, Cecil Field, Phase I, Task 2; Alternate Procedures Request for Free Product Removal* (April).

ABB-ES 1995c. *Alternative Procedures Request*, Mike Dunaway, Florida PE 39451 (May).

ABB-ES 1995d. Memorandum: North Fuel Farm, Cecil Field, Phase I, Task 2, "Free Product Removal Modifications (with Recirculation)" (March).

ABB-ES 1995e. Memorandum: "Redesign of Bioslurper Wells at NAS Cecil Field, North Fuel Farm (June).

Michigan Department of Natural Resources, Waste Management Division, Hazardous Waste Program Section, 1994. *Guidance Document for Verification of Soil Remediation* (April).

Southern Division Naval Facilities Command, Department of Navy, 1995a. Memorandum: *Draft Meeting Minutes, 14 April 1995, North Fuel Farm, BCT/Partnering Team*

APPENDIX A

FIGURES

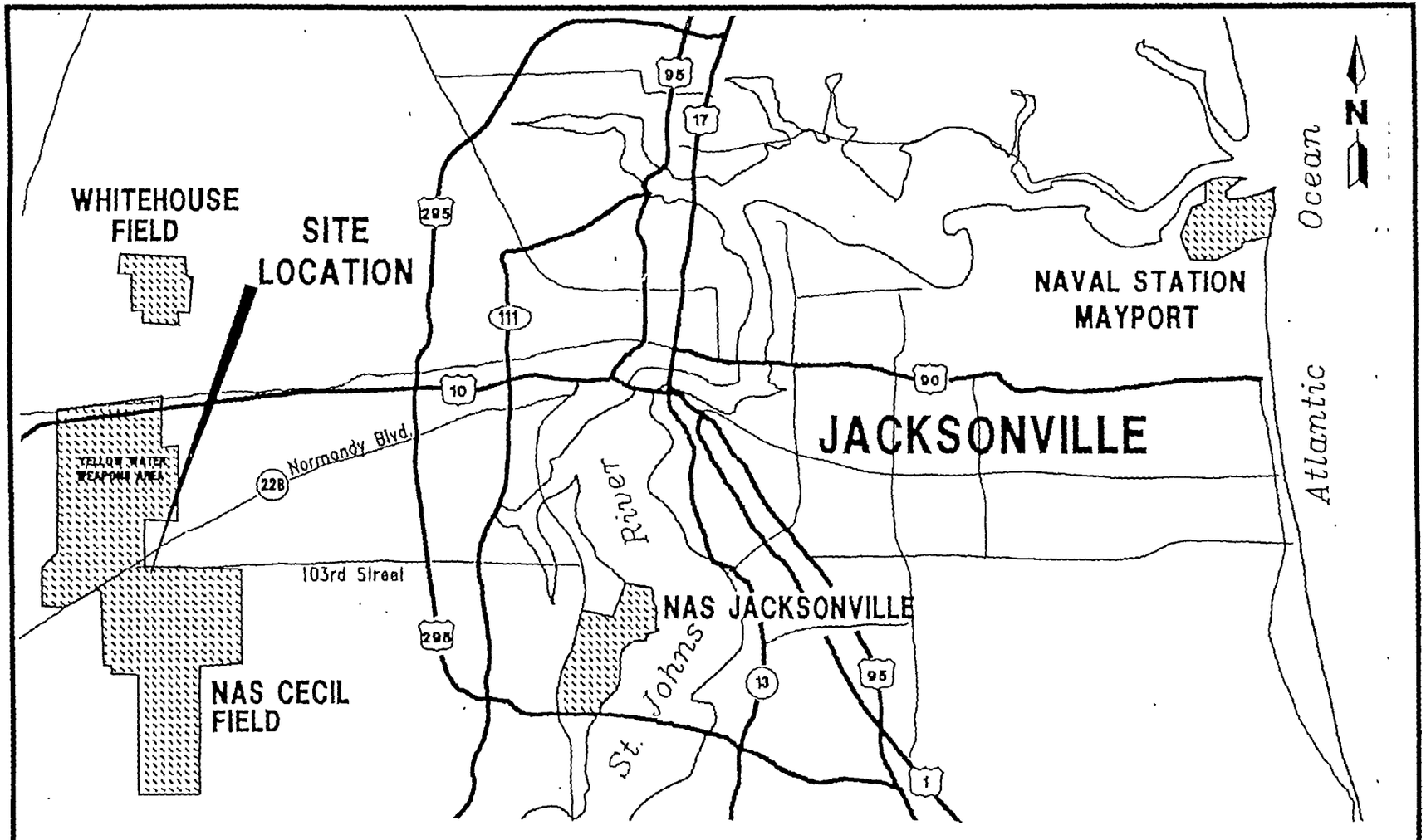

FIGURE 1-1
FACILITY LOCATION

0 1.75 3.5 MILES
SCALE: 1" = 3.5 MILES

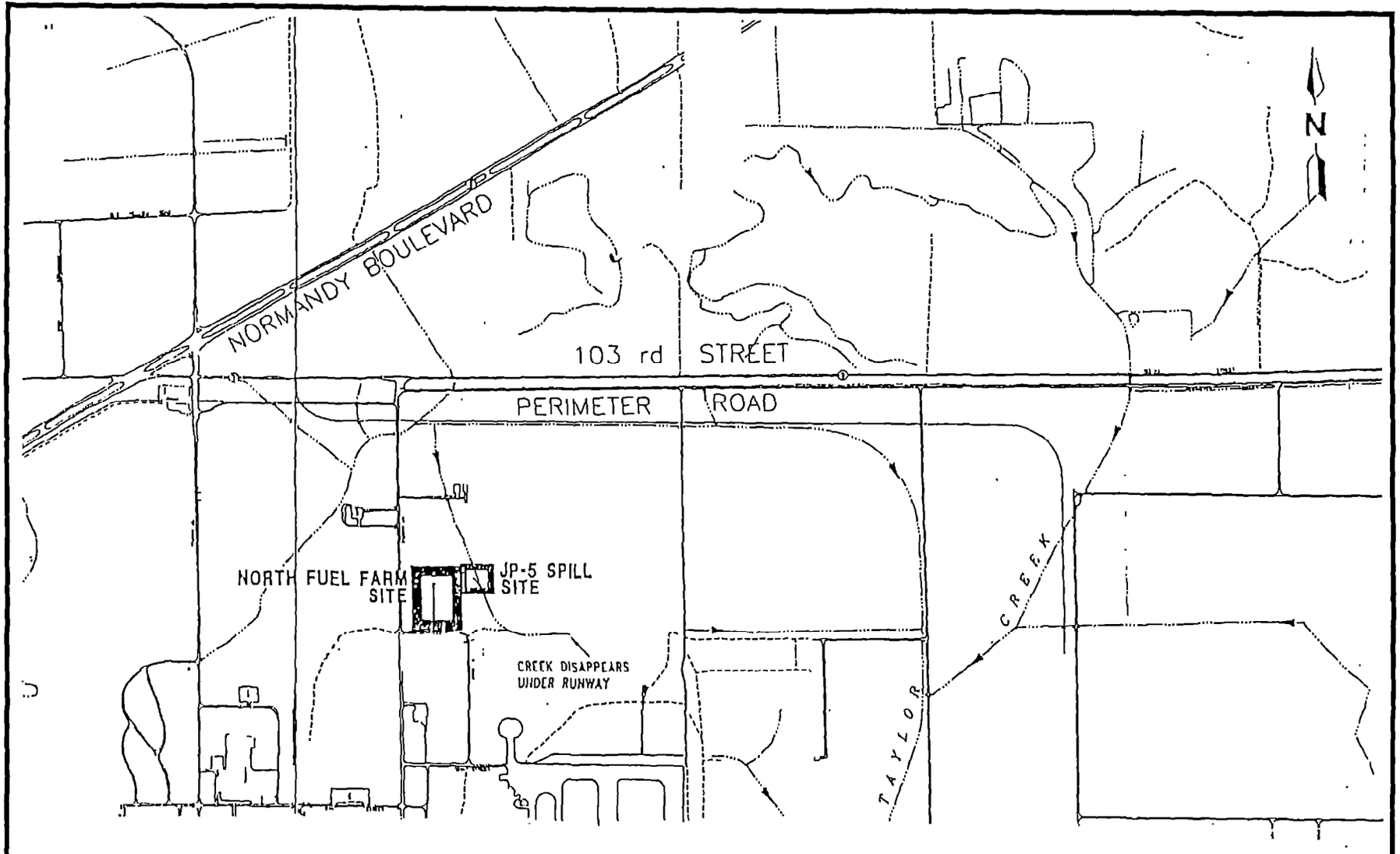

FIGURE 1-2
SITE LOCATION

APPENDIX B

BECHTEL NAVY RAC TECHNICAL SPECIFICATIONS

DEPARTMENT OF THE NAVY

SOUTHERN DIVISION

TECHNICAL SPECIFICATION

FOR

CLEARING AND GRUBBING

0	7/21/94	Issued for use	KK	RJ		
NO.	DATE	REASON FOR REVISION	BY	CHECK	SUPV	PE

ORIGIN	CLEARING AND GRUBBING	JOB NO. 22567	
		TECHNICAL SPECIFICATION	Rev.
		001-SP000-002	0
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4.0 SUBMITTALS 3

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5.2 GRUBBING 4

TECHNICAL SPECIFICATION FOR CLEARING AND GRUBBING

1.0 GENERAL

This specification defines the technical requirements and establishes the quality and workmanship required for clearing and grubbing. Not all operations defined herein may be required. Reference is directed to applicable subcontract Scope of Work and engineering drawings for specific services required.

2.0 ABBREVIATIONS

None.

3.0 CODES AND STANDARDS

The Subcontractor shall control the quality of items and services to meet the requirements of this specification, applicable codes and standards, and other Subcontract documents.

4.0 SUBMITTALS

4.1 Engineering documentation requirements are summarized on the Subcontractor Submittal Requirements Summary, Exhibit F, and are augmented by detailed requirements listed herein. Bechtel Environmental, Inc., (BEI) will determine if documentation is complete as submitted by the Subcontractor, and reserves the right to reject and require resubmittal of any submittal that does not meet the Subcontract requirements.

4.2 Unless noted otherwise, all Subcontractor submittals shall be made to BEI at least two (2) weeks prior to use, fabrication, or implementation.

4.3 For those submittals needed within the two (2) weeks following Subcontract award, submittals shall be made no later than commencement of work; BEI will notify the Subcontractor of the status of the submittal by telephone within three (3) work days following receipt of the submittal.

5.0 FIELD OPERATIONS

5.1 CLEARING

5.1.1 Clearing shall consist of removing and disposing of only designated trees and shrubs, and mowing grass inside the work area. Trees and shrubs designated for removal shall be cut to no more than 2 inches high, measured on the side adjacent to the highest ground. Grass within the work area shall be mowed to a maximum height of one inch prior to excavation.

5.1.2 The Subcontractor shall clear only areas designated on the engineering drawings or as directed by BEI in the field. The Subcontractor shall protect all trees, shrubs, or plants which are not specified for removal. The Subcontractor shall be responsible for restoring any unauthorized removal or damage to trees, shrubs, or plants at no additional cost to BEI.

5.1.3 All removed trees and shrubs shall be cut or otherwise suitably reduced in size for safe transport. Grass clippings shall be placed in heavy duty garbage bags.

5.1.4 All above-ground cleared materials shall be hauled and disposed of at a licensed local sanitary landfill or stockpiled as directed by BEI.

5.1.5 All stumps with a trunk diameter exceeding 6 inches shall be treated by one of the following methods:

a. Stumps shall be ground in place with a stump cutter.

b. Stumps shall be uprooted, broken down, and checked for contamination. Stump debris shall be disposed of at a licensed local sanitary landfill or stockpile as directed by BEI.

5.2 GRUBBING

5.2.1 Material to be grubbed, together with logs and other organic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below original surface level of the ground in areas indicated to be grubbed. Depressions made by grubbing shall be filled with a suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

5.2.2 Subcontractor shall verify that grubbed material is uncontaminated as directed by BEI.

DEPARTMENT OF THE NAVY

SOUTHERN DIVISION

TECHNICAL SPECIFICATION

FOR

CONTAMINATED EARTHWORK AND MISCELLANEOUS DEMOLITION

1	1/9/95	Revised to CSI format and Section 3.8	KK	GAC	FAC	JRM
0	7/21/94	Issued for use	KK	RTJ	PH	RBB
NO.	DATE	REVISION	BY	CHECK	SUPV	PE

ORIGIN		NO. 22567	
		TECHNICAL SPECIFICATION	REV
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PART 1 GENERAL

1.1 SCOPE

This Specification provides the technical requirements for the excavation of contaminated material and miscellaneous demolition. Not all work defined herein is necessarily required; reference is directed to the Scope of Work and engineering drawings for specifiec services required.

1.2 WORK INCLUDED

1.2.1 Furnishing labor, materials, tools and equipment.

1.2.2 Installing and maintaining dust, sediment and erosion control.

1.2.3 Demolishing existing concrete and asphalt surfaces.

1.2.4 Providing shoring as needed.

1.2.5 Securing area (temporary barriers) as needed.

1.2.6 Excavating contaminated material.

1.2.7 Decontaminating subcontractor-supplied equipment.

1.3 WORK NOT INCLUDED

1.3.1 Establishing limits of excavation.

1.3.2 Sampling and testing excavated material.

1.3.3 Backfilling

1.3.4 Treating contaminated material.

1.3.5 Loading and transporting contaminated material.

1.3.6 Clearing and grubbing is included in Technical Specification 001-SP000-002.

1.3.7 Operations of decontamination facility, other than that required for subcontractor equipment decontamination.

1.3.8 Temporary storage/placement of contaminated material.

1.3.9 Disposal of decontamination water.

1.4 REFERENCED CODES AND STANDARDS

Unless otherwise specified or shown, the latest edition at the time of bid of the following Codes and Standards shall apply to the extent indicated herein:

OCCUPATIONAL SAFETY AND HEALTH (OSHA)

29 CFR 1910 Occupational Safety and Health Regulations for General Industry

29 CFR 1926 Occupational Safety and Health Regulations for Construction

The Subcontractor shall comply with all federal, state, local, and facility codes and standards applicable to the propose work.

1.5 SUBMITTALS

Not all submittals defined herein may be required. Only engineering document requirements as summarized in Exhibit F (Attachment A), "Subcontractor Submittal Requirements Summary" (SSRS), shall apply. Submittals identified shall meet the detailed requirements defined herein. Bechtel will determine if documentation is complete as submitted and reserves the right to require the resubmittal of any submittals that do not meet specified requirements.

1.5.1 Equipment List

Submit list of equipment for use in contaminated earthwork. The list shall include the type, size, and rated capacity of the equipment proposed.

1.5.2 Drainage, Dewatering, and Stream Diversion Design

Submit proposed drainage, dewatering, and stream diversion design prior to construction not indicated on engineering drawings. Design shall be signed and stamped by a Professional Engineer licensed in the state where the work is performed.

1.5.3 Shoring Design and Calculations

Submit proposed shoring design and engineering calculations or alternate slope protection measures in accordance with Subpart P, OSHA 29 CFR 1926. Design shall be signed and stamped by a Professional Engineer licensed in the state where the work is performed.

1.5.4 Excavation Daily Inspections

Submit daily inspections of the excavation areas in accordance with OSHA 29 CFR 1910 and 1926 prior to commencing work each day.

1.5.5 Shoring Inspector

Submit name and resume of the shoring inspector to be provided for bid evaluation. Inspector shall be qualified in accordance with OSHA 29 CFR 1926, Subpart P.

1.5.6 Professional Engineer's License

Submit copy of Professional Engineer's license for bid evaluation (for the state where work is performed) of Professional Engineer(s) used for the shoring and drainage designs.

1.5.7 Alternate Methods

Submit copy of alternate shoring method when applicable at least one week prior to use. Design shall be signed and stamped by a Professional Engineer licensed in the state where the work is performed.

1.5.8 Temporary Decontamination Facility Plan

Submit plans for a temporary decontamination facility at least one week prior to mobilization.

1.5.9 Sediment Barriers

Submit copy of materials and plan for sediment barriers prior to use.

1.5.10 Erosion Control Blankets

Submit product data sheet for erosion control blankets prior to use.

1.6 QUALITY STANDARDS

Perform the work and control the quality of items and services to meet the requirements of this specification, subcontract documents, and applicable codes and standards.

PART 2 PRODUCTS

2.1 SEDIMENT BARRIERS

Materials used for sediment barriers shall consist of straw bales, hay bales, geotextile filter fabric made expressly for use as a silt screen, or other materials approved by Bechtel prior to their use. Straw and hay bales shall not be used for permanent sediment barriers unless approved by Bechtel.

2.1.1 Baled hay or straw shall be laid end to end such that no gap exists between bales. Reinforcing bars shall be #4 bar and a minimum of 2½ feet long.

2.1.2 Filter fabric shall be a material made expressly for the purpose of sediment control such as Exxon GTF 101S Silt Screen or approved equal.

2.2 EROSION CONTROL BLANKETS

Erosion control blankets shall be Curlex Blankets manufactured by American Excelsior Company or approved equal.

PART 3 EXECUTION

3.1 PRE-EARTHWORK EVALUATION

Prior to performing any earthwork, examine the work area if possible depending on the site conditions as determined by Bechtel, to identify pre-existing conditions (e.g. overhead power lines, access, etc.) that could impact the performance and completion of work. Bechtel will provide available information on the location of underground utilities. Verify these locations, provide structural support to utility lines, and coordinate inspection with and provide support to utility companies. Unless directed otherwise, the services of all underground utilities encountered during any earthwork shall be restored to their original condition. Applicable permits shall be obtained prior to commencing work unless directed otherwise.

3.2 EROSION AND SEDIMENT CONTROL

3.2.1 Potentially contaminated material shall be prevented from being eroded or transported into an uncontaminated area or an area with a lower level of contamination.

3.2.2 Temporary sediment barriers shall be installed in accordance with the subcontract documents and maintained during construction until permanent sediment barriers are in place.

3.2.3 Erosion and sediment shall be controlled by the following techniques subject to Bechtel review on a case-by-case basis:

- covering with synthetic liner material
- covering with uncontaminated soil material
- sediment barriers

3.3 DUST CONTROL

Dust shall be controlled by the following techniques subject to Bechtel review on a case-by-case basis:

- wetting with water
- wetting with a synthetic dust suppressant
- establishing temporary vegetative cover compaction
- sealing by rolling with a smooth drum
- maintaining slopes of exposed surfaces within defined limits

3.4 DRAINAGE, DEWATERING, AND STREAM DIVERSION

3.4.1 Drainage

Surface water shall be directed away from excavation and construction areas. Diversion ditches, check dams, dikes, and/or grading shall be developed and maintained during construction.

Excavated slopes and backfill surfaces shall have a minimum 3 percent slope to promote runoff and shall be protected from erosion and sloughing. Excavation slopes shall conform to Subpart P, "Excavation, Trenching, and Shoring," of OSHA 29 CFR 1926.

3.4.2 Dewatering

Unless noted otherwise, all excavations shall be kept in a dewatered condition. Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls; boils, uplift, and heave in the excavation; and to eliminate any interference with excavation progress. Water, which has come in contact with contaminated material, shall be collected and transported to an offsite location, which is not within the scope of this specification.

3.4.3 Stream Diversion

Stream diversion(s) shall be developed as shown on the engineering drawings or Scope of Work, and maintained to prevent the spread of contamination.

3.5 BLASTING

Blasting is not permitted.

3.6 EXCAVATION

3.6.1 General

Excavation shall conform to the lines, grades, and depths identified on the engineering drawings or Scope of Work, and field-verified by Bechtel. Excavated areas shall be maintained in a clean condition, free from leaves, brush, trash and other debris. They shall be inspected and documented daily in accordance with OSHA 29 CFR 1910 and 1926 prior to commencing work.

Rocks, 6 inches or greater in any dimension, shall be separated from the soil and cleaned of most soil material by scrapers, brushes, etc. These rocks shall be left in the excavation area.

3.6.2 Contamination Control

Excavation shall be performed such that the spread of contamination is prevented. Unless indicated otherwise, the cutting edge of the excavator(s) shall be toothless and the excavation performed in the direction of surface run-off (i.e., from high to lower elevation). Contamination spread through the improper execution of the subcontract documents shall be cleaned up to the satisfaction of Bechtel at no expense to Bechtel.

3.6.3 Shoring

Shoring, including temporary sheet piling, shall be furnished and installed as necessary to protect workers, slopes, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled to prevent cave-ins. Alternate methods (e.g. benching, sloping, trench boxes, etc.) may be used where applicable. They shall be developed in accordance with OSHA 29 CFR 1926, Subpart P.

Care shall be taken to minimize exposure of shoring or other slope protection devices to contamination. These items shall not be released from the site until they have been decontaminated in accordance with this specification.

3.6.4 Excavation Sequence

The sequence for the excavation of contaminated material shall be as follows:

(1) Define and isolate exclusion zones identified on the engineering drawings, Scope of Work, or as directed by Bechtel.

(2) Construct haul road identified on the engineering drawings, Scope of Work or as directed by Bechtel.

(3) Perform initial excavation to the lines and grades identified on the engineering drawings, Scope of Work or as directed by Bechtel.

(4) Allow excavated area to be sampled to determine if the area meets remedial cleanup standards.

(5) Continue excavation as directed by Bechtel. Allow area to be resampled after each lift of material is removed.

(6) Cease excavation upon direction by Bechtel.

3.7 DEMOLITION OF CONCRETE AND ASPHALT SURFACES

3.7.1 Demolition shall consist of demolishing, rubblizing, scabbling and/or disposing of asphalt, concrete, or bituminous concrete surfaces within the limits to be excavated as identified on the engineering drawings, Scope of Work and/or as directed by Bechtel.

3.7.2 Construction joints shall be saw cut in existing concrete or asphalt, where new concrete or asphalt will be placed.

3.7.3 Reinforcing bars encountered during concrete removal shall be cut with a method approved by Bechtel.

3.7.4 Daily inspections shall be performed in accordance with OSHA 29 CFR 1910 and 1926 when fuel powered tools are used indoors. Inspections shall include the review and documentation of administrative and engineering controls and measurement of air quality in confined spaces. No personnel shall enter the work area until required corrective measures are completed.

3.8 EQUIPMENT DECONTAMINATION

3.8.1 The equipment decontamination facility shall have a 30-mil plastic liner and be bermed to provide containment of decontamination water.

3.8.2 All equipment and tools used in contaminated areas shall be decontaminated to remove all adhering dirt and mud.

3.8.3 Authorization shall be obtained from Bechtel before entering or exiting the decontamination facility.

3.8.4 Bechtel is not responsible for the operations of the decontamination facility.

3.8.5 Equipment that has been in contaminated areas shall be decontaminated. The decontamination facility shall be used only for light and final decontamination and not for operations that would require gross decontamination (i.e., removal of most visible materials by scrapers, brushes, etc). Gross decontamination, if required, shall be performed as part of the specified earthwork at the area where trucks are loaded or unloaded. Decontamination shall be repeated as required. Following decontamination, all equipment shall be made available for inspection by Bechtel. Equipment shall be cleaned to the satisfaction of Bechtel.

3.8.6 Written approval from Bechtel shall be obtained prior to removing equipment from the site.

3.8.7 The decontamination water shall be containerized in 55-gallon drums, which is not within the scope of this specification.

3.9 PROTECTION OF WORK

Settlement or erosion that occurs in compacted materials prior to acceptance of the work shall be repaired to required conditions at no expense to Bechtel.

3.10 SECURITY

Work areas shall be secured using barriers (e.g., rope, snow fence) to prevent inadvertent entry to work areas as determined by Bechtel.

DEPARTMENT OF THE NAVY

SOUTHERN DIVISION

STANDARD SPECIFICATION

FOR

UNCONTAMINATED EARTHWORK

1	1-31-95	Revised throughout and to CSI format	KK	STB	FAR	JRM
0	7/21/94	Issued for use	KK	RTJ	PH	RBB
NO.	DATE	REVISION	BY	CHECK	SUPV	PE

ORIGIN		NO. 22567	
		STANDARD SPECIFICATION	Rev
	Uncontaminated Earthwork	001-SP000-006	1
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PART 1.0 GENERAL

1.1 SCOPE

Perform excavation of uncontaminated materials.

1.2 WORK INCLUDED

1.2.1 Furnishing labor, materials, tools and equipment.

1.2.2 Installing and maintaining dust, sediment and erosion control.

1.2.3 Performing soil testing

1.2.4 Providing shoring as needed.

1.2.5 Securing area (temporary barriers) as needed.

1.2.6 Excavating and backfilling uncontaminated material.

1.3 RELATED WORK NOT INCLUDED

1.3.1 Establishing limits of excavation and backfill.

1.3.2 Clearing and grubbing is included in Technical Specification 001-SP000-002.

1.4 REFERENCED CODES AND STANDARDS

Unless otherwise specified or shown, the latest edition of the following Codes and Standards at the time of bid shall apply to the extent indicated herein.

1.4.1 American Society for Testing and Materials (ASTM)

ASTM D 1556 Density of Soil In-Place by the Sand-Cone Method

ASTM D 1557 Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop

ASTM D 2167 Density and Unit Weight of Soils In-Place by the Rubber Balloon Method

ASTM D 2216 Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures

ASTM D 2487 Classification of Soils for Engineering Purposes

ASTM D 2922 Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)

ASTM D 3017 Water Content of Soil and Rock In-Place by Nuclear Methods (Shallow Depth)

ASTM D 4253 Maximum Index Density of Soils Using a Vibratory Table

ASTM D 4254 Minimum Index Density of Soils and Calculation of Relative Density

ASTM D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.4.2 Occupational Safety and Health (OSHA)

29 CFR 1910 Occupational Safety and Health Regulations for General Industry

29 CFR 1926 Occupational Safety and Health Regulations for Construction

1.5 SUBMITTALS

Not all submittals defined herein may be required. Only engineering document requirements as summarized in Exhibit F (Attachment A), "Subcontractor Submittal Requirements Summary" (SSRS), shall apply. Submittals identified shall meet the detailed requirements herein. Bechtel will determine if documentation is complete as submitted and reserves the right to require the resubmittal of any submittals that do not meet specified requirements.

1.5.1 Testing Reports

Submit two unbound copies of testing results, including calibration curves and calibration results within 24 hours of conclusion of physical tests.

1.5.2 Testing Laboratory Certifications and Qualifications

Submit qualifications and requested certifications of the commercial testing laboratory. Include resumes of key personnel, client references from previous work of similar scope and laboratory capabilities.

1.5.3 List of Equipment

Submit a list of equipment proposed for use. Include type, size, and rating of equipment proposed to be used. For compactive rollers, include the weight, drum, or wheel size and cleat size, if any.

1.5.4 Onsite Borrow Pit Operations

Submit proposed operations plans for any onsite borrow pit(s). Include proposed procedures and plans for control of water, erosion and dust, access road construction and maintenance, and borrow excavation. Bechtel will provide the information on onsite borrow pit location and available test reports on the borrow material.

1.5.5 Offsite Borrow Pit Operations

Submit proposed offsite borrow information to include: borrow pit location and address, owner's name and state permit/licensing number, and the ASTM test reports required to satisfy the requirements listed in the "2.0 PRODUCTS" section of this specification.

1.5.6 Aggregate Source

Submit proposed offsite aggregate source information to include aggregate source location and address, owner's name and state permit/licensing number, and ASTM test reports required to satisfy the requirements listed in the "2.0 PRODUCTS" section of this specification.

1.5.7 Protection of Existing Foundations

Submit proposed modifications to protect existing foundations in accordance with this specification.

1.5.8 Shoring Design and Calculations

Submit proposed shoring design and engineering calculations or alternate slope protection measures in accordance with Subpart P, OSHA 29 CFR 1926. Design shall be signed and stamped by a Professional Engineer licensed in the state where the work is performed.

1.5.9 Soils Laboratory Test Results

Submit soil classification test results and relative density or compaction curve test results, as appropriate.

1.5.10 Drainage Design

Submit proposed drainage design prior to drainage system construction not indicated on engineering drawings. Design shall be signed and stamped by a Professional Engineer licensed in the state where the work is performed.

1.5.11 Excavation Daily Inspections

Submit daily inspections of the excavation areas in accordance with OSHA 29 CFR 1910 and 1926 prior to commencing work each day.

1.5.12 Shoring Inspector

Submit resume of the shoring inspector to be provided for bid evaluation. Inspector shall be qualified in accordance with Subpart P, OSHA 29 CFR 1926.

1.5.13 Professional Engineer's License

Submit copy of Professional Engineer's license for bid evaluation (for the state where work is performed) for Professional Engineer(s) used for the shoring and drainage designs.

1.6 QUALITY STANDARDS

Perform the work and control the quality of items and services to meet the requirements of this specification, subcontract documents, and applicable codes and standards.

1.7 DEFINITIONS

1.7.1 Unstable Material

Materials too weak, as determined by Bechtel, to properly support the utility pipe, conduit or appurtenant structure.

1.7.2 Rock

Material that (1) measures approximately 1/2 cubic yard or more and cannot be removed without systematic drilling and blasting, such as rock material in ledges, bedded deposits, unstratified masses, and conglomerate deposits or (2) is below-grade concrete or masonry structures, exceeding 1/2 cubic yard in volume and greater than 9 in. in thickness. Asphaltic or portland cement pavements is not considered rock.

PART 2.0 PRODUCTS

2.1 BACKFILL

2.1.1 General

Cohesive or cohesionless well-graded materials free of contamination, trash, debris, roots or other organic matter, frozen material, stones, or other material larger than 3 in. in any dimension, with a plasticity index (PI) $\leq$ 20.

2.1.2 Structural

Structural fill shall meet the requirements of general fill (Section 2.1.1) but shall have a PI of $\leq$ 15.

2.2 BEDDING MATERIALS

Bedding material shall consist of well-graded sand, gravel, or slag composed of hard, tough, and durable particles and shall contain not more than 10 percent by weight of material passing a No. 200 sieve and no less than 95 percent by weight, passing the 1-in. sieve or the maximum size recommended by the pipe manufacturer, whichever is smaller.

DEPARTMENT OF THE NAVY

SOUTHERN DIVISION

TECHNICAL SPECIFICATION

FOR

ON-SITE TRANSPORTATION OF CONTAMINATED MATERIALS

0	7/21/94	Issued for use	KK	MMR	HEM	JRM
NO.	DATE	REASON FOR REVISION	BY	CHECK	SUPV	PE

ORIGIN	TRANSPORTATION OF CONTAMINATED MATERIALS	JOB NO. 22567	
		TECHNICAL SPECIFICATION	REV
		201-SP007-001	0
		SHEET 1 OF 5	

D. Large Equipment Decontamination

Large equipment shall be decontaminated using the following procedure:

1) Remove heavy accumulation of mud/spoils at drill site.

2) Move equipment to the decontamination pad at the exclusion zone of intrusive activities after sampling/field activities are complete.

3) Decontaminate equipment with a high pressure steam cleaner which utilizes a soap and water cycle. Scraping and scrubbing may be necessary to remove encrusted material. Items shall be placed on nonwooden sawhorses, pallets, or the equivalent to prevent contact with the ground.

4) Place equipment on polyethylene sheeting, saw horses, or clean pallets and allow to air dry. Saw horses and pallets shall not be constructed of wood.

5) Sampling and field equipment shall not be allowed to contact the ground surface before their use at the next sampling location. Wrap appropriate equipment (i.e., monitoring well installation supplies, augers, drill rods, etc.) in polyethylene sheeting and secure with duct tape. Specific sampling equipment will be wrapped in aluminum foil in accordance with guidelines for equipment storage set forth in Section 3.09 (F) of this specification. The Subcontractor shall store decontamination fluids in 55-gal UN1A1 steel drums (49 CFR 173) or other suitable containers approved by Bechtel, load the drums, haul, unload and place them at the locations designated by Bechtel.

E. Small Equipment Decontamination

Small equipment, including all sampling equipment, shall be decontaminated as follows:

1) Wash thoroughly with phosphate-free laboratory detergent and tap water using a brush to remove all particulate matter and surface film.

2) Rinse thoroughly with tap water.

3) Rinse thoroughly with deionized water.

4) Rinse twice with isopropanol using only teflon-squeeze bottles.

5) Rinse thoroughly with organic-free water, using stainless steel, glass, or teflon lined applicators, and allow to air dry.

6) If organic-free water is not available, allow equipment to air dry until the isopropanol has evaporated.

F. Equipment Storage

Decontaminated equipment shall be stored on clean tables with polyethylene sheeting and wrapped in aluminum foil between uses. Following decontamination, the sampling equipment shall not be allowed to touch the ground prior to use. All decontamination fluids shall be contained and care shall be taken to ensure that the isopropanol and other fluids do not contact the ground surface. Isopropanol and any other solvent rinsates shall be segregated from other decontamination fluids and containerized

3.10 WELL INSTALLATION

Wells shall be installed in boreholes at the locations shown on the engineering drawings or designated by Bechtel. All wells shall be installed immediately after completion of drilling activities and before moving to a new borehole location.

A. Annular Space

The borehole shall be of sufficient diameter so that well installation and construction can proceed without difficulties. To ensure adequate size, a minimum 2-in. annular space is required between the well casing and the borehole wall (or the hollow stem auger wall). The work shall be scoped as to allow the Subcontractor to know which boreholes will potentially be used for well construction in order to allow the Subcontractor to initially drill the appropriate sized borehole.

B. Installing Conductor Casing for Double Cased Wells

Double cased wells shall be constructed when there is reason to believe that interconnection of two aquifers by well construction may cause cross contamination. They can also be installed when flowing sands make it difficult or impossible to install a monitoring well using conventional methods. This will be determined by Bechtel prior to well installation in the field during drilling operations.

1) A borehole shall be drilled through the overburden and/or the contaminated zone into a clay confining layer, 5 ft below the known elevation of contamination or bedrock as determined in the field by Bechtel and dependent on the specific lithology encountered at the borehole location.

2) A conductor casing shall then be placed into the borehole and sealed with grout. The borehole and conductor casing shall extend into tight clay a minimum of 5 ft or into <u>competent</u> bedrock a minimum of 2 ft, dependent on the specific lithological conditions at the borehole location. The total depths into the clay or bedrock will vary, depending on the plasticity of the clay and the extent of weathering and/or fracturing of the bedrock. The size of the conductor casing shall be of sufficient inside diameter (ID) to contain the inner casing, and allow 2-in. minimum annular space for the inner casing. In addition, the borehole shall be of sufficient size to contain the conductor casing and a 2-in. minimum annular space.

3) The conductor casing shall be grouted by either the tremie method or by pressure grouting to within 2 ft of the ground surface. The grout shall be pumped into the annular space between the conductor casing and the borehole wall. This can be accomplished by:

   - placing the tremie pipe in the annular space and pumping the grout from the bottom of the borehole to the surface,
   - placing a grout shoe or plug inside the casing at the bottom of the borehole and pumping the grout through the bottom grout plug and up the annular space on the outside of the casing.

   If the conductor casing is set into tight clay, both of the above methods might have to be used, because the clay usually forms a tight seal in the bottom and around the outside of the casing preventing grout from flowing freely during grout injection. Bridging is not anticipated in bedrock thus, conductor casing set into bedrock normally will have space enough to allow grout to flow freely during injection. A minimum of 24 hours shall be allowed for the grout plug (seal) to "set" or cure before attempting to drill through it. The grout mixture used to seal the outer annular space can be either a cement/bentonite, cement/sand/bentonite, or a pure bentonite grout. However, the seal or plug at the bottom of the borehole and conductor casing shall consist of a Type I Portland cement/bentonite or cement/sand mixture. The use of a pure bentonite grout for a bottom plug or seal is not acceptable.

4) When drilling through the plug, care shall be taken to avoid cracking, shattering, and/or washing out of the annular seal. If caving conditions exist so that the conductor casing cannot be sufficiently sealed by grouting, the conductor casing shall be fitted with a drive shoe and driven into place with a grout seal placed in the bottom of the casing.

C. Installing Screen and Riser Casing

Before installation of the riser pipe assembly (e.g., riser pipe, screen, sump, and bottom cap), the final depth of the hole shall be measured with a weighted tape to ± 0.1 feet, and the assembly and appurtenances cleaned in accordance with Section 3.09. All cuttings shall be removed from the borehole prior to the installation of the monitoring well.

1) If the hollow-stem auger method is used to construct the well, equilibrium or excess water pressure inside the hollow-stem auger relative to the observed groundwater level shall be maintained at all times during the screen and riser installation (if necessary by adding potable water to the hollow stem) to prevent a "heaving" condition at the bottom of the borehole. This is particularly applicable when the bottom consists of loose, sandy soils.

2) The riser pipe assembly shall then be lowered into the borehole. In boreholes greater than 50 ft deep, centering devices shall be used to maintain the entire riser pipe assembly in the center of the borehole at intervals designated in the field by Bechtel. Centering of riser pipe assembly through the hollow stem of an auger shall be provided by suspending the assembly using the

cable/hoist method such that the riser pipe assembly is located in the center of the borehole upon completion.

D. Installing Filter Pack

As soon as the riser pipe and screen assembly is in place, the filter pack shall then be placed into the annular space between the well screen and borehole wall by tremie method or free fall through the hollow-stem augers as designated by Bechtel in the field. If the hollow-stem auger method is used the augers shall be slowly withdrawn as the filter pack is placed to allow the annular space between the screen and the borehole to be properly filled. The filter pack shall extend from the bottom of the borehole to at least two feet but not more than five feet above the top of the screen. The protective casing, if applicable, shall be removed upon direction from Bechtel.

All water discharged from the boreholes during well installation shall be collected in 55-gal UN1A1 steel drums (49CFR173) or other suitable containers as directed by Bechtel. Drums or other containers shall be loaded, hauled, and unloaded to a staging area specified by Bechtel. Water shall be controlled by the Subcontractor to prevent erosion and other damages.

E. Installing Gravel Filter Pack

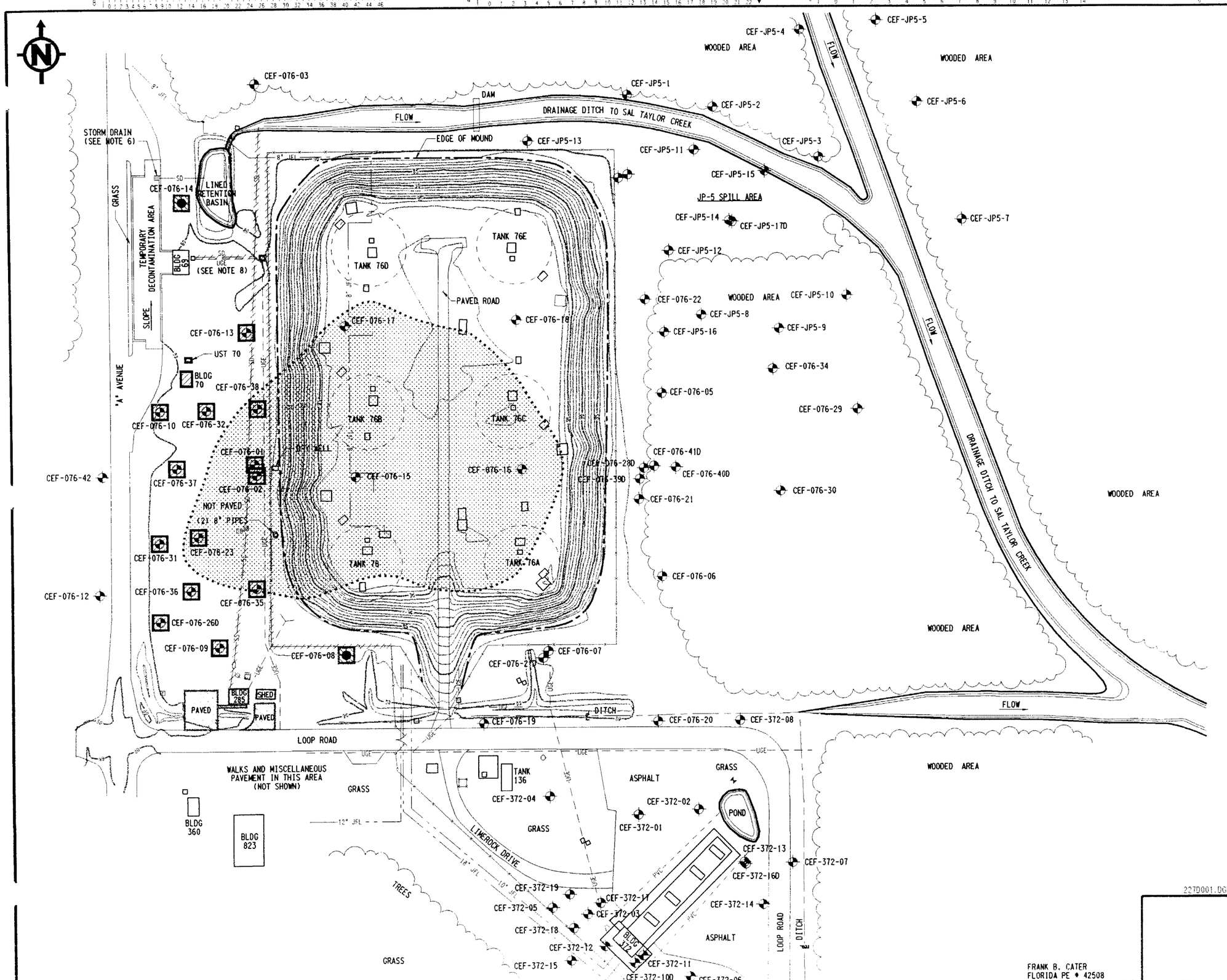
When the riser pipe and screen assembly is in place in the borehole, the gravel pack shall then be placed into the annular space between the well screen and borehole wall by carefully pouring the pea gravel into the annular space. If the hollow-stem auger method is used the augers shall be slowly withdrawn as the gravel pack is placed to allow the annular space between the screen and the borehole wall to be properly filled. The gravel pack will be poured until it is 2 ft but not more than 5 ft above the top of the screen.

F. Installing Seal and Backfill

An annular seal of bentonite pellets shall be installed in the borehole after the filter or gravel pack is placed. The minimum thickness of this bentonite seal, after tamping, shall be 2 ft. The completed bentonite seal shall be allowed to hydrate for a minimum of eight hours or the manufacturer's recommended hydration time, whichever is greater, before proceeding with the grouting operation. Following placement of the annular seal, the remainder of the annular space between the riser casing and borehole wall shall be filled with cement/bentonite grout or volclay as specified in the Subcontractor Scope of Work or as shown on the engineering drawings. The annular space shall be filled to 2 ft below ground surface or as shown on the engineering drawings. The cement/bentonite or volclay grout shall be installed through a tremie by placing a rod, pipe, or hose to a point immediately above the seal and pumping the grout into the hole. The tremie pipe will be equipped with a side discharge port to preclude disruption of the seal. Should loss or shrinkage of grout occur, boreholes shall be refilled until they remain full as outlined in Section 3.08 A2 "Tremie Method." The grout shall be allowed to set-up for a minimum of 24 hours before the concrete surface pad is installed, or as directed by Bechtel..

APPENDIX C

PRELIMINARY CONSTRUCTION DRAWINGS



227D001.DGN

FRANK B. CATER
FLORIDA PE # 42508
EXPIRES FEBRUARY 28, 1997

SEAL

NOTES

1. DEMOLITION SHALL BE PERFORMED IN ACCORDANCE WITH TECHNICAL SPECIFICATION 22567-001-SP000-017, AND TECHNICAL SPECIFICATION 22567-001-SP000-005, UNLESS NOTED OTHERWISE.
2. MONITORING WELL ABANDONMENT SHALL BE PERFORMED IN ACCORDANCE WITH TECHNICAL SPECIFICATION 22567-001-SP000-022, UNLESS NOTED OTHERWISE. (SEE WORK PLAN)
3. ITEMS TO POTENTIALLY BE DEMOLISHED WILL BE DETERMINED BY BECHTEL BASED ON HEADSPACE READING DURING EXCAVATION.
4. SITE INFORMATION WAS PROVIDED TO BECHTEL BY THE NAVY.
5. SEE "INTERIM REMEDIATION WORK PLAN, SOIL AND FREE PRODUCT REMOVAL, NORTH FUEL FARM, NAS CECIL FIELD, JACKSONVILLE, FL" FOR SCOPE OF WORK.
6. IF EXISTING TRUCK STAND AREA IS USED AS DECONTAMINATION PAD, STORM DRAIN WILL BE RENDERED INOPERABLE DURING DECONTAMINATION ACTIVITIES.
7. COORDINATE ALL DEMOLITION WITH THE NAVY IN THE FIELD.
8. COORDINATE REMOVAL/REROUTE OF UGE WITH THE NAVY.

TECHNICAL SPECIFICATIONS

DEMOLITION OF STRUCTURES	22567-001-SP000-017
EXCAVATION OF CONTAMINATED SOIL AND MISCELLANEOUS DEMOLITION	22567-001-SP000-005
MONITORING WELL INSTALLATION AND ABANDONMENT	22567-001-SP000-022

REFERENCE DRAWINGS

EXCAVATION PLAN	227-DD000-002

LEGEND

- MONITORING WELL TO BE ABANDONED
- MONITORING WELL TO POTENTIALLY BE ABANDONED
- STRUCTURE OR AREA TO BE DEMOLISHED
- STRUCTURE OR AREA TO POTENTIALLY BE DEMOLISHED
- APPROXIMATE AREA OF FREE PRODUCT PLUME
- EXISTING FENCE
- PORTION OF FENCE TO BE REMOVED (FIELD COORDINATE)
- SD — EXISTING STORM DRAIN (4")
- SD — EXISTING STORM DRAIN (4") TO BE REMOVED
- SS — EXISTING SANITARY SEWER (4") TO BE REMOVED
- UGE — EXISTING UNDERGROUND ELECTRIC
- JFL — EXISTING JET FUEL LINE
- EXISTING TELEPHONE
- CB — EXISTING CATCH BASIN
- JP-5 STORAGE TANK (UNDERGROUND)
- POWER POLE
- ABOVE GROUND ELECTRIC TRANSFORMER

0 50 100 150
1"=50'

NO.	DATE	REVISIONS	BY	CHKR	DESIGN SUPV	ENGR	PROJ ENGR	MICRO FILMD
B	7/14/95	ISSUE FOR WORK PLAN	JED	RA	RDL			
A	5/22/95	ISSUE FOR REVIEW	RLP	RTJ	FBC	KK		

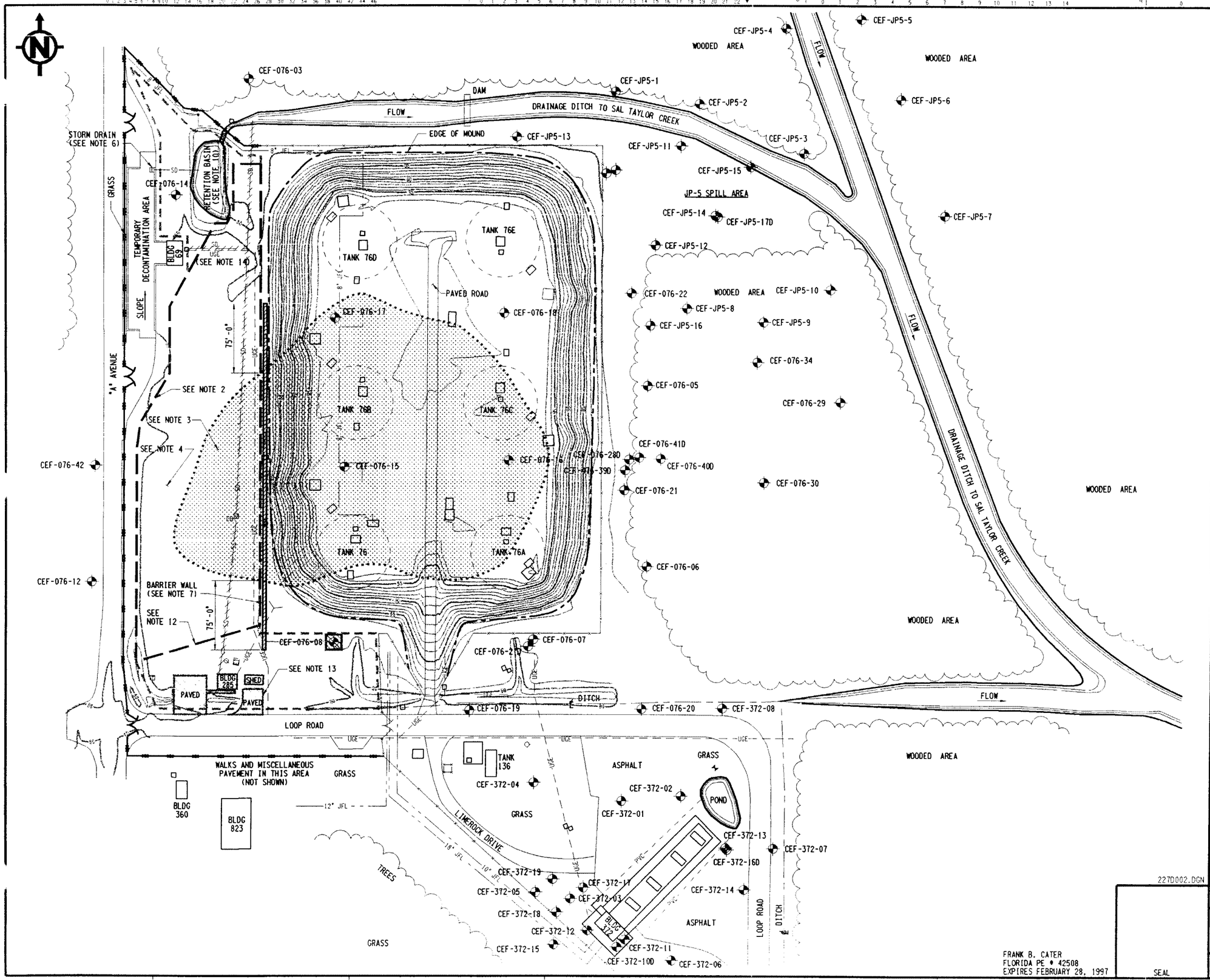
SCALE 1" = 50'

BECHTEL ENVIRONMENTAL INC.
OAK RIDGE, TENNESSEE

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA

NAS CECIL FIELD
NORTH FUEL FARM
DEMOLITION PLAN

JOB NO.	DRAWING NO.	REV
22567	227-DD000-001	B



227D002.DGN

FRANK B. CATER
FLORIDA PE # 42508
EXPIRES FEBRUARY 28, 1997

SEAL

NOTES

1. EXCAVATION SHALL BE PERFORMED IN ACCORDANCE WITH TECHNICAL SPECIFICATION 22567-001-SP000-005, UNLESS NOTED OTHERWISE.
2. EXCAVATION ADJACENT TO EXISTING STRUCTURES SHALL BE 10' FROM THE FOOTPRINT OF THE BUILDING. EXCAVATION ADJACENT TO EXISTING ROAD SHALL BE NO CLOSER THAN 5' TO EDGE OF ROAD.
3. EXCAVATION WITHIN THE FREE PRODUCT PLUME AND OTHER AREAS WHERE FREE PRODUCT IS ENCOUNTERED, SHALL BE TO 5' DEPTH. USE SKIMMER PUMP TO RECOVER FREE PRODUCT.
4. EXCAVATION OUTSIDE THE FREE PRODUCT PLUME SHALL BE TO 1' BELOW TOP OF GROUNDWATER TABLE, IF HEADSPACE READINGS ARE GREATER THAN 50 PPM.
5. EXCAVATED MATERIAL WILL BE LOADED AND TRANSPORTED TO SITE 3 AS DIRECTED BY CECIL FIELD NAS PERSONNEL.
6. MAINTAIN MINIMUM 2v:1h SLOPE ON EXCAVATION SIDEWALL, EXCEPT AT BARRIER WALL.
7. INSTALL 80 MIL HDPE BARRIER WALL TO DEPTH OF 12' BELOW LAND SURFACE. REFER TO WORK PLAN FOR SPECIFIC DETAILS. EXACT LOCATION OF BARRIER WALL TO BE COORDINATED WITH THE NAVY IN THE FIELD.
8. SITE INFORMATION WAS PROVIDED TO BECHTEL BY THE NAVY.
9. IF EXISTING TRUCK STAND AREA IS USED AS DECONTAMINATION PAD, STORM DRAIN WILL BE RENDERED INOPERABLE DURING DECONTAMINATION ACTIVITIES.
10. EXCAVATION OF RETENTION AREA REQUIRES PRIOR APPROVAL OF NAVY. IF AREA IS EXCAVATED REBUILD TO MATCH EXISTING.
11. SEE "INTERIM REMEDIATION WORK PLAN SOIL AND FREE PRODUCT REMOVAL, NORTH FUEL FARM, NAS CECIL FIELD, JACKSONVILLE, FL" FOR ADDITIONAL INFORMATION.
12. ESTIMATED LIMIT, DETERMINE ACTUAL LIMIT IN FIELD BASED ON HEADSPACE LESS THAN 50 PPM.
13. EXCAVATION IN AREAS DENOTED AS POTENTIAL WILL BE COORDINATED AND APPROVED BY THE NAVY, PRIOR TO EXCAVATION IN THESE AREAS.
14. COORDINATE REMOVAL/REROUTE OF UGE WITH THE NAVY.

TECHNICAL SPECIFICATIONS

EXCAVATION OF CONTAMINATED SOIL AND MISCELLANEOUS DEMOLITION	22567-001-SP000-005

REFERENCE DRAWINGS

DEMOLITION PLAN	227-DD000-001

LEGEND

- MONITORING WELL TO POTENTIALLY BE ABANDONED
- STRUCTURE OR AREA TO POTENTIALLY BE DEMOLISHED
- APPROXIMATE AREA OF FREE PRODUCT PLUME
- EXISTING FENCE (COORDINATE WITH NAVY)
- FENCE TO BE INSTALLED (COORDINATE WITH NAVY)
- INITIAL EXCAVATION LIMITS
- POTENTIAL EXCAVATION LIMITS (SEE NOTE 13)
- SD — EXISTING STORM DRAIN (4")
- SD — EXISTING STORM DRAIN (4") TO BE REMOVED
- SS — EXISTING SANITARY SEWER (4") TO BE REMOVED
- UGE — EXISTING UNDERGROUND ELECTRIC
- JFL — EXISTING JET FUEL LINE
- CB — EXISTING CATCH BASIN
- JP-5 STORAGE TANK (UNDERGROUND)
- POWER POLE
- ABOVE GROUND ELECTRIC TRANSFORMER

0 50 100 150
1"=50'

NO.	DATE	REVISIONS	BY	CHKR	DESIGN SUPV	ENGR	PROJ ENGR	MICRO FLMD
B	7/14/95	ISSUE FOR WORK PLAN	JED	JRM				
A	5/22/95	ISSUE FOR REVIEW	RLP	RTJ	FBC	KK		

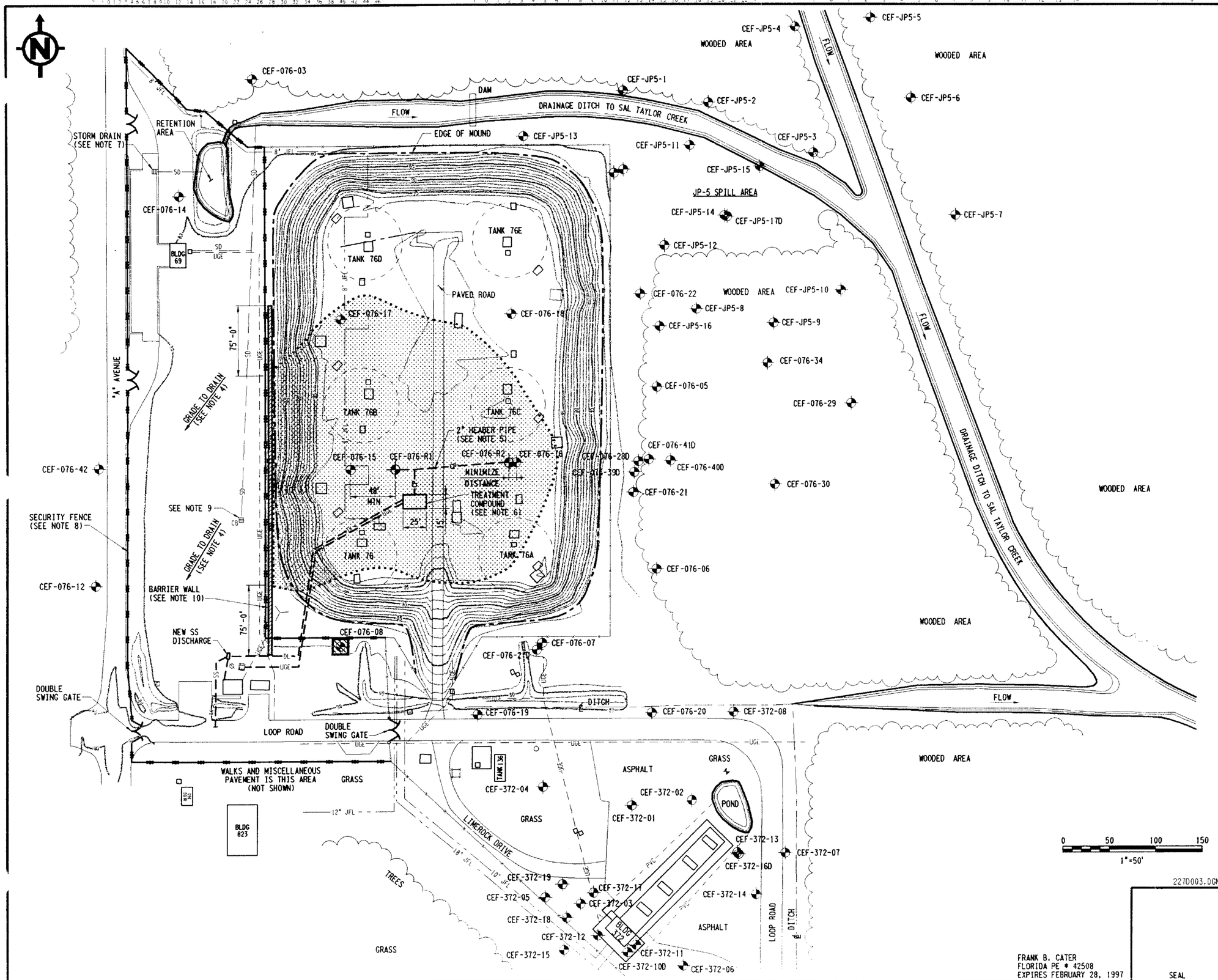
SCALE 1"=50"

BECHTEL ENVIRONMENTAL INC.
OAK RIDGE, TENNESSEE

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA

NAS CECIL FIELD
NORTH FUEL FARM
EXCAVATION PLAN - SOIL REMOVAL

JOB NO.	DRAWING NO.	REV
22567	227-DD000-002	B



NOTES

1. BACKFILL SHALL BE PERFORMED IN ACCORDANCE TECHNICAL SPECIFICATION 22567-001-SP000-006, UNLESS NOTED OTHERWISE.
2. SITE INFORMATION WAS PROVIDED TO BECHTEL BE THE NAVY.
3. BACKFILL SHALL BE COMPACTED TO 85% MAXIMUM DENSITY UNLESS OTHERWISE DIRECTED BY THE NAVY.
4. MATCH EXISTING GRADE IN BACKFILLED AREA. SLOPE TO DRAIN AS INDICATED.
5. TREATMENT SYSTEM PIPING WILL BE PLACED 18" BELOW GRADE, UNLESS ABOVE GROUND PIPING IS APPROVED BY NAS CECIL FIELD PERSONNEL.
6. FINAL TREATMENT COMPOUND LOCATION IS TO BE COORDINATED IN THE FIELD (SEE DRAWING 227-DD000-005 FOR COMPOUND LAYOUT). PROVIDE 6" 3000psi 6x6 6/6 WWF REINFORCED PAD WITH THICKENED EDGE FOOTER.
7. AT COMPLETION OF DECONTAMINATION ACTIVITIES, RESTORE STORM DRAIN.
8. FINAL SITE RESTORATION OF SECURITY FENCE SHALL BE COORDINATED WITH CECIL FIELD PERSONNEL. FENCING ALONG ROAD IS TO BE REMOVED, UNLESS DIRECTED OTHERWISE.
9. PROVIDE NEW CATCH BASIN AND STORM DRAIN TO MATCH EXISTING BASIN AND DRAIN REMOVED DURING EXCAVATION.
10. FINAL "STICK UP" OF BARRIER WALL TO BE FIELD COORDINATED WITH THE NAVY.
11. NEW RECOVERY WELL LOCATIONS ARE DEPENDENT UPON FIELD CONDITIONS. LOCATE NEW WELLS AS CLOSE TO EXISTING WELLS 15 AND 16 AS POSSIBLE.
12. PROVIDE 480v/60Hz/3 PHASE POWER TO COMPOUND AREA. POWER HOOK UP, CABLES, AND TRENCHING WILL BE IN ACCORDANCE WITH LOCAL CODES AND PROVIDED BY A LICENSED ELECTRICIAN.

TECHNICAL SPECIFICATIONS

UNCONTAMINATED EARTHWORK	22567-001-SP000-006

REFERENCE DRAWINGS

DEMOLITION PLAN	227-DD000-001
EXCAVATION PLAN	227-DD000-002

LEGEND

- NEW RECOVERY WELL
- EXISTING MONITORING WELL
- MONITORING WELL TO POTENTIALLY BE ABANDONED
- STRUCTURE OR AREA TO POTENTIALLY BE DEMOLISHED
- AREA OF FREE PRODUCT
- EXISTING FENCE
- FENCE TO BE INSTALLED
- CP — TREATMENT SYSTEM CONVEYANCE PIPE
- UGE — UNDERGROUND ELECTRIC LINE
- SD — 6" STORM DRAIN
- DL — TREATMENT SYSTEM DISCHARGE LINE
- SS — SANITARY SEWER LINE

NO.	DATE	REVISIONS	BY	CHKR	DESIGN SUPV	ENGR	PROJ ENGR	MICRO FILMD
B	7/14/95	ISSUED FOR WORK PLAN						
A	5/21/95	ISSUE FOR REVIEW	RLP	KK	FBC	RLT		

SCALE 1"=50'

BECHTEL ENVIRONMENTAL INC.
OAK RIDGE, TENNESSEE

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA

NAS CECIL FIELD
NORTH FUEL FARM - SITE RESTORATION PLAN
AND BIO SLURPING REMEDIATION LAYOUT

JOB NO.	DRAWING NO.	REV
22567	227-DD000-003	B

FRANK B. CATER
FLORIDA PE # 42508
EXPIRES FEBRUARY 28, 1997

SEAL

T30 - MOISTURE SEPARATOR
CAPACITY: 40 GAL

P01 - OIL TRANSFER PUMP
TYPE: DIAPHRAGM, ELECTRIC
POWER: HP DETERMINED BY MFG.
460/3/60
CAPACITY: 20 GPM

B01 - LIQUID RING PUMP
TYPE: LIQUID RING PUMP
POWER: 10 HP, 460/3/60
CAPACITY: 125 CFM @ 22" Hg VACUUM

B02 - FAN
TYPE: CENTRIFUGAL
POWER: 0.5 HP, 460/3/60
CAPACITY: 50 CFM

P02 - LIQUID SEAL PUMP
TYPE: CENTRIFUGAL
POWER: HP DETERMINED BY MFG.
460/3/60
CAPACITY: DETERMINED BY MFG.

T10 - DISCHARGE SEPARATOR
CAPACITY: 300 GAL (MIN)

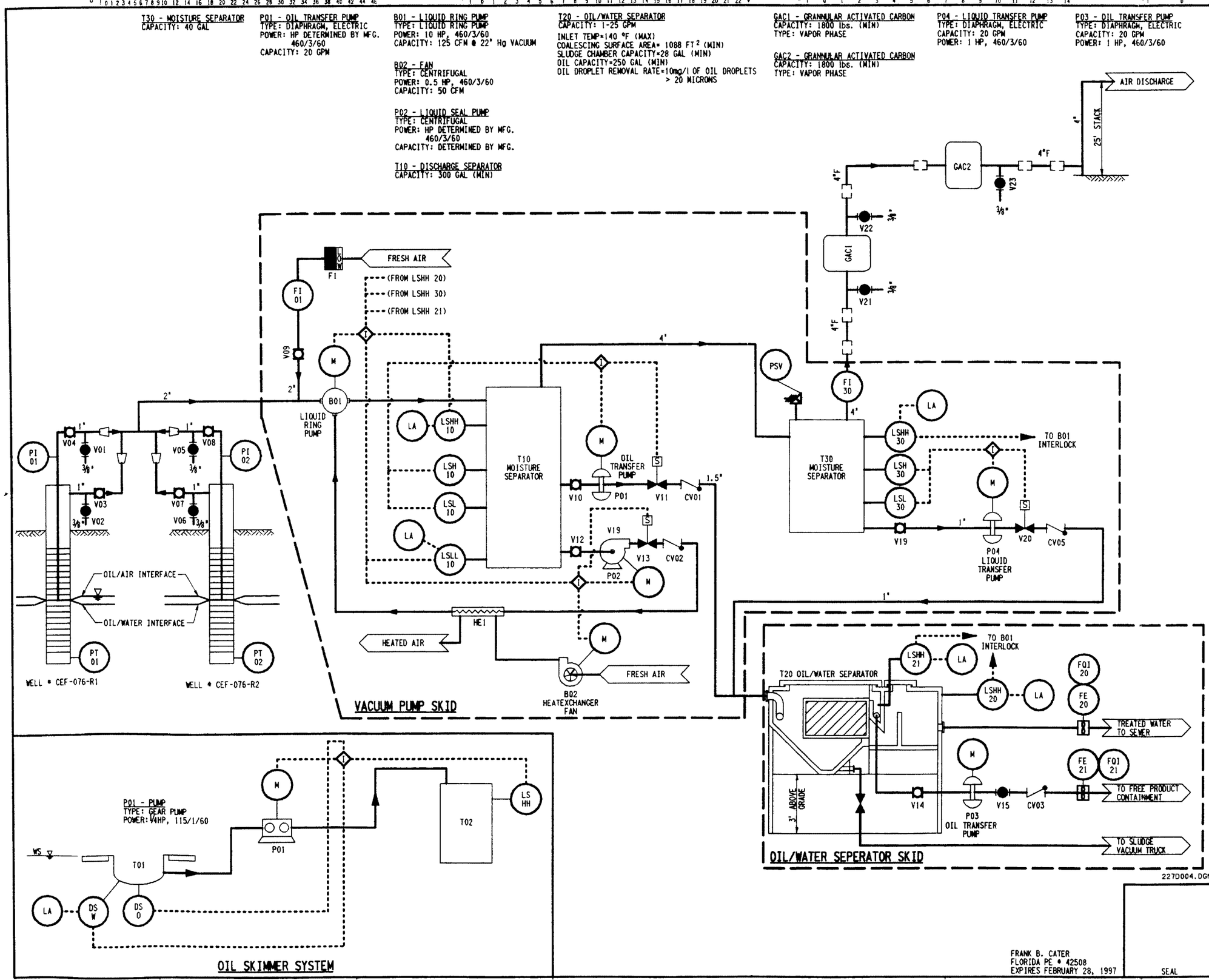
T20 - OIL/WATER SEPARATOR
CAPACITY: 1-25 GPM
INLET TEMP=140 °F (MAX)
COALESCING SURFACE AREA= 1088 FT^2 (MIN)
SLUDGE CHAMBER CAPACITY=28 GAL (MIN)
OIL CAPACITY=250 GAL (MIN)
OIL DROPLET REMOVAL RATE=10mg/l OF OIL DROPLETS
> 20 MICRONS

GAC1 - GRANNULAR ACTIVATED CARBON
CAPACITY: 1800 lbs. (MIN)
TYPE: VAPOR PHASE

GAC2 - GRANNULAR ACTIVATED CARBON
CAPACITY: 1800 lbs. (MIN)
TYPE: VAPOR PHASE

P04 - LIQUID TRANSFER PUMP
TYPE: DIAPHRAGM, ELECTRIC
CAPACITY: 20 GPM
POWER: 1 HP, 460/3/60

P03 - OIL TRANSFER PUMP
TYPE: DIAPHRAGM, ELECTRIC
CAPACITY: 20 GPM
POWER: 1 HP, 460/3/60



227D004.DGN

LEGEND

- HEAT EXCHANGER
- GEAR PUMP
- LIQUID RING PUMP
- CENTRIFUGAL PUMP
- DIAPHRAGM PUMP
- CHECK VALVE
- BALL VALVE
- PRESSURE RELIEF VALVE
- BLOWER
- PARTICULATE FILTER
- SOLENOID
- INSTRUMENT FOR SINGLE MEASURED VARIABLE (LOCALLY MOUNTED)
- LINE VALVE STATUS-NORMALLY OPEN
- LINE VALVE STATUS-NORMALLY CLOSED
- HOSE QUICK CONNECT
- REDUCER
- PRESSURE CONTROL VALVE

PT - PRESSURE TRANSMITTER
CV - CHECK VALVE
FX - PARTICULATE FILTER/SILENCER
F - FLEXIBLE HOSE
PSV - PRESSURE SAFETY VALVE
GAC - GRANULAR ACTIVATED CARBON
FI - FLOW INDICATOR
FQI - TOTALIZING FLOW METER
TI - TEMPERATURE INDICATOR
PI - PRESSURE INDICATOR
TXX - TANK
BXX - BLOWER
HS - HAND CONTROL SWITCH
V - VALVE
PCV - PRESSURE CONTROL VALVE
HE - HEAT EXCHANGER
LA - LOCAL ALARM
M - MOTOR
DSO - DENSITY SWITCH, OIL
DSW - DENSITY SWITCH, WATER

NOTES:
1. ALL LINES AND FITTINGS ARE 4" SCH 40 PVC EXCEPT WHERE NOTED.
2. ALL VALVES ARE 4" PVC EXCEPT WHERE NOTED.

NO.	DATE	REVISIONS	BY	CHKR	MGRPM SUPV	ENGR	PROJ ENGR	MICRO FLMD
B	7/14/95	ISSUED FOR WORK PLAN	RLP	ABJ	FBC	WRZ		
A	5/22/95	ISSUED FOR REVIEW	RLP	ABJ	FBC	WRZ		

SCALE

BECHTEL ENVIRONMENTAL INC.
OAK RIDGE, TENNESSEE

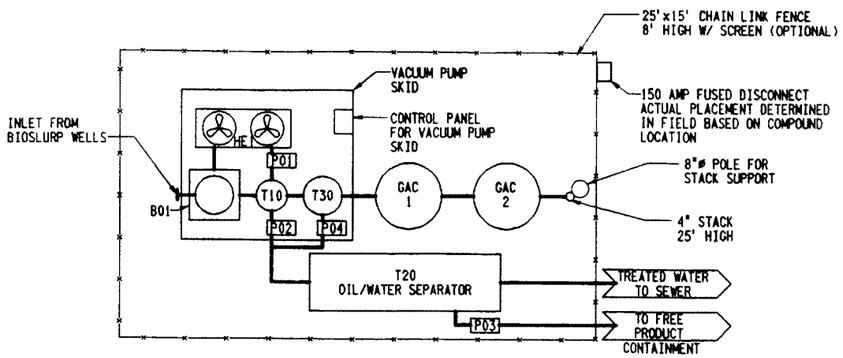
DEPARTMENT OF THE NAVY
SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA

PROCESS AND INSTRUMENTATION DIAGRAM FOR BIOSLURPER SYSTEM AND OIL SKIMMER SYSTEM

JOB NO.	DRAWING NO.	REV
22567	227-DD000-004	B

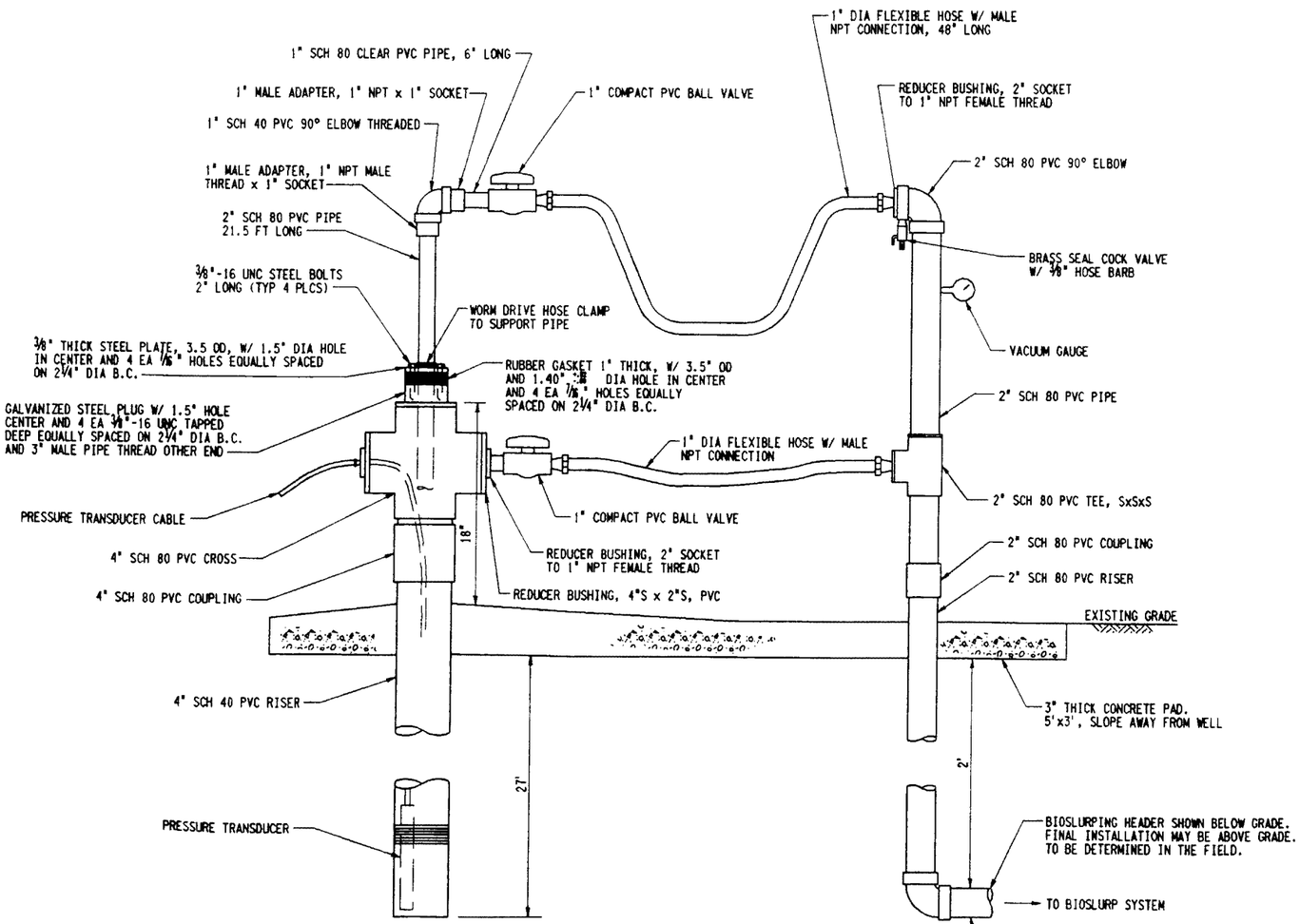
FRANK B. CATER
FLORIDA PE # 42508
EXPIRES FEBRUARY 28, 1997

SEAL



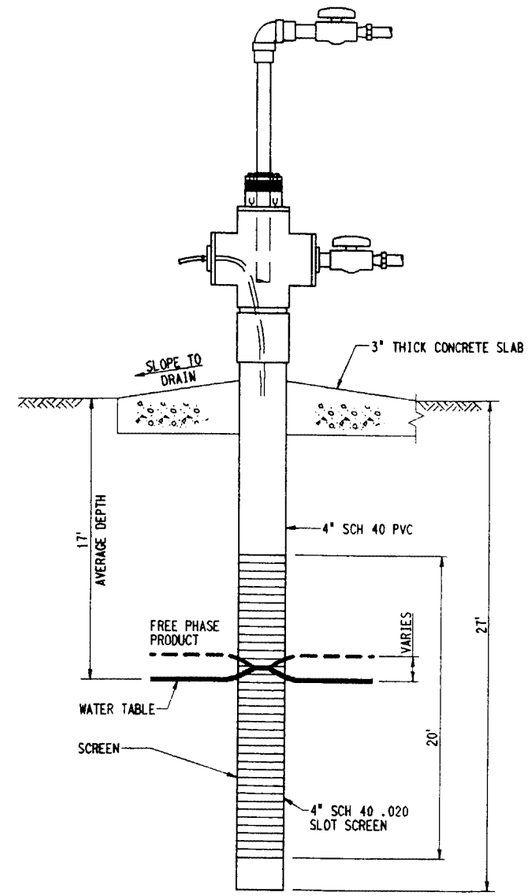
BIOSLURPING SYSTEM COMPOUND LAYOUT

SCALE: 1/4" = 1'-0"



BIOSLURPING WELL HEAD DETAIL

NTS



BIOSLURPER WELL DETAIL

NOTES

1. TYPICAL BIOSLURPER WELL INSTALLATION:
   - FILTER PACK PLACED TO APPROXIMATELY 2' ABOVE TOP OF WELL SCREEN.
   - 2' THICK BENTONITE SEAL (3/8"-1/4" PELLET) PLACED ABOVE FILTER PACK.
   - PORTLAND CEMENT GROUT PLACED IN REMAINING ANNULAR SPACE TO GRADE.

NO.	DATE	REVISIONS	BY	CHKR	RESIDENT ENGR	ENGR	PROJ ENGR	MICRO FLMD
B	7/14/95	ISSUED FOR WORK PLAN	RLP	ABJ	EBC	WRZ		
A	5/22/95	ISSUED FOR REVIEW	RLP	ABJ		WRZ		

SCALE NOTED

BECHTEL ENVIRONMENTAL INC.
OAK RIDGE, TENNESSEE

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA

227D005.DGN

BIOSLURPER SYSTEM DETAILS

JOB NO.	DRAWING NO.	REV
22567	227-DD000-005	B

FRANK B. CATER
FLORIDA PE # 42508
EXPIRES FEBRUARY 28, 1997

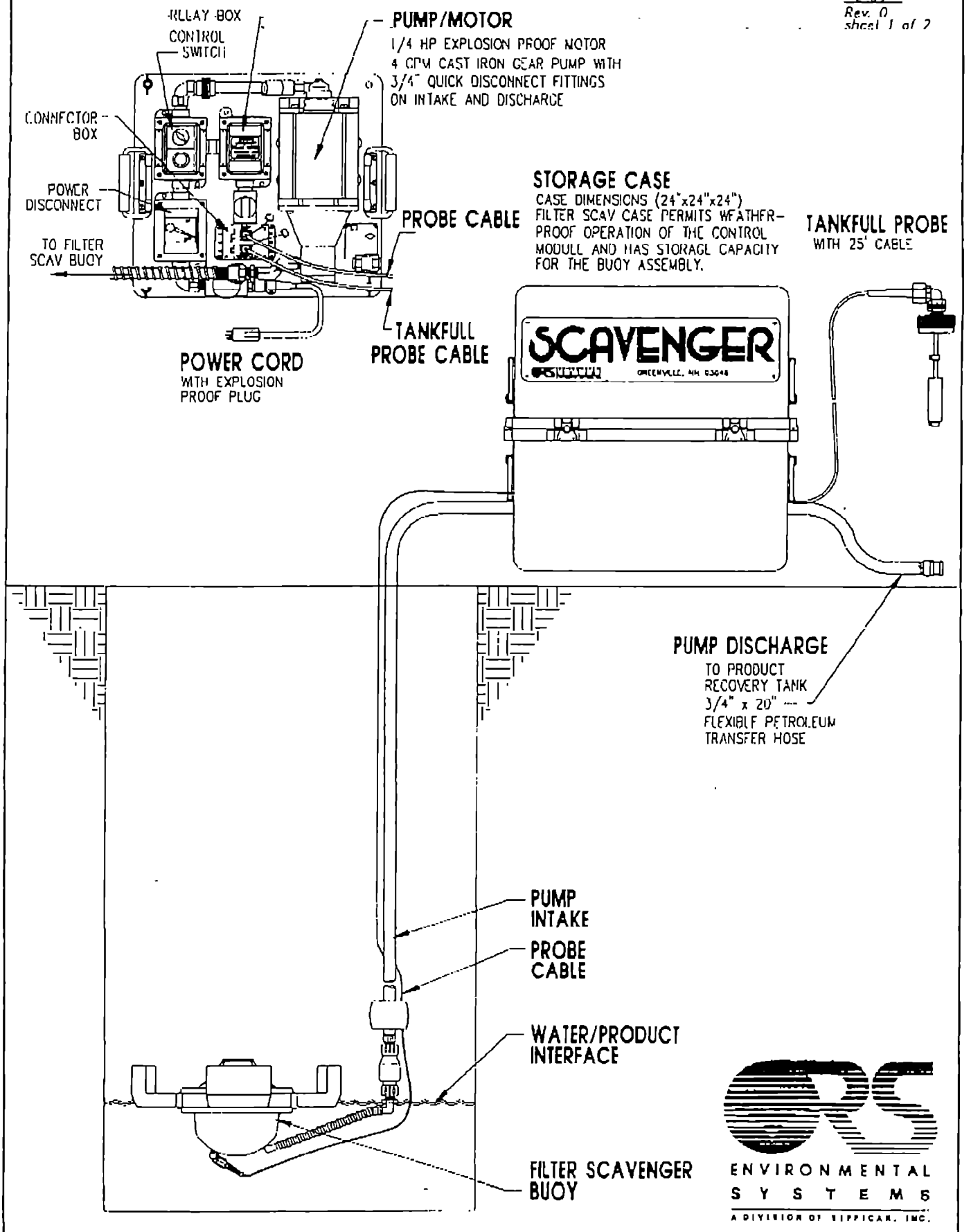
SEAL

APPENDIX D

MISCELLANEOUS PRODUCT INFORMATION

FILTER SCAVENGER™

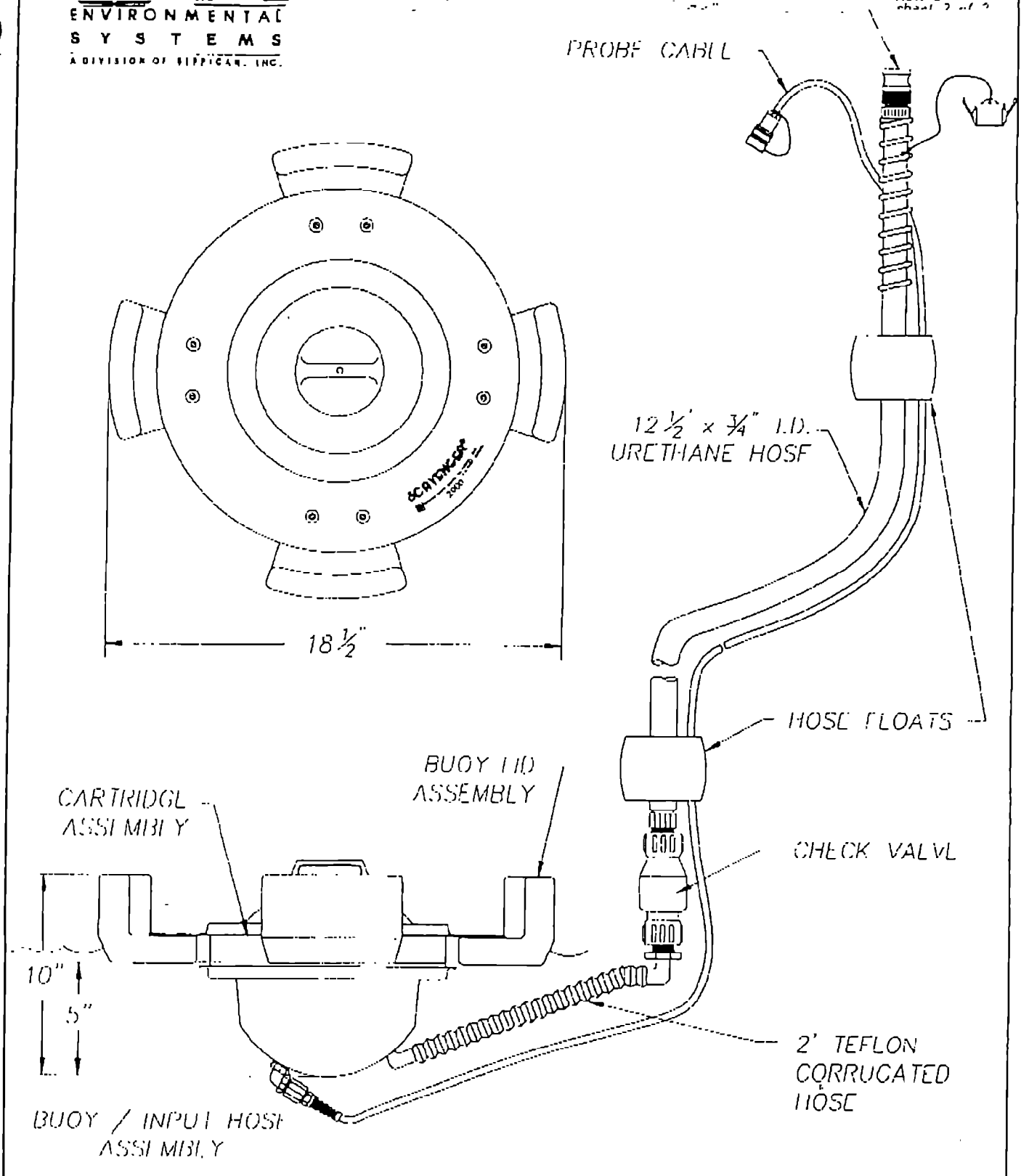
FILTSCAV
Rev. 0
sheet 1 of 2



ENVIRONMENTAL SYSTEMS
A DIVISION OF SIPPICAN, INC.

FILTER SCAVENGER™

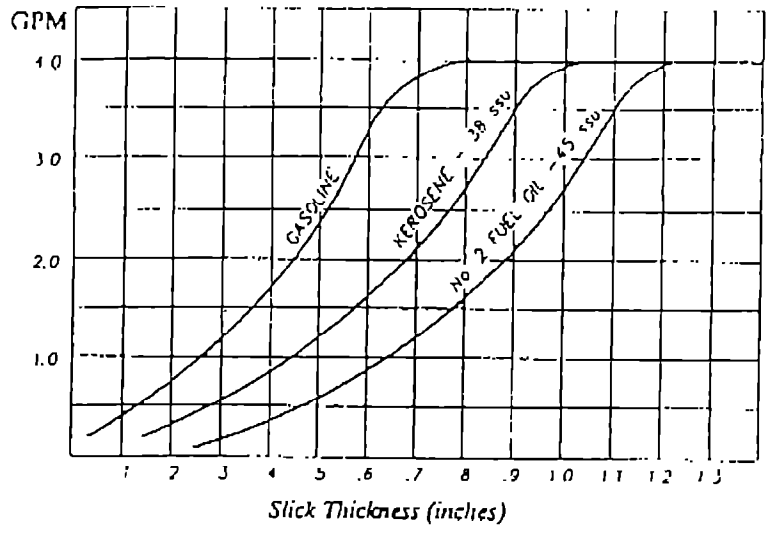
FILTSCAV
Rev. 0



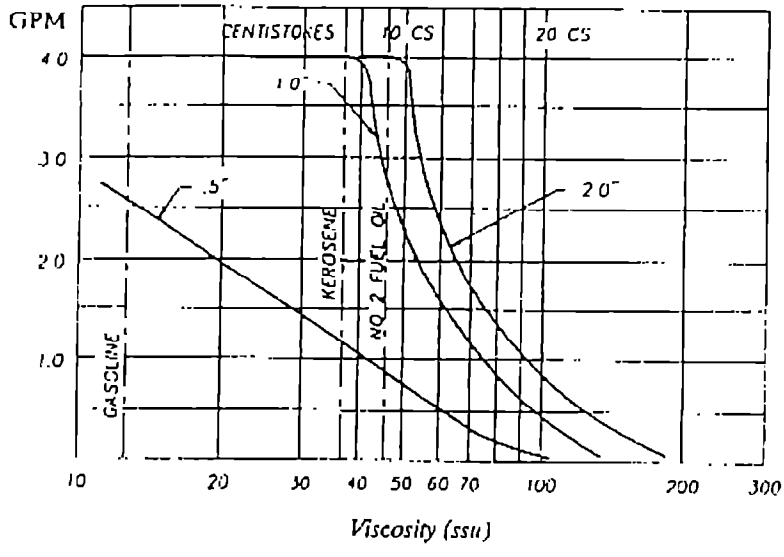
FILTER SCAVENGER BUOY / INPUT HOSE AND LID ASSEMBLY
WEIGHT – APPROX 11lbs

APPENDIX B

HYDROCARBON RECOVERY RATES



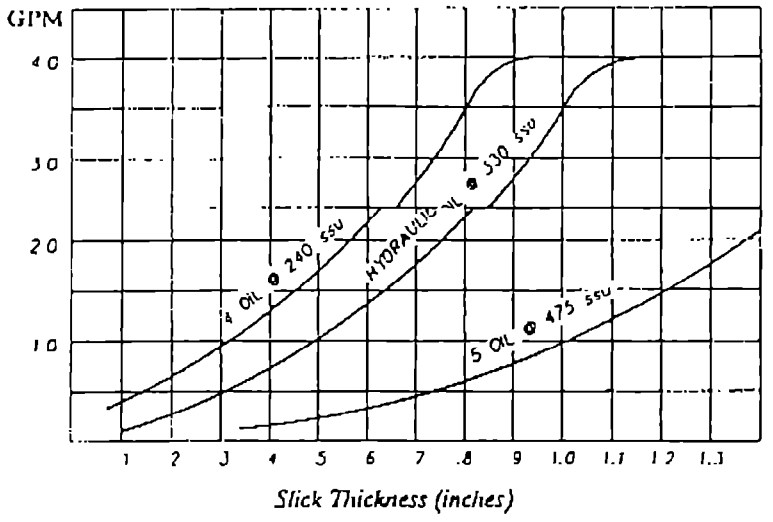
RECOVERY RATE VS. SLICK THICKNESS AT VARIOUS VISCOSITIES



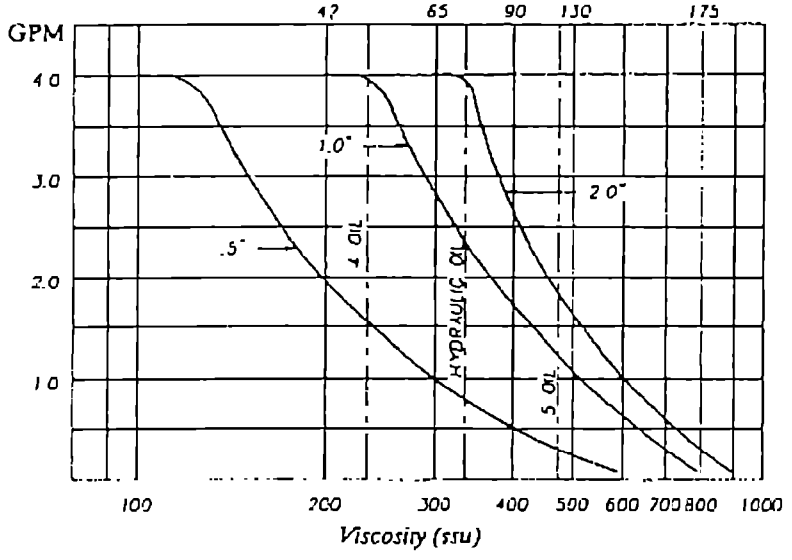
RECOVERY RATE VS. VISCOSITY AT VARIOUS SLICK THICKNESSES

FIGURE 8. Recovery rates for light oils using 100 mesh Filter Scavenger cartridge.

ORS ENVIRONMENTAL EQUIPMENT



RECOVERY RATE VS. SLICK THICKNESS AT VARIOUS VISCOSITIES



RECOVERY RATE VS. VISCOSITY AT VARIOUS SLICK THICKNESSES

FIGURE 9. Recovery rates for heavy oils using 60 mesh Filter Scavenger cartridge.

ORS

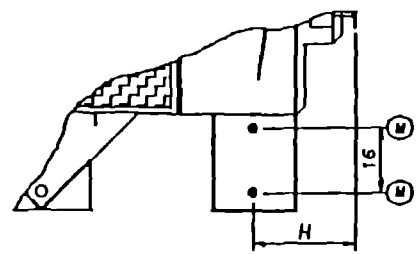
NOTES:

ALL FLANGES TO BE 150# FLAT FACE A-105 STEEL & CONFORM TO ANSI B16.5
ALL STEEL PIPE TO BE SCHEDULE 40 ASTM A-53
TANK, INTERIOR BAFFLES & LIDS TO BE FABRICATED OF ASTM A-36 CARBON STEEL

INTERIOR SURFACES ARE TO BE BLASTED TO AN SSPC SP-10, NEAR WHITE METAL BLAST AND GIVEN TWO COATS OF COAL TAR EPOXY (160/FT)
EXTERIOR SURFACES ARE TO BE BLASTED TO AN SSPC SP-6, COMMERICAL BLAST, AND GIVE ONE COAT OF HIGH BUILD EPOXY (6 DFT)

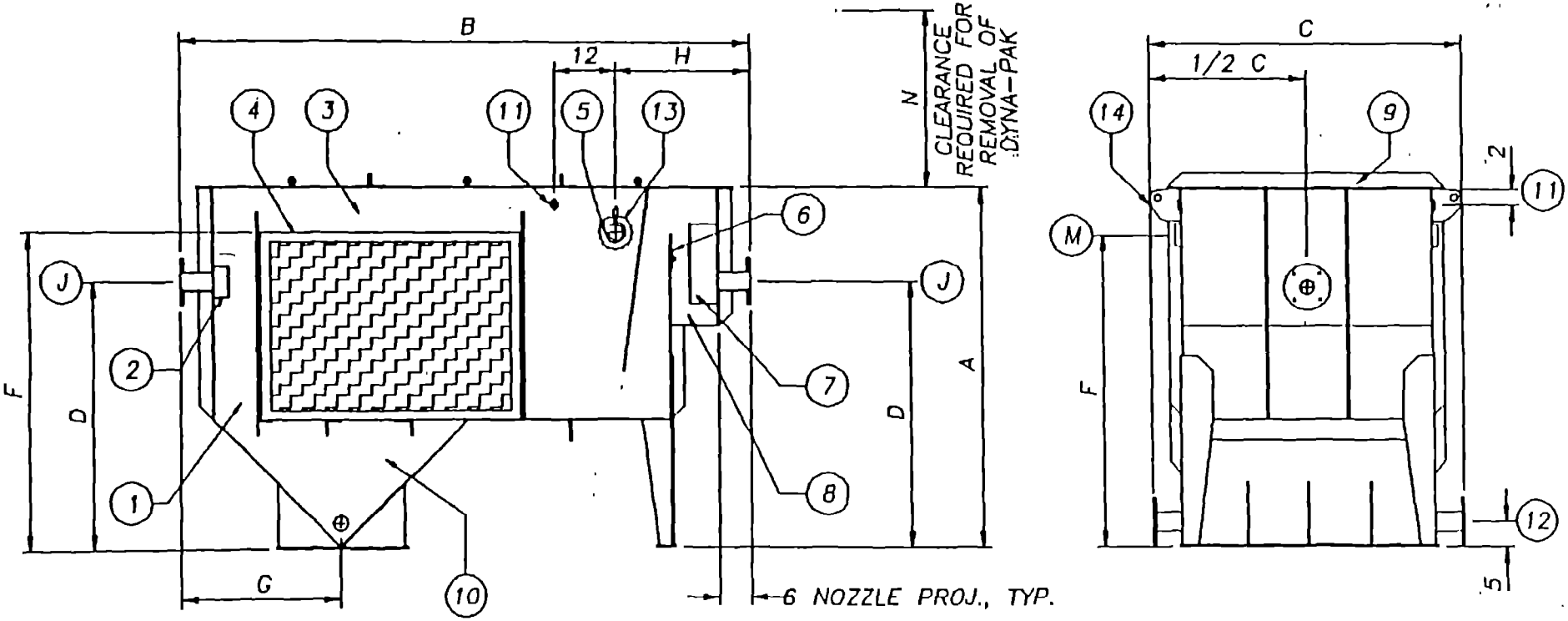
AVAILABLE DISCHARGE HEAD = "F" MINUS 3"

THE WEIR PLATES & MEDIA FRAMES ARE TO BE FABRICATED OF ASTM A-167/A-240 COLD ROLLD, ANNEALED #28 STAINLESS STEEL



OPTIONAL MODEL SHOWN WITH OIL RESERVOIR

ITEM	QTY	DESCRIPTION
1	1	INFLUENT DIFFUSION CHAMBER
2	1	INFLUENT DIFFUSION BAFFLE
3	1	SEPARATION CHAMBER
4	1	REMOVABLE DYNA-PAK
5	1	ADJUSTABLE OIL SKIMMING WEIR
6	1	EFFLUENT WEIR
7	1	EFFLUENT SHEEN BAFFLE
8	1	EFFLUENT CHAMBER
9	1	REMOVABLE LID WITH HANDLES
10	1	SLUDGE COLLECTION CHAMBER
11	2	1 # VENT
12	2	3 # SLUDGE OUTLET
13	1	ROTARY PIPE SKIMMER
14	4	LIFTING LUG



HYDROFLO TECHNOLOGIES INC.

DYNA-PAK COALESCING TYPE OIL/WATER SEPARATOR
WITH ROTARY PIPE SKIMMER
CARBON STEEL CONSTRUCTION
DP-24 THRU DP-128 G.A. DRAWING

UNLESS OTHERWISE SPECIFIED
TOLERANCE ON FRACTIONS +/- 3/16

DRAWN GAG DATE 5-1-93
NEXT ASSY.
SCALE
DRAWING NUMBER
DP-GADO-802

HYDRO-FLO TECHNOLOGIES, INC. DP- SERIES DIMENSIONAL INFORMATION

(Inches)

FIBERGLASS DP- SERIES	See drawing DP-GA00-B04																		
											(cu. ft.) PROJECTED SURFACE AREA					(gal) SLUDGE	(gal) SEPARATION	(gal) SEPARATOR	
	HGT	LEN	WID		HWL			DIA	DIA		MEDIA #	MEDIA #	MEDIA #	WEIGHTS (lbs)		CHAMBER	CHAMBER	OIL	
MODEL #	A	B	C	D	F	G	H	J	M	N	15	21	34	SHIPPING	OPERATING	CAPACITY	CAPACITY	CAPACITY	MODEL #
DP- 2	34	64	31	15	21	13.5	22.5	2	2	24	30	42	68	75	2400	22	52	15	DP- 2
DP- 3	34	64	43	15	21	13.5	22.5	2	2	24	45	63	102	100	3300	33	78	25	DP- 3
DP- 4	37	76	31	21	27	20	22.5	2	2	24	60	84	136	150	3100	37	67	30	DP- 4
DP- 8	49	76	31	33	39.5	20	22.5	2	2	24	120	168	272	250	4200	37	134	30	DP- 8
DP- 12	49	76	43	33	39.5	20	22.5	3	3	24	180	252	408	350	5900	54	201	45	DP- 12
DP- 16	49	76	55	33	39.5	20	22.5	3	3	24	240	336	544	450	7500	72	268	55	DP- 16

STEEL DP- SERIES	See drawing DP-GA00-B01																	OPTIONAL	
DP- 4	33	66	30	21	25	15	17	2	2	24	60	84	136	450	2700	14	60	30	DP- 4
DP- 8	45	66	30	30	37	15	17	2	2	24	120	168	272	650	3700	14	120	30	DP- 8
DP- 12	45	66	42	30	37	15	17	3	3	24	180	252	408	800	5100	21	180	45	DP- 12
DP- 16	45	66	54	30	37	15	17	3	3	24	240	336	544	1000	6500	28	240	55	DP- 16

STEEL DP- SERIES	See drawing DP-GA00-B02																	OPTIONAL	
DP- 24	69	108	36	51	61	30	25.5	4	3	48	360	504	816	1200	10000	56	300	70	DP- 24
DP- 36	69	108	48	51	61	30	25.5	4	3	48	540	756	1224	1500	13000	84	450	90	DP- 36
DP- 48	69	108	60	51	61	30	25.5	6	3	48	720	1008	1632	1800	17000	112	600	120	DP- 48
DP- 64	81	108	60	60	73	30	25.5	6	3	60	960	1344	2176	2200	20000	112	800	120	DP- 64
DP- 80	81	108	72	60	73	30	25.5	6	3	60	1200	1680	2720	2500	24000	140	1000	140	DP- 80
DP- 96	81	108	84	60	73	30	25.5	8	3	60	1440	2016	3264	2800	28000	168	1200	170	DP- 96
DP- 128	81	108	108	60	73	30	25.5	8	3	60	1920	2688	4352	3500	36000	224	1600	220	DP- 128

STEEL DP- SERIES	See drawing DP-GA00-B03																	OPTIONAL	
DP- 160	81	180.5	72.5	60	73	30	26	6	3	60	2400	3360	5440	7500	44000	280	1945	180	DP- 160
DP- 192	81	180.5	84.5	60	73	30	26	8	3	60	2880	4032	6528	9000	51000	336	2334	210	DP- 192
DP- 224	81	180.5	96.5	60	73	30	26	8	3	60	3360	4704	7616	10500	59000	392	2773	240	DP- 224
DP- 256	81	180.5	108.5	60	73	30	26	8	3	60	3840	5376	8704	12000	67000	448	3112	270	DP- 256
DP- 320	81	180.5	132.5	60	73	30	26	10	3	60	4800	6720	10880	15000	82000	560	3889	330	DP- 320

INLET VACUUM AIR FILTERS

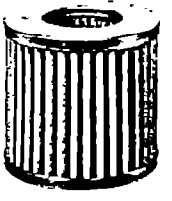
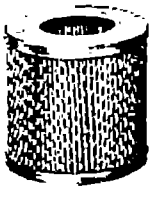
CSL Series
(Closed System "L")
1/2" FPT to 12" Flange
Up to 4950 CFM

Since 1968 Solberg has been manufacturing quality OEM and industrial filters for air compressor, blower and vacuum applications. By pioneering many filter manufacturing techniques and building their own production machinery, Solberg is fulfilling their commitment of continual product improvement and prompt response to customer needs.

The Solberg line includes most all sizes of inlet, inline, and exhaust system filters and elements, filter silencers, oil mist filters, high temperature filters and more. There is a choice of media to suit specific duty requirements. As the filter specialist, Solberg can also provide reliable products for individual needs and unique filter applications. Ask for an engineering evaluation of your requirements.

CSL-235P-400F

- Connection size; 400 = 4"; F at the end of model # denotes flange connection.
- Element part #: Odd #'s = Polyester, Even #'s = Paper, Even #'s + s = Wire Mesh. P = Polyurethane foam pre-filter included.
- CSL denotes Closed System "L" design.

SMI MODEL NUMBERS - CSL Series	
 W/Polyester Element	 W/Paper Element
CSL-05-025	CSL-04-025
CSL-05-038	CSL-04-038
CSL-07-038	CSL-06-038
CSL-07-050	CSL-06-050
CSL-843-050HC	CSL-842-050HC
CSL-843-075HC	CSL-842-075HC
CSL-843-100HC	CSL-842-100HC
CSL-849-100HC	CSL-848-100HC
CSL-843-125HC	CSL-842-125HC
CSL-849-125HC	CSL-848-125HC
CSL-849-150HC	CSL-848-150HC
CSL-851-200HC	CSL-850-200HC
CSL-851-250HC	CSL-850-250HC
CSL-235P-300	CSL-234P-300
CSL-335P-300	CSL-334P-300
CSL-235P-400	CSL-234P-400
CSL-335P-400	CSL-334P-400
CSL-245P-500	CSL-244P-500
CSL-345P-500	CSL-344P-500
CSL-275P-600	CSL-274P-600
CSL-375P-600	CSL-374P-600
CSL-235P-400F	CSL-234P-400F
CSL-335P-400F	CSL-334P-400F
CSL-245P-500F	CSL-244P-500F
CSL-345P-500F	CSL-344P-500F
CSL-275P-600F	CSL-274P-600F
CSL-375P-600F	CSL-374P-600F
CSL-377P-800F	CSL-376P-800F
CSL-685P-1000F	CSL-384P(2)-1000F
CSL-685P-1200F	CSL-384P(2)-1200F
CSL-485P(2)-1200F	CSL-484P(2)-1200F

APPLICATIONS

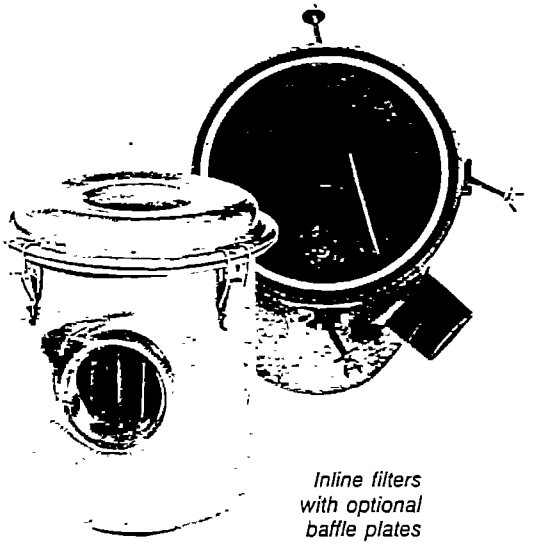
- Soil Venting
- Soil Remediation
- Vacuum Pumps & Systems
- Intake Suction Filters
- Blowers
- Pneumatic Conveying Systems
- Air Compressors
- Remote Installations

FEATURES

- Use as an elbow in a package without removing for service
- Rugged all steel construction
- Low pressure drop
- Positive sealing — Vacuum tested
- Large dirt holding capacity and easy field cleaning, especially when mounted horizontally or inverted

OPTIONS
(Inquiries Encouraged)

- Larger sizes available
- 1/8" or 1/4" FPT tap holes on inlet & outlet for differential pressure gauge
- Support stands
- Stainless steel housings
- Epoxy coated housings
- Hot dipped galvanized housings
- Unique centrifugal 2-stage filtering system/baffle plates
- Special fittings available for volume orders
- Various elements available- See Element Bulletin
- Activated carbon pad or prefilter to reduce odor



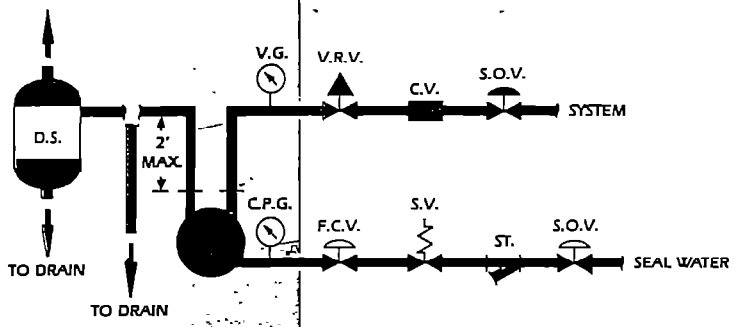
Inline filters with optional baffle plates provides centrifugal flow to knock down large particulates.

EFFECTIVE SURFACE AREA OF ELEMENT IN SQUARE FEET		CONNECTION		Flow CFM	Approx. Shipping Wt. Lbs.	DIMENSIONS					
Polyester	Paper	Size	Type			A	B	C	D	E	F
THREADED CONNECTIONS											
.2	.2	1/4"	MPT	6	.5	2-11/16"	*5/8"	2-1/2"	2-1/4"	*5/8"	—
.2	.2	3/8"	MPT	6	.5	2-11/16"	*5/8"	2-1/2"	2-1/4"	*5/8"	—
.58	.58	3/8"	MPT	8	1	3-15/16"	*5/8"	3-1/4"	2-15/16"	*5/8"	—
.58	.58	1/2"	MPT	10	1	4-1/4"	15/16"	3-1/4"	3-1/4"	15/16"	—
.6	1.75	1/2"	FPT	10	3	4-3/8"	3/8"	5-7/8"	2-5/8"	9/16"	5"
.6	1.75	3/4"	FPT	20	3	4-3/8"	3/8"	5-7/8"	2-5/8"	9/16"	5"
.6	1.75	1"	FPT	25	3	4-3/8"	5/8"	5-7/8"	2-5/8"	3/4"	5"
2.0	4.5	1"	FPT	40	5	6-1/2"	3/4"	7-5/16"	4-1/2"	3/4"	6-13/16"
.6	1.75	1-1/4"	FPT	45	3	4-3/8"	5/8"	5-7/8"	2-5/8"	3/4"	5"
2.0	4.5	1-1/4"	FPT	60	5	6-1/2"	3/4"	7-5/16"	4-1/2"	3/4"	6-13/16"
2.0	4.5	1-1/2"	FPT	80	5	6-1/2"	3/4"	7-5/16"	4-1/2"	3/4"	6-13/16"
4.5	13.75	2"	FPT	150	15	10-1/4"	3/4"	8-3/4"	5"	3/4"	7-5/8"
4.5	13.75	2-1/2"	FPT	195	15	10-1/2"	1"	8-3/4"	5-1/2"	1-1/4"	7-5/8"
8.3	22.8	3"	MPT	300	47	27-1/8"	3"	14"	18-1/2"	3"	13"
12.0	34.0	3"	MPT	300	50	27-1/8"	3"	14"	18-1/2"	3"	13"
8.3	22.8	4"	MPT	520	52	27-1/8"	3"	14"	18-1/2"	3"	13"
12.0	34.0	4"	MPT	520	55	27-1/8"	3"	14"	18-1/2"	3"	13"
14.0	35.5	5"	MPT	800	82	28-1/8"	3"	18-1/2"	19-1/2"	3"	17"
22.1	57.0	5"	MPT	800	88	28-1/2"	3"	18-1/2"	19-1/2"	3"	17"
19.0	45.4	6"	MPT	1100	95	28-1/8"	4"	18-1/2"	20-1/2"	4"	17"
28.0	68.1	6"	MPT	1100	97	28-1/8"	4"	18-1/2"	20-1/2"	4"	17"
FLANGED CONNECTIONS											
8.3	22.8	4"	FLG	520	62	27-1/8"	3"	14"	18-1/2"	3"	13"
12.0	34.0	4"	FLG	520	64	27-1/8"	3"	14"	18-1/2"	3"	13"
14.0	35.5	5"	FLG	800	90	28-1/8"	3"	18-1/2"	19-1/2"	3"	17"
22.1	57.0	5"	FLG	800	88	28-1/2"	3"	18-1/2"	19-1/2"	3"	17"
19.0	45.4	6"	FLG	1100	110	28-1/8"	4"	18-1/2"	20-1/2"	4"	17"
28.0	68.1	6"	FLG	1100	113	28-1/8"	4"	18-1/2"	20-1/2"	4"	17"
50.0	125.0	8"	FLG	1800	185	38"	4"	22-1/2"	25-1/2"	4"	21"
100.0	280.0	10"	FLG	2900	380	57-1/2"	4"	26-13/32"	45"	4"	25"
100.0	280.0	12"	FLG	3300	390	57-1/2"	4"	26-13/32"	45"	4"	25"
150.0	400.0	12"	FLG	4950	465	70"	4"	26-13/32"	57"	4"	25"

*Currently 15/16" soon to be 5/8"

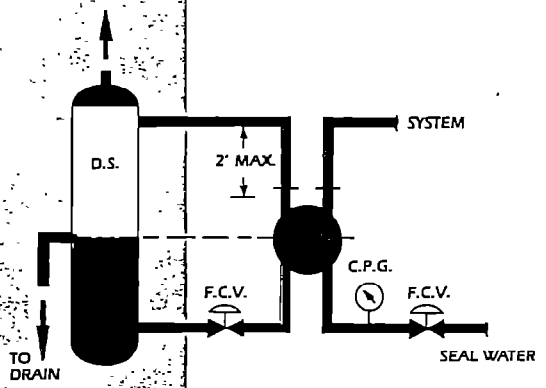
LIQUID RING PUMP SEAL WATER SYSTEMS

VACUUM OPERATION



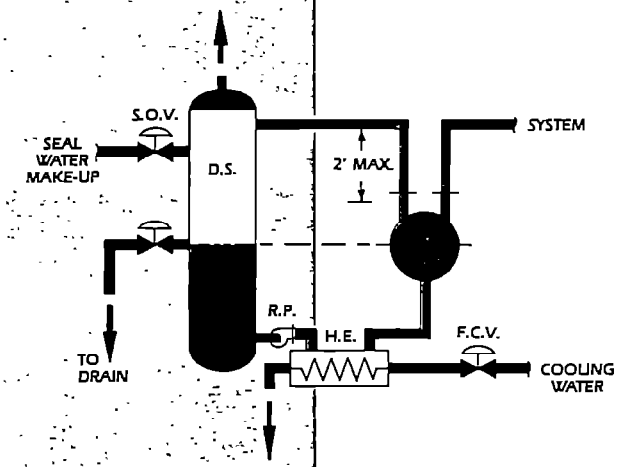
1. ONCE-THROUGH

This system is what the name implies. Water is fed to the pump and then discharged down a drain or used for another purpose.



2. PARTIAL RECIRCULATION

This is a system where some of the seal liquid is recirculated and mixed with fresh sealant. This reduces the amount of fresh sealant required. Consideration must be given to heat buildup within the Liquid Ring.

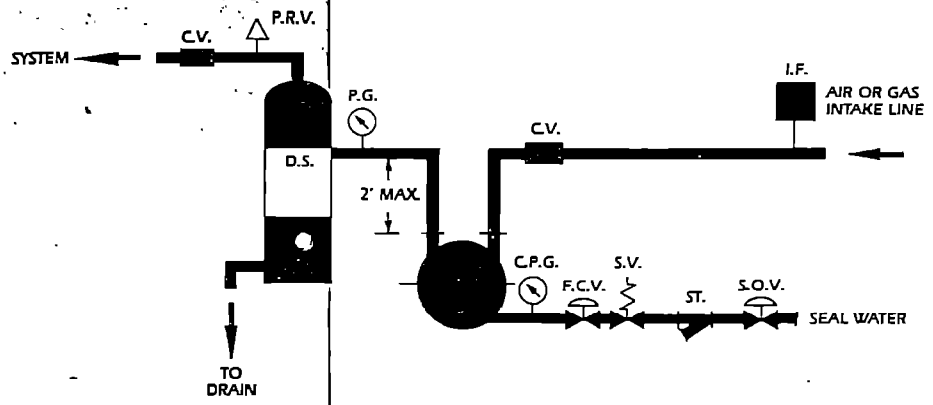


3. COMPLETE RECIRCULATION

This system reuses the sealant. Heat buildup of the sealant must be prevented by using some type of heat exchanger. It can be exchanger. It can be shell and tube or air to liquid. In some cases where the pump is small, and the separator tank has a large surface area, radiation can dissipate sufficient heat for the Liquid Ring Pump to function.

COMPRESSOR OPERATION

AIR OR GAS
MIXTURE: GAS & SEAL WATER
SEAL WATER

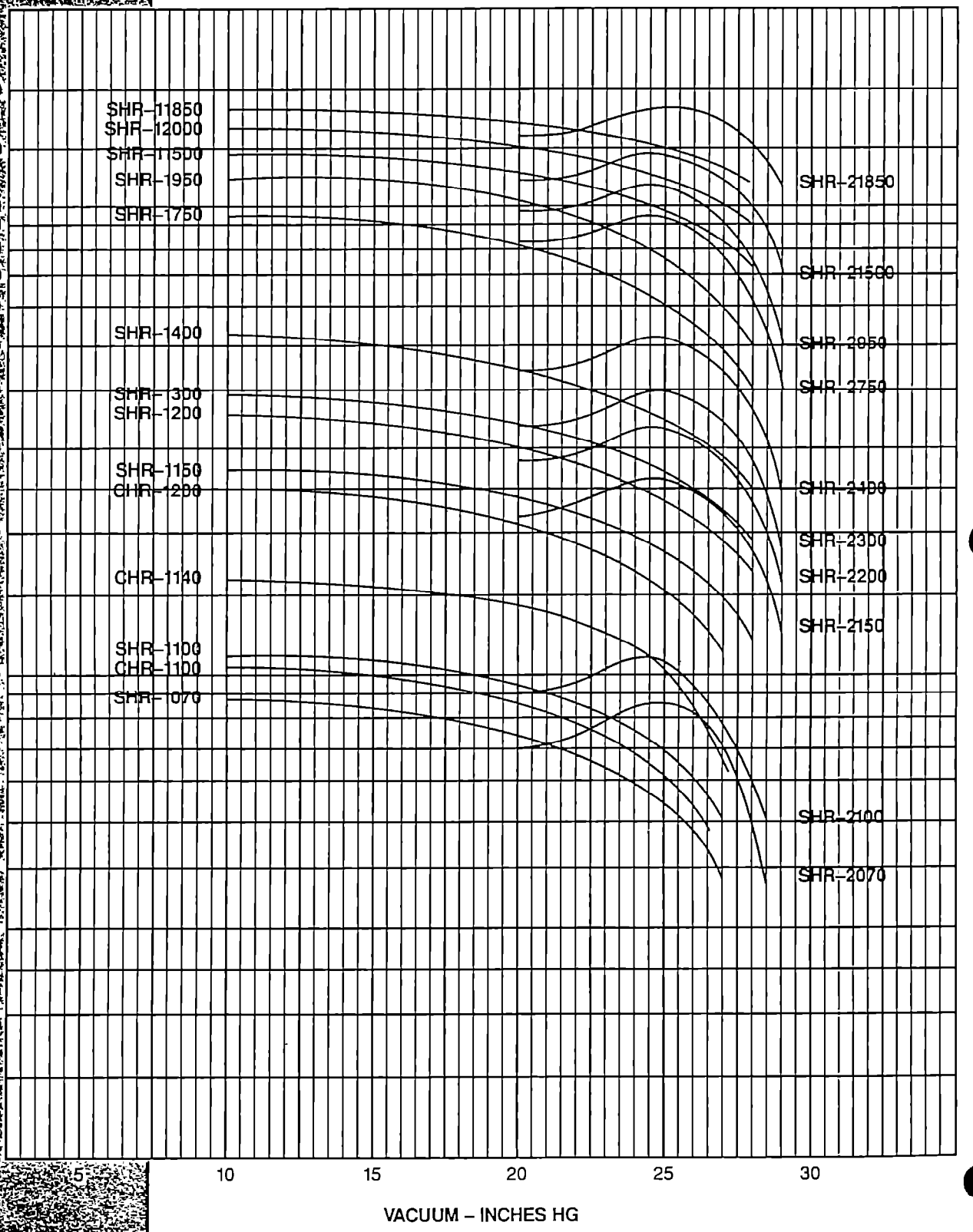


LEGEND

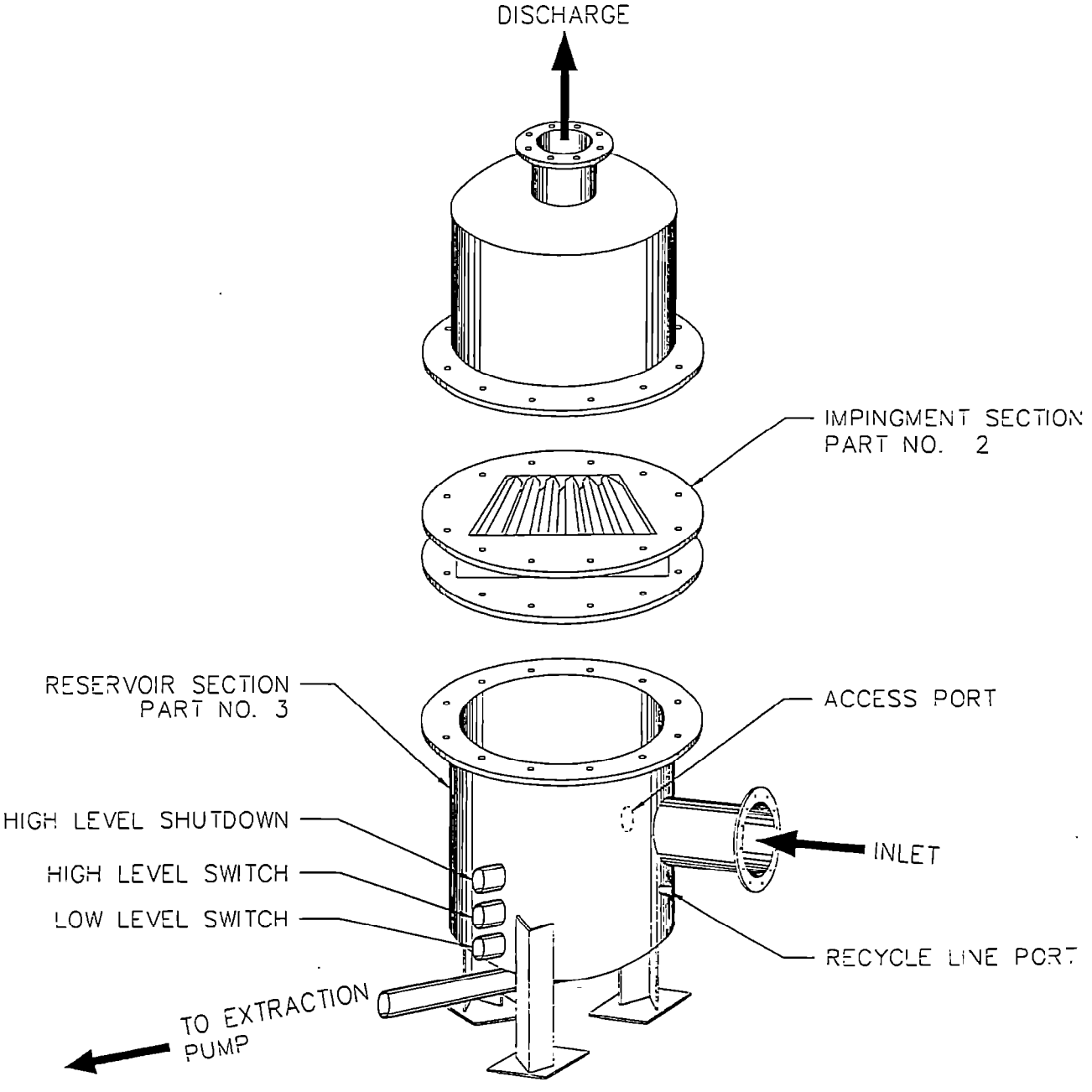
BCV — BALL COCK VALVE
CPG — COMPOUND PRESSURE GAUGE -30" HG TO 30 PSIG
CV — CHECK VALVE
DS — DISCHARGE SEPARATOR
FCV — FLOW CONTROL VALVE (GLOBE)
HE — HEAT EXCHANGER
IF — INLET FILTER
PG — PRESSURE GAUGE 0-30 PSIG
PRV — PRESSURE RELIEF VALVE
RP — RECIRCULATING PUMP
SOV — SHUT-OFF VALVE (GLOBE)
ST — STRAINER
SV — SOLENOID VALVE (NC)
VG — VACUUM GAUGE
VRV — VACUUM RELIEF VALVE

LIQUID RING PUMPS

VACUUM PERFORMANCE CHART



CURVES BASED ON STANDARD CONDITIONS & 60°F SEAL WATER



REP STANDARD - REP SEP 1000

GENERAL LAYOUT

(E) ACADWIN\DWG\STD\SEP3D

100 V 1.0

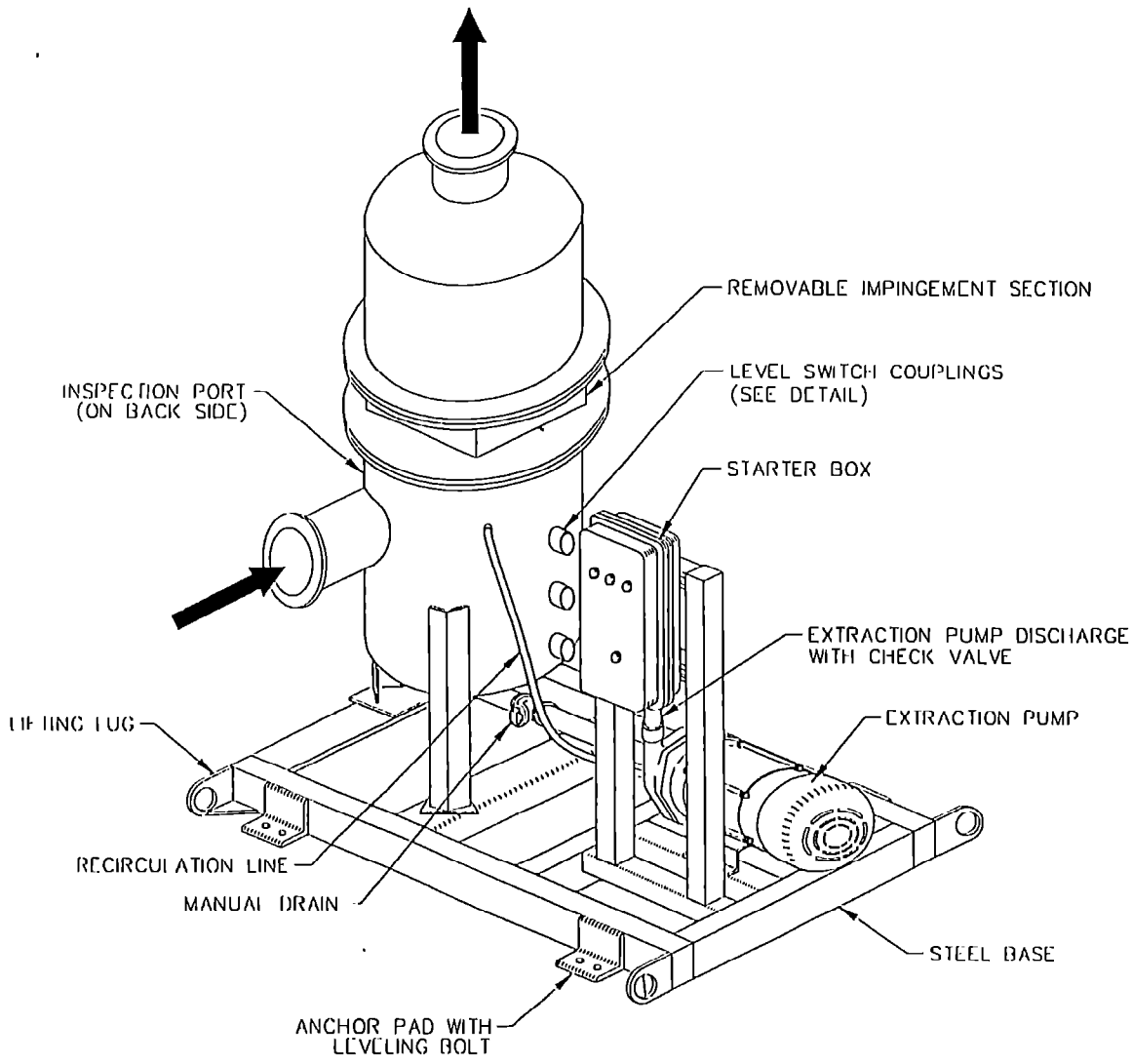
L MYERS

01 MAY 94

01 MAY 94

Rotating Engineered Products, Inc

2405 MURPHY BOULEVARD
GAINESVILLE, GEORGIA 30504
TOLL FREE (800) 526-9933
(404) 538 0020
(404) 538 0022 FAX



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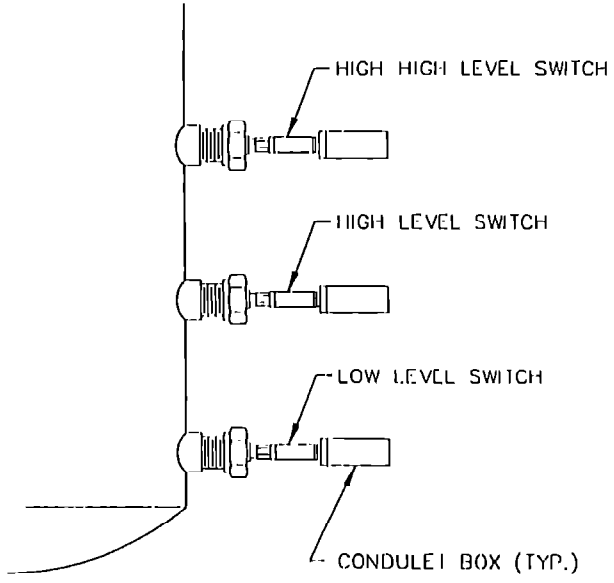

LEVEL SWITCH DETAIL

Rotating Engineered Products, Inc.	2405 WORTHY BOULEVARD GAINESVILLE, GEORGIA 30501 TOLL FREE: (800) 536-9933 (404) 538-0020 (404) 538-0022 FAX	CUSTOMER NAME AND LOCATION: REP STANDARD SEPARATOR PACKAGE	CUSTOMER P.O. #: –	DRAWING NO: SEPISO V 1.0	VERSION #: 1.0	DATE: 01 AUG 94	REVISIONS	SYM	DATE	BY	DESCRIPTION
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APPENDIX E

MICHIGAN GUIDANCE DOCUMENT

DEPARTMENT OF NATURAL RESOURCES
WASTE MANAGEMENT DIVISION
HAZARDOUS WASTE PROGRAM SECTION
P O BOX 30241
LANSING, MICHIGAN 48909

MICHIGAN DEPARTM

GUIDANCE DOCUMENT FO

EXECUTIVE SUMMARY

The document provides guidance for sampling soils to verify that soil contamination has been remediated to Type A or Type B criteria in accordance with Act 307 P.A. 1982, as amended. This document is not designed to either guide investigations to determine whether a release has occurred or the nature and extent of an identified release, nor to guide due diligence by a potential property owner.

Soil sampling and analyses to verify that site remediation is complete can result in two basic errors.

- Declaring a site clean when it is contaminated
- Declaring a site contaminated when it is clean

A soil sampling plan submitted to the DNR must minimize these errors. The guidance document presents acceptable methods for verifying soil remediation. It contains guidance on soil sampling protocols and documentation necessary to characterize and verify cleanup of contaminated soils. The document provides recommended procedures for establishing soil background concentrations, sampling grids, chemical constituent evaluations, statistical comparisons, verifying excavation and in-situ and ex-situ remedies, evaluating treated soils, and soil characterization. The recommended procedures are not *absolutes*. Other methods are available to verify soil remediation. The Department of Natural Resources will evaluate other sampling and statistical strategies on a case-by-case basis.

The guidance document is divided into two parts:

Part 1 contains guidance for small site cleanup verification (less than 10,890 square feet--<.25 acre). It is a "biased" sampling strategy recommending soil sampling from areas most likely to contain contamination.

Part 2 contains guidance for soil characterization and cleanup verification of medium and large sites (greater than 10,890 square feet-->.25 acre). It is a statistical random sampling strategy that minimizes biases in sampling.

Both sampling strategies require discrete soil samples. Compositing samples for cleanup verification is not accepted without prior DNR approval.

The guidance document contains verification checklists and reporting sections. The reporting sections should be carefully followed in reporting sampling rationale.

Reader's Note: Questions regarding this guidance document should be directed to Department staff you are currently working with for your project or site.

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VERIFICATION OF SOIL REMEDIATION

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DNR–GUIDANCE DOCUMENT, PART 1

SMALL SITE SOIL CLEANUP VERIFICATION (LESS THAN 10,890 SQUARE FEET)

Part 1 of this document is a guide for a biased sampling strategy to verify that soil contamination has been remediated at small sites. Soil sampling and analyses to verify that a site remediation is complete can result in two basic errors.

- Declaring a site clean when it is contaminated
- Declaring a site contaminated when it is clean

A soil sampling plan submitted to the DNR must minimize these errors. Part 1 presents a biased sampling method of verifying soil remediation at small sites. The biased sampling approach specified in this guidance recommends soils sampling from areas most likely to still exceed cleanup criteria. The location of the soil sample points relies on a site specific analysis of the released or contaminant distribution and the soil types encountered. The remediation is verified using a point by point comparison of sample values with the appropriate cleanup criteria. If the cleanup criteria are exceeded at any sampled point, the biased sampling methodology may require additional remediation at that point until the criteria are met. Verification of cleanup utilizing the biased approach should generally require fewer samples to demonstrate attainment than by using the unbiased approach. DNR will evaluate other sampling and statistical strategies on a case-by-case basis.

Any biased sampling plan, whether presented in the guidance document or some other geostatistical approach, requires professional judgment. Therefore, documentation and the rationale used to select sample locations is extremely important. The report section (page 9) of this guidance document should be carefully followed.

Compositing samples for verifying soil remediation is not acceptable without prior DNR approval. When verifying a soil remediation is complete, contaminant concentrations will be low. Compositing may result in the contaminant concentrations not being representative of what remains in the soil. If concentrations are low, compositing may dilute the concentrations of a contaminant to below its threshold detection limit. Additionally, if contamination is indicated in a composited sample, the location of the contamination remains unknown.

Part 1 is divided into four main sections: Verifying Excavation Remedies, Verifying In-Situ and Ex-Situ Soil Remedies, Background Soil Samples, and Reports. The excavation and in-situ remediations require different strategies for verification. Guidance is presented for statistically determining background concentrations of compounds/contaminants. Guidance for reporting all appropriate information is presented to facilitate remediation approval.

VERIFYING EXCAVATION REMEDIES

Verifying that contaminated soil is remediated by means of excavation requires samples from the excavation bottom and sidewalls. Tables and formulas presented provide the minimum number of samples necessary to verify cleanup for various size excavations. The biased approach specified in this guidance recommends soil sampling from areas most likely to still exceed cleanup criteria. The location of the sample collection points relies on site specific analysis of the release or contaminant distribution and the soil types encountered in the excavation. The minimum number of excavation floor and sidewall samples required to demonstrate verification using a point by point comparison with the cleanup criteria are specified. If the cleanup criteria are exceeded at any point, this verification methodology may require additional excavation at that point until the criteria are attained.

Sampling and analyzing the locations most likely to have contaminants can minimize the number of samples needed to verify remediation is complete. Since professional judgment and site specific knowledge are required for selecting sampling locations, the rationale used to select these locations must be documented in the verification report.

SAMPLE LOCATIONS

Using a biased sampling approach, samples must be collected where they will most likely encounter contamination which could exceed the cleanup criteria. This will minimize the number of samples needed to verify a site is remediated. A sampling strategy that uses bias to choose sample locations is recommended. While it is inappropriate for this guidance document to dictate exact locations for sample collection in this strategy, site specific information (e.g., the location of leaks in an underground storage tank or its piping) from the remedial investigation concerning the release and soil conditions should be used along with professional judgment and the general guidance provided here to select appropriate soil sampling locations.

EXAMPLE: It would be incorrect to sample the north side of an excavation pit as extensively as the south side when the leak was confirmed on the south side of the tank.

Because a site must be remediated to a certain degree before approval can be considered, an analysis of data generated by prior investigation should yield information for the verification analysis. The field personnel present during remediation should be sufficiently familiar with the conditions on site to implement an appropriate verification strategy. A soil verification strategy should incorporate all pertinent biases of a site which may include, but are not limited to, those listed below.

- preferential pathways of contaminant migration
- source areas
- stained soils
- other site specific "clues" (e.g., fractures in clays)
- changes in soil characteristics (e.g., sand/clay interfaces)
- soil types and characteristics

NUMBER OF SAMPLES

The following tables are used to determine the minimum number of samples necessary from the floor and sidewalls of an excavation no greater than 0.25 acres using a biased sampling approach. If the area of the excavation floor exceeds 10,890 square feet, use Part 2 of this guidance document. A site may have an appropriate number of samples collected for verification, but, if the samples are not collected from the appropriate locations (discussed previously) and adequately reported, remediation may not be considered adequate. All sample locations must be accurately located, described, and reported. It should be noted that "excavation" as used here refers only to that area excavated for remediation purposes and being verified to meet Type A/Type B cleanup criteria.

Number of Excavation Floor Samples

Determine the minimum number of excavation floor samples from the table below.

TABLE 1

Excavation Floor Samples

Area of Floor (sq ft)	*Number of Samples*
< 500	2
500 < 1,000	3
1,000 < 1,500	4
1,500 < 2,500	5
2,500 < 4,000	6
4,000 < 6,000	7
6,000 < 8,500	8
8,500 <10,890	9

Number of Excavation Sidewall Samples

Sidewall samples are required to verify that the horizontal extent of contamination has been remediated. Use Table 2 to determine the minimum number of required sidewall samples. In no case is less than one sample on each sidewall (i.e., four) acceptable. In the case of irregularly shaped excavations, where four walls are not readily discernible, divide the total wall area into four segments of approximately equal size. Sidewall samples should be located in accordance with "biases" outlined earlier in Part 1.

TABLE 2

Excavation Sidewall Samples

Total Area of Sidewalls (sq ft)	*Number of Samples*
< 500	4
500 < 1,000	5
1,000 < 1,500	6
1,500 < 2,000	7
2,000 < 3,000	8
3,000 < 4,000	9
> 4,000	1 sample per 45 lineal feet of sidewall

VERIFYING IN-SITU AND EX-SITU SOIL REMEDIES

The effectiveness of in-situ soil remedies must be verified by three-dimensional random soil sampling. Refer to Attachment 2 for approved statistical sampling strategies. Certain ex-situ remedies, such as bio-piles or above-ground vapor extraction, may be amenable to statistical sampling strategies or batch sampling. Any proposed sampling strategy for in-situ or ex-situ remedies should be pre-approved by the DNR.

BACKGROUND SOIL SAMPLES

ESTABLISHING SOIL BACKGROUND

Establishing soil background, as required by Act 307 PA 1982, as amended, Michigan Environmental Response Act (MERA), can be accomplished by utilizing Operational Memorandum #15 or using the following guidance.

Background should be established for site specific waste constituents, specific chemicals used in various processes, facility operations, or remedial investigation results. Sample analyses may include metals, organic constituents, or other site specific waste constituents. Analyses should be in accordance with Act 307 P.A. 1982, as amended.

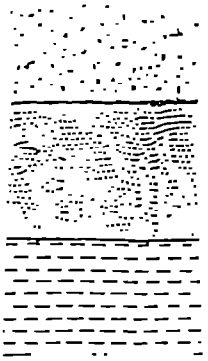
Many factors can play a part in the background concentrations of a chemical in soil.

EXAMPLE: The geologic origin (e.g., the parent rock) of glacial drift may have been high in copper, lead, or other metals that may be potential contaminants. Additionally, the hydrogeologic situation can alter the quantity of these elements. Groundwater recharge areas (e.g., highlands) are frequently leached of metals while groundwater discharge areas (e.g., swamps, floodplain) are the recipients of leached metals. Thus, sites in low areas will usually have higher background concentrations than upland areas. Other conditions, such as precipitation and atmospheric fallout from widely dispersed human and natural activities, also affect soil concentrations.

A minimum of four samples must be used to establish "background" in soils. This will help account for natural constituent occurrences and inherent variability within each distinctive soil horizon. Background samples must be collected in an area which has not been impacted by environmental contamination from the site and representative of natural background conditions. Based on waste type, contaminant mobility, operation practices, and soil type (sand, silty sand, clay), an estimate of contamination depth should be made and background samples taken at comparable depths for the particular soil type. Multiple soil horizons should have "background" established separately (e.g., minimum of four samples per each soil unit).

EXAMPLE:

Ground Surface

Brown medium-coarse SAND		4 samples
Lt. brown silty fine SAND		4 samples
Gray silty CLAY w/trace of fine-med sand		4 samples

STATISTICAL ANALYSIS FOR ESTABLISHING BACKGROUND CONCENTRATIONS

The recommended statistical method for establishing background concentrations at small sites is (1) establishing the upper limit of background concentration of a constituent at the mean plus 3 standard deviations or (2) other statistical methods submitted to DNR for approval.

1. *Mean Plus 3 Standard Deviation Approach*

   Calculate the "upper limit" of background concentration by using the following 5 step process.

   A. Calculate the background mean ($\overline{X}_b$) by dividing the sum of the total background readings by the total number of background readings:

$$\overline{X}_b = \frac{X_1 + X_2 + \ldots X_n}{n}$$

   B. Calculate the background variance (S_b^2) by taking the sum of the squares of each reading minus the mean and dividing by the degrees of freedom (the total number of background samples minus one):

$$S_b^2 = \frac{(X_1 - \overline{X}_b)^2 + (X_2 - \overline{X}_b)^2 \ldots (X_n - \overline{X}_b)^2}{n-1}$$

   NOTE: Any sample populations less than (n<30 samples) must use n - 1 for degrees of freedom.

   C. Calculate the background standard deviation (S_b) by taking the square root of the variance:

$$S_b = \sqrt{S_b^2}$$

D. The Coefficient of Variation Test (CV) where

$$CV = \frac{S_b}{\overline{X}_b}$$

is used to evaluate data distribution. The background data should generally have a CV of less than 0.5 for granular soils, less than 0.75 for cohesive soils, or an explanation accounting for higher CV values. The maximum recommended CV is 1.00. If the data distribution exceeds a CV of 1.00, then a thorough evaluation will need to be made to account for this variability (e.g., lab QA/QC, typographical errors, soil classification, sample location, data not normally distributed etc.). If the CV exceeds 1.0 and there is sufficient evidence to suggest a data point does not accurately represent background conditions or if QA/QC problems exist which invalidate that data point, the outlier data may be dropped or additional samples collected and analyzed to ensure a sufficient representative data population (n) is achieved. A high concentration in and of itself is not sufficient justification to exclude the data point.

E. Use the $\overline{X}_b + 3*S_b$ of "background" data as the maximum allowable limit or upper limit. Where $3*S_b$ equals three times the standard deviation and $\overline{X}_b$ equals the background mean (this statistical method only requires one sample per station). Compare each sample point to the calculated maximum allowable limit or upper limit analyzed from background data.

EXAMPLE: Four sand samples from a site were analyzed for background concentrations for lead. Concentrations of lead from the sample analyses returned from the lab were 56, 25, 18, and 35 ppb. Now, the investigator wants to examine the data set to discover whether the 56 ppb sample is an outlier:

$$\overline{X}_b \ mean = \frac{56+25+18+35}{4} = 33.5$$

$$S_b^2 = \frac{[56-33.5]^2+[25-33.5]^2+[18-33.5]^2+[35-33.5]^2}{3} = 273.67$$

$$S_b = (standard\ deviation) = \sqrt{S_b^2} = 16.5$$

$$CV = \frac{16.5}{33.5} = 0.49$$

Because 0.49 is less than 0.5, no further evaluation of the background data set is necessary.

Therefore, the background upper limit value for this site is

$$background\ upper\ limit = \overline{X}_b + (3*S_b) = 33.5 + (3*16.5) = 83.0\ ppb$$

If a value is found to be an outlier which is not representative of background conditions, it may be replaced by another sample that is not an outlier to maintain at least four samples for background determination.

2. *Other statistical procedures for establishing background.* Refer to a statistical reference book or U.S. EPA's Interim Final Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities (April 1989) and Addendum (July 1992).

PROCEDURES FOR NON-DETECT VALUES

The following provides some guidelines in incorporating non-detectable sample results into the procedure to calculate background concentrations.

1. If less than 50% of the background data is below the detection limit (DL), use ½ of the detection limit as the value.

2. If more than 50% of the background data is below the detection limit, use one of the following procedures.

   - Alternate "0" and the detection limit (DL) resulting in a net value of ½ the detection limit, with a variance.

EXAMPLE:	Actual Value	Substitute Value
	<DL	DL
	<DL	0
	<DL	DL
	<DL	0

   - The Continuity Correction procedure with the t-test, Cohen's method, or other approved methods.

REPORT FOR SMALL SITE VERIFICATION

Soil cleanup verification reports for small sites must identify the number and location of samples and justify the sample location selected (why and how). The verification report must include the following.

1. MAP(s) and CROSS SECTIONS

   Provide a scaled map of the floor and walls of an excavation (the vertical and horizontal area treated for "in-situ" remediations) with sample locations identified. The cross section should depict the stratigraphy, fractures, soil types, discolorations, unusual characteristics, odor, etc.

2. SAMPLE LOCATION RATIONALE

   A. Background sample location
   B. Verification sample locations
   C. Sample depths
   D. Sample collection procedures
   E. Describe biases and rationale used for collecting each sample (e.g., clay fractures, discolored soil, location of leak in tank)

3. DATA ANALYSES

   A. Analytical parameters
   B. Analytical methods used
   C. Method detection limits
   D. Laboratory Quality Assurance/Quality Control

4. STATISTICAL ANALYSES

   A. Calculation of background concentrations
   B. Coefficient of variance calculations
   C. Lab results
   D. Narrative explanation of background concentrations

DNR--GUIDANCE DOCUMENT, PART 2

MEDIUM AND LARGE SITE SOIL CLEANUP

VERIFICATION (GREATER THAN 10,890 SQUARE FEET)

Part 2 describes statistical random sampling strategies to verify the remediation of medium and large sites greater than 0.25 acres in size. The strategies employ the use of gridding to facilitate the unbiased selection of sampling points and accepted statistical tools for evaluating the resultant data. The strategies provide a 95% confidence level of determining any hot spot concentrations on a site. It contains guidance on sampling protocol and necessary documentation for clean closures. Part 2 also discusses how to establish grid intervals, set grids, sample grids, statistically evaluate the data, use grids to guide additional remedial activities, disposal options, reporting, and a certification checklist. It also provides guidance on the sampling of ex-situ remedial processes (e.g., thermal desorption).

The term 'clean closure' means that the site has been restored to either Type A or Type B levels. Type A is defined in Act 307 P.A. 1982, as amended, which references non-detect or background levels. Type B is defined in Act 307 P.A. 1982, as amended, which references risk-based or background levels. Waste, soil, other environmental media, and/or debris removed should be classified as hazardous or non-hazardous to determine disposal options and handling requirements (i.e., solid waste under Act 641 P.A. 1978, as amended; hazardous waste under Act 64 P.A. 1979, as amended; land ban restrictions under 40 CFR Part 268).

All cleanup verification evaluations must consider the spatial arrangements of sample values (patterned vs totally random) and the impacts on the present and future uses of the site. Because Type B cleanups are based on residual risk, the distribution of that risk, now and in the future, must be determined. These procedures are not *absolutes*. Other sampling approaches may be developed and submitted for DNR approval.

Three of the statistical sampling strategies most commonly used for evaluating remedial sites and wastes are described in Attachment 2. For further discussion on sampling strategies and sample collection methods, see "Test Methods for Evaluating Solid Waste," SW-846 Volume II: Field Methods, November 1986, Third Edition, US EPA.

Compositing samples for verifying soil remediation is not acceptable without prior DNR approval. When verifying a soil remediation is complete, contaminant concentrations will be low. Compositing may result in the contaminant concentrations not being representative of what remains in the soil. If concentrations are low, compositing may dilute the concentrations of a contaminant to below its threshold detection limit. Additionally, if contamination is indicated in a composited sample, the location of the contamination remains unknown.

ESTABLISHING GRID INTERVALS

When obtaining samples to verify that soil or wastes have been adequately remediated, it is important to insure that the analytical results obtained will provide an accurate representation of the entire area or volume under consideration. The location and number of samples to be taken at a particular remediation site depends on many factors: the level of confidence desired, the spatial and temporal variability of the media to be sampled, and the costs involved. An important objective in any sampling program is to obtain the most accurate data possible while minimizing the associated costs. One method to accomplish this goal is to use statistically valid sampling strategies. The appropriate sample number can be estimated and the sampling locations can be chosen without bias.

Such strategies employ the use of gridding to facilitate the unbiased selection of sampling points and accepted statistical tools for evaluating the resultant data. Statistical theory allows for the sampling of a subset of the grid points to achieve a reliable characterization of the entire remedial area or waste. Subsections describe ways to use sampling grids and statistical tools to evaluate areas of remediation.

The following equations and tables provide a simple basis to establish a grid system to facilitate unbiased selection of sampling points and sample coverage proportional to the area being verified.

1. *Basic Strategies.* A grid system should be established over the area being remediated. Grid point representation should be proportional to the size of the area. For excavation, both the sidewalls and bottom areas would be included in the determination of the area size. It is recommended that one of the following equations be used to determine grid intervals for stationing:

small site: see Part 1

$$\text{medium site: } \frac{\sqrt{A/\pi}}{4} = GI$$

$$\text{large site: } \sqrt{\frac{A\pi}{SF}} = GI$$

where: A = area to be grid (square feet)
GI = grid interval
SF = Size Factor, length of area to be grid (unitless)

It appears that there are logical size ranges of sites to which the grid equations apply:

A) small: up to 0.25 acre

B) medium: 0.25 - 3.0 acres

C) large: 3.0 acres and greater

To simplify this application, use the following chart based on an average size range of sites (1 acre = 43,560 square feet). The approximate grid ranges are provided as a quick check on numbers generated for specific sites using the above formulas.

*Site Acreage**	*Square Feet**	*≈ Grid Interval Ranges*
up to 0.25 (small)	up to 10,890	See Part 1
0.25-3.00 (medium)	10,890-130,680	15-50 feet
3.0 and over (large)	130,680 +	30 feet plus

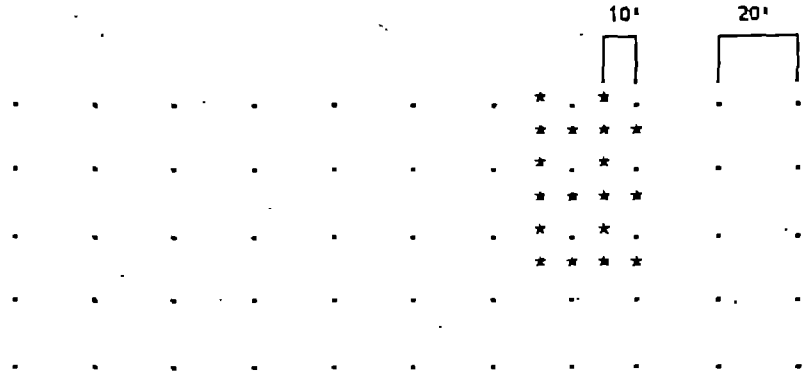
* Site acreage, square footage, is total area of sidewalls and base of excavation.

2. *Setting the Grid.* After the grid interval is calculated, it is recommended that a scaled grid overlay be made to superimpose on a map of the remediated area (this area includes both sidewalls and base). Some specified point (usually the southwest corner) should be designated as the 0,0 coordinate. The grid can then be adjusted to maximize sampling coverage. Some grid adjustment may be necessary for unusually shaped areas. Grid adjustment may also be needed to accommodate a minimum of at least one sample from each sidewall.

3. *Variations on Basic Strategy.*

A. Subgridding. It may be warranted to apply grids with different intervals within the remediated area so that a proportional sampling can be focused on suspect areas (such as sumps, tank leak areas, etc.).

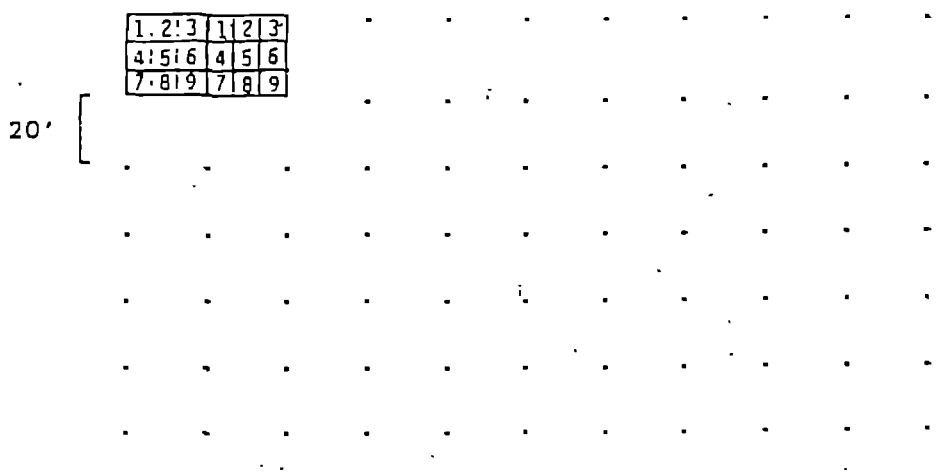
EXAMPLE:



. Area I Sample Station, 80' x 200', GI = 20'
* Area II (subset of I) Sample Station, 30' x 50', GI = 10'

B. Further Randomization. Sites that may have a patterned distribution of waste or contamination due to time sequence of filling, production sequences, or physical site conditions (i.e., furrows) may require a further randomization of sampling. In such cases, the following grid cell sampling format may be selected instead of at grid point stations. Each grid cell to be sampled must be divided into nine equal sized "subcells." Next, a random number table is used to select in which of the subcells the sample will be taken. The random number table is used again to select which subcell for the next cell and so on.

EXAMPLE:



Area = 120' x 200', GI = 20'

In the example above, a sampling grid has been set up with grid point stations 20 feet apart using the appropriate formula. Two cells which have been selected at random have been divided into nine subcells each. Subcell #4 was chosen randomly in one cell and subcell #2 in the other cell. This process is continued for all of the cells selected at random for sampling. Samples are then taken in each randomly chosen subcell.

C. Three dimensional gridding: In-Situ and Ex-Situ Remediations.

In-situ and ex-situ remediations involving soils and/or wastes with a significant vertical component should be evaluated in three dimensions (volume evaluation). Examples of such remediations would be in-situ soil vapor extraction or ex-situ bioremediation involving several cubic feet of soil and/or waste. A grid is superimposed on the remediation area as described in the previous sections and a vertical component is added at each node. The vertical sampling increments would be site specific and require prior approval from the DNR.

SAMPLING OF GRID

Sampling of grids may include all of the grid stations or a phased subset of the total stations. The subset of grid stations is created by assigning coordinates to all the nodes and randomly selecting nodes using a random number generator or a random number table (refer to Attachment 2). A minimum of 10 samples or 25%, whichever is larger, of the total grid stations should be sampled and analyzed initially to allow a large enough data pool for statistical analysis. It is advisable that extra samples also be taken and kept under proper chain of custody and storage procedures at the time of initial sampling. If the statistical analysis indicates that more samples are needed, an additional sample trip to the field may have been avoided. A method for calculating the sample size requirements is presented in Attachment 2 (Lamda relationship).

ESTABLISHING SOIL BACKGROUND

Establishing soil background, as required by Act 307 PA 1982, as amended, Michigan Environmental Response Act (MERA), can be accomplished by utilizing Operational Memorandum #15 or using the following guidance.

Background should be established for site specific waste constituents, specific chemicals used in various processes, facility operations, or remedial investigation results. Sample analyses may include metals, organic constituents, or other site specific waste constituents. Analyses should be in accordance with Act 307 P.A. 1982, as amended.

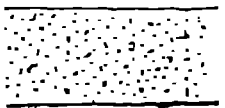
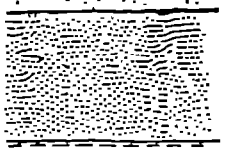
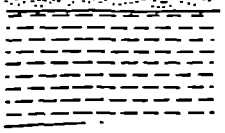
Many factors can play a part in the background concentrations of a chemical in soil.

EXAMPLE: The geologic origin (e.g., the parent rock) of glacial drift may have been high in copper, lead, or other metals that may be potential contaminants. Additionally, the hydrogeologic situation can alter the quantity of these elements. Groundwater recharge areas (e.g., highlands) are frequently leached of metals while groundwater discharge areas (e.g., swamps, floodplain) are the recipients of leached metals. Thus, sites in low areas will usually have higher background concentrations than upland areas. Other conditions, such as precipitation and atmospheric fallout from widely dispersed human and natural activities, also affect soil concentrations.

A minimum of four samples must be used to establish "background" in soils. This will help account for natural constituent occurrences and inherent variability within each distinctive soil horizon. Background samples must be collected in an area which has not been impacted by environmental contamination from the site and representative of natural background conditions. Based on waste type, contaminant mobility, operation practices, and soil type (sand, silty sand, clay), an estimate of contamination depth should be made and background samples taken at comparable depths for the particular soil type. Multiple soil horizons should have "background" established separately (e.g., minimum of four samples per each soil unit).

EXAMPLE:

Ground Surface

Brown medium-coarse SAND		4 samples
Lt. brown silty fine SAND		4 samples
Gray silty CLAY w/trace of fine-med sand		4 samples

STATISTICAL ANALYSIS FOR ESTABLISHING BACKGROUND CONCENTRATIONS

The recommended statistical method(s) for establishing background concentrations at medium and large sites are (1) establishing the upper limit of background concentration of a constituent at the mean plus 3 standard deviations, (2) tolerance limit, (3) t-tests, and (4) other statistical methods submitted to the DNR for approval.

1. *Mean Plus 3 Standard Deviation Approach.*

   Calculate the "upper limit" of background concentration by using the following 5 step process.

   A. Calculate the background mean ($\bar{X}_b$) by dividing the sum of the total background readings by the total number of background readings:

$$\bar{X}_b = \frac{X_1 + X_2 + \ldots X_n}{n}$$

   B. Calculate the background variance (S_b^2) by taking the sum of the squares of each reading minus the mean and dividing by the degrees of freedom (the total number of background samples minus one):

$$S_b^2 = \frac{(X_1-\overline{X}_b)^2+(X_2-\overline{X}_b)^2 \ldots (X_n-\overline{X}_b)^2}{n-1}$$

NOTE: Any sample populations less than (n<30 samples) must use n - 1 for degrees of freedom.

C. Calculate the background standard deviation (S_b) by taking the square root of the variance:

$$S_b = \sqrt{S_b^2}$$

D. The Coefficient of Variation Test (CV) where

$$CV = \frac{S_b}{\overline{X}_b}$$

is used to evaluate data distribution. The background data should generally have a CV of less than 0.5 for granular soils, less than 0.75 for cohesive soils, or an explanation accounting for higher CV values. The maximum recommended CV is 1.00. If the data distribution exceeds a CV of 1.00, then a thorough evaluation will need to be made to account for this variability (e.g., lab QA/QC, typographical errors, soil classification, sample location, data not normally distributed etc.). If the CV exceeds 1.0 and there is sufficient evidence to suggest a data point does not accurately represent background conditions or if QA/QC problems exist which invalidate that data point, the outlier data may be dropped or additional samples collected and analyzed to ensure a sufficient representative data population (n) is achieved. A high concentration in and of itself is not sufficient justification to exclude the data point.

E. Use the $\overline{X}_b + 3*S_b$ of "background" data as the maximum allowable limit or upper limit. Where $3*S_b$ equals three times the standard deviation and $\overline{X}_b$ equals the background mean (this statistical method only requires one sample per station). Compare each sample point to the calculated maximum allowable limit or upper limit analyzed from background data.

EXAMPLE: Four sand samples from a site were analyzed for background concentrations for lead. Concentrations of lead from the sample analyses returned from the lab were 56, 25, 18, and 35 ppb. Now, the investigator wants to examine the data set to discover whether the 56 ppb sample is an outlier:

$$\overline{X}_b \ mean = \frac{56+25+18+35}{4} = 33.5$$

$$S_b^2 = \frac{[56-33.5]^2+[25-33.5]^2+[18-33.5]^2+[35-33.5]^2}{3} = 273.67$$

$$S_b = (standard\ deviation) = \sqrt{S_b^2} = 16.5$$

$$CV = \frac{16.5}{33.5} = 0.49$$

Because 0.49 is less than 0.5, no further evaluation of the background data set is necessary.

Therefore, the background upper limit value for this site is

$$background\ upper\ limit = \overline{X}_b + (3*S_b) = 33.5 + (3*16.5) = 83.0\ ppb$$

If a value is found to be an outlier which is not representative of background conditions, it may be replaced by another sample that is not an outlier to maintain at least four samples for background determination.

2. *Tolerance Limit*. This statistical procedure is a fairly sensitive program for environmental purposes. It minimizes false positive and is simple to perform. A minimum background data base of n=8 (optimum n=16) is needed for this method. Other suggested criteria follow:

A. The Coefficient of Variation Test (CV) to evaluate data distribution. See this Guidance Document, Part 2, Statistical Comparisons, #1.D. (the Coefficient of Variation Test....).

B. Using the mean ($\overline{X}_b$) and standard deviation (S_b), construct the one-sided upper tolerance limit (TL) by taking the mean plus a tolerance coefficient (K) at the 95% probability level for a 95% coverage (for K values, see Attachment 3) times the standard deviation as follows:

$$TL = \overline{X}_b + KS_b$$

3. *t-tests.* Any t-test should be "approved" by DNR prior to use since there are a number of variations. The Gosset Student t-test (1908) or Cochran's Approximation to the Behren's-Fisher Student's t-test as referenced in the 40 CFR Part 264, Appendix IV are recommended. Note that these statistical comparison methods require that two or more discrete samples be taken at each sampling station.

4. *Other statistical procedures for establishing background.* Refer to a statistical reference book or U.S. EPA's Interim Final Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities (April 1989) and Addendum (July 1992).

PROCEDURES FOR NON-DETECT VALUES

The following provides some guidelines in incorporating non-detectable sample results into the procedure to calculate background concentrations.

1. If less than 50% of the background data is below the detection limit (DL), use ½ of the detection limit as the value.

2. If more than 50% of the background data is below the detection limit, use one of the following procedures.

   - Alternate "0" and the detection limit (DL) resulting in a net value of ½ the detection limit, with a variance.

EXAMPLE:	Actual Value	Substitute Value
	<DL	DL
	<DL	0
	<DL	DL
	<DL	0

   - The Continuity Correction procedure with the t-test, Cohen's method, or other approved methods.

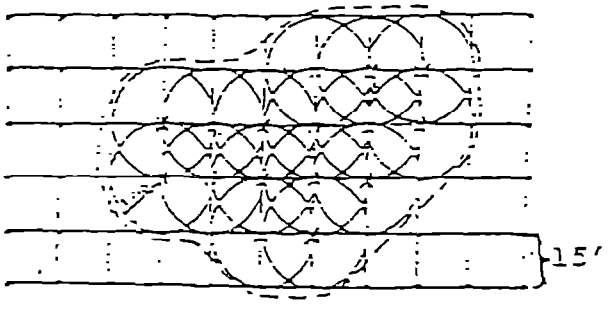
STATISTICAL EVALUATION OF DATA

A detailed description of an acceptable approach for evaluating the data generated by statistically based random sampling strategies such as those described in the foregoing sections is provided in Attachment 2 (page 27). The 95% upper confidence limit (UCL) of the mean is calculated for each constituent of concern and compared to the regulatory threshold (RT) (i.e., cleanup criterion, eg., Type A or B). If the UCL is less than the RT and an adequate number of samples have been collected and spatially evaluated, the remediation is deemed complete. Attachment 2 also provides a step wise procedure for determining whether an adequate number of samples have been collected, based on the analytical data derived from the initial and subsequent rounds of samples. All evaluations must consider the spatial correlation of sample values (e.g., highest concentrations in the same area), present and future uses of the site, residual risk, and distribution of that risk now and in the future. Other acceptable methods for UCL and sample size calculations can be found in U.S. EPA SW-846, Third Edition, Section 9.1.1.3.

GRID APPROACH TO ADDITIONAL REMEDIATION

1. *Two-Dimensional Node Sampling Excavation Grid.* Verification sampling as described above will at times indicate that remediation is incomplete. Excavation of contaminated areas should be based on the established grid system interval (as recommended in this Guidance Document, Part 2). Where a subset of grid points has indicated that the entire area exceeds the cleanup, the nodes adjacent to the sampled nodes that are causing the exceedance should be sampled, and this process repeated until the "Hot spots" requiring removal have been defined. The radius of excavation around the contaminated sample point(s) is equal to the grid interval (GI=r). Excavation depth is to the deepest point of contamination or to the depth where acceptable levels are anticipated. After excavation, the impacted point(s) must be resampled at their new elevations to verify that the area meets the selected cleanup criteria. If continued contamination is detected, the excavation format is repeated until a satisfactory result is obtained.

EXAMPLE:



GL = 150
A = 11,250
GI = 14.9

. Sample Station
x Contaminated Station
r = GI = 15 feet

Remediation of contaminated soil by excavation will be in accordance with Act 307 P.A. 1982, as amended. The proposed remedial action plan must be approved by the DNR.

2. *Two-Dimensional Subcell Sampling Excavation Grid.* Use this Guidance Document, Part 2. The radius of excavation around a contaminated point may need to be adjusted to greater than the GI distance. This adjustment is due to the variable distances between sampling points.

3. *Three-Dimensional Cleanup Verification.* If sampling and statistical analysis using this Guidance Document indicate that Act 307 cleanup criteria have not been met, additional remediation will be required. The sampling protocol and strategies described in Attachment 2 and in SW-846, Third Edition, Volume II, Part III, Chapter 9, are acceptable. All sampling strategies, detection levels, and sampling pathways must be in accordance with Act 307 P.A. 1982, as amended. If any portion of the soil mass in question appears to be causing the material to fail, it may be identified through hot spot sampling and selectively removed. Subsequent sampling must be done to confirm that the remaining material meets Act 307 P.A. 1982, as amended.

4. *Batch Sampling for ex-situ treatment processes.* If ex-situ treatment processes of contaminated soil or waste is used in the remediation, a sampling program for the process stream needs to be developed. The basis of this program is to get representative samples over time versus a spatial approach (Attachment 2, Sampling Process Streams).

DISPOSAL OPTIONS

Soils remediated to Act 307 P.A. 1982, as amended, standards (Type A and/or Type B) are no longer considered a waste per Act 64 P.A. of 1979, as amended, and RCRA regulations. Disposal of excavated waste, soil, other environmental media, and/or debris must be in accordance with all applicable Federal, State, and local regulations.

REPORT FOR MEDIUM AND LARGE SITES VERIFICATION

Soil cleanup verification reports for medium and large sites must identify the number and location of samples and justify the sample location selected (why and how). The verification report must include the following.

1. MAP(S) AND CROSS SECTIONS
   Provide a scaled map of the floor and walls of the excavation (the vertical and horizontal area treated for "in-situ" remediations) with sample grid and sample locations identified. Appropriate cross section should depict the stratigraphy, fractures, soil types, and final depth and elevations of the excavation.

2. SAMPLE LOCATION RATIONALE
   a. Properly labelled and easily identified sampling grid stations (map) including background stations
   b. Sample Depths
   c. Sample Collection Procedures
   d. Results of all tests to determine clean closure (charts, tables, lab sheets, field notes, well logs, boring logs)

3. DATA ANALYSES
   a. Analytical parameters
   b. Analytical methods used
   c. Method detection limits
   d. Laboratory Quality Assurance/Quality Control

4. STATISTICAL ANALYSES
   a. Explanation and calculation of background concentrations
   b. Statistical comparisons on sampling results compared to background (this should include full computations on background and statistical analysis)
   c. Lab results

5. Additional information to support closure (e.g, residual risks, spatial correlation of sample values, present and future land uses)

RCRA CLEAN CLOSURE CERTIFICATION CHECKLIST

Attachment 4 is a guide that indicates the information that a facility should provide to certify that their activities meet the conditions for a clean closure under the Act 64/RCRA regulations.

ATTACHMENT 1

GUIDE TO SAMPLE BIAS

Many factors can play a part in the concentrations of contaminants. The following contains some of the factors impacting chemical concentrations and locations.

CHEMICAL TRANSFORMATIONS

Many organic chemicals may undergo aerobic and anaerobic degradation. A description of these processes is beyond the scope of this document. The subject is approached here, however, to be sure that samplers are aware that the chemical(s) spilled may not be the only chemical(s) in the soil after a transformation has occurred. These occurrences should be documented in the remedial investigation. The full scan of chemicals from the remedial investigation requiring cleanup should be analyzed when doing a closure. Analyses should be done for all chemicals that have been identified as breakdown products of the chemicals found on site.

The professional literature contains many articles on this subject (Cline and Brown, 1989; Borden and Bedient, 1987; Wilson and Wilson, 1985). The interested reader is directed to these articles.

Organic Carbon Content of Soil

The organic carbon content of soils is a key factor in the ability of any soil to adsorb contaminants. For a variety of reasons (Lindsay, 1979), an increase in organic carbon content leads to an increase in the adsorption of several classes of chemicals.

> Where to sample: Areas of the excavation that appear to have excess organic carbon (e.g. peat, muck, darker soils) should be preferentially sampled.

Medium Sand or Larger Grains

Medium to larger grain size sand has from 20 to 40 percent porosity. Most sands in Michigan are composed of quartz, limestone, and small amounts of metamorphic rock fragments. These soils have a low capacity for adsorbing metals or hydrophilic (soluble) organic chemicals. Hydrophobic (insoluble) organic chemicals with low molecular weight will adsorb to this soil in small amounts. Hydrophobic chemicals with high molecular weight will adsorb in moderate amounts (Cline & Brown, 1989). These soils have a low capacity to hold contaminants in the grain interstices due to low capillary action. Contaminants that are held in these soils adhere to the grains themselves in dry soils and are forced into the smaller pore spaces in wet soils (Schwille, 1988).

> Where to sample: Samples should be placed at regular intervals along the base and sidewalls of the excavation being sure that samples are located where the source was removed. In these soils, the capillary force is low enough to ignore its effects in transporting contaminants lateral to gravity. Therefore, sidewall samples should be located near the excavation floor. This is especially true for low surface tension products such as gasoline.
>
> The limestone sand grains can act as a buffer to contaminants that cause pH changes (e.g., steel mill pickling acids). For these types of contaminants, the sampler should be on the lookout for intra-granular precipitates. These can appear as grain surface staining or make the soil appear clumpy or aggregated. Soils containing precipitates should be sampled.

Fine Sand and Silt

These soils have strong capillary action due to the small inter-granular distances. A determination of the fluid surface tension of the spilled product is helpful. High surface tension aids in the ability of a substance to overcome gravity by capillary action. As before, higher molecular weight products can be expected to adsorb to the grains to a greater degree. This allows a product to move lateral to gravity and, to a degree, upward from the leak location. Low surface tension products, such as TCE (trichloroethene), are more likely to go straight down than oils in these kinds of soils. However, the hydraulic head (i.e., the amount of product in the original spill) must be substantial to force a dense non-aqueous phase liquid through a media with a hydraulic conductivity less than 1×10^{-3} cm/sec (Schwille, 1988).

> **Where to sample:** Interfaces between fine sand layers with larger grains above should be sampled. When high surface tension contaminants are suspected, silt layers should be sampled.

Clays

Clay soils are very different from the sands and silts. Clays possess a net negative charge. This causes heavy metal cations (e.g., Cr^{+3}, Cd^{+2}, Pb^{+2}) to adsorb to the clay surface. In fact, this is true for any positive ionizable substance. Clays also have a much greater secondary porosity than primary (primary porosity is the space between the soil particles; secondary porosity is the space between fractures, bedding planes, and soil structures). As a result, spills in clay soils tend to follow preferred pathways. Clays will often show signs of shrinkage cracks or fractures that will allow contaminants to migrate in what would otherwise be considered a "tight" soil in a lab analysis of permeability. Signs of fracturing include "patterned" mottling. This is where the Fe (and also Mn) will be oxidized to a red, yellow, or reddish brown color along the crack while the matrix remains the reduced blue/gray color (Lindsay, 1979).

> **Where to sample:** It is very important to take clay soil samples from fractures. The fractures are the avenue of travel for contaminants in clay soils. Clay soils may also have sand lenses which should always be sampled. Sand lenses in clays tend to collect fluids. As such, they may harbor contaminants.

Bedrock

Excavations in bedrock present difficult problems. Unlike clay, some bedrock formations have substantial primary porosity as well as secondary porosity. In Michigan, these are sandstones, conglomerates, and brecciated/coarse grained limestones. Examples of bedrock in Michigan with low primary porosity are fine grained limestones, shale, and crystalline metamorphic rocks (e.g., gneiss). If the sampler is unaware of the type of bedrock that is in an excavation, a geologist must be consulted.

> **Where to sample:** Excavations in areas of bedrock with significant primary porosity must be sampled in both the fractures and the matrix. Bedrock without primary porosity should have sampling predominantly in the fractures as in the clay situation. Weathered zones in bedrock will hold contaminants better than unweathered zones. This is due to the increased number of adsorption sites available in weathered rock.

ATTACHMENT 2

SAMPLING PROTOCOL
FOR CHARACTERIZING WASTE/TREATMENT LEVELS:

STRATEGIES FOR EVALUATING TREATED SOILS AND WASTE MATERIALS

When obtaining samples to characterize a treated soil or waste material, it is important to insure that the analytical results obtained will provide an accurate estimation of the nature of the entire area/volume under consideration. The location and number of samples to be taken at a particular site depends on many factors: the degree of accuracy desired, the spatial and temporal variability of the media to be sampled, and the costs involved. An important objective in any sampling program is to obtain the most accurate data possible while minimizing the associated costs. One method to accomplish this goal is to use statistically valid sampling strategies. The appropriate sample number can be estimated and the sampling locations can be chosen without bias.

Attachment 2 provides information on the methods used to obtain accurate data while minimizing the costs. The attachments include a discussion of three statistical sampling strategies and methods to determine the appropriate grid size for the area under investigation. If several areas on a site are under investigation, it may be advisable to grid them separately. This is especially true if information does not exist to indicate that the areas contain similar constituents or that they were placed at the same time period.

Information is also supplied on the statistical evaluation of the resultant analytical data. A minimum of 10 samples or 25%, whichever is greater, of the total grid stations should be sampled and analyzed initially to allow a large enough data pool for the statistical analysis. Extra samples should be taken and kept under proper chain of custody and handling procedures at the time of initial sampling. If the statistical analysis indicates that two or three more samples are needed, an additional trip to the field may not be necessary. This may also avoid the need to reestablish the grid pattern at a later date.

For further discussion on sampling strategies and sample collection methods, see "Test Methods for Evaluating Solid Waste," SW-846 Volume II: Field Methods, November 1986, Third Edition, US EPA.

STATISTICAL SAMPLING STRATEGIES

Statistical sampling strategies can often produce increased data accuracy while eliminating sampler bias. Random sampling is based on the theory of random chance probabilities in order to choose the most representative sample. Knowledge of the waste distribution is not necessary. The error in data accuracy of a random sampling scheme can be objectively measured since the probability of choosing each sampling point is known. A random numbers table (attached) or a random numbers generator should be used to select the sampling locations eliminating bias by the sample collector.

Several statistical sampling strategies are available to produce an unbiased, representative sampling program. The principles behind three of these and the situations for which they are best suited are provided below. To achieve true random sampling, composite sampling is not acceptable.

1. *Simple Random* is a method that requires little or no prior knowledge of material distribution. It relies on random chance probability theory--where each sampling location has an equal and known probability of being selected. In this way, sampling error can be accurately estimated. Usually, the area of interest is sectioned into a two or three dimensional grid pattern and random coordinates are chosen for sampling.

2. *Systematic random* is an extension of simple random sampling that may produce a more efficient sampling survey. It can be more efficient by reducing the sampling error while maintaining the sample number, or by reducing the number of samples needed to achieve a specified sampling error, or by reducing the cost of collection. This method also requires little or no knowledge about the waste distribution, but bias and imprecision can be introduced if unseen trends or cycles exist. Two methods used to select sample locations under this method follow.

   A) randomly selecting a transect or transects and sampling at preselected intervals.

   B) preselecting both the transect or transects and the sampling interval and starting from a randomly selected point.

3. *Stratified random sampling* requires some knowledge about the waste distribution. When stratification is known or suspected, sampling efficiency can be improved by dividing the material into strata that are more homogeneous than the total area. Simple random sampling techniques can then be used to sample each stratum independently. Each stratum is divided into a grid pattern and the sampling points are selected randomly. If the area is vertically stratified, the sampling points in each stratum are selected randomly and then selected depths are sampled. If the area is horizontally stratified, the sampling points within each stratum are selected randomly, but the total depth is sampled. An analysis of variance (ANOVA) should be done on the analytical results to determine if the strata differ significantly. This is done to assure that the use of stratified random sampling was statistically valid. When the volume of the strata differ or the number of samples within each strata differs, the results must be weighed appropriately to avoid bias.

RANDOM NUMBERS TABLE

03	47	43	73	86	36	96	47	36	61	46	98	63	71	62
97	74	24	67	62	42	81	14	57	20	42	53	32	37	32
16	76	62	27	66	56	50	26	71	07	32	90	79	78	53
12	56	85	99	26	96	96	68	27	31	05	03	72	93	15
55	59	56	35	64	38	54	82	46	22	31	62	43	09	90
16	22	77	94	39	49	54	43	54	82	17	37	93	23	78
84	42	17	53	31	57	24	55	06	88	77	04	74	47	67
63	01	63	78	59	16	95	55	67	19	98	10	50	71	75
33	21	12	34	29	78	64	56	07	82	52	42	07	44	38
57	60	86	32	44	09	47	27	96	54	49	17	46	09	62
18	18	07	92	46	44	17	16	58	09	79	83	86	19	62
26	62	38	97	75	84	16	07	44	99	83	11	46	32	24
23	42	40	64	74	82	97	77	77	81	07	45	32	14	08
52	36	28	19	95	50	92	26	11	97	00	56	76	31	38
37	85	94	35	12	83	39	50	08	30	42	34	07	96	88
70	29	17	12	13	40	33	20	38	26	13	89	51	03	74
56	62	18	37	35	96	83	50	87	75	97	12	25	93	47
99	49	57	22	77	88	42	95	45	72	16	64	36	16	00
16	08	15	04	72	33	27	14	34	09	45	59	34	68	49
31	16	93	32	43	50	27	89	87	19	20	15	37	00	49

HOW TO USE THE RANDOM NUMBERS TABLE

1. If sampling containerized material, segregate the containers according to type based on available information. Number containers of the same type consecutively starting from 01. If sampling surface waters or piles, divide the area into a two or three dimensional grid and number the grid locations.

2. Determine the number of samples you need to take. For regulatory or research purposes, a large sample size may be needed (such as one sample for every five containers or grid points). Using a random scheme will generate more statistically valid data.

3. Using the random numbers table, choose any number as a starting point.

4. From this number, go in any direction until you have selected the predetermined number of samples with no repetitions. Numbers larger than the population size are ineligible.

SAMPLING GRIDS

1. A grid system should be established over the specified area (sidewalls and base). Grid point representation should be proportioned to the size of the area. It is recommended that one of the following equations be used to determine grid intervals for stationing.

$$\text{small site} \qquad \frac{\sqrt{A/\pi}}{2} = GI$$

$$\text{medium site} \qquad \frac{\sqrt{A/\pi}}{4} = GI$$

$$\text{large site} \qquad \sqrt{\frac{A\pi}{SF}} = GI$$

where: A = area to be grid (sq. ft.)
GI = grid interval
SF = Size Factor, length of area to be grid (unitless)

It appears that there are logical size ranges of sites to which the three equations apply:

A) small: up to 0.25 acre

B) medium: 0.25 - 3.0 acres, and

C) large: 3.0 acres and greater

To simplify this application, use the following chart based on an average size range of sites (1 acre = 43,560 square feet). The approximate grid ranges are provided as a quick check on numbers generated for specific sites using the above formulas.

*Site Acreage**	*Square Feet**	*≈ Grid Interval Ranges*
up to 0.25 (small)	up to 10,890	See Part 1
0.25-3.00 (medium)	10,890-130,680	15-50 feet
3.0 and over (large)	130,680 +	30 feet plus

* Site acreage, square footage, is total area of sidewalls and base of excavation.

2. After the grid interval is calculated, it is recommended that a scaled grid overlay be made to superimpose on the area under consideration. Some specified point (usually the southwest corner) should be designated as the 0,0 coordinate. The grid can then be adjusted to maximize sampling coverage. Some grid adjustment may be necessary for unusually shaped areas.

STATISTICAL EVALUATION
WASTE/TREATMENT CHARACTERIZATION SAMPLINGS

Following is a step by step description of the approach used to calculate confidence limits based on the analytical data derived from the preliminary samples.

1. Calculate a preliminary estimate of X

$$\overline{X}=\frac{\sum_{i=1}^{n} Xi}{n}$$

where: n = number of measurements
X = variable concentration
Xi = individual measurements

2. Calculate a preliminary estimate of the variance (S^2) and the standard deviation (S). Standard deviation is a function of both sampling variability and measurement variability.

$$S^2=\frac{\sum_{i=1}^{n} Xi^2-\frac{\left(\sum_{i=1}^{n} Xi\right)^2}{n}}{n-1}$$

$$S=\sqrt{S^2}$$

3. Calculate the standard error of the mean (Sx). Standard error is inversely proportional to the square root of the number of samples (increasing n from 4 to 16 reduces Sx by 50%).

$$Sx=\frac{S}{\sqrt{n}}$$

4. Since the concern is only whether the upper limit of a confidence interval is below or above the regulatory threshold, the lower confidence limit (LCL) need not be considered. The upper confidence limit (UCL) can be calculated using the one-tailed (one-sided) t values with n-1 degrees of freedom derived from a table of the Student's t distribution. Where only small sized statistical samples are involved (n<30), the normal or Gaussian distribution is not accurate, and the t distribution must be used.

5. The 95% UCL is calculated by using the following formula and substituting the values determined above plus the appropriate t value obtained from the t table.

$$UCL = \overline{x} + [t0.95(n-1)]Sx$$

The term in brackets indicates a one-tailed t-test at n-1 degrees of freedom. See the t-distribution table in Attachment 2.

The UCL number resulting from this formula will indicate with a 95% probability that it is either above or below the regulatory threshold (RT) developed for the constituent being subjected to the test. If a compound does not have a specified RT, then the UCL is compared to whatever concentration is of concern (i.e., a clean up level, action level, etc). Other confidence levels can be used, based on the specific sampling situation.

If the preliminary data indicate that more samples are needed to make a hazard determination, the Lambda (λ) relationship should be used. A step by step approach to calculating the appropriate sample size follows:

1. The appropriate number of samples to be collected can be estimated by use of the Lambda (λ) relationship and then consulting a table of values and their corresponding sample size number.

$$\lambda = \frac{RT - \overline{X}}{S}$$

The lower the calculated value, the more samples are required to maintain a certain level of confidence. Also, as $\overline{X}$ approaches RT, λ becomes smaller, and therefore a greater sample size is indicated for a certain level of confidence.

2. To obtain the appropriate sample size from the table of values, use the single sided value for α to test at the desired significance level (for 5%, $\alpha = 0.05$).

3. Randomly collect any additional samples that may be needed using the same grid and random numbers sequence as the first sampling. All field and laboratory procedures should be kept as consistent as possible to lower the amount of variability in the data.

4. Use all data values to calculate new $\overline{X}$, S, and Sx.

5. If the new $\bar{X} \geq RT$, then the contaminant is present at an unacceptable concentration and the study would be complete.

6. If $\bar{X} < RT$ and $\bar{X} > S^2$, calculate C (the criterion for determining if contamination is present at hazardous concentration). If $\bar{X} = S^2$ or $\bar{X} < S^2$, the data must be transformed prior to calculating C.

   Using the new data, C is calculated by the formula:

$$C = \frac{RT-\bar{X}}{Sx}$$

7. Compare the calculated C value to the two-tailed t value for the level of significance desired. The two-tailed t-value is used because both the possibility that C is > t or that C is < t must be checked.

   Use t0.95 and df (degrees of freedom) = n-1.

8. If C > t value, the contaminant is present at unacceptable concentrations and the study would be over. If C < t value, re-estimate the total number of additional samples to be collected by deriving a new λ. Use the newly calculated values of $\bar{X}$ and S.

9. If this new number of samples is not more than 20% greater than the last set collected, there is little chance that additional samples would decrease Sx and result in the material being considered unacceptable. Therefore, the study would be complete.

EXAMPLE

CALCULATION OF CONFIDENCE LIMITS AND LAMDA CALCULATION

Problem 1: STATISTICAL SAMPLING

A metal plating factory has been discharging process wastewaters into a large nearby swampy area for several years. This swampy area drains into a small river. The discharged wastewaters are known to be contaminated with very low levels of cadmium and chromium (i.e., the levels in the wastewater are below the facilities NPDES permit limitations). However, it has been suspected that the sediments in this swampy area may contain high levels of cadmium and chromium. Three preliminary sediment samples were taken with a Ponar dredge and analyzed to determine whether or not these sediments were contaminated with hazardous levels of these two metals. In 40 CFR 261.24, it states that a waste is hazardous under the characteristic of EP toxicity if it contains cadmium at a level $\geq$ 1.0 mg/ℓ or chromium at a level $\geq$ 5.0 mg/ℓ. The analysis of the three preliminary samples indicated a mean cadmium concentration of 0.37 mg/ℓ (3 samples at 0.25, 0.51, and 0.35 mg/ℓ) and a mean chromium concentration of 4.66 mg/ℓ (3 samples at 4.93, 4.21, and 4.84 mg/ℓ). Based on this analytical data, the cadmium level is well below the regulatory threshold (RT), but the chromium level closely approaches its RT. Because large legal or monetary losses may be incurred if the sediments are declared hazardous, the analytical data must be sound and a high degree of confidence is necessary in any decision made.

QUESTIONS: Given the above scenario, answer the following questions and calculate the appropriate answers.

1. Based on the chromium data supplied

Calculate S^2, S, $S\bar{x}$

Calculate the 95% UCL

With what degree of confidence can it be stated that the chromium concentration does not exceed the RT?

2. If more samples are deemed necessary, determine how many

Calculate the λ value

Calculate the appropriate number of additional samples using α = 0.05 and β = 0.05

PROBLEM 1 ANSWER SHEET

Given three samples with chromium concentrations of 4.93, 4.21, and 4.84 mg/ℓ and

$$\overline{X} = 4.66\ mg/\ell$$

(1a) Calculate S^2

$$S^2 = \frac{\sum_{i=1}^{n} X_i^2 - (\sum_{i=1}^{n} X_i)^2/n}{n-1}$$

$$= \frac{4.93^2+4.21^2+4.84^2-(4.93+4.21+4.84)^2/3}{2}$$

$$= 0.15$$

Calculate S

$$S = \sqrt{S^2} = \sqrt{0.15} = 0.39$$

Calculate $S_{\overline{x}}$

$$S_{\overline{x}} = \frac{S}{\sqrt{n}} = \frac{0.39}{\sqrt{3}} = 0.23$$

(1b) Calculate the 95% UCL

$$95\%\ UCL = \overline{X} + [t0.95(n-1)]S_{\overline{X}}$$

$$= 4.66 + (2.920)\ (0.23)$$
$$= 5.33$$

(1c)

$$90\%\ UCL = \overline{X} + [t0.90(n-1)]S_{\overline{x}}$$

$$= 4.66 + (1.886)(0.23)$$
$$= 5.09$$

$$80\%\ UCL = \overline{X} + [t0.80(n-1)]S_{\overline{x}}$$

$$= 4.66 + (1.061)(0.23)$$
$$= 4.90$$

The preceding two calculations indicate that it can be stated with somewhere between 80% and 90% confidence that the chromium concentration does not exceed the RT. This degree of confidence may not be sufficient to meet the needs of the sampling plan. Therefore, more samples may need to be taken.

2a. Calculate the λ value

$$\lambda = \frac{RT - \overline{X}}{S} = \frac{5.0 - 4.66}{0.39} = 0.87$$

2b. Calculate the number of additional samples

Using Attachment 2, *Number of Observations for T Test of Mean*, page 34 of this Guidance Document, using a single-sided test with α=0.05 and β=0.05, approximately 15 to 17 total samples need to be collected. Therefore, based on the three preliminary samples that were collected, an additional 13 samples need to be taken.

Cumulative t Distribution

					p				
	one-tailed	0.550	0.750	0.080	0.900	0.950	0.975	0.990	0.995
	two-tailed	0.100	0.500	0.600	0.800	0.900	0.950	0.980	0.990
	1	0.158	1.000	1.376	3.078	6.314	12.706	31.821	63.657
	2	0.142	0.816	1.061	1.886	2.920	4.303	6.925	9.925
	3	0.137	0.765	0.978	1.638	2.353	3.182	4.541	5.841
	4	0.134	0.741	0.941	1.533	2.132	2.776	3.747	4.604
	5	0.132	0.727	0.920	1.476	2.015	2.571	3.365	4.032
	6	0.131	0.718	0.906	1.440	1.943	2.447	3.143	3.707
	7	0.130	0.711	0.896	1.415	1.895	2.365	2.998	3.499
	8	0.130	0.706	0.889	1.397	1.860	2.306	2.896	3.355
	9	0.129	0.703	0.883	1.383	1.833	2.262	2.821	3.250
	10	0.129	0.700	0.879	1.372	1.812	2.228	2.764	3.169
	11	0.129	0.697	0.876	1.363	1.796	2.201	2.718	3.106
	12	0.128	0.695	0.873	1.356	1.782	2.179	2.681	3.055
	13	0.128	0.694	0.870	1.350	1.771	2.160	2.650	3.012
	14	0.128	0.692	0.868	1.345	1.761	2.145	2.624	2.977
	15	0.128	0.691	0.866	1.341	1.753	2.131	2.602	2.947
	16	0.128	0.690	0.865	1.337	1.746	2.120	2.583	2.921
	17	0.128	0.689	0.863	1.333	1.740	2.110	2.567	2.898
	18	0.127	0.688	0.862	1.330	1.734	2.101	2.552	2.878
df	19	0.127	0.688	0.861	1.328	1.729	2.093	2.539	2.861
(n-1)	20	0.127	0.687	0.860	1.325	1.725	2.086	2.528	2.845
	21	0.127	0.686	0.859	1.323	1.721	2.080	2.518	2.831
	22	0.127	0.686	0.858	1.321	1.717	2.074	2.508	2.819
	23	0.127	0.685	0.858	1.319	1.714	2.069	2.500	2.807
	24	0.127	0.685	0.857	1.318	1.711	2.064	2.492	2.797
	25	0.127	0.684	0.856	1.316	1.708	2.060	2.485	2.787
	26	0.127	0.684	0.856	1.315	1.706	2.056	2.479	2.779
	27	0.127	0.684	0.855	1.314	1.703	2.052	2.473	2.771
	28	0.127	0.683	0.855	1.313	1.701	2.048	2.467	2.763
	29	0.127	0.683	0.854	1.311	1.699	2.045	2.462	2.756
	30	0.127	0.683	0.854	1.310	1.697	2.042	2.457	2.750
	40	0.125	0.681	0.851	1.303	1.684	2.021	2.423	2.704
	60	0.126	0.679	0.848	1.296	1.671	2.000	2.390	2.660
	120	0.126	0.677	0.845	1.289	1.658	1.980	2.358	2.617
		0.126	0.674	0.842	1.282	1.645	1.960	2.326	2.576

NOTE: For one-tailed distributions $\alpha/2 = 1-p$
For two-tailed distributions $\alpha = 1-p$

NUMBER OF OBSERVATIONS FOR T TEST OF MEAN

Level for t Test

Single-sided / Double-sided	α = 0.005 / = 0.01					α = 0.01 / = 0.02					α = 0.025 / = 0.05					α = 0.05 / = 0.1				
λ	β= 0.01	0.05	0.1	0.2	0.5	0.01	0.05	0.1	0.2	0.5	0.01	0.05	0.1	0.2	0.5	0.01	0.05	0.1	0.2	0.5
0.05																				
0.10																				
0.15																				122
0.20										139					99					70
0.25					110					90				128	64			139	101	45
0.30				134	78				115	63			119	90	45		122	97	71	32
0.35			125	99	58			109	85	47		109	88	67	34		90	72	52	24
0.40		115	97	77	45		101	85	66	37	117	84	68	51	26	101	70	55	40	19
0.45		92	77	62	37	110	81	68	53	30	93	67	54	41	21	80	59	44	33	15
0.50	100	75	63	51	30	90	66	55	43	25	76	54	44	34	18	65	45	36	27	13
0.55	83	63	53	42	26	75	55	46	36	21	63	45	37	28	15	54	38	30	22	11
0.60	71	53	45	36	22	63	47	39	31	18	53	38	32	24	13	46	32	26	19	9
0.65	61	46	39	31	20	55	41	34	27	16	46	33	27	21	12	39	28	22	17	8
0.70	53	40	34	28	17	47	35	30	24	14	40	29	24	19	10	34	24	19	15	8
0.75	47	36	30	25	16	42	31	27	21	13	35	26	21	16	9	30	21	17	13	7
0.80	41	32	27	22	14	37	28	24	19	12	31	22	19	15	9	27	19	15	12	6
0.85	37	29	24	20	13	33	25	21	17	11	28	21	17	13	8	24	17	14	11	6
0.90	34	26	22	18	12	29	23	19	16	10	25	19	16	12	7	21	15	13	10	5
0.95	31	24	20	17	11	27	21	18	14	9	23	17	14	11	7	19	14	11	9	5
1.00	28	22	19	16	10	25	19	16	13	9	21	16	13	10	6	18	13	11	8	5
1.1	24	19	16	14	9	21	16	14	12	8	18	13	11	9	6	15	11	9	7	
1.2	21	16	14	12	8	18	14	12	10	7	15	12	10	8	5	13	10	8	6	
1.3	18	15	13	11	8	16	13	11	9	6	14	10	9	7		11	8	7	6	
1.4	16	13	12	10	8	14	11	10	9	6	12	9	8	7		10	8	7	5	
1.5	15	12	11	9	7	13	10	9	8	6	11	8	7	6		9	7	6		
1.6	13	11	10	8	6	12	10	9	7	5	10	8	7	6		8	6	6		
1.7	12	10	9	8	6	11	9	8	7		9	7	6	5		8	6	5		
1.8	12	10	9	8	6	10	8	7	7		8	7	6			7	6			
1.9	11	9	8	7	6	10	8	7	6		8	6	6			7	5			
2.0	10	8	8	7	5	9	7	7	6		7	6	5			6				
2.1	10	8	7	7		8	7	6	6		7	6				6				
2.2	9	8	7	6		8	7	6	5		7	6				6				
2.3	9	7	7	6		8	6	6			6	5				5				
2.4	8	7	7	6		7	6	6			6									
2.5	8	7	6	6		7	6	6			6									
3.0	7	6	6	5		6	5	5			5									
3.5	6	5	5			5														
4.0	6																			

99% confidence

95% confidence

SAMPLING PROCESS STREAMS

Although sampling is generally thought to occur on a pile of material or over an area of treated soil, other schemes are possible. The most common instance is when the material is to be sampled at the point of generation. This is the preferred method, since it is most representative of the material under study. The lack of exposure to elements that might cause chemical degradation and/or leaching will result in material most indicative of actual conditions.

A sampling point along the material conveyor that can be fairly easily and safely reached should be chosen. It should be in an area where the entire belt can be accessed for sampling. Under this scenario, a temporal, rather than a spatial, approach needs to be used.

Time stratum should be established over the course of the process day. Ideally, the entire active time of the line should be included in the sampling scheme. Once time strata are chosen, the random numbers table can be used to establish sampling times. For a four hour period, a point somewhere on the table would be chosen and every number greater than 0 but less than 240 would be selected until the number of samples for that strata were obtained. The number would relate to time in minutes. This would be added to the starting time for that strata to determine the time of sampling.

If the time strata chosen are of unequal lengths, the number of samples chosen from any one strata should reflect the percentage contribution that strata makes to the time frame as a whole. For example, if for a 24 hour operating time, strata 1 is 4 hours and strata 2 is 8 hours, strata 2 should have twice as many samples as strata 1.

When the appropriate sampling time arrives, the material from the conveyor belt point that had been identified would be removed. This material should be well mixed and a subsample taken for inclusion in the jar for lab analysis. An example of the use of this protocol is attached.

RANDOM TIME WASTE SAMPLING EXAMPLE

	Sampling Point	Random Minute	Time
Stratum #1			
6:00 to 8:00 hours	1	28	6:28
	2	62	7:02
	3	99	7:39
	4	112	7:52
Stratum #2			
8:00 to 20:00 hours	1	11	8:11
	2	107	9:47
	3	156	10:36
	4	173	10:53
	5	296	12:56
	6	313	13:13
	7	398	14:38
	8	497	16:17
	9	555	17:15
	10	600	18:00
	11	637	18:37
	12	706	19:46
Stratum #3			
20:00 to 22:00 hours	1	13	20:13
	2	52	20:52
	3	88	21:28
	4	108	21:48
Stratum #4			
22:00 to 6:00 hours	1	48	22:48
	2	113	23:53
	3	153	24:33
	4	189	1:09
	5	227	1:47
	6	290	2:49
	7	314	3:14
	8	474	5:44

TOLERANCE FACTORS (K)

TOLERANCE FACTORS (K) FOR ONE-SIDED NORMAL TOLERANCE INTERVALS WITH PROBABILITY LEVEL (CONFIDENCE FACTOR) Y = 0.95 AND COVERAGE P = 95%

n	K	n	K
3	7.655	75	1.972
4	5.145	100	1.924
5	4.202	125	1.891
6	3.707	150	1.868
7	3.399	175	1.850
8	3.188	200	1.836
9	3.031	225	1.824
10	2.911	250	1.814
11	2.815	275	1.806
12	2.736	300	1.799
13	2.670	325	1.792
14	2.614	350	1.787
15	2.566	375	1.782
16	2.523	400	1.777
17	2.486	425	1.773
18	2.453	450	1.769
19	2.423	475	1.766
20	2.396	500	1.763
21	2.371	525	1.760
22	2.350	550	1.757
23	2.329	575	1.754
24	2.309	600	1.752
25	2.292	625	1.750
30	2.220	650	1.748
35	2.166	675	1.746
40	2.126	700	1.744
45	2.092	725	1.742
50	2.065	750	1.740
55	2.036	775	1.739
60	2.017	800	1.737
65	2.000	825	0.736
70	1.986	850	1.734
		875	1.733
		900	1.732
		925	1.731
		950	1.729
		975	1.728
		1,000	1.727

SOURCE: FOR SAMPLE SIZES $\leq$ 50: Lieberman, Gerald F. 1958. "Tables for One-sided Statistical Tolerance Limits." *Industrial Quality Control*. Vol. XIV, No. 10.

FOR SAMPLE SIZES $\geq$ 50: K values were calculated from large sample approximation.

NTIS Document PB-89-151-047

WASTE MANAGEMENT DIVISION'S

CLEAN CLOSURE CERTIFICATION CHECKLIST

This checklist was developed to review RCRA clean closures. Due to direct reference to 40 CFR, Part 264, Subpart G, by Act 64, Rule 613; Act 64 closures should also be evaluated by this checklist.

Documentation supporting the owners/operators and the independent registered professional engineer's certification can be requested under 40 CFR, 264.115 and 265.115 (as of October 29, 1986). The owner/operator must submit at least four copies of certification documentation.

The checklist identifies items recommended to properly evaluate a closure certification. These items are not "absolutes." Other information or substitutions may be provided which technically justify and certify a "clean closure."

This checklist can be used for land disposal, storage, and treatment facilities. Several of the items would not be required for storage and/or treatment facilities where testing was minimal. Items 1 through 5 would be required for all closures. Items 6 through 11 would be optional for storage and/or treatment facilities, dependent on extent of testing required. Land disposal facilities would require all items listed.

1. Manifests (or some type of manifest/waste removal summary) of where and how much waste was shipped.

2. Certification statement is needed by the owner/operator AND an independent registered engineer. All independent registered professional engineer certificates must have an original stamp on at least one copy.

3. Summary of decontamination procedures (pressure wash, Steam clean, etc.) and how the resultant waste water was disposed.

4. Summary analysis (include conditions of haul roads, time table, soil and groundwater results, weather conditions, runoff controls, equipment decontamination, etc.).

5. Results of all tests used to determine clean closure (charts, tables, lab sheets).

6. Statistical comparisons on sampling results compared to cleanup criteria (this should include full computations on background and statistical analysis).

7. Sampling and analysis procedures (specify references).

8. Final depth and elevations of excavations of wastes and soils.

9. Properly labelled and easily identified sampling locations and grid stations (map) including background stations.

10. Groundwater data (and statistical evaluation) used to determine if groundwater degradation has occurred (usually four sets of replicate analysis compared to sampling event after closure activities). Monitor well construction details and sampling and analysis procedures may be required if documentation is not in the file.

11. Summary of final restoration of excavated area...
information on fill material used and/or future land use outline. If clean closure cannot be achieved (e.g., contaminated soils to water table and groundwater results show contamination). This summary item should be used to address the need for any post closure program and/or corrective action.

12. A copy of all field notes pertaining to these closure activities.

13. A copy of the approved closure plan and letter of closure plan approval.

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APPENDIX F

RESPONSES TO COMMENTS

ON DRAFT WORK PLAN

BECHTEL ENVIRONMENTAL, INC. NAVY RAC

TELEPHONE CALL

By:	Frank Cater	Of:	Navy RAC - Mayport Building 25	Route/Copy	Steve Wilson Bryan Kizer Rao Angara Mike Dunaway Cecil Field BCT
To:	Lynn Sims	Of:	Bechtel Environmental, Inc.		
Date:	6/26/95	Time:	2:10 PM		
Subject:	North Fuel Farm Cecil Field Work Plan Comments Telecon			Job No:	22567-243
				File:	

Teleconference call was held to discuss the above mentioned work plan and drawings for the bioslurp portion of the work. The following comments were discussed and resolved:

1. The 5,000-gal holding tank will be removed from the process flow system. If sampling is required for the FOTW discharge, then it can be accomplished periodically from the oil/water separator wet well. The work plan and drawing will be revised to indicate such.

2. Bechtel to provide new calculations to the Engineer of Record regarding the vapor emissions. Carbon units for off-gas treatment were not to be added, but based on conversations the next day, the carbon units for off-gas treatment will be added.

3. Piping will be located either above ground or below ground as site conditions dictate. Preferred location of the treatment system is on top of the bermed tank mound.

4. Bioslurping may happen prior to the excavation, or concurrently. Revise work plan to remove phased approach.

5. Much discussion was held regarding the vapor separator. It was agreed that the revision to the original design (20,000-gal tank) was acceptable. Bechtel to provide calculation as indicated in Item 2.

6. Bechtel will need final Engineer of Record concurrence for execution of the Work Plan.

7. Parameters for testing of the discharge water from the oil/water separator will need to be provided to Bechtel prior to commencement of operations.

COMMENT RESPONSE TABLE

INTERIM REMEDIATION WORK PLAN
SOIL AND FREE PRODUCT REMOVAL ACTIVITIES FOR
NORTH FUEL FARM
NAS CECIL FIELD

Revision A June 1995

Comments by: Bryan Kizer, Code 1842
Remedial Project Manager
Southern Division Naval Facilities Command

Comment Number	Page No. Section No. Paragraph No.	Comment	Response
1	Page 7 (and Drawing 002) Section 3.1	Should the excavation limits go through the pond. The pond is lined and digging through the pond would destroy the integrity of the liner. In addition, it may cause the water in the drainage ditch to backup into the excavation. I would advise digging at least 3 feet around the pond.	The BCT has agreed that the northern limit of the excavation is the recently installed 8 inch pipeline. Bechtel will revise the work plan to indicate that excavation of the pond area will be avoided, unless directed to otherwise by the Navy. This will allow Bechtel to excavate to the north and determine if the pond area is excessively contaminated, and then notify the Navy.
2	Page 13 Section 3.1.10 First Paragraph	Where is 85% compaction required and where is 90-95% compaction required. Needs to be defined.	This paragraph discusses revisions to the Bechtel General Specification for Earthwork found in Appendix B. For cost effectiveness, Bechtel is indicating changes to the specifications attached to the RWP instead of creating all new specifications. Bechtel had taken the higher compaction requirements from a set of drawing created by Enterprise Engineering provided by NAS Cecil Field. The original Enterprise drawings for the Truck Stand indicated a need for 90-95% compaction in part of the area to be excavated. In the time since the Revision A issue of the work plan, Bechtel has coordinated with NAS Cecil Field personnel and was advised that the 90-95% compaction requirement is not necessary. This section, and Drawing 003, will be revised to indicate that in general, all backfill compaction for this project will be at 85% compaction, unless directed otherwise by the Navy.
3	Page 17 Section 3.2.3	After much discussion, it has been decided to reinstall the wells in the mound. Bechtel shall coordinate with ABB as to the optimum placement of these wells. Well shall be screened in the vadose zone and area of free product.	Bechtel agrees. We are currently coordinating with the Activity to identify clear areas at the top of the tank mound. The intent is to install the well as close to the CEF-076-16 and CEF -076-015 monitoring wells as possible. Once we have cleared a location of interferences, we will coordinate with the Engineer of Record for concurrence regarding the location and the well design. We will then discuss the new well installation in the Work Plan and indicate the new design on Drawing 005.
4	Page 17 Section 3.2.4 First Paragraph	Need to state the location of the skid mounted treatment unit. Need to coordinate with Fuel Farm Operator and Activity personnel as to where to place this equipment.	Bechtel is currently pursuing this coordination. We have suggest that the treatment system be located in the vicinity of Building 285, at least 25 feet east of the new transformer box.

INTERIM REMEDIATION WORK PLAN
SOIL AND FREE PRODUCT REMOVAL ACTIVITIES FOR
NORTH FUEL FARM
NAS CECIL FIELD

Revision A June 1995

Comments by: Bryan Kizer, Code 1842
Remedial Project Manager
Southern Division Naval Facilities Command

Comment Number	Page No. Section No. Paragraph No.	Comment	Response
5	Page 18 Section 3.2.5 Paragraphs 5 & 6	Doesn't the oil/water separator need to have a coalescent type filter to help treat the dissolved product?	This is correct. A typical oil/water separator has a coalescent type filter. Bechtel will include specification criteria for the oil/water separator in this section as follows. The Specific design requirements for the oil/water separator vendor will require the oil/water separator to remove all non-emulsified JP-5 from the wastewater stream and produce an effluent containing no more than 10 mg/l of JP-5 droplets 20 microns or larger. The separation process will be automatic and incorporate the use of a bank(s) of slant rib, sinusoidal, oleophillic, coalescing plate(s) arranged to induce oil droplet impingement on the plate surfaces. Solids will settle into a sludge chamber(s). The separator will efficiently process variable influent flows from 5 to 25 gpm.
6	Drawing 005 Appendix A	Redo well detail with re-installed wells.	Refer to response to comment number 3.

REMEDIATION WORK PLAN FOR
SOIL AND FREE PRODUCT REMOVAL ACTIVITIES FOR
NORTH FUEL FARM
NAS CECIL FIELD

Revision A June 1995

Comments forwarded by: Mike Deliz, P.G.
Remedial Project Manager, Technical Review Section
Comments by: Greg Brown, P.E.
Professional Engineer II, Technical Review Section
Florida Department of Environmental Protection

Comment Number	Page No. Section No. Paragraph No.	Comment	Response
1	Page 4 Section 1.3.2 Paragraph 4	Section 1.3.2 mentions that a final RAP is being prepared. A CAR must be approved prior to RAP preparation. The CA is not complete but is presently in-progress.	This sentence will be revised to reflect the fact that the CA is still underway and that when the Final RAP is developed, groundwater contamination, if present, will be addressed at that time.
2	Page 7 Section 3.1.1	A vertical isolation barrier is proposed without gravel trench previously specified. Please explain the change in plan. What will be the impacts of the vertical isolation barrier on the subsurface hydrology of the site and the slope stability of the tank farm structure.	We are not sure what document or what "plan" indicated references to a gravel trench, but we suspect it was one of the December 1994 or January 1995 concept technical memorandums that discussed gravel drains for the recovery of the free product. This option will not be implemented, as discussed and agreed upon by the partnering team. The vertical isolation barrier shown was originally proposed in December 1994, without gravel. The purpose of this barrier wall is to provide a barrier for future free product migration into the area of excavation. The depth of the barrier is 12 feet below land surface and the water table fluctuates between 2 and 6 feet bls. Since the length of the wall is only for part of the site, subsurface hydrology impact will be negligible. There is a potential for localized mounding, but very localized in the area of the wall. Please refer to Drawing 003 for proposed location. The installation of this wall is being performed by a specialty subcontractor that provides for a "trenching" and fill method simultaneously. This method is more appropriate than the open trenching method since there is no required shoring. The structural integrity of the surrounding soils is not affected, so the impact to the tank mound structure is negligible. Slope stability of the area will remain the same, since there is no open trench.

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3	(Assumed) Page 8 Section 3.1.3	The Navy should minimize contaminated storm water by implementing best management practices. BMPs include, but are not limited to, containment by grading, berming, and covering. These method can prevent storm water from contacting contaminated media or migrating off-site. Nylon scrim may not be sufficient to prevent contact between storm water and contaminated soil.	We assumed the comment is in reference to this section. This section is being revised. The major revision to this section involves the staging of the contaminated soil prior to transport to Site 3 treatment area. Instead of allowing contaminated soils to drain back into the excavation, we will be excavating "wet" and loading directly into the transport trucks. The trucks will, of course, be water tight to prevent leakage. As discussed in this section, Site 3 has been designated as the Cecil Field thermal treatment area. The site has been graded to provide for run-on and run-off controls. A sump in conjunction with the lined and bermed area has capacity for a 4 inch storm event, with sump discharge to the base FOTW being proposed as backup. The Nylon scrim is not intended to completely prevent storm water contact, but only keep soil stockpiles dry. Bechtel has implemented best management practices at Site 3 with regard to the storm water controls. We will expand this paragraph to include the above discussion.
4	Page 18 Section 3.2.5 Paragraph 4	Off-gas treatment should be implemented in accordance with the Department's guidance ESS-3, Vacuum Extraction, Pilot Studies, Air Emissions, and Monitoring Requirements, September 10, 1993.	FDEP ESS-3 is RAP Design Requirements for NPDES Discharges. We assume this reference was for ESS-4 as indicated by the title. As noted in the Work Plan, the proposal presented in the APA was for direct discharge of off-gas via a 25 foot stack. The APA request was prepared by the Engineer of Record and has been approved by FDEP. However, we agree that as a precautionary measure, the provisions of Attachment A of the FDEP ESS-4 should be used. These provide that two months of off-gas controls should be provided and the exhaust monitored (pre-control and post-control). Based on the results of the two months of monitoring, recommendations can then be made, based on SCREEN modeling, as to the appropriateness of continued treatment. This discussion will be added to the work plan.

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5	Page 27 and 23 Section 4.2.7	The Navy may consider sampling the oil/water separator effluent and analyzing for less extensive analyte list once the waste stream is believed to be adequately characterized. This analyte list would depend on the FOTW's requirements for waste characterization.	Analysis listed in this section and in Table 4-1 are the analytes provided to the Navy in accordance with the NAS Cecil Field NPDES General Permit. Discussions with Mr. Larson and Mr. Battone of FDEP and Navy personnel have determined the sampling requirements. Further, the Navy's CLEAN contractor prepared a document listing required sampling criteria for all FOTW discharge at NAS Cecil Field.
6	Page 26 Section 4.2.2	The statistically based sampling plan using Michigan's guidance appears adequate for this specific project. The Navy should state in the sampling plan, however, the null hypothesis and its alternative for the specific sampling objectives.	Michigan Department of Natural Resources guidance on statistically based sampling of a medium size site provides a 95% confidence level of determining any hot spot concentrations at NFF using unbiased sampling. The null hypothesis assumes that, following excavation, if a sample from the tested area contains any target analyte above the cleanup standard the area is still contaminated. Areas in question will be further remediated followed by hot spot sampling (i.e.., subquadrant confirmatory sampling) in order to maintain that the area is clean in accordance to the alternative hypothesis and that the null hypothesis is false. The alternative hypotheses assumes that sample results above the cleanup criteria indicate the site has been remediated to cleanup goals.

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NAS Cecil Field Public Works Department

Comment Number	Page No. Section No. Paragraph No.	Comment	Response
1a	Page 4 Section 1.3.2 First Paragraph After Bullets	Should state all free product will be removed.	The requirements of 62-770 FAC provide for the recovery of free product to the "extent practicable". Guaranteed removal of "all" free product from the excavation is not practicable. Skimmer pumps are only able to capture free product that is at least 1/8" thick. In addition, some free product may be in emulsion and not become apparent for long periods of time.
1b	Page 5 Section 2.1.3 First Paragraph	What is the cost of using the specialty contractor rather than standard installation?	Standard installation would involve the use of shoring, or sheetpile installation; engineering time; potential slope destabilization, etc. Using a specialty subcontractor to install the vertical barrier wall will save an estimated $15,000 on the cost of the installation.
1c	Page 7 Section 3.1.1	What hydraulic changes will occur under the tank system as the result of the barrier being placed to a depth of 12 feet? Could this cause structural problems with the tanks? What about an above grade barrier to prevent any run off from the tank mound or another spill from recontamination of the clean section. This barrier has been discussed at several BCT meetings and if I remember correctly everyone agreed that the barrier must extend above grade to protect the clean fill.	The barrier is being installed in an aquifer that starts two to five feet below land surface and continues to at least 75 feet bls. The length of the wall does not close off the site hydraulically, so there should be minimal affect on subsurface hydrology. Localized mounding may occur, but should stabilize rapidly. We are assuming that the gradient in this area is on the order of 30 to 50 feet per year (based on the migration of the previous spill). Using the specialty contractor to install this wall will prevent any structural affect to the tank or the tank mound area. The barrier wall will have an above grade component, but the below grade component is the primary barrier to recontamination. The above grade component will prevent runoff recontamination, but without below grade stoppage of the migration of the free product, recontamination of the excavation area is highly probable. This is the main purpose of the wall, and is discussed in Section 3.1.1.
1d	Page 5 Section 2.4	All monitoring wells will be properly closed.	As noted in this section, the requirements of FDEP and local authorities will be followed for closure of the monitoring wells. Bechtel will add that we will provide the Navy with closure reports.

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Comment Number	Page No. Section No. Paragraph No.	Comment	Response
1e	Page 8 Section 3.1.2	Has the Fire Department approved of the fire main being disabled?	Bechtel will coordinate with all NAS utilities and appropriate personnel prior to disconnection of any of the utilities. This is discussed in this section. The pre-construction meeting with the ROICC would be an appropriate venue to discuss these issues.
1f	Page 13 Section 3.1.10 First Paragraph	Do we really want to backfill simultaneous, cross contamination could occur?	This section is going to be revised to indicate that the backfilling of the area will occur when deemed appropriate, based upon completion of the thermal treatment of the excavated soils, or when cross contamination potential is minimal due to the size of the excavation. Bechtel will not be able to excavate the entire area prior to backfilling of the excavation, so there will be some amount of simultaneous backfilling.
1g	Page 13 Section 3.1.12	Why put a liner under clean soil, or is this part of the thermal treatment unit's process?	The clean soil stockpile is actually an area for the stockpile of the thermally treated soil, prior to the confirmation samples indicating that the clean soil criteria of 62-775 FAC has been achieved. Since there is always the potential that the soil in this stockpile could be contaminated, it is sound engineering practice to place it on a liner.
1h	Page 14 Section 3.1.14	If trucks are contaminated, brush the dirt off, no pressure washing should be required.	Bechtel waste management practices require that removal of petroleum contamination be achieved via the use of pressure washing. This practice reduces the potential to spread contamination. Bechtel will take this comment under advisement.
1i	Page 19 Section 3.2.6 Paragraph 2	Why use a tanker truck, cost comparison for portable tanker should be done to determine cost effectiveness.	Agree. Bechtel will revise this section to indicate the use of a portable tank for containment of the free product. This tank will have to meet API requirements for transport of petroleum products.
1j	Appendix B Specification 001-SP000-005 Page 7 Section 3.4.2	Do not dewater except as the result of skimming.	Dewatering is not planned even in the skimming operation. This specification is a generic specification developed for all Navy RAC work performed by Bechtel. It was intended to be attached to subcontract packages for subcontractor execution. The reference to this specification, and description of its intent , is on page 10, Section 3.1.5 of the RWP. This paragraph points out that section 3.4.2 of the referenced specification is not included as part of this work. Bechtel will note in the RWP the relationship of the attached specifications to the work plan.

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1k	Appendix B Specification 001-SP000-006 Page 12 Section 3.9 Paragraph 2	Clean backfill borrow site will be determined by Cecil Field not Bechtel.	This specification was developed as a generic specification (which results in cost savings to all jobs) intended for subcontractor implementation. This specification is first noted in the RWP on page 13, Section 3.1.10. As noted in this paragraph , this section is not applicable to this work. Bechtel will note in the work plan that if there is a need for backfill material, the source will be approved by NAS Cecil Field personnel.
1l	Appendix B Specification 001-SP000-006 Page 13 Section 3.11	Backfill should be low organic content.	As noted on page 13, Section 3.1.11 of the RWP, the borrow is to be of low organic content. A reference will be added to the RWP section that the RWP discussion of the Borrow Source will override the Specification contained in Appendix B.
1m	Appendix B Specification 001-SP000-006 Page 13 or 14 Section 3.12.1	All damage to be repair at Bechtel's cost, not the Station.	We are assuming the actual reference commented on here is Section 3.12.2, Page 14, first paragraph of the referenced specification. This paragraph indicates that damaged underground piping will be repaired at no cost to Bechtel. Again, this specification is intended for use in projects where Bechtel has assigned the work to a subcontractor, and any damage by the subcontractor will be repaired at his cost. Bechtel has no intention of charging the Station. Since Bechtel is executing this work, the last five words of this paragraph are not applicable.
1n	Appendix B Specification 001-SP000-006 Page 14 Section 3.15	Bechtel is responsible.	Agree. Since Bechtel is executing this work, again the last five words of this sentence are not applicable.

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1o	Appendix B Specification 001-SP000-006 Page 15 Section 3.16	Security chain link fence will go around the entire area along with traffic barriers as needed along "A" Avenue.	This specification is provided for general guidance, unless noted elsewhere in the RWP or construction drawings. The construction drawings indicate the security fencing along all of "A" Avenue as required. Section 2.1.2 also discusses this temporary fencing, and Drawing 002 indicates the new construction of the fencing. Page 12, Section 3.1.7, second paragraph discusses transportation requirements and the fact this will be coordinated with NAS Cecil Field personnel.
1p	Pages 21-26 Sections 4.2.1 & 4.2.2	Why all these samples? I thought the soil contamination delineation was complete and it was determined to go as close to "A" Avenue as possible, the fence line for the tank mound.	FDEP procedures and Bechtel standard operating procedures require remediation goal confirmatory sampling. The action described in the RWP is an Interim remedial action. It is possible that not all "excessively contaminated" soils will be removed during this action. Confirmatory sampling to indicate that a 95% confidence level of removal of "excessively contaminated" soils has been achieved, or not, is required. The "delineation" is based on a limited number of samples and a "connect" the dot method. Exposing the soils and actual remediation requires confirmatory sampling. The limits of the excavation have been established in BCT meetings, but confirmation of removal, or not, within and to the extent of these limits must be established.

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1q	Page 27 Section 4.2.4 First Paragraph	Why duplicate samples? If Bechtel doesn't trust their subcontractors they shouldn't be using them.	Bechtel's contract with Naval Facilities Command, Southern Division requires Bechtel to use only NEESA approved laboratories. To date, Bechtel has only one laboratory approved for use by Bechtel on Navy RAC projects. The thermal treatment subcontractor is required by their general permit to perform pre-burn sampling and have the laboratory cost included in the unit rates. They typically use a laboratory that is not NEESA approved and may or may not be Navy RAC approved. Bechtel, under the Federal Acquisition Regulations, can not direct the subcontractor to use Bechtel's Navy approved laboratory. When faced with the possibility of having the subcontractor do all the pre-burn samples for general permit compliance (legal) and Bechtel repeating all of the pre-burn samples with Bechtel's Navy approved laboratory (contractual), Bechtel suggested to the Navy several cost saving ideas. The final decision was for Bechtel to provide duplicate (split) sampling at Bechtel's approved laboratory. This duplicate sampling has nothing to do with Bechtel "trusting" or not trusting our subcontractors, but is a Southern Division requirement.
1r	Page 27 Section 4.2.7	User knowledge of the wastewater should be acceptable, if not only one sample analysis would be necessary.	Bechtel followed the guidance from Southern Division, the CLEAN contractor, and NAS Cecil Field in development of this section. If reduced parameters and testing frequency are acceptable to all parties involved (BCT, FOTW, PWC, ABB, FDEP, etc.) then Bechtel will reduce the requirements.
1s	Appendix B Specification 001-SP000-017 Page 7 Section 6.7	Tank removal must be in accordance with F.A.C 61-671.	This is a general specification intended to give guidance to subcontractors or Bechtel field personnel. The reference to this specification is on page 6, Section 2.5 of the RWP and discusses the demolition of the valve house. The tank (UST 70) removal is discussed on page 11, Section 3.1.6 and references 61-761 FAC. The section in the specification also references applicable state requirements.

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1t	Appendix B Specification 001-SP000-017 Page 7 Section 6.7	All monitoring wells will be permitted/closed according to regulations.	Bechtel is assuming the specification, page number, and section referenced in the comment are correct. This section of the specification deals with tank abandonment, not monitoring well abandonment. The monitoring well abandonment is discussed on page 5, section 2.4 of the RWP and requires all abandoned monitoring wells to meet the state and local requirements. Also refer to our response to comment 1d.
1u	Appendix B Specification 001-SP000-017 Page 7 Section 6.7	If station water is available, it should be used instead of portable water.	Bechtel is assuming the specification, page number, and section referenced in the comment are correct. Page 5, Section 2.1.2 of the RWP discusses temporary utilities and indicates that potable water is available.