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NWS EARLE
5090.3a

WORK PLAN FOR BUILDING 566 UNDERGROUND STORAGE TANK REMEDIATION NWS EARLE NJ

1/7/1998

FOSTER WHEELER ENVIRONMENTAL CORPORATION

000000583

Prepare in quintuplicate (original and 4 copies)

CONTRACTOR DRAWINGS & INFORMATION SUBMITTAL
NORTHNAVFACENGCOM 4335/3 (Rev. 6/80)

CONTROL NO. 4

CONTRACT NO.	DELIVERY ORDER	ACTIVITY LOCATION
N62472-94-D-0398	0017 Mod. #8	Naval Weapons Station Earle, Colts Neck, NJ

PROJECT TITLE:
BUILDING 566, UST REMEDIATION

FROM:	DATE
Foster Wheeler Environmental Corp. - Program QCM: Akram Aziz	January 7, 1998
TO:	DATE
COTR: P. BRIEGEL (3 COPIES)	JANUARY 7, 1998

1. THE CONTRACTOR SUBMITTALS LISTED BELOW ARE FORWARDED FOR YOUR REVIEW AND RECOMMENDATIONS.
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2. THESE SUBMITTALS SHOULD BE RETURNED TO THIS OFFICE BY _____
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FOR COMMANDING OFFICER, NORTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND — DATE

ITEM NO.	SUBMITTAL DESCRIPTION	PREPARED/ SUBMITTED BY	APPROVED	DISAPPROVED	REMARKS
4	SD-18, Records	J. Hottinger			
	Work Plan for Building 566 UST	for A. Aziz			
	Remediation				

WORK PLAN
FOR
BUILDING 566 UST REMEDIATION
AT
NAVAL WEAPONS STATION - EARLE
COLTS NECK, NEW JERSEY

Issued:

January 7, 1998

Prepared for:

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REMEDIAL ACTION CONTRACT N62472-94-D-0398
DELIVERY ORDER NO. 0017
MODIFICATION NO. 8

Revision	Date	Prepared By:	Approved By:	Pages Affected
1	January 7, 1998	M. Heffron, P.G.	J. Gorgol, P.E.	7, 8, 10, 13 through 19, 21, 23, 24, 26, 32, 33 through 40

WORK PLAN
FOR
BUILDING 566 UST REMEDIATION
AT
NAVAL WEAPONS STATION - EARLE
COLTS NECK, NEW JERSEY

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1.0 INTRODUCTION/ PROJECT OBJECTIVES

Foster Wheeler Environmental Corporation (Foster Wheeler Environmental or FWENC) has been contracted by the Northern Division, Naval Facilities Engineering Command (Navy) to excavate and dispose of petroleum impacted soils and remove any light non-aqueous phase liquid from the groundwater which seeps into the excavation at Building 566 at the Naval Weapons Station (NWS) Earle located in Colts Neck, NJ. This Work Plan is being submitted to satisfy the pre-construction submittal requirements included in paragraph 1.2.1, Pre- and Post-Construction Documentation of the Statement of Services for Delivery Order No. 0017, Modification No. 8 under Remedial Action Contract No. N62472-94-D-0398.

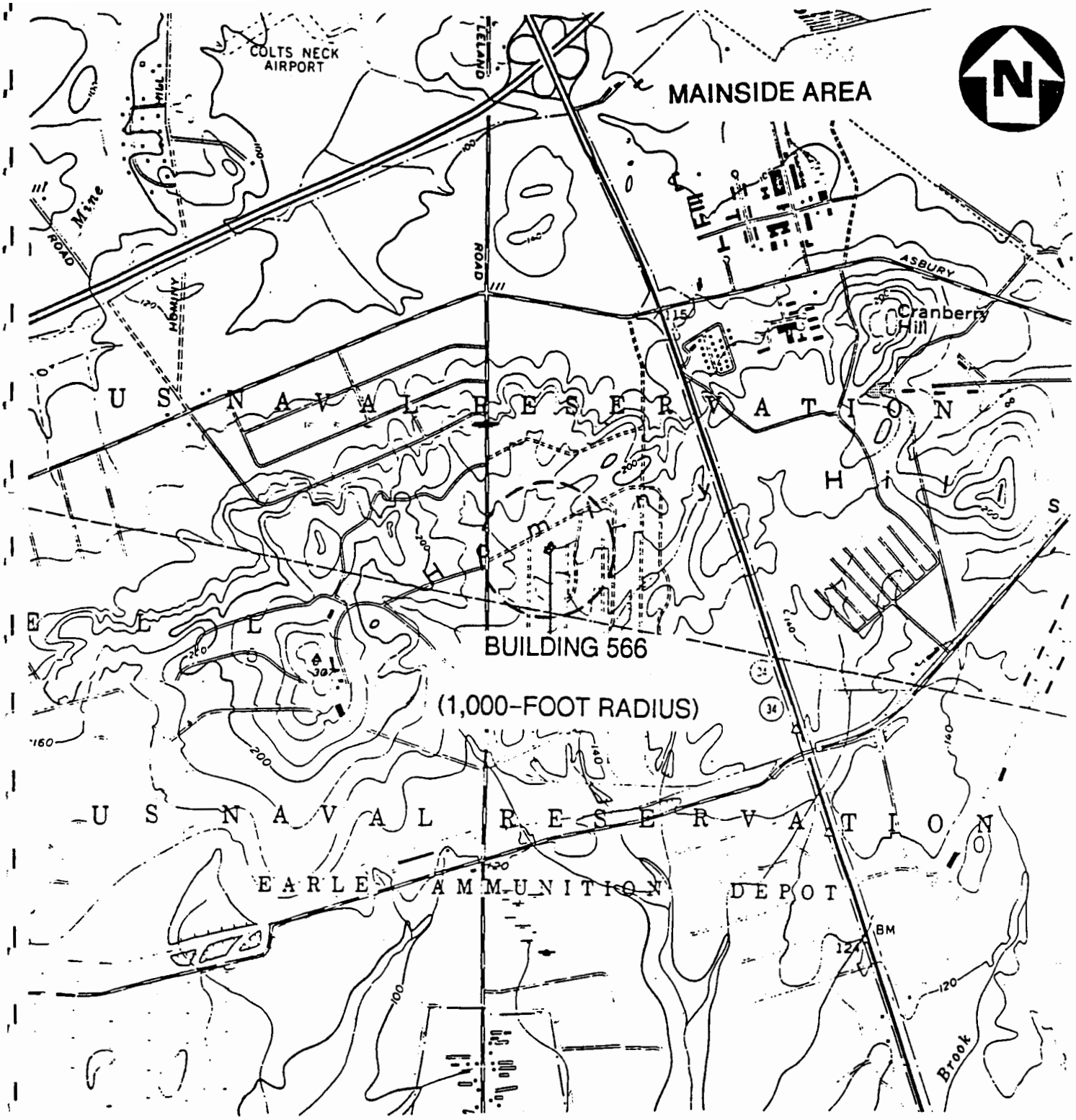
Project objectives include the removal of petroleum contaminated soils above the NJDEP clean-up criteria for volatile organics, the removal of free phase oil from the water in the excavation, backfilling the excavation, and reseeding the area.

2.0 PROJECT LOCATION AND DESCRIPTION

NWS-Earle is located in east-central Monmouth County in the town of Colts Neck, New Jersey. Building 566 is located on the Mainside portion of the NWS-Earle facility off Guadacanal Road in an area known as Ordnance Area "M". Refer to Figure 2.1 for the location of Building 566. The Mainside area of NWS-Earle is located approximately six miles inland of the Atlantic Ocean and at elevations ranging from 100 to 300 feet above mean sea level (AMSL).

The Area of Concern (AOC) is located at the southeastern side of Building 566. The AOC is comprised of: two former UST tanks which have been removed, a septic tank, a 4,000 square foot buried drainage field and seeps associated with the drainage field. The UST site and the wastewater disposal system comprise approximately one acre. Figure 2-2 depicts the site layout

The original USTs were installed in 1974. The USTs included a 6,000 gallon diesel fuel UST (Tank ID No. 566/1) and a 4,000 gallon No. 2 fuel oil UST (Tank ID No. 566/2). Both USTs failed tightness tests on September 15, 1993 and were subsequently removed. UST 566/2 and 120 cubic yards of soil were removed in December, 1993. TPH concentrations of up to 25,000 mg/kg, prior to the soil removal, indicating leaks or spills from the tank. UST 566/1 and impacted soil were removed in May, 1994. The total area of the excavation, including UST 566/1, was 30 feet wide by 35 feet long by 9 feet deep. After the USTs were removed, two new USTs, approximately 50 percent above grade and covered with gravel, were placed in the same location. Approximately 800 tons of the soil removed from the UST area did not pass TCLP testing for VOCs, including chlorinated solvents, and was disposed of as hazardous waste. The source of the chlorinated solvents was never determined, however the analytical results of soil and



SOURCE: (7.5 MINUTE SERIES) U.S.G.S. MARLBORO, NJ QUADRANGLE AND FARMINGDALE, NJ QUADRANGLE

GENERAL LOCATION MAP – BUILDING 566

(SCALE 1:24000)

U.S. Navy RAC
NWS Earle, Colts Neck, N.J.

Figure 2-1
Site Location Map

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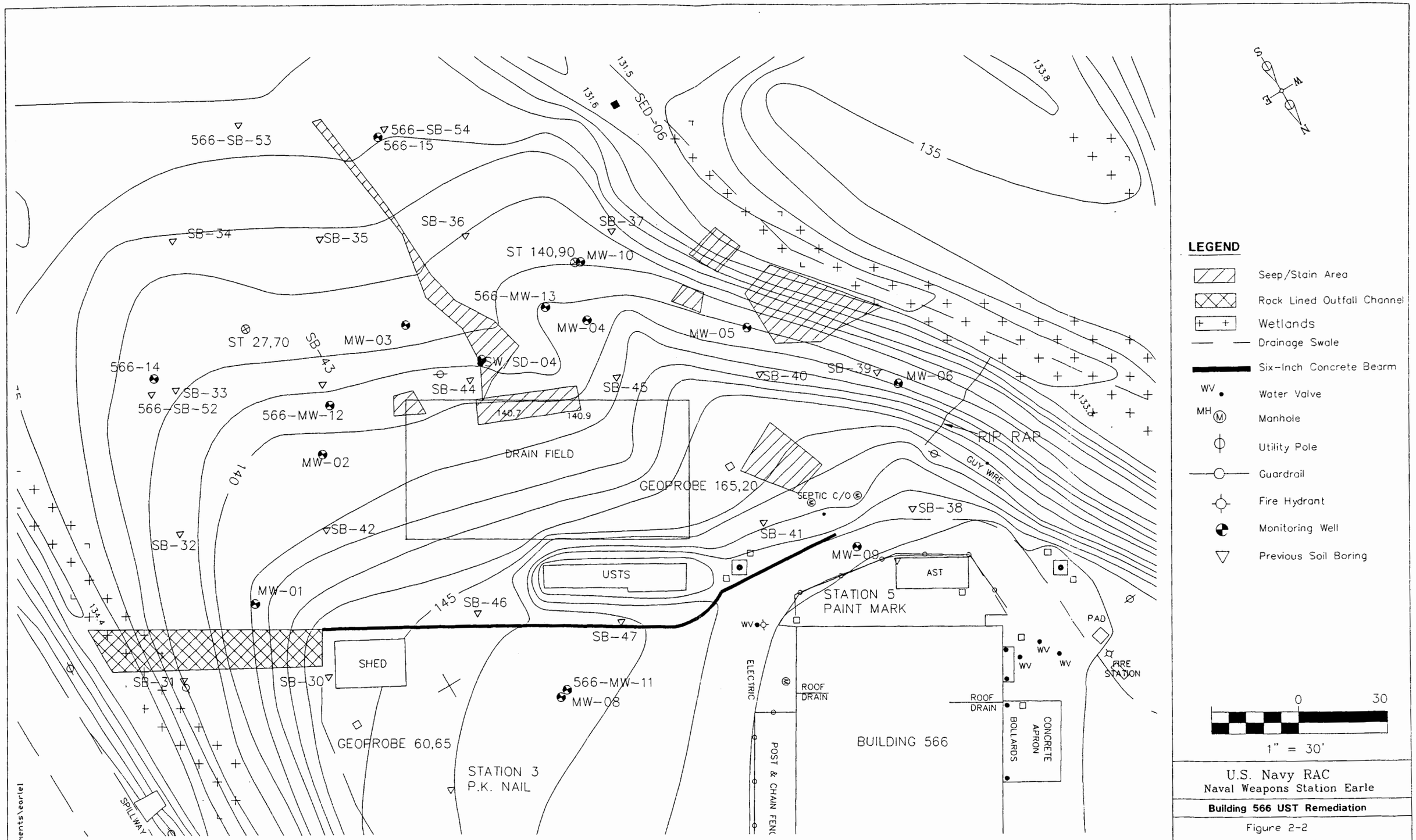

Source: Brown & Root Environmental, Phase I RI Report

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U.S. Navy RAC
Naval Weapons Station Earle

Building 566 UST Remediation

Figure 2-2
Site Layout

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groundwater samples collected by B&R Environmental did not indicate chlorinated solvent contamination.

In late 1993 or early 1994, the Navy indicated that oil was observed seeping from the ground surface at several locations downgradient of the two USTs and the drainage field for the wastewater disposal system. The Navy also indicated that oil may have been accidentally pumped into the septic tank and drain field during an oil delivery for the UST system. The volume of oil discharged to the wastewater disposal system is unknown. The maximum volume of the septic tank is approximately 11,000 gallons, however the original fuel oil UST had a capacity of 4,000 gallons.

Historical drawings depict the drainage field to be 100 feet long by 40 feet wide, however the interpretation of borings advanced during the Remedial Investigation (RI) indicate the drainage system is only 95 feet long by 50 feet wide. Historical engineering drawings indicate that the drain field is covered with fill material. Results of borings during the RI confirmed that the fill extended to a depth of 12 to 28 inches below grade, at which depth the top of the gravel zone was encountered. The engineering drawings indicate that the drain field consists of a 12 inch thick gravel bed for the 4 inch diameter fiber press pipe system. The piping system consists of lateral lines of perforated fiber pipes running the length of the drain field and covered with approximately 2 inches of gravel from the top of the piping. Appendix A contains the septic system design. Borings advanced during the RI indicate that the gravel bed of the drainage field is approximately 30 to 46 inches thick.

2.1 Previous Investigations

Brown and Root (B&R) Environmental conducted a Phase I Remedial Investigation (RI) at Building 566 under the Comprehensive Long-Term Environmental Action-Navy (CLEAN) Contract. The investigation performed by B&R Environmental consisted of the following tasks:

- Preparation of an Interim Action Work Plan
- Determination of wetland boundaries, survey of site features, determination of the depth to groundwater in areas down gradient of the oil seeps, and determination of the potential lateral extent of TPH contamination above 1,000 mg/kg in soils.
- Evaluation of site conditions and determination of the engineering requirements to construct a trench downgradient of the drain field to collect the seeping oil.

B&R Environmental submitted an Interim Action Investigation Report in February 1995 and concluded that wetlands were within 100 feet downslope of the drainage field and that the oil contamination was confined to soils within the drainage area. Figure 2-2 depicts the site layout and the previous sample locations.

In early May 1995, B&R Environmental began the second phase of the site delineation. The site conditions during the second phase of the delineation were different than the conditions during the interim actions. During the second phase, water was observed surcharging from the manholes in the septic tank, the soils within and downslope of the drainage field were completely saturated to within 0 to 1.5 feet of the surface, and free product was observed within the subsurface soils immediately downslope of the drainage field. The saturated conditions at the site were determined to be caused by: a leaking water line inside Building 566 continually overfilling the septic tank, runoff from the adjacent upgradient paved surfaces, and the limited downward percolation due to a shallow silt clay unit underlying the site.

B&R Environmental conducted several interim actions at the site to stabilize the hydrologic conditions. An independent plumber evaluated the water supply system at Building 566, but was unable the determine the exact nature of the leak because the system apparently required extensive repairs. The Navy pumped the water out of the septic tank and eventually turned off the main supply to the building. In April, 1996, B&R Environmental placed a concrete curb diversion along the edge of the paved area immediately upslope of the USTs and septic tank. A rip rap dam was installed at the discharge end of the diversion curb for energy dissipation. A topographic survey of the site was also completed.

2.2 Site Conditions

2.2.1 Surface Water and Wetlands

Surface water runoff from the AOC flows radially toward the south, east, and west into a series of drainage swales located immediately downgradient from the AOC. Surface water in the drainage swales flow southwest toward the headwaters to the eastern branch of the Mingamahone Brook located approximately 900 feet east of the AOC. The eastern branch of the Mingamohone Brook converges with the western branch approximately 1,700 feet south of the AOC.

In April 1996, B&R Environmental placed a concrete curb diversion along the edge of the paved area immediately upslope of the USTs and septic tank. The curb was approximately 200 feet in length. A rip rap dam was installed at the discharge end of the diversion curb for energy dissipation. The concrete curb and rip rap area were constructed to prevent runoff from the paved area upgradient of the AOC.

B&R Environmental completed a wetlands delineation in accordance to the 1987 Army Corps of Engineers Wetland Delineation Manual. Appendix A contains the wetlands delineation map and the boring logs from the wetlands delineation.

2.2.2 Groundwater

The shallow aquifer at the site is composed of native sandy soils and clean fill. The shallow aquifer is approximately 2 to 4 feet below grade in the drainage field area and the slope of the water table surface generally closely follows the surface topography at the site. The groundwater flow is generally towards the south. The seeps downgradient of the AOC to the south and southeast are located where the water table intersects the ground surface. A silt-clay lithologic unit underlies the drainage field at a depth of approximately 8 feet below grade, and outcrops at the seep areas to the south and southeast. The unit consists of orange-brown to gray, thin to very thin interbedded layers of silt, clay, and some very fine-grained sand and silty clayey sand. The maximum thickness of this unit is unknown, however, a shelby tube collected south of the drainage field during the RI revealed 9 feet of the silty clay unit. The silty clay unit was detected in all 30 borings taken from the AOC during the RI.

3.0 SCOPE OF WORK

The objectives of the this effort are to excavate and remove petroleum contaminated soil, stone and piping from the drainage field and the associated seep areas and to pump out any free phase oil that enters the open excavation. The excavation shall remain open and oil recovered until all available free phase oil is removed from the excavation.

3.1 TASK 1 - Project Planning/Management

Project Planning/Management activities include the preparation of pre-construction submittals, coordinating utility requirements, mobilization to the site, and providing home office support functions during the estimated period of performance. The subtasks involved in Project Planning/Management are described below.

3.1.1 Subtask 1A - Pre-Construction Submittals

Foster Wheeler Environmental will prepare and submit the following pre-construction documents to the Navy:

Work Plan
The Work Plan presents Foster Wheeler Environmental's approach to executing the project, including the site description, statement of work, procurement approach, system information, materials, engineering data, transportation and disposal data, and sampling and analytical requirements.

Health and Safety Plan (HASP)
The HASP includes Foster Wheeler Environmental's approach to providing for the health and safety of its employees during the project.

3.1.2 Subtask 1B - Mobilization

Mobilization will consist of contacting appropriate Navy personnel at NWS Earle to arrange for contractor passes and to coordinate support requirements for the soil excavation and recovery of free-phase oil. A utility survey shall be conducted to determine all utility lines in the AOC. Utilities, primarily electric, shall be locked and tagged out and/or terminated at the source. Subsurface utilities shall be located by NWS-Earle Public Works personnel. A dig permit shall be obtained prior to any drilling or excavation work.

3.1.3 Subtask 1C - Home Office Support

Foster Wheeler Environmental's Langhorne, Pennsylvania office will provide home office support for the one year project duration. Home office support includes the preparation of the required monthly progress, financial and technical reports.

3.2 TASK 2 - Permit and Report Preparation Submission

3.2.1 Subtask 2A- Wetlands Permit

Foster Wheeler Environmental shall complete and submit, with the Navy's approval, an NJDEP Statewide General Permit #4 for the proposed cleanup activities at Building 566 which occur in and near wetlands. A complete copy of this permit shall be kept on site.

3.2.2 Subtask 2B- Dig Permit

Foster Wheeler Environmental shall contact the NWS-Earle Public Works Department to obtain a dig permit and have all utilities marked-out prior to excavation activities.

3.2.3 Subtask 2C- Soil Erosion and Sediment Control Permit

Since the proposed excavation involves the disturbance of more than 5,000 square feet of land surface, a Soil Erosion and Sediment Control Permit Application must be submitted to the county or regional soil conservation district in accordance with N.J.A.S. A. 4:29-39 et seq..

FWENC shall prepare and submit the Soil Erosion and Sediment Control Permit Application to the Navy for submittal to the Freehold County Soil Conservation District. A complete copy of this permit shall be kept on-site.

3.2.4 Subtask 2D - Treatment Works Approval/Permit

Foster Wheeler Environmental shall complete and submit, with the Navy's approval, a Treatment Works Approval (TWA) permit application in order to construct and operate a temporary groundwater treatment system. The treatment system shall be constructed in

order to treat groundwater pumped from the excavation during the recovery of free-phase oil from the excavation. A complete description of the recovery and treatment processes are contained in Section 3.5. A complete copy of this permit shall be kept on-site.

3.2.5 Subtask 2E - New Jersey Pollution Discharge Elimination System Permit

Foster Wheeler Environmental shall complete and submit, with the Navy's approval, a New Jersey Pollution Discharge Elimination System (NJPDES) permit application to discharge treated groundwater to surface water. The treated groundwater shall be discharged to the Mingamohone Brook adjacent to the site. A complete description of the treatment system is contained in Section 3.5. A complete copy of this permit shall be kept on-site.

3.2.6 Subtask 2F-Preparation of Post Remediation Report

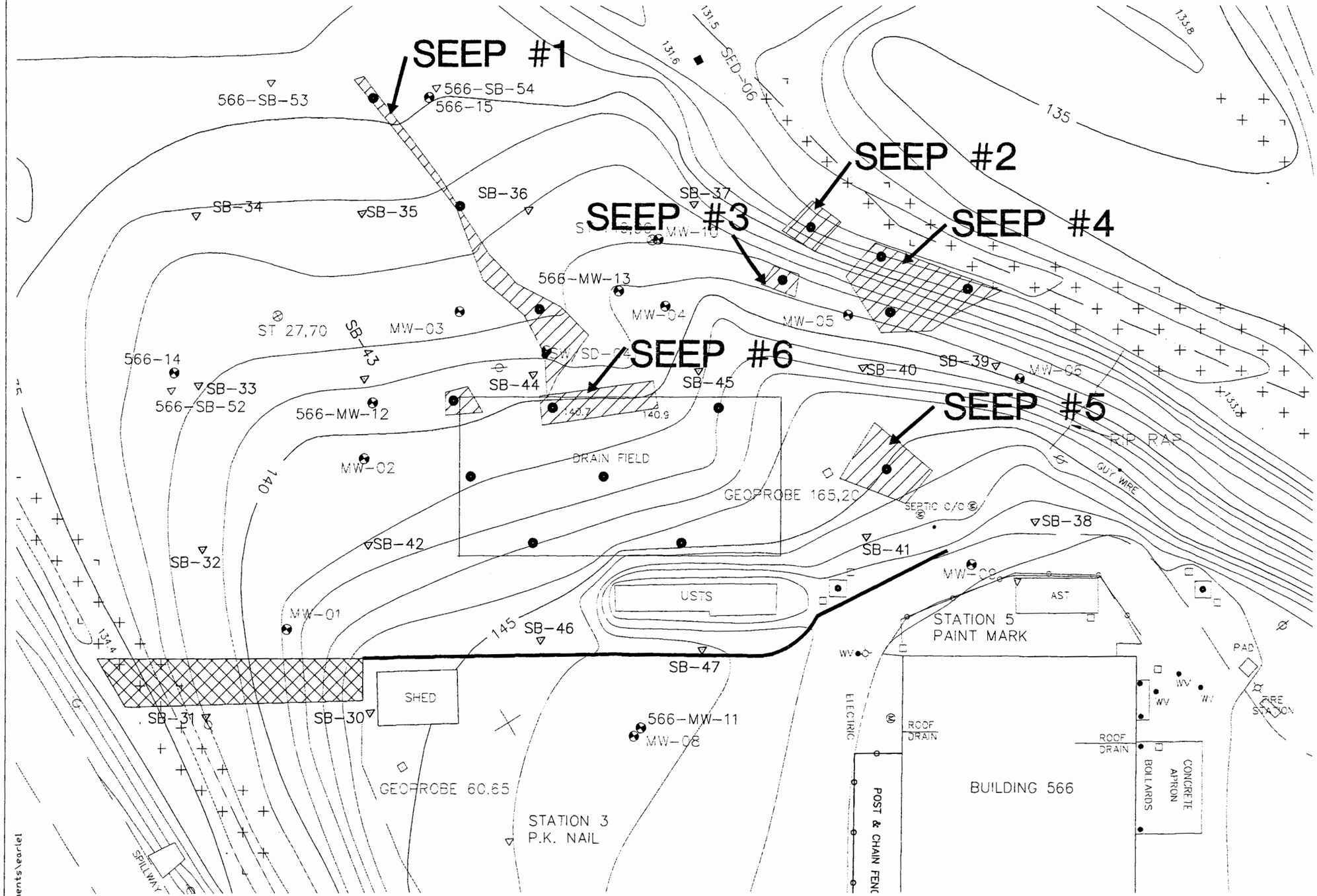
Foster Wheeler Environmental shall prepare a Post Remediation Report in accordance with NJAC 7:26E-6.6. The report shall include the delineation activities completed, location and quantities of soil removal, analytical results and disposal data.

3.3 TASK 3 - Collection of Waste Characterization Samples

Surface and subsurface soil samples shall be collected in order to characterize the soils to be excavated, arrange disposal options, and to expedite the transportation and off-site disposal of the soils. The soil can be direct loaded from the excavation to the trucks if the soil characterization is conducted prior to the actual excavation activities. The waste characterization sampling is based upon the NJDEP requirements, as well as the requirements of the proposed recycling/disposal facilities. One waste characterization sample shall be obtained for every 100 tons of soil to be removed and analyzed for total petroleum hydrocarbons (TPH) and total organic halogens (TOX). It is assumed that 1 cubic yard of soil shall weigh approximately 1.5 tons. Four soil samples shall also be collected and analyzed for RCRA characteristics, full scan TCLP, and TAL metals. The Sampling and Analysis Plan in Section 4.0 details the analytical methods and sample frequency.

The drainage field shall be gridded out as indicated on Figure 3-1 and in the Sampling and Analysis Plan in Section 4.0. The Drainage Field was gridded into 3 rows and samples shall be collected at approximately 60 foot intervals along the rows. Composite samples shall be collected from 0 to 4 feet below grade at each of the sample grids and analyzed for TPH and TOX. Three of the samples shall also be analyzed for RCRA characteristics, full TCLP scan, and TAL metals.

Waste characterization soil samples shall be collected from the seep areas from 0 to 2 feet below grade. For identification purposes, the seep/stain areas have been numbered on Figure 3-1. Three soil samples shall be collected from 0 to 2 feet below grade at 60 foot intervals at Seep #1 for waste characterization. Individual soil sample shall be collected



LEGEND

- Seep/Stain Area
- Rock Lined Outfall Channel
- Wetlands
- Drainage Swale
- Six-Inch Concrete Bearm
- WV Water Valve
- MH Manhole
- Utility Pole
- Guardrail
- Fire Hydrant
- Monitoring Well
- Previous Soil Boring
- Proposed Sample Location

Source: Brown & Root Environmental, Phase I RI Report

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Building 566 UST Remediation

Figure 3-1
Proposed Sample Location Map

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from Seeps 2, 3 and Seep 5 and analyzed for waste characterization parameters: TPH and TOX. Three soil samples shall be collected from Seep 4 and analyzed for TPH and TOX. The most visibly contaminated seep sample shall also be analyzed for RCRA characteristics, full TCLP scan, and TAL metals. The Sampling and Analysis Plan details the sample collection method and specific sample analyses.

3.4 TASK 4 - Excavation of Soils

3.4.1 Subtask 4A - Installation of Web Sheeting

A geoprobe shall be used to advance borings between the USTs and the drainage field to ensure there are no foundations, boulders, etc. which may interfere with the installation of the sheeting. The geoprobe borings shall also determine the thickness of the clay layer in this area. The geoprobes shall be advanced to a depth of 12 feet below grade, the depth in which the web sheeting shall be installed. The geoprobe borings shall be logged by a geologist, and the boreholes shall be grouted from the bottom-up upon completion of each hole.

Seventy five (75) linear feet of PZ-22 web sheeting shall be driven to a depth of approximately 7 feet below grade. The sheet pile wall shall extend 10 feet before and after the USTs to ensure proper support during the excavation activities adjacent to this area. The sheet piling shall be driven as far away from the USTs as possible to minimize vibrations to the USTs from the pile driving. After all the excavation is complete, the sheet piling shall be cut off at the existing grade and left in place.

The complete engineering report and associated drawings and calculations are located in Appendix B.

3.4.2 Subtask 4B - Erosion Control

Erosion and Sediment Controls

Filter fabric barriers shall be installed downgradient of all the seep and drain field excavations in order to control soil erosion. Absorbent socks shall also be placed along the bottom of the filter in case there is any oil released during the excavation of the seep areas. Details regarding erosion and sediment controls shall be provided in the Soil Erosion and Sediment Control Permit Application which shall be a separate submittal. The approved Soil and Erosion Control Permit shall be kept on-site.

In April 1996, B&R Environmental placed a 200 foot concrete curb along the edge of the asphalt, immediately upslope of the USTs and septic tank, in order to divert surface water run-off. A rip rap dam was installed at the discharge end of the diversion curb for energy dissipation.

3.4.3 Subtask 4C - Excavation of Seep Areas

A tracked excavator, with an extendible arm, shall be used to excavate the seep areas. A shallow depression shall first be excavated in the drainage field area to stage the seep soils, which are expected to be saturated with water. The soil from the shallow excavation in the Drain Field shall be placed around the edges of the field to contain any saturated soils. Seeps #2 and #4 shall be excavated first since these seeps are expected to contain the most moisture due to their location next to wetlands and a drainage swale. The majority of the seep areas shall be excavated from the most downslope portion, back towards the Drain Field. The visibly contaminated soils in the seep/stain areas shall be excavated down to a depth of 2 feet below grade. The soils shall be placed in the shallow excavation atop the Drain Field. Placing the seep soils in the Drain Field will allow the excess moisture to percolate into the field, and if necessary, the soils excavated from the shallow portion of the Drain Field can be mixed with the saturated soils in order to decrease the moisture content of the soils for loading and transporting. All soil underlying the staged soils from the seep area shall be removed during the excavation of the Drain Field.

Plastic sheeting and a geotextile layer shall be placed on the ground surface northeast of the Drain Field, between the excavation/staging area and the loading area. Plastic sheeting shall be placed atop the asphalt area to the northeast of the Drain Field which shall be used for the loading area. A rubber tire loader shall be used to move the soils from the Drain Field Area to the loading area. The soils shall be loaded into trucks with plastic lining and covers. The trucks shall drive up on the plastic sheeting for loading. Any soils that fall onto the plastic while loading shall be removed prior to the trucks pulling out to ensure that soil is not tracked off the plastic. The trucks shall not require any decontamination since the tires shall not come into contact with any of the soils.

3.4.4 Subtask 4D - Post-Excavation Sampling of Seep Areas

Soil samples shall be collected from each of the sidewall of the seep excavation and analyzed for total petroleum hydrocarbons (TPH) and target compound list volatile organic compounds (TCL VOCs). The soil samples shall be collected 0 to 6 inches above the water table on each of the sidewalls with a stainless steel trowel in accordance with N.J.A.C. 7:26E-6.3. The Sampling and Analysis Plan in Sections 4.0 and 5.0 details the sample collection and analysis procedures.

3.4.5 Subtask 4 E - Excavation of Drain Field

The tracked excavator shall be used to excavate the soils and piping from the Drain Field. The sides of the excavation shall be sloped 2: 1 horizontal to vertical since the excavation is expected to be approximately 4 feet deep. The drier soils on top of the Drain Field can be direct loaded for off-site transportation and disposal. All of the piping associated with the field shall be excavated and placed in separate roll-off containers or direct loaded for

off-site disposal. The saturated gravel at the bottom of the Drain Field shall be excavated and placed on a plastic bermed area which slopes back into the excavation in order to drain off the excess moisture. Once the excess moisture has been drained off the gravel, the material shall be loaded into the trucks at the loading area. The Drain Field shall be excavated to one foot below the groundwater table, removing all visibly contaminated soils.

3.4.6 Subtask 4F - Post-Excavation Sampling of Drain Field

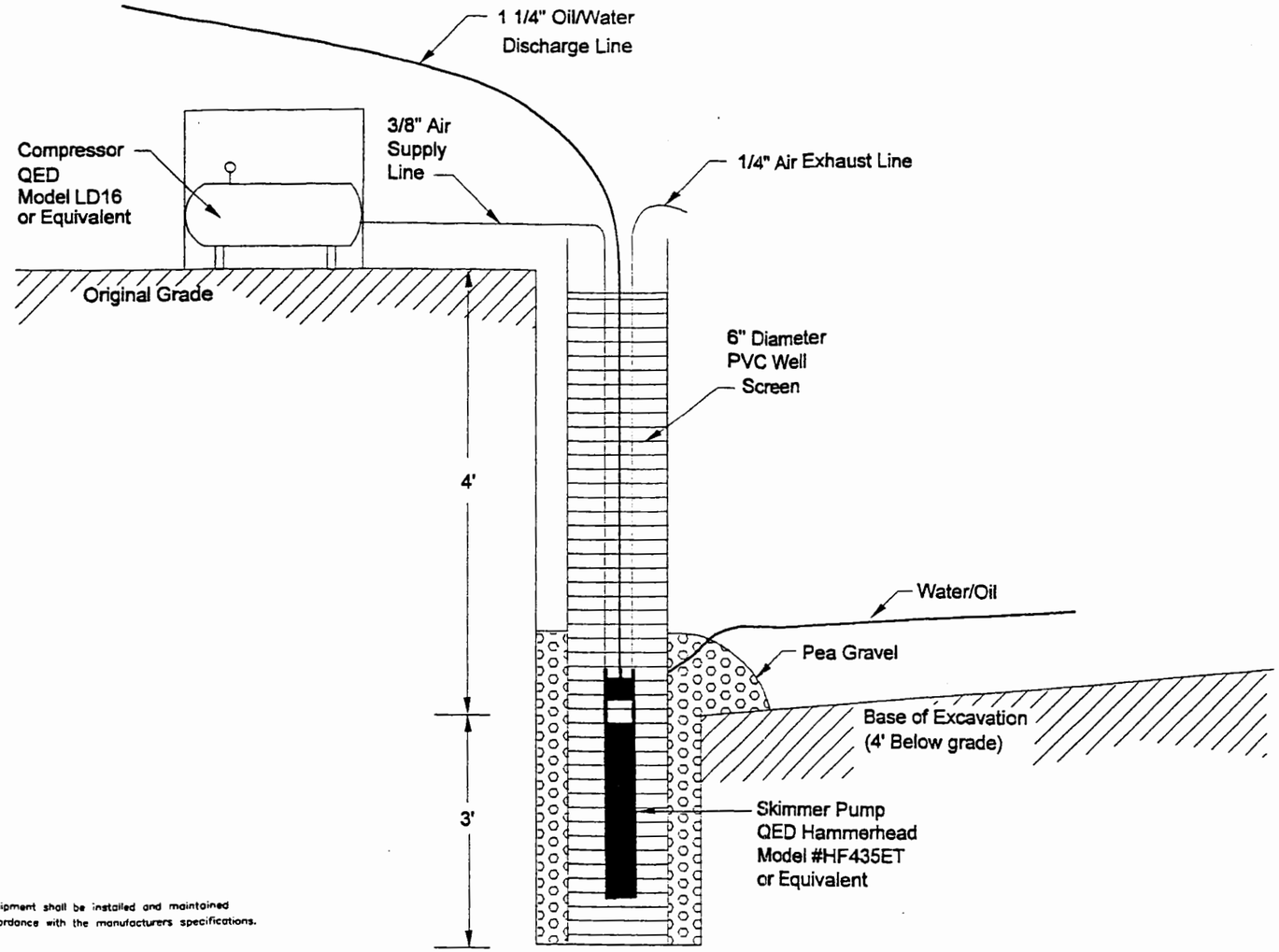
The collection of the post excavation samples shall be dependent upon the amount of oil that infiltrates into the excavated area during the soil removal process. If only a small amount of oil enters the excavation, the samples shall be collected immediately after excavation activities are completed. If a large amount of oil and water infiltrate the excavation, it shall be necessary to first remove all the available free product from the excavation, and the soil on the sidewalls may have to be scraped off with the excavator and disposed. By scraping off the sidewalls, the soils that were previously affected by the oil in the excavation can be removed and a more representative sample of the existing soil can be obtained.

In accordance with N.J.A.C. 7:26E-6.3, soil samples shall be collected from each of the sidewalls at intervals of 30 linear feet and analyzed for TPH and TCL VOCs. The soil samples shall be collected 0 to 6 inches above the water table on each of the sidewalls with a stainless steel trowel. The Sampling and Analysis Plan in Sections 4.0 and 5.0 detail the sample collection and analysis procedures.

3.5 TASK 5 - Removal of Oil/Water from the Excavation

A sump shall be constructed on the southern portion of the Drain Field during the excavation activities. According to the RI Report, the base of the drain field slopes to the south, and groundwater flow direction is also to the south. The sump shall constructed of 6 inch diameter slotted PVC. The slotted PVC shall be inserted approximately 3 feet below the base of the excavation, or a total of 7 feet below grade. The southern corner of the drain field shall be excavated to the desired depth, 3 feet deeper than the bottom of the drain field, the PVC pipe inserted, and the area around the PVC shall be backfilled with washed pea gravel.

A 4 inch diameter skimming pump shall be placed in the slotted PVC sump. The skimmer pump draws water into the top of the pump, creating a cone of depression and drawing in and removing free-phase oil along with the water. The sump de-watering system layout is provided in Figure 3-2, and the pump specification sheets are located in Appendix C. The recovered oil and water shall be pumped into a 4,900 gallon storage tank. Since the 4,900 gallon tank will contain free-phase oil, the tank shall be constructed with secondary containment.



Note: All equipment shall be installed and maintained in accordance with the manufacturers specifications.

GE-34357

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Building 566 -
Sump Dewatering System Layout

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N.T.S.		12/19/97	FINAL				3-2	M. Helfron, PG	J. Gorgol, PE
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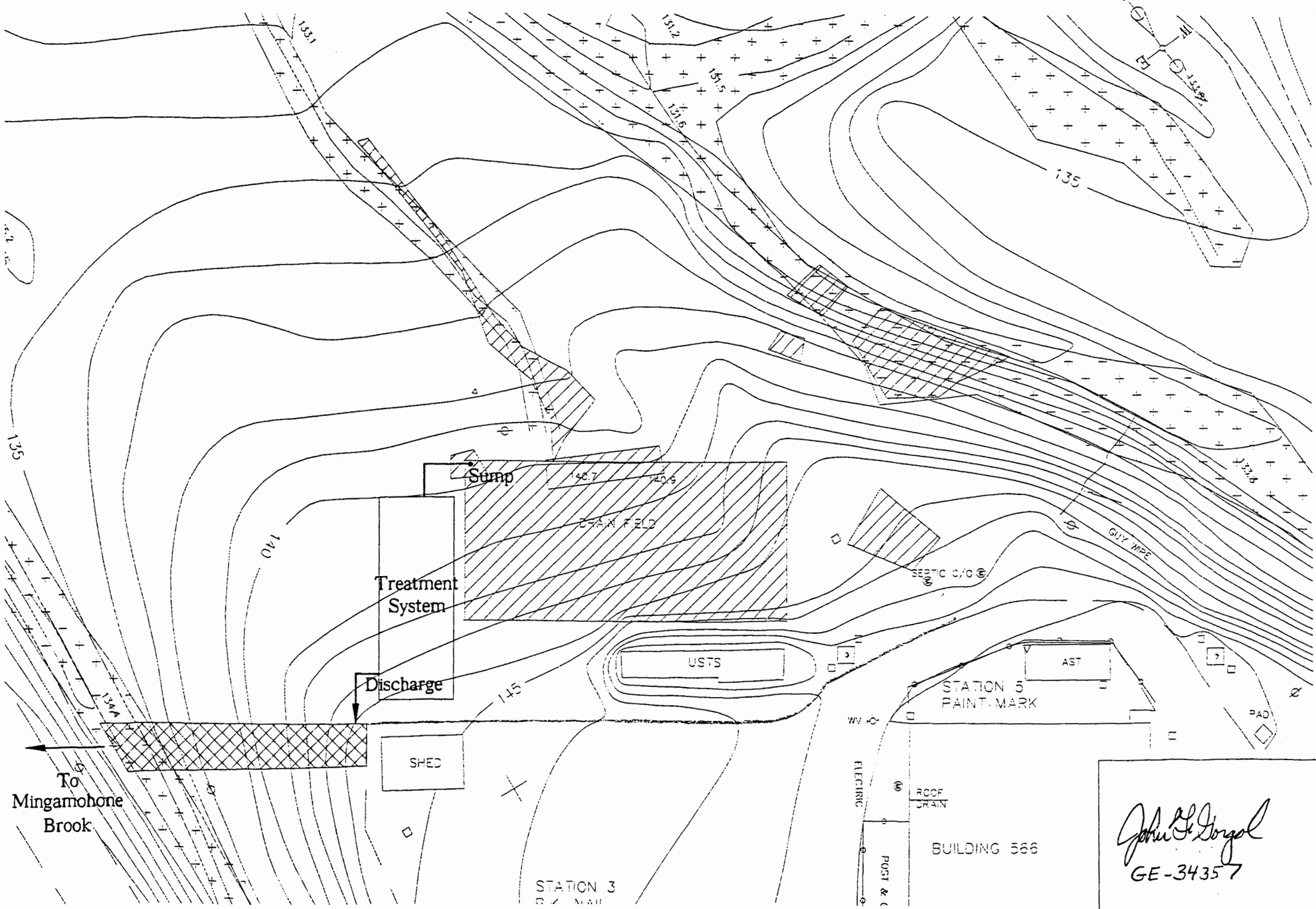

LEGEND

- Areas to be Excavated
- Rock Lined Outfall Channel
- Wetlands
- Drainage Swale
- Six–Inch Concrete Berm
- WV — Water Valve
- MH — Manhole
- Utility Pole
- Guardrail
- Fire Hydrant

0 30

Approx. scale: 1" = 30'

John G. Gorgol
GE-34357

U.S. Navy RAC
Naval Weapons Station – Earle

Building 566 –
Treatment System and Discharge Locations

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1"=30'		12/19/97	Final				3-3	M. Heffran, PG	J. Gorgol, PE
SCALE	NO.	DATE	DESCRIPTION	PREP	CHECK	APPROVED	DRAWING NO.	DRAWN BY	APPROVED

Note: Base Map From Brown & Root Environmental RI Report, 1996.
Topographic Contours Based on New Jersey State Plane Coordinates NAD 83

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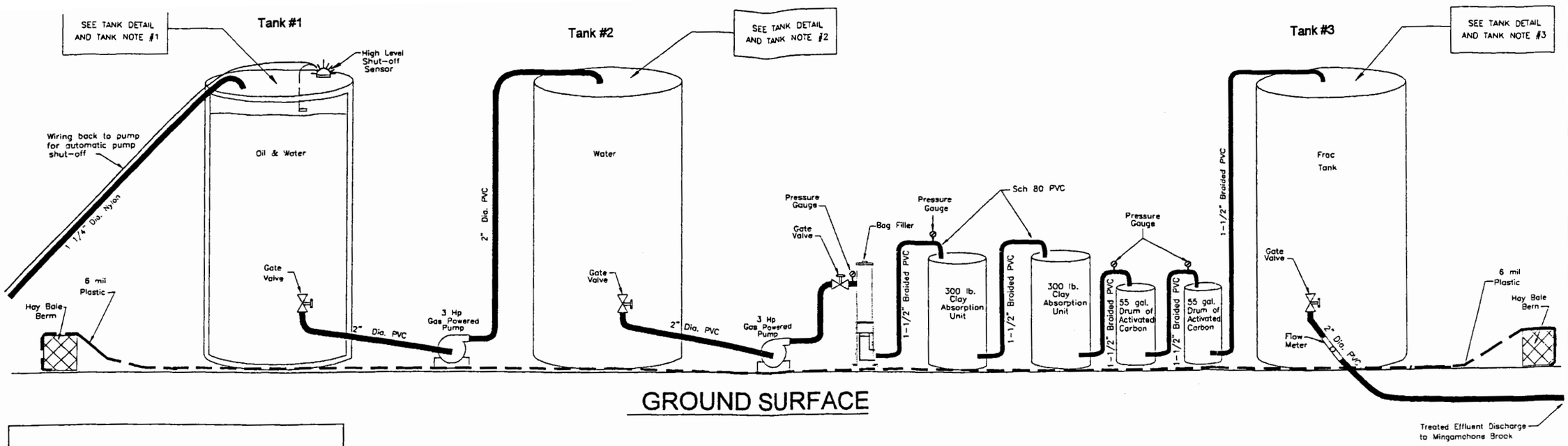
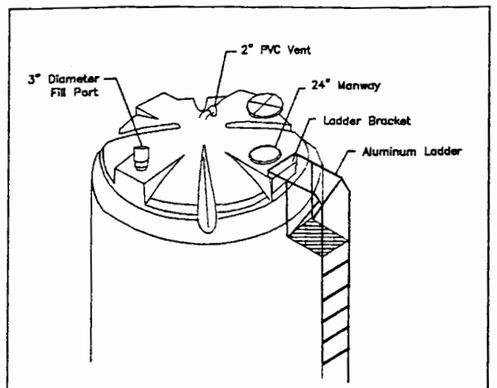




TANK DETAIL
FOR TANKS # 1, # 2 AND # 3

EQUIPMENT SPECIFICATIONS

High Level Alarm – QED TM Model #L374 or equivalent

Tank 1, Double Walled – Rain for Rent TM Model # 746000 or equivalent

Tanks 2 & 3, Single Walled – Rain for Rent TM Model # 946000

Gate Valve – Ryan Herco TM Model # 5002 (1–1/2) or equivalent

Gas Powered Pump (3 hp) – McMaster Corp.TM Model # 43735KI or equivalent

Bag Filter – Fibri–Basket TM Model # 224 or equivalent

Pressure Gauges – Ashcroft TM Model # 1490 or equivalent

Clay Absorption Units – CETCO Model # PC24 or equivalent

Activated Carbon Drums – CETCO TM Model # MX–200–L or equivalent

Flow Meter – Badger Meter Inc. TM Model # M35 or equivalent

2" Diameter PVC Flexible Pipe – McMaster Corp. TM Model # 437 or equivalent

1–1/4" Diameter Nylon Flexible Pipe QED TM Model # 37216 or equivalent

1–1/2" Diameter Wire Reinforced PVC Tubing– Herco–Flex TM Model # 0518(130) or equivalent

1–1/2" Braided PVC Flexible Pipe – Ryan Herco TM Model #0580(130) or equivalent

TANK NOTES

Tank #1: The 3" diameter fill port shall be fitted with schedule 80 PVC elbow and reducer to a 1–1/4" diameter hose barb. The 1–1/4" diameter nylon flexible pipe from skimmer pump shall be attached to the hose barb with a stainless steel clamp.

Tank #2: The 3" diameter fill port shall be fitted with schedule 80 PVC elbow and reducer to a 2" male quick–disconnect. The 2" diameter flexible pipe shall be equipped with a quick–connect shank coupler.

Tank #3: The 3" diameter fill port shall be fitted with schedule 80 PVC elbow and reducer to a 1–1/2" male quick–disconnect. The 1–1/2" diameter flexible pipe shall be equipped with a quick–connect shank coupler.

GENERAL NOTES:

1– FIRST AID KITS AND EYE WASH STATIONS SHALL BE PROVIDED IN READILY ACCESSIBLE LOCATIONS.

2– SECONDARY CONTAINMENT SHALL COMPLY WITH ALL APPLICABLE REGULATIONS.

3– HAND RAILS AND NON–SKID TREDS SHALL BE PROVIDED FOR ALL STAIRS.

4– WARNING SIGNS SHALL BE POSTED IN ALL HAZARDOUS LOCATIONS AND ALL EQUIPMENT/DRUMS/TANKS SHALL BE LABELED IN ACCORDANCE WITH ALL APPLICABLE REGULATIONS.

5– EQUIPMENT SHALL BE INSTALLED AND MAINTAINED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS

6– IN ACCORDANCE WITH N.J.A.C. 7:14B–4.1, THE HIGH LEVEL SHUT–OFF SWITCH SHALL AUTOMATICALLY RESTRICT THE FLOW INTO THE TANK WHEN THE TANK IS 90% OF CAPACITY

7 – MATERIALS OF CONSTRUCTION FOR ALL PROCESS EQUIPMENT LINES AND FITTINGS ARE COMPATIBLE WITH PETROLEUM CONTAMINANTS.

John L. Gorgol
GE-34357

U.S. Navy RAC
Naval Weapons Station – Earle

Building 566 –
Treatment Equipment Layout

FOSTER WHEELER ENVIRONMENTAL CORPORATION

N.T.S.		12/19/97	FINAL				3-4	M. Heffron, PG	J. Gorgol, PE
SCALE	NO.	DATE	DESCRIPTION	PREP	CHECK	APPROVED	DRAWING NO.	DRAWN BY	APPROVED

earle\bios1.dwg

A portable treatment system shall be constructed in order to treat the groundwater removed from the excavation during the recovery of the free-phase oil. Figure 3-3 depicts the location of the treatment system. The treatment system shall be placed on 6 mil plastic which shall be bermed using hay bales. The treatment system shall be comprised of three 4,900 gallon storage tanks, portable pumps, a bag filter, clay absorption canisters, and activated carbon adsorption drums. Figure 3-4 depicts the treatment system layout, and equipment specification sheets are provided in Appendix C. The treatment system shall be designed to pump and treat the recovered groundwater in batches. The recovery and treatment system shall be operated 8 hours a day, 5 days a week until all free-phase product entering the excavation is recovered. The oil and water shall be pumped from the excavation into the double-walled storage tank, allowing the oil to separate overnight in the storage tank. The water shall be pumped from the bottom of the oil/water storage tank to an adjacent 4,900 gallon storage tank using a gas-powered transfer pump. Once the water has been pumped from the bottom of the oil/water tank, the oil recovery operation can resume. Utilizing the water storage tank will allow the oil/water recovery system to operate concurrently with the treatment system. The oil shall be periodically removed from the storage tank, via the 24 inch manhole in the top of the tank. An oil recycling vendor shall use a vacuum truck to vacuum the oil off the top of the tank for off-site recycling.

The recovered groundwater shall be treated and then discharged to the adjacent Mingamahone Brook. The construction and operation of the treatment system shall be permitted with a NJDEP TWA permit, and the discharge to surface water shall be permitted with a NJPDES permit. In order to achieve the required discharge requirement for the discharge to surface water, several treatment vessels shall be employed to treat the groundwater. The design of the groundwater treatment system was based on the highest observed analytical results of groundwater samples obtained from monitoring wells adjacent to the area to be excavated during a Remedial Investigation (RI). The calculations and media specification information used in evaluating the effectiveness of the treatment system are contained in Appendix D. The water shall first be pumped through a 35 micron bag filter. The bag filter shall remove any suspended particles which could decrease the life of the downgradient treatment units. The groundwater shall then be pumped through two clay absorption canisters, each containing 300 pounds of clay media. The clay absorption media removes higher molecular weight organics, petroleum hydrocarbons, and the low water soluble semivolatile organics. The water shall then be pumped through two activated carbon drums, in series, to reduce the concentrations of dissolved organic compounds. The treated water shall be pumped into a 4,900 gallon storage tank. The water, at least initially, shall be kept in the tank until analytical results are reviewed and it is determined that the effluent concentrations are lower than the limits set forth in the NJPDES permit for discharge to surface waters.

3.6 TASK 6- Backfill of Excavations

The excavated areas shall be backfilled and reseeded after the Navy reviews the analytical data from the post excavation samples and informs Foster Wheeler Environmental to proceed with the restoration. Clean sand shall be used to fill the excavation to 6 inches below grade in the areas outside the wetlands. The top 6 inches of the excavation, outside the wetlands areas, shall be backfilled with topsoil, and the area reseeded with local grass seed. The wetland areas shall be backfilled with soil similar to the excavated soil to a depth of eight inches below grade. In accordance with NJDEP, the upper eight inches of the excavation shall be backfilled with topsoil containing a high organic component. The wetlands shall be reseeded in accordance with the Freshwater Wetlands General Permit. The seeding information is contained in Appendix E. All reseeding shall be in compliance with the standard to the set in the wetland permit application. Silt fences shall be left in place until the seed takes root and the erosion potential decreases.

4.0 FIELD SAMPLING AND ANALYSIS PLAN

4.1 Introduction

Foster Wheeler Environmental Corporation (FWENC) is submitting this Sampling and Analysis Plan (SAP) for Building 566 UST Excavation at the Naval Weapons Station (NWS) Earle located in Colts Neck, NJ. The purpose of the sampling is to analyze the soils, free product, and water for waste characterization, and to determine if soil clean-up criteria levels are reached during the excavation activities. This work is being performed under Delivery Order No. 0017 to Navy Contract N62472-94-D-0398

The SAP presents the procedures to be followed during the Building 566 UST excavation activities. The SAP specifically addresses the following areas:

- Analytical Requirements
- Responsibilities of Site Personnel
- Sample Analytical Program
- Sample Packing and Shipping
- Documentation
- Field Sampling Program
- Quality Assurance/Quality Control
- Procedures for Field Changes and Corrective Actions

The Quality Assurance Project Plan (QAPP), which has been submitted as a separate document, establishes the structure of the quality assurance plan for field activities. Site-specific Standard Operating Procedures have been included (Section 4) to describe the sampling procedures. Any modifications necessary to these SOPs due to field conditions or other unforeseen situations shall be recorded in the site logbook, documented on the

appropriate Change Request Form (CRF) forms by site personnel, and approved by the Project Manager (See Section 4.2).

4.2 Personnel Responsibilities

The project team will include the following personnel:

The Senior Project Engineer/Manager (SPEM) has final responsibility for the development of the SAP and management of the project team.

The Project Superintendent (PS) is responsible for assuring that proper collection, packaging, preservation, and shipping of samples is performed in accordance with the SAP. In addition, the PS is responsible for coordinating with the subcontracted laboratory during sample analysis and for reviewing the analytical data received from the laboratory.

The Site Health and Safety Officer (SHSO) is responsible for the safety of all site personnel as detailed in the site-specific Health and Safety Plan (HASP), presented under separate cover.

The Drilling Subcontractor is responsible for supplying all services (including labor), equipment, and material required to perform the drilling, including all maintenance and quality control of such equipment. The drilling subcontractor will be responsible for all required drilling permits, licenses, and clearances. The drilling subcontractor will also be responsible for following decontamination procedures specified in the bid package. Upon completion of work, the drilling subcontractor will be responsible for demobilizing all equipment and restoring the work area to original conditions.

The Laboratory Subcontractor is responsible for supplying all services (including labor), equipment, and material required to perform the analysis of the environmental samples. The laboratory subcontractors are responsible for following all specified methodology protocols, including quality assurance/quality control (QA/QC) requirements. In addition, the laboratory subcontractors are responsible for the proper disposal, including all associated costs, of the environmental samples upon completion of the analytical work.

4.3 Field Sampling Activities

This section addresses the field investigation activities, including:

- Sample Tracking System
- Sample Analytical Requirements
- Sample Packaging and Shipping
- Sample Documentation

4.3.1 Sample Tracking System

The objective of the sample identification system is to provide a framework for developing sample numbers that are unique to that sample and convey information regarding sample type that will enable data users to easily identify sample locations. The sample designation is established in order to integrate the data into the Navy's Geographical Information System (GIS)

The first two number of the sample tracking system shall refer to this site specific location, which in our case is Building 566. All soil and groundwater sample identifiers shall begin with the number 566. For example 566Soil01 would refer to Building 566, soil sample one. In order to identify the specific sample, the date and round shall be appended to the sample name. 566 Soil01-97-1 would refer to Building 566, soil sample 1 taken from the first round in 1997. A "D" would be added to the sample nomenclature to indicate a duplicate sample. For the purposes of this sampling effort, the following characters shall be assigned to identify the various matrices:

GW = Groundwater SOIL=Soil
EW= Effluent Water

For example, 566EW01-97(3) would be the effluent discharge sample number 1 collected during the third round of sampling in 1997.

A cumulative sampling master log will be maintained as the field program progresses. The samples taken will be referenced to each sampling location in the master log and on a detailed site map.

All location information for the samples will be recorded in the field sampling logbook (Section 4.3.4).

4.3.2 Sample Analytical Requirements

Table 4-1 specifies location, number of samples, matrix, laboratory analyses, and rationale for each sample type. Specific procedures governing sample preservation are presented below.

Reagents required for sample preservation will be added to the sample containers by the laboratory prior to their shipment to the field or added in the field. In general, aqueous samples of low concentration organics (or soil samples of low or medium concentration organics) are cooled to $4^{\circ}C$. Medium and high hazard aqueous or high hazard soil samples are not preserved. Low concentration aqueous samples for TPH are acidified with H_2SO_4 while medium concentration and high hazard aqueous metal samples are not preserved. Soil samples for metals are not preserved.

The soil samples to be analyzed for volatile organics shall be preserved collected and preserved in accordance with NJDEP's Methodology for Field Extraction/Preservation of Soil Samples with Methanol for Volatile Organic Compounds, which is contained in Appendix F.

The following subsections describe the procedures for preparing and adding chemical preservatives. In most cases, preservatives will be added to the sample bottleware by the subcontracted laboratory prior to shipment to the site.

Addition of the following acids and solvents are specified for sample preservation:

Acid/Base Acidification		Concentration	Amount for Normality
H_2SO_4 *	1:1 dilution of concentrated H_2SO_4	18N	2-5 ml
Methanol	2.5:1 volume of methanol to weight of soil ratio	--	--

*Amount of acid to add (at the specified strength) per liter of water to reduce the sample pH to less than 2, assuming that the water is initially at pH 7, and is poorly buffered and does not contain particulate matter.

These reagents should be reagent (AR) grade and should be diluted to the required concentration with double-distilled, deionized water.

The approximate volumes needed to acidify one liter of neutral water to a pH of less than 2 (or raise the pH to 12) are shown in the last column of the above table. These volumes are only approximate; if the water is more alkaline, contains inorganic or organic buffers, or contains suspended particles, more acid may be required. The final pH must be checked using narrow range pH-paper.

Sample acidification or base addition should proceed as follows:

1. Check initial pH of sample with wide range (0-14) pH paper.

2. Fill sample bottle to within 5-10 ml of final desired volume and add about 1/2 of the estimated acid or base required, stir gently and check pH with medium range pH paper (pH 0-6 or pH 7.5-14, respectively).

3. Add acid or base a few drops at a time while stirring gently. Check for final pH using narrow range (0-2.5 or 11-13, respectively) pH paper; when desired pH is reached, cap sample bottle and seal.

Never dip pH paper into the sample; apply a drop of sample to the pH paper while using the stirring rod.

TABLE 4-1
NAVAL WEAPONS STATION-EARLE
DELIVERY ORDER 0017-MODIFICATION NO. 8
SAMPLING AND ANALYSIS REQUIREMENTS

Media	*Analyses*	*Frequency*	*Quantity* *	*Method*	*Rationale*
Soil	TCLP/RCRA Characteristics	Composite soil samples collected from 0 to 4 feet below grade in the drainage field.	4	Full TCLP-EPA SW-846 Total Metals EPA SW-846 3050/6010 RCRA Characterization	Analytical results shall be used to classify soils for transportation and disposal.
Soil	TPH, TOX	Composite samples collected from 0 to 4 feet below grade in the drainage field and 0 to 2 feet below grade in the seep/stain areas	17	EPA 418.1 SW846 Methods 3540A/9020A	Analytical results shall be used to classify soils for transportation and disposal.
Soil	TPH	Grab samples from the excavation sidewalls. One sample per sidewall on the seep excavations, and one sample per 30 linear feet of the drain field excavation. All soils shall be collected 0 to 6 inches above the top of the water in the excavation.	33	SW-846/8015B	Analytical results are to confirm the excavation has removed the soils above the NJDEP clean-up criteria.
Soil	VOCs	Grab samples from the excavation sidewalls. Samples to be collected in areas with TPH concentrations exceeding 1,000 mg/kg.	10	SW-846 Method 8010/8020	Analytical results are to confirm the excavation has removed the soils above the NJDEP clean-up criteria.
LNAPL (Oil)	VOCs, PCBs, BTU, Flashpoint, TSS, TOX	An LNAPL sample of the free phase oil recovered in the excavation	1	SW-846 Method 8010/8020	Analytical results shall be used for characterizing the oil for transportation and recycling.
Water	VOCs, Semi-VOCs TPH	The groundwater pumped from the excavation shall analyzed prior to and after treatment.	11	SW-846 Method 8010/8020 SW-846 Method 8270 EPA-SW-846/8015B	Analytical results shall be used to evaluate the effectiveness of the treatment system and ensure the effluent discharge meets the NJPDES discharge requirements.

* Quantities do not include quality assurance samples

Note: The frequency and parameters of the Effluent Water analyses may be reduced based on historical data collected and the requirements of the NWS-Earle sewer treatment facility.

The laboratory analysis of the vapor discharge may be replaced by monitoring with a PID after initial analytical data is collected.

4.3.3 Sample Packaging and Shipping

The objective of the sample packaging and shipping requirements are to maintain sample integrity from the time a sample is collected until it is received at the analytical laboratory. Chain-of-custody (COC) forms, sample labels, custody seals, and other sample documents will be completed to maintain sample integrity. Specific procedures for packaging and shipping of environmental samples are presented below. These procedures were obtained from the NJDEP Field Sampling Procedures Manual.

4.3.3.1 Environmental Samples

Low-concentration samples are defined as environmental samples and should be packaged for shipment as follows:

1. A sample label is attached to the sample bottle. The label should be taped over with clear packing tape to preserve legibility.

2. A picnic cooler (such as a Coleman or other sturdy cooler) is typically used as a shipping container. In preparation for shipping samples, the drain plug is taped shut from the inside and outside, and a large plastic bag is used as a liner for the cooler. Approximately 1 inch of packing material, such as asbestos-free vermiculite, perlite, or styrofoam beads, is placed in the bottom of the liner. The cooler containing methanol-preserved volatile soil samples must have the following markings on the cooler: Limited Quantity, This End Up. Each sample shall not contain more than one (1) liter of methanol or one (1) gallon of fumic acid, and the total weight of the cooler and packaging material must not exceed four pounds.

3. The sample bottles are placed in the lined picnic cooler. Cardboard separators, and/or additional packing material, should be placed between the bottles to prevent breakage during shipping.

4. Aqueous samples for low or medium-level analysis must be shipped cooled to 4°C with ice. No ice is used in shipping high-level aqueous samples, or soil samples, or dioxin samples. Ice is not required in shipping soil samples, but may be utilized at the option of the sampler. All cyanide samples, however, must be shipped cooled to 4°C.

5. The lined cooler is filled with packing material (such as asbestos-free vermiculite, perlite, or styrofoam beads), and the large inner liner is taped shut. Sufficient packing materials should be used to prevent sample containers from making contact during shipment.

6. The paperwork being shipped to the laboratory is placed inside a plastic bag. The base is sealed and taped to the inside of the cooler lid. A copy of the COC form

should be included in the paperwork sent to the laboratory. The last block on the COC form should indicate the overnight carrier and airbill number. The airbill must be filled out before the samples are handed over to the carrier. The laboratory should be notified if the shipper suspects that the sample contains any substance for which the laboratory personnel should take safety precautions.

7. The cooler is taped shut with strapping tape (filament-type).

8. At least two signed custody seals are placed on the cooler, one on the front and one on the back.

9. The cooler is handed over to the overnight carrier. A standard airbill is necessary for shipping environmental samples.

10. The name and address of the shipper and consignee are placed on the exterior of the container in addition to the shipping papers. Commercial address labels may be used.

    - The DOT Proper Shipping Names and UN# are placed on the outside of the cooler:

      For methanol preserved samples: Methanol, PG II, UN1230, or Flammable Liquid, NOS (Methanol), PG II, UN1230

    - The words "Limited Quantity" are written on the cooler adjacent to the Proper Shipping Name and UN#. A DOT Hazard Class Label is not required for limited quantity samples.

    - Markings indicating "This End Up" with upward pointing arrows are placed on two (2) sides of the container. Commercially printed labels shall be used.

11. The cooler is handed over to the overnight carrier. A Dangerous Goods airbill is necessary for shipping environmental samples if preserved with methanol or acid. A standard airbill can be used to ship the samples if there are no preservatives.

12. Arrow symbols indicating "This Way Up" should be placed on the cooler in addition to the marking and labels described above.

13. Restricted-article/Dangerous Goods airbills are used for shipment indicating the following:

    - Number of packages or number of coolers

    - Proper shipping name and packaging group. If unknown, use FLAMMABLE SOLID, N.O.S. or FLAMMABLE LIQUID, N.O.S.

- Hazard Class; if unknown, use flammable solid or flammable liquid.

- Words "Limited Quantity" if inner containers meet the volume limits for limited quantities under 49CFR173.

- Identification number; if unknown, use UN1325 (for flammable solids) or UN1993 (for flammable liquids).

- Net quantity per package or amount of substance in each cooler.

- Radioactive materials section (leave blank).

- Passenger or cargo aircraft (cross off the nonapplicable). Up to 25 pounds of flammable solid per cooler can be shipped on a passenger or cargo aircraft. Up to one quart of flammable liquid per cooler can be shipped on a passenger aircraft, and up to 10 gallons of flammable liquids per cooler can be shipped on a cargo aircraft). Use Hazardous Materials Table (49CFR172.101) column (9) to verify quantity restrictions for other Proper Shipping Names.

- Name and title of shipper (printed).

- An emergency telephone number at which the shipper can be reached within 24-48 hours.

- Emergency Response Guide Number

- Shipper's signature

NOTE: The penalties for improper shipment of hazardous materials are severe. A fine of $25,000 and five years imprisonment can be imposed for each violation.

4.3.3.2 Hazardous Samples

Medium- and high-concentration samples are defined as hazardous and must be packaged as follows:

1. A sample label is attached to the sample bottle. The label should be taped over with clear packaging tape to preserve legibility.

2. Each sample bottle is placed in a plastic bag, and the bag is sealed. For medium-concentration water samples, each VOA vial is wrapped in a paper towel, and the two vials are placed in one bag. As much air as possible is squeezed from the bags before sealing.

3. Each bottle is placed in a separate paint can, the paint can is filled with vermiculite, and the lid is fixed to the can. The lid must be sealed with metal clips, or with filament or evidence tape; if clips are used, the manufacturer normally recommend six clips.

4. Arrows are placed on the can to indicate which end is up.

5. The outside of each can must contain the proper DOT shipping name and identification number for the sample. The information may be placed on stickers or printed legibly. A liquid sample of an uncertain nature is shipped as a flammable liquid with shipping name "FLAMMABLE LIQUID, N.O.S." and the identification number "UN1993." A solid sample of uncertain nature is shipped as a flammable solid with the shipping name "FLAMMABLE SOLID, N.O.S." and the identification number "UN1325." If the nature of the sample is known, 49 CFR 171-177 is consulted to determine the proper labeling and packaging requirements.

6. The cans are placed upright in a cooler lined with a plastic garbage-type bag, with the drain plug taped shut inside and out. Asbestos-free vermiculite, perlite, or styrofoam is placed in the bottom of the cooler. Two sizes of paint cans are used: half-gallon and gallon. The half-gallon paint cans may be stored on top of each other; however, one-gallon cans are too high to stack. The cooler is filled with packing material and the plastic liner is taped shut.

7. The paperwork going to the laboratory is placed inside a sealable plastic bag and taped to the inside of the cooler lid. A copy of the COC form must be included in the paperwork sent to the laboratory. The sampler keeps one copy of the COC form. The laboratory should be notified if the sample is suspected of containing any substance for which laboratory personnel should take safety precautions.

8. The cooler is closed and sealed with strapping tape. At least two custody seals are placed on the outside of the cooler (one on the front and one on the back).

9. The following markings are placed on top of the cooler:

    - Proper shipping name (49 CFR 172.301)
    - DOT identification number (49 CFR 172.301)
    - Shipper's or consignee's name and address (49 CFR 172.306)
    - "This End Up" legibly written if shipment contains liquid hazardous materials (49 CFR 172.312)

10. The following labels are required on top of the cooler (49 CFR 172.406e):

    - Appropriate hazard class label (placed next to the proper shipping name)

- "Cargo Aircraft Only" (if applicable as identified in 49 CFR 172.101)

11. Arrow symbols indicating "This Way Up" should be placed on the cooler in addition to the marking and labels described above.

12. Restricted-article airbills are used for shipment indicating the following:

    - Number of packages or number of coolers.
    - Proper shipping name. If unknown, use FLAMMABLE SOLID, N.O.S. or FLAMMABLE LIQUID, N.O.S.
    - Classification; if unknown, use flammable solid or flammable liquid.
    - Identification number; if unknown, use UN1325 (for flammable solids) or UN1993 (for flammable liquids).
    - Net quantity per package or amount of substance in each cooler.
    - Radioactive materials section (leave blank).
    - Passenger or cargo aircraft (cross off the nonapplicable). Up to 25 pounds of flammable solid per cooler can be shipped on a passenger or cargo aircraft. Up to 1 quart of flammable liquid per cooler can be shipped on a passenger aircraft, and up to 10 gallons of flammable liquids per cooler can be shipped on a cargo aircraft).
    - Name and title of shipper (printed).
    - An emergency telephone number at which the shipper can be reached within 24-48 hours.
    - Shipper's signature.

NOTE: The penalties for improper shipment of hazardous materials are severe. A fine of $25,000 and five years imprisonment can be imposed for each violation.

4.3.4 Sample Documentation

The following documentation is associated with sample collection and transfer:

- Field Logbooks
- Site Logbooks
- Master Sample Log

- Sample Label
- Chain-of-Custody Form
- Custody Seals
- Shipping Airbill.

5.0 FIELD INVESTIGATION ACTIVITIES

5.1 Standard Operating Procedures (SOPs)

Technical guidelines used in preparing this SAP were obtained primarily from the following sources:

- June 1988 Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program, NESSA 20.2-047B

- The USEPA REM III/ARCS II Program Field Technical Guidelines, prepared for the USEPA by FWENC under Contract Number 68-01-7250 (Field Technical Guidelines)

- The New Jersey Department of Environmental Protection (NJDEP) Field Sampling Procedures Manual (May 1992)

- The New Jersey Department of Environmental Protection Methodology for the Field Extraction of Soils with Methanol for Volatile Organics. December 1996

All of the aforementioned guidance documents were consulted in preparation of this SAP to ensure that the procedures presented in this SAP are consistent with each document.

5.2 Field Investigation Program

The following sections detail the field investigation program. Primary tasks of the program include Mobilization/Demobilization (Section 5.2.1), Soil Sampling Prior to Excavation (Section 5.2.2), Water Sampling (Section 5.2.3), LNAPL Sampling (Section 5.2.4), and Confirmatory Soil Sampling (Section 5.2.6).

5.2.1 Mobilization and Demobilization

Mobilization shall consist of contacting appropriate Navy personnel at NWS Earle to arrange for contractor passes and to coordinate support requirements for the soil excavation and removal and the operation of the recovery system.

As part of the mobilization activity, FWENC shall see if the Navy is able to cut the power to the overhead power lines above the drain field to be excavated to ensure safe working

In addition to the items listed above, all pertinent observations about drilling rate, equipment operation, or unusual conditions should be noted. Such information might include the following:

- Size of casing used and method of installation
- Rig reactions such as chatter, rod drops, and bouncing
- Drilling rate changes
- Depth and percentage of fluid losses
- Changes in fluid color or consistency
- Material changes
- Zones of caving or heaving

Description of soils is based on the Unified Soil Classification System (USCS) as described in ASTM D2487-69(1975) Test Method for Classification of Soils for Engineering Purposes and ASTM D2488-69(1975) Recommended Practice of Description of Soils (Visual-Manual Procedure).

5.2.3 Water Sampling

Objective

The objectives of the water sampling and analysis are to demonstrate the effectiveness of the groundwater treatment system, establish media loading factors, and ensure compliance with the NJPDES permit for discharge to surface waters.

Location, Frequency and Analysis

During the initial start-up of the groundwater treatment system, several water samples shall be obtained along the treatment train to establish removal efficiencies, media loading factors, and effluent concentrations. One sample of groundwater, prior to treatment, shall be sampled and analyzed for volatile organics, semi-volatile organics, and total petroleum hydrocarbons (TPH). Effluent samples shall be collected and analyzed for volatile organics, semi-volatile organics, and TPH after each of the clay absorption units and each of the activated carbon units. The treated effluent, at least during the initial start-up, shall be stored in a frac tank until the analytical results are reviewed.

One set of effluent samples a week shall be obtained during the operation of the treatment system. One water sample after the two clay units and one after the two carbon units shall be collected and analyzed for volatile organics, semi-volatile organics and TPH.

5.2.4 LNAPL Sampling

Objective

The free phase oil, or LNAPL, pumped from the excavation shall be analyzed for waste characterization in order to arrange the transportation and recycling of the oil.

Location, Frequency and Analysis

An oil/LNAPL sample shall be collected and analyzed when a sufficient volume has been collected from the excavation. The oil shall be analyzed for TCL VOCs, PCBs, BTU, Flashpoint, TSS, and TOX.

The product accumulation drum shall be measured weekly in order to determine the amount of oil being recovered.

Equipment and Procedures

A sample of the free-phase oil shall be collected once a sufficient volume of oil is recovered from the excavation.

The free-phase oil shall be decanted from the top of the water into a sample jar.

Measuring Devices

The free-phase oil accumulating in the product drum shall be measured in order to evaluate the amount of oil being recovered. A Solinst Model 121 interface meter will be used to measure product thickness. All product thickness and groundwater level measurements will be made to the nearest 0.01' and recorded in a Field Logbook.

5.2.5 Confirmatory Soil Sampling

Objectives

Post excavation samples shall be collected in order to determine if the NJDEP clean-up criteria have been satisfied.

Location, Frequency and Analysis

In accordance with N.J.A.C. 7:26E-6.3 soil samples shall be collected from each sidewall of the seep excavations and analyzed for total petroleum hydrocarbons (TPH) The soil samples shall be collected 0 to 6 inches above the water table on each of the sidewalls with a stainless steel trowel. Four sidewall samples shall be collected from each excavation with the exceptions of Seep #6 and Seep #1. The confirmatory samples for

Seep #6 shall be incorporated with the Drain Field Sampling. A total of seven soil samples shall be collected from the sidewalls of Seep #1 in order to comply with N.J.A.C 7:26E-6.3 requirements of 1 sample per 30 linear feet of sidewall. A minimum of one soil sample shall be collected and analyzed for volatile organics plus ten (VO+10). The one sample soil VO+10 shall be biased towards the area anticipated to contain the highest concentration.

The collection of the post excavation samples from the Drain Field shall be dependent upon the amount of oil that infiltrates into the excavated area during the soil removal process. If only a small amount of oil enters the Drain Field excavation, the samples shall be collected immediately after excavation activities are completed. If a large amount of oil and water infiltrate the excavation, it shall be necessary to first remove all the available free product from the excavation, and the soil on the sidewalls may have to be scraped off with the excavator and disposed. By scraping off the sidewalls, the soils that were previously affected by the oil in the excavation can be removed and a more representative sample of the existing soil can be obtained.

Soil samples shall be collected from each of the sidewalls of the Drain Field at intervals of 30 linear feet and analyzed for TPH. The soil samples shall be collected 0 to 6 inches above the water table on each of the sidewalls with a stainless steel trowel. A minimum of one soil sample shall be collected and analyzed for volatile organics plus ten (VO+10). The one sample soil VO+10 shall be biased towards the area anticipated to contain the highest concentration. If the analytical results of any of the confirmatory soil samples reveal TPH concentration greater than 1,000 mg/kg, soil samples shall be collected from those areas after additional excavation, and analyzed for TPH and VO+10.

Sampling Equipment and Procedures

A dedicated, modified syringe shall be used to collect small diameter cores (10 grams) of soil samples to be analyzed for VOCs. A complete description of the sampling collection and analysis procedure for VOCs is presented in Appendix D.

5.3 Decontamination

The objective of this section is to provide the methodology for the proper decontamination procedures to be used on chemical sampling and field analytical equipment.

In order to assure that chemical analysis results are reflective of the actual concentrations present at sampling locations, chemical sampling and field analysis equipment must be properly decontaminated prior to the field effort, during the sampling program (i.e. between sample points), and at the conclusion of the sampling program. This will minimize the potential for cross-contamination between sample points and the transfer of contamination off-site.

Prior to sampling, equipment will be decontaminated using the following procedures:

1. Potable water rinse.

2. Alconox or Liquinox detergent wash.

3. Scrubbing with a scrub brush may be required if the equipment is heavily contaminated with heavy or extremely viscous compounds (not anticipated).

4. Potable water rinse.

5. Rinse with 10% nitric acid solution

6. Distilled, deionized water rinse.

7. Methanol rinse.

8. Distilled, deionized water rinse.

9. Air dry.

10. Wrap sampling equipment in aluminum foil (shiny side out).

Decontamination fluids containing nitric acid and methanol rinse solutions should be containerized separately from rinse water consisting of water and soap only.

6.0 QA/QC VERIFICATION OF FIELD SAMPLING AND PROCEDURES FOR FIELD CHANGES AND CORRECTIVE ACTION

6.1 QA/QC Field Audits

Quality assurance and quality control during the sampling program will be performed by the Foster Wheeler Environmental Project Superintendent (PM). The PM will supervise all sampling and documentation and subcontractor operations to ensure that all activities are being performed in accordance with the SAP. The PM will report all findings to the SPEM.

6.2 Field Changes and Corrective Actions

The SPEM or his designee is responsible for all site activities. In this role, the SPEM is required at times to adjust the field program to accommodate site-specific needs. When it becomes necessary to modify a program, the responsible sampling personnel will notify the SPEM of the anticipated changes prior to implementation. Changes will only be acted upon with the SPEM's concurrence. The SPEM will consult with the Navy Technical Representative (NTR) ahead of time for major changes and receive his/her

approval. If changes are implemented that are subsequently determined to be unacceptable, the actions taken during the period of deviation will be evaluated to determine the significance of any departure from established program practices.

The changes in the program will be documented on a Change Request Form (CRF), which will be signed by the PS and the SPEM. The CRFs for each change will be numbered sequentially starting with the number "01." A copy of the CRF will be attached to the file copy of the SAP. The SPEM is responsible for controlling, tracking, and implementing the identified changes.

7.0 HEALTH AND SAFETY REQUIREMENTS

The site-specific Health and Safety Plan (HASP) is provided as a separate submittal. As required by paragraph 1.2.1, Pre- and Post-Construction documentation, the HASP includes organizational information, a potential hazards assessment, protective equipment requirements, air monitoring, site controls and protective zones, medical surveillance procedures, emergency response and spill control measures, and training requirements.

8.0 WASTE REMOVAL/REGULATORY COMPLIANCE

This section addresses how the various waste streams generated during the Building 566 UST Remediation will be handled. These waste streams include excavated soils, groundwater, recovered free product, and investigation derived wastes.

8.1 Soils

The soils to be excavated shall be sampled and analyzed for waste characterization prior to the excavation activities. Seventeen (17) soil samples shall be collected and analyzed for TPH and TOX as described in Table 4-1. The samples shall be collected in the drain field from the gridded locations and the seep areas depicted on Figure 3-1. The soil samples shall be collected from 0 to 4 feet below grade in the drain field and 0 to 2 feet below grade in the seep areas. Four soil samples shall be collected from the most visibly contaminated areas in the drain field and analyzed for full scan TCLP, total metals, RCRA characterization, TPH and TOX as described in Table 4-1. The petroleum contaminated soils are likely to be sent to a recycling facility.

8.2 Groundwater

The groundwater and oil pumped from the excavation shall be contained in a double-walled 4,900 gallon frac tank. After allowing the oil to separate overnight, the water shall be pumped from the bottom of the frac tank to a second 4,900 gallon frac tank for subsequent treatment. The groundwater shall be treated and discharged to the adjacent Mingamohone Brook. The treatment system shall be operated in accordance with a Treatment Works Approval (TWA) permit obtained from NJDEP. The treatment system shall consist of a bag filter, two clay absorption units, and two carbon adsorption units in series. The treated groundwater will be discharged to the surface waters of Mingamohone Brook under a NJPDES permit. The water shall be analyzed for the parameters to be set in the NJPDES permit.

8.3 Recovered Free Product

Recovered free product shall periodically vacuumed of the top of the double-walled frac tank by an oil recycler. The oil will be transported off-site for recycling. The oil shall be analyzed for TCL VOCs, PCBs, BTU, Flashpoint, TSS, and TOX prior to recycling.

8.4 Investigation Derived Wastes

As part of the Building 566 Soil Excavation, several investigation derived waste streams will be generated. These include decontamination fluids, PPE, and other miscellaneous debris. These wastes shall be collected, stored separately and tested to determine waste characteristics for purposes of waste classification and disposal facility selection. Depending upon classification, investigation derived wastes will be disposed of in accordance with NJDEP solid waste and/or Hazardous Waste Regulations.

8.5 Manifests/Shipping Papers

Foster Wheeler Environmental shall provide completed waste manifests and/or bills of lading and transport documentation to the Navy for review and signature.

8.6 Waste Transport and Disposal

Foster Wheeler Environmental shall subcontract for waste transport and disposal (T&D) services. The T&D subcontractor shall be competitively procured from the five firms with which Foster Wheeler Environmental has preplaced basic ordering agreements. This assures the Navy that solid and/or hazardous wastes will be sent to an EPA NJDEP-approved facilities. All disposal facilities transporters both hazardous and solid waste, to be used for disposal of the Navy's wastes, will be evaluated for regulatory compliance and approved for use in accordance with Foster Wheeler Corporation Regulatory Compliance Procedures. Approved facilities and transporters will be submitted to the Navy for final approval.

- Each container of hazardous waste of 110 gallons or less will be marked in accordance with US DOT requirements under 49 CFR 172.304 with the following:

  HAZARDOUS WASTE-FEDERAL LAW PROHIBITS IMPROPER DISPOSAL. If found contact the nearest police or public safety authority or the Environmental Protection Agency.
  Generator name and Address_____
  Manifest Document Number_____

- Waste will be placed in containers in good condition. If container begins to leak, the contents will be transferred from the defective container into a good container.

- The containers used will be made of or lined with a material that does not react with and is compatible with the waste.

- The containers shall remain closed during storage except when waste is added or removed from the container.

- The containers will not be opened, stored, or handled in a manner which will cause the container to leak.

- The containers will be labeled to accurately identify their contents.

- The storage area and containers will be inspected at least weekly to identify leaks and/or deterioration. Inspection reports will be documented in writing.

- Incompatible wastes will not be placed within the same container or in an unwashed container that previously held an incompatible waste or material.

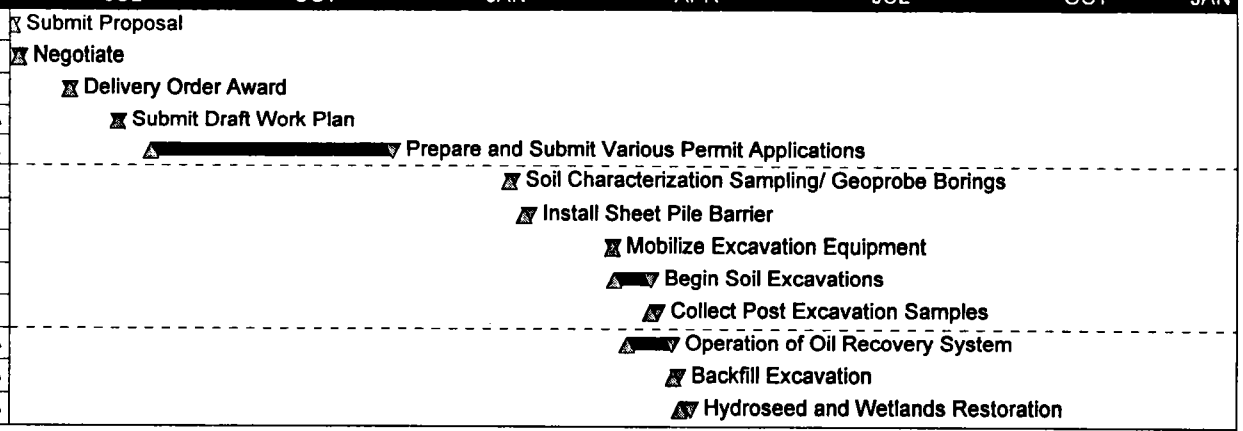
- A container holding a waste that is incompatible with other wastes or materials will be segregated from the other materials or protected by means of an impermeable dike, wall, berm or other device.

- Upon project closure, all hazardous waste and hazardous waste residues will be removed from the containment system. The containment system will be decontaminated and all wastes will be disposed off-site at a permitted disposal facility.

- Appropriate hazardous training will be provided to site personnel as per 40 CFR 265.16, and 29 CFR 1910.120.

- A Contingency Plan will be developed to handle any fire, spill, or emergency and appropriate emergency response equipment (spill cleanup materials, fire protection

Description	Early Start	Early Finish
Submit Proposal	24JUN97 A	24JUN97
Negotiate	27JUN97 A	27JUN97 A
Delivery Order Award	21JUL97 A	21JUL97 A
Submit Draft Work Plan	13AUG97 A	13AUG97 A
Prepare and Submit Various Permit	29AUG97 A	22DEC97 A
Soil Characterization Sampling/ Geoprobe	16FEB98 A	17FEB98 A
Install Sheet Pile Barrier	23FEB98 A	25FEB98 A
Mobilize Excavation Equipment	06APR98 A	06APR98 A
Begin Soil Excavations	07APR98 A	24APR98 A
Collect Post Excavation Samples	24APR98 A	27APR98 A
Operation of Oil Recovery System	13APR98 A	04MAY98 A
Backfill Excavation	05MAY98 A	07MAY98 A
Hydroseed and Wetlands Restoration	08MAY98 A	13MAY98 A



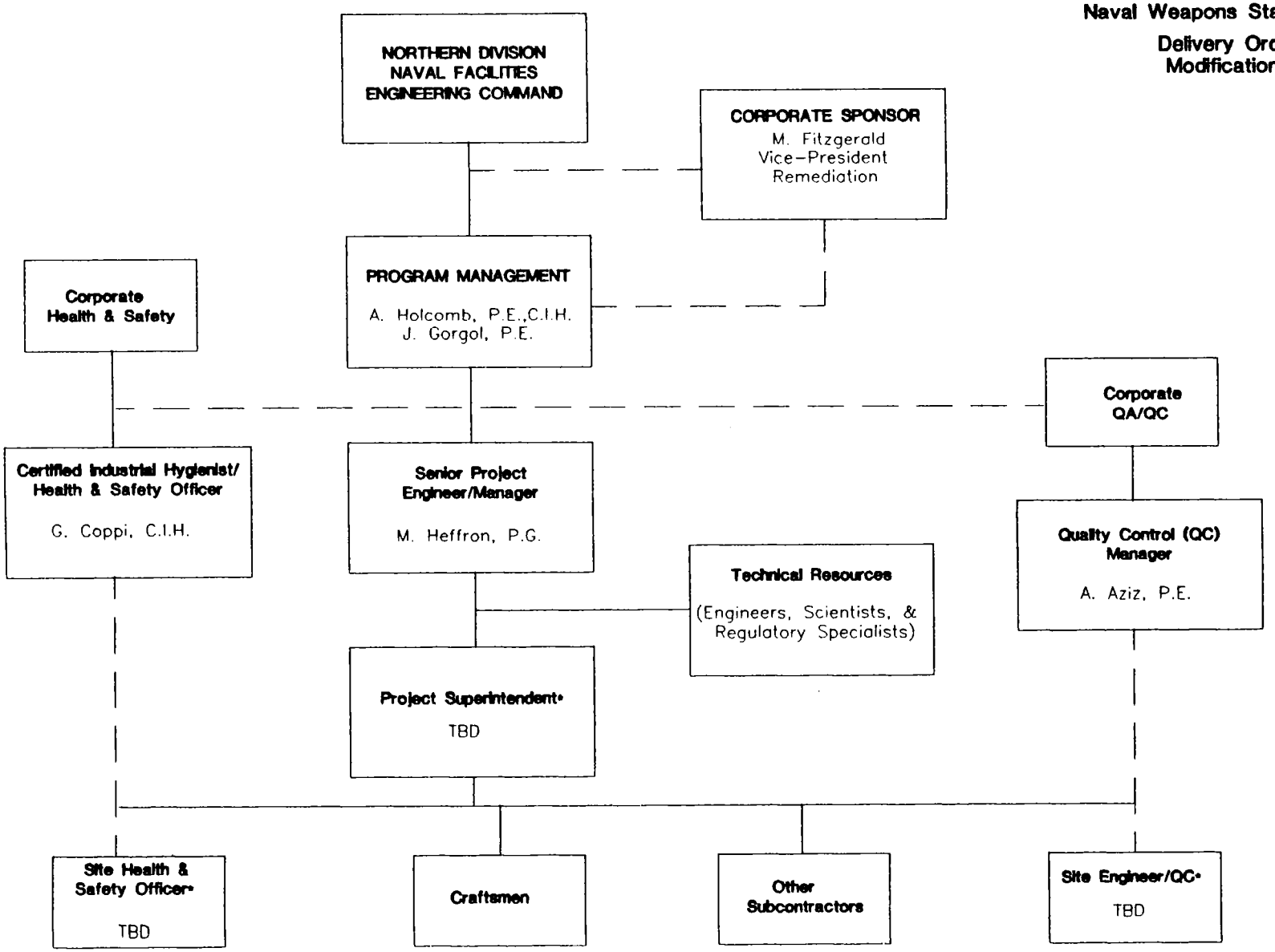
▲ Early start point	—— Summary bar
▼ Early finish point	▲ Progress point
▬ Early bar	▲ Critical point
▼ Late finish point	▼ Summary point
▬ Total float bar	◆ Start milestone point
▬ Progress bar	◆ Finish milestone point
▬ Critical bar	

EXHIBIT 9-1
FOSTER WHEELER ENVIRONMENTAL
Naval Weapons Station Earle

Building 566 UST Remediation

Date	Revision	Checked	Approved
25AUG95	0	MH	JTS
07JAN98	1	MH	

Figure 9-2
Naval Weapons Station - Earle
Delivery Order 17
Modification 08



novyrac\akram4

10.4 Tests and Inspections

Foster Wheeler Environmental will perform preparatory, initial, and follow-up inspections.

10.5 Changes

If circumstances develop during the project that make it necessary or advisable to revise the Work Plan in order to accomplish project objectives, a CRF will be forwarded to the Navy for approval. Events such as a change in the site conditions or system performance may result in a CRF. Changes may be discussed with the Navy Design Manager telephonically and followed up with a CRF to avoid negative impacts on the project budget.

10.6 Documentation

Documentation of operations, record keeping, photographic evidence of work performed, and as analytical results will be provided to the Navy in the Closure Report.

10.6.1 Operations Record keeping

All field inspection and testing activities will be documented in a project logbook. The project logbook will be maintained in accordance with the relevant Foster Wheeler Environmental Field Technical Guidelines. The Project Manager will maintain records of quality control operations and activities for subcontractors and suppliers.

10.6.2 Photographic Documentation

Still 35mm color photographs will be taken as needed to record work progress. At a minimum, photographs will be taken of the existing conditions before work begins, during the excavation activities and during the groundwater treatment and backfilling operations. Photograph location, date and description of the activity recorded will be entered in a photo documentation log. The photographs and log will be submitted with the Closure Report

Summary for the Wetland Delineation at Building 566
NWS Earle

Introduction

The Building 566 Site was visited on December 8, 1994 to excavate wells and delineate the wetlands. The site was visited again on December 9, 1994 to reevaluate the depth to standing water in the wells. The Building 566 Site overlooks the headwaters of Mingamahone Brook. The area was impacted by development of the NWS Earle facility many years ago and the wetlands were channalized, straightened, and dredged. The area today is a complex of mowed, grassed swales and ditches with flowing water in the ditches. The wetlands occurred within and adjacent to the streams and ditches and in several seeps located upslope of the streams.

Soils

Although mapped as a Udorthent soil, altered by excavating and filling, unaltered wooded areas to the north and south indicate the area was once Atsion sand (hydric) and frequently flooded Humaquepts (hydric). Soil borings indicated that the area nearest the ditches was likely Manahawkin muck (hydric) inclusions and still retains many of the characteristics of this soil. The borings in the lower portions of the area adjacent to the streams revealed a surface layer of 8-10 inches of black organic muck on top of grayish brown sand. The upland portions of the area contained little or no organic muck over the sand. The 1987 Corps of Engineers Wetland Delineation Manual states that organic material above the mineral soil in sandy soils is indicative of hydric soils. Additionally, saturated soils were often encountered within 1 foot of the soil's surface. Those areas containing organic muck soils and saturated soils within 1 foot of the soil's surface satisfied the soils component of the wetland determination.

Hydrology

Shallow wells (approximately 2 feet deep) were excavated in transects upslope from the streams and ditches. Between three and five holes were excavated on each transect and the holes were allowed to stand for 1 to 2 hours. If water appeared in the holes at a depth of less than 12 inches the point was recorded as having satisfied the hydrology component of the wetlands determination. In one instance, near wetland point 11, and immediately downslope of the suspected contamination, flowing water was observed in the creek, 2 feet downslope of the hole, yet no water appeared in the excavated well. Because it was unusual to find a dry well so close to flowing water, this well was covered, to keep out rain, and visited the next day. After 24 hours, as expected, the hole had filled with water to within 2 inches of the soil's surface. However, the hole dug 15 feet upslope contained no water after 24 hours. The wetland line was established and surveyed between these two points and 4 feet upslope from the hole containing 2 inches of water.

Vegetation

The vegetation in the ditches and immediately adjacent to the ditches was primarily of the genus Juncas. Because of the lack of seed heads during the winter, this plant could not be identified to species. However, the four Juncas species found on NWS Earle are all hydrophytic species indicative of wetlands. The species include: J. tenuis, J. effusus, J. brachycephalus, and J. diffusissimus. Farther upslope from the ditch, the Juncas is gradually replaced by fescue. The entire area is mowed. Phragmites communis is found in the ditch between wetland points19 and 22.

Additionally, several seeps were noted upslope of the streams. Although considerably upslope of the streams and dominated by fescue, the seeps contained about

25 percent Juncas with water at the soil's surface. The soils were black muck over sand and clay.

Much of the area mapped as wetlands contained a predominance of fescue and only 25 to 50 percent Juncas. While these areas did not meet the strict requirements for the vegetation component of the wetlands determination, they were still mapped as wetlands. Because the Juncas and fescue were mowed and could not be identified to species, it was felt that if the saturated, black muck soils, and water 2 inches below the soil's surface was ignored and these areas containing predominately fescue were mapped as uplands; it would underestimate the wetland area. To more accurately understand this hydrology, the area would have to be visited several times during the growing season before a recent mowing. However, for the purposes of this project, it should not be necessary to perform these additional surveys if we take the conservative approach and map the areas according to the soils and hydrology component of the wetlands determination.

While the smell of petroleum was intense near the black stained upland area behind Building 566. No oil was noted on the water's surface in any of the ditches, streams, or seeps. Additionally, no wetland vegetation exhibited stressed conditions that could not be attributed to mowing or cold weather.

DATA FORM 1 WETLAND DETERMINATION

Applicant Name: NWS EARLE Application Number: _____ Project Name: 561

State: N. J. County: Monmouth Legal Description: Township: _ Range: _____

Date: 12/8/94 Plot No.: ~~[redacted]~~ A41 Section: _____

Vegetation [list the three dominant species in each vegetation layer (5 if only 1 or 2 layers)].

Indicate species with observed morphological or known physiological adaptations with an asterisk.

Hole 13 8' SW of WL Line

Species	Indicator Status	Species	Indicator Status
Trees		**Herbs**	
1.		7. Juncus effusus brachycephalus	OBL
2. None		8. Festu diffussissima	FACW
3.		9.	
Saplings/shrubs		**Woody vines**	
4.		10.	
5. None		11.	
6.		12.	

All Fescue are FAC or FACW

% of species that are OBL, FACW, and/or FAC: 50. Other indicators: _____.

Hydrophytic vegetation: Yes ~~N~~. No ✓. Basis: 50% of plants are OBL FACW The altered state of the ~~site~~ area is upland but soils & Hydrology Disagree confuses the issue, Plants say the FAC

Soil

Series and phase: Atsion Sand On hydric soils list? Yes ✓ No _____

Mottled: Yes _____; No ✓. Mottle color: _____; Matrix color: _____

Gleyed: Yes _____ No ✓. Other indicators: _____

Hydric soils: Yes ✓; No _____; Basis: Top 8" is Black organic muck on top of Sand

Hydrology

Inundated: Yes _____ No ✓ Depth of standing water: _____

Saturated soils: Yes ✓; No _____. Depth to saturated soil: 10" to saturated soil

Other indicators: _____

Wetland hydrology: Yes ✓; No _____. Basis: _____

Atypical situation: Yes ✓; No ___.

Normal Circumstances?: Yes ✓ No ~~HH~~.

Wetland Determination: Wetland ✓; Nonwetland _____

Comments: Staked wetland line 8' upslope of point

Determined by: Robert Abornethy

DATA FORM 1 WETLAND DETERMINATION

Applicant Name: NWS EARLE Application Number: _____ Project Name: 566

State: N. J. County: Monmouth Legal Description: Township: _ Range: ____

Date: 12/9/94 Plot No.: 566 A 1 Section: _____

Vegetation [list the three dominant species in each vegetation layer (5 if only 1 or 2 layers)].

Indicate species with observed morphological or known physiological adaptations with an asterisk.

Species	Indicator Status	Species	Indicator Status
Trees		**Herbs**	
1.		7. Fescue	all Fescue are Fac or FacW
2. None		8. Juncus Tenuis	Fac
3.		Juncus effusus	FacW+
Saplings/shrubs		9. Juncus brachycephalus	OBL
4.		Juncus diffusissimus	FACW
5. None		**Woody vines**	
6.		10. None	
		11.	
		12.	

of The 4 Juncos found on Earle all are Hydrophytic

% of species that are OBL, FACW, and/or FAC: 25%. Other indicators: _____.

Hydrophytic vegetation: Yes __. No ✓. Basis: Less than 50% obligate

Soil Atsion Sand

Series and phase: On hydric soils list? Yes ✓ No _____

Mottled: Yes _____; No ✓. Mottle color: _____; Matrix color: _____

Gleyed: Yes _____ No ✓. Other indicators: _____

Hydric soils: Yes _____; No ✓; Basis: Although the soil is on the hydric soils list, saturation was 18 inches below the soil's surface and there was no distinct organic layer above the sand.

Hydrology

Inundated: Yes _____ No ✓. Depth of standing water: _____

Saturated soils: Yes _____, No ✓. Depth to saturated soil: Saturated at 19"

Other indicators: _____

Wetland hydrology: Yes _____; No ✓. Basis: _____

Atypical situation: Yes ✓; No _____.

Normal Circumstances?: Yes __ No ✓.

Wetland Determination: Wetland ✓; Nonwetland _____

Comments: The area is a mowed ditch Bank and Juncos is present but not Dominant

Point is 1' upslope ~~wetland line~~ & Flagged Line ~~[illegible]~~

Determined by: Robert Abernethy

Baseball size stone RipRap The bottom and sides of much of this Ditch water is flowing

DATA FORM 1 WETLAND DETERMINATION

Applicant Name: NWS EARLE Application Number: _____ Project Name: 566

State: N. J. County: Monmouth Legal Description: Township: _ Range: _____

Date: 12/9/94 Plot No.: A-11 Section: _____

Vegetation [list the three dominant species in each vegetation layer (5 if only 1 or 2 layers)].

Indicate species with observed morphological or known physiological adaptations with an asterisk.

Species	Indicator Status	Species	Indicator Status
Trees		Herbs	
1.		7. Juncus effusus	FAC-
2. None		8. Festuca brachycephalus	FACW
3.		9. Festuca diffusissima	OBL
Saplings/shrubs		Woody vines	FACW
4.		10.	
5. None		11. None	
6.		12.	

all Festuca are Fac or FacW

all Juncus on Earle are Hydrophytic

% of species that are OBL, FACW, and/or FAC: 25% Other indicators: _____.

Hydrophytic vegetation: Yes __. No ✓. Basis: less than 50%

Again this site is highly altered

Soil

Series and phase: Atsion Sand On hydric soils list? Yes ✓ No _____

Mottled: Yes _____; No ✓. Mottle color: _____; Matrix color: _____

Gleyed: Yes _____ No ✓. Other indicators: standing water in Ditch and 2" down in hole

Hydric soils: Yes ✓; No _____; Basis: Saturated soils not evident 24 hours later 2' and 15' upslope of line

creek is 2' downslope

Hydrology ✓

Inundated: Yes _____ No ✓. Depth of standing water: 1" drop in creek

Saturated soils: (Yes) _____; No _____. Depth to saturated soil: ~~2~~ 2" after 24 hours

Other indicators: _____

Wetland hydrology: Yes ✓; No _____. Basis: _____

Atypical situation: Yes ✓; No _____

Normal Circumstances?: Yes __ No ✓.

Wetland Determination: Wetland ✓; Nonwetland _____

Comments: point taken at Down slope of Flagged wetland line

Holes dug 15' upslope Determined by: Robert Abernethy

Saturation in holes 1 15' upslope at 24" after 24 hours

DATA FORM 1 WETLAND DETERMINATION

Applicant Name: NWS EARLE Application Number: _____ Project Name: 566

State: N. J. County: Monmouth Legal Description: Township: _ Range: ____

Date: 12/8/94 Plot No.: A 47 Section: _____

Vegetation [list the three dominant species in each vegetation layer (5 if only 1 or 2 layers)].

Indicate species with observed morphological or known physiological adaptations with an asterisk.

Species	Indicator Status	Species	Indicator Status
Trees		**Herbs**	
1.		7. Fescue all Fescue are FacuFacu	
2. None		8. Juncus effusus Fenuis	Fac-
3.		9. brachycephalus diffusissimus	OBL FacW
Saplings/shrubs		**Woody vines**	
4.		10.	
5. None		11. None	
6.		12.	

% of species that are OBL, FACW, and/or FAC: 25%. Other indicators: _____.

Hydrophytic vegetation: Yes ~~NO~~. No ~~YES~~ ✓. Basis: ~~Not 50%~~ The point does not have 50% Fac OBL FacW Fac however this is an altered site and soils + hydrology say it is not

Soil

Series and phase: Atsion sand On hydric soils list? Yes ✓ No _____

Mottled: Yes _____; No ✓. Mottle color: _____; Matrix color: _____

Gleyed: Yes _____ No ✓. Other indicators: _____

Hydric soils: Yes ✓; No _____; Basis: Blackmock Soils are type of sands

Hydrology

Inundated: Yes _____ No ✓. Depth of standing water: _____

Saturated soils: Yes ✓; No _____. Depth to saturated soil: ~~0~~ 14" to Saturated Soil

Other indicators: _____

Wetland hydrology: Yes ✓; No _____. Basis: _____

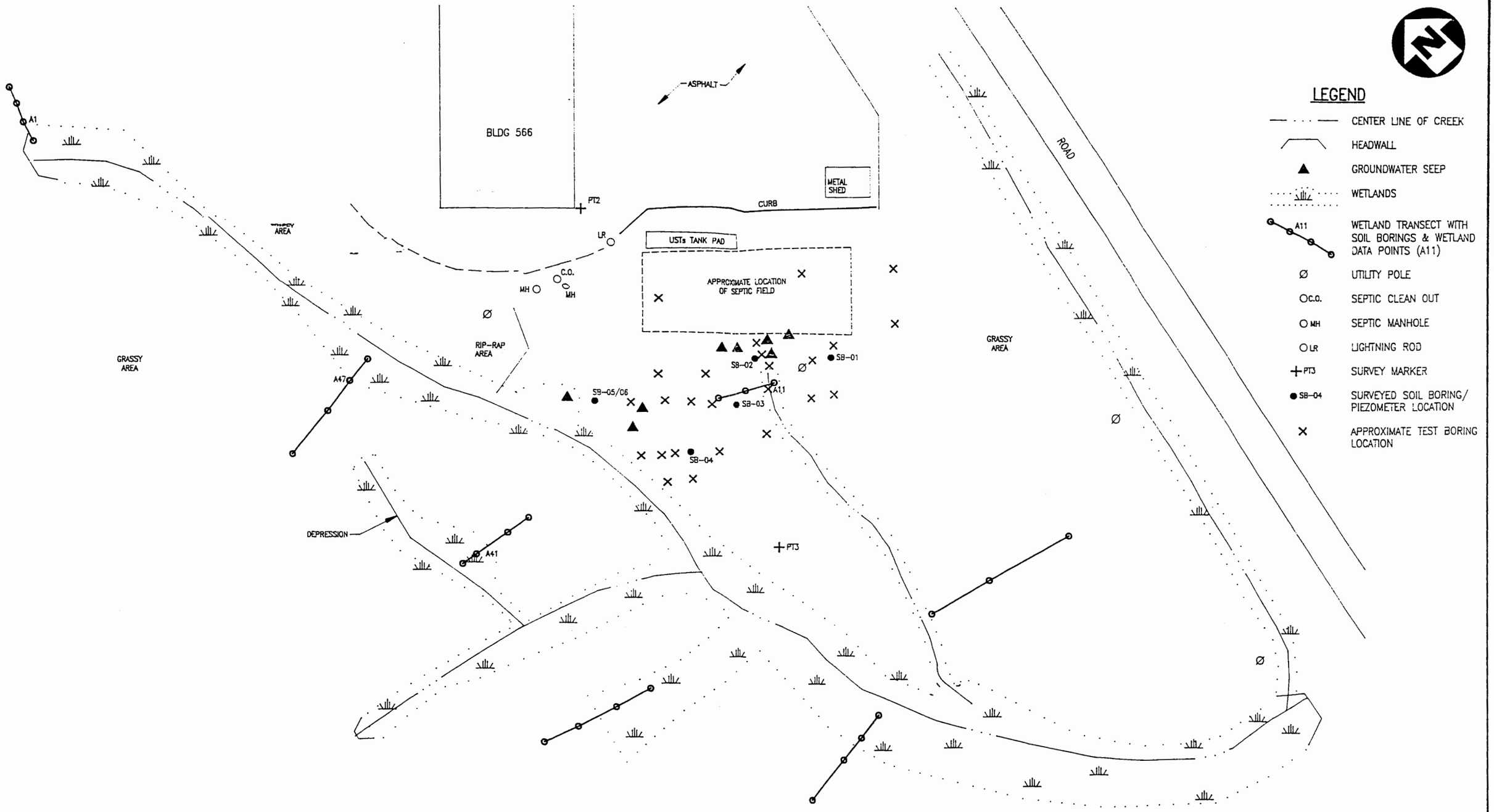
Atypical situation: Yes ✓; No _____

Normal Circumstances?: Yes ✓ No ~~NO~~.

Wetland Determination: Wetland ✓; Nonwetland _____

Comments: Point 13 2' down slope from Flag

Determined by: Robert Abernethy



SAMPLE LOCATION MAP
CTO 206 – INTERIM ACTION FIELD WORK FOR BUILDING 566
NWS EARLE, NEW JERSEY

FIGURE 3-1

Halliburton NUS CORPORATION

00583G047

NAVAL WEAPONS STATION - EARLE

DESIGN OF STEEL SHEET PILING ADJACENT TO UST

By
Foster Wheeler Environmental Corporation

Certified by Carl Tippman
NJPE No.
GE 38152

Rev.	Designed by	Approved by	Revision
0	8-7-97 M. Hsieh	8-12-97 C. Tippman	

FOSTER WHEELER ENVIRONMENTAL CORPORATION

BY M Hsieh DATE 8-4-97 SHEET 1 OF 8

CHKD. BY _____ DATE _____ OFS NO. _____ DEPT. NO. _____

CLIENT _____

PROJECT Naval Weapon Station - Earle

SUBJECT Steel sheet Piling Revised 8-11-97

Purpose : To design a steel sheet pile wall to be installed between USTs and a septic drainage field which is to be excavated.

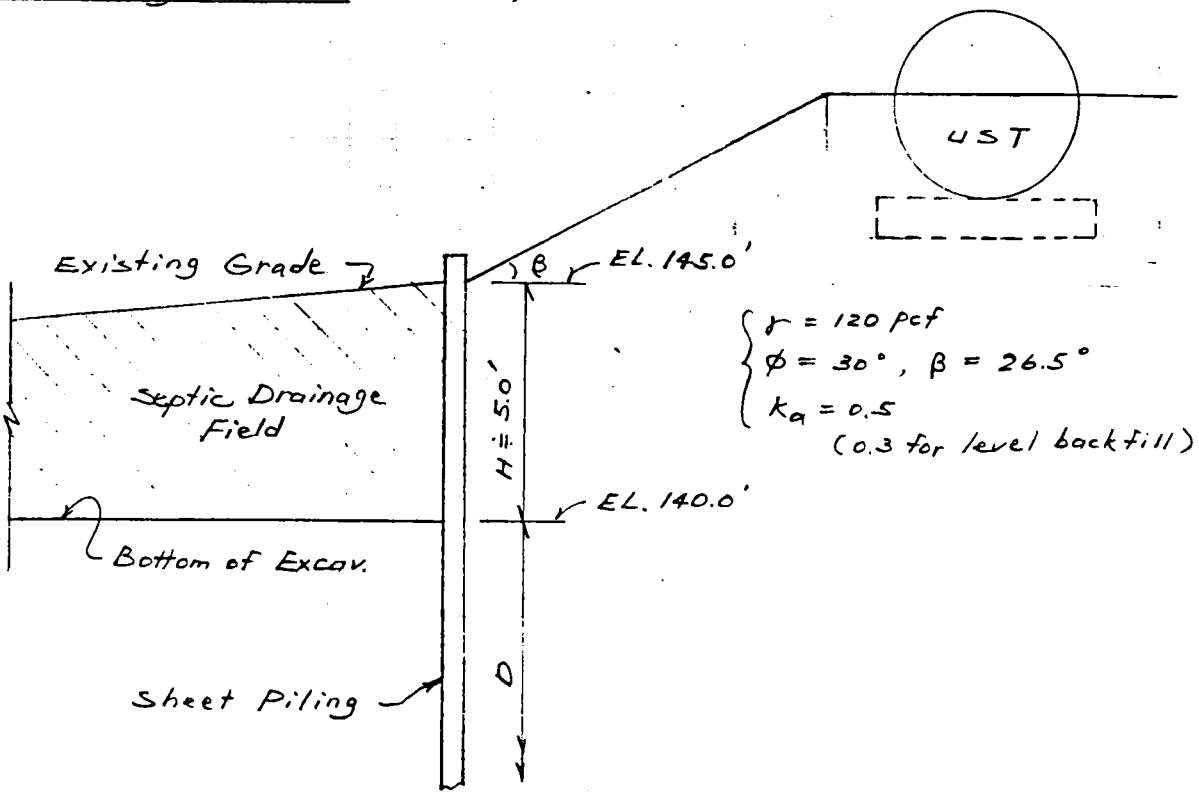
Design Data : (Ref. 1)

Steel sheet piles : PZ 22 @ Grade EL. 145'
USTs : Approx. 3' above grade, 3' below grade on conc Pad.
Septic Drainage Field : Excavate to EL. 140' Approx.
Site soil : general area : Silty fine sand, silty clay 8' below grade, 9' thick (min.)
Sheet Pile area : Sand

References :

1. Memo from M. Heffron to S. Bhalla on sheet piles design dated 7-31-97 (with attachments : Site plan & cross sections).
2. Steel Sheet Piling Design Manual by United States Steel
3. Foundation Analysis and Design by Joseph E. Bowles, Mc Graw Hill Co., 5th Ed.
4. Beams on Elastic Foundation by M. Hetényi, The Univ. of Michigan Press., Ann Arbor
5. Bethlehem Steel Sheet Piling by Bethlehem Steel

Sheet Piling Location (Ref. 1)



Active Soil Pressure :

- Assume granular soil (sand) behind sheet piles (Ref. 1)
  $\phi = 30°$, $\gamma = 120$ pcf (Moist)
- Sloping backfill with 2 : 1 slope, $\beta = 26.5°$ (Ref. 1)
- Friction between steel sheet pile and soil, $\tan\delta = 0.3$, $\delta = 17°$
- Lateral pressure from UST is approximated by a surcharge of 300 psf.

k_a = Active Press. Coef = 0.5 (Ref. 2)

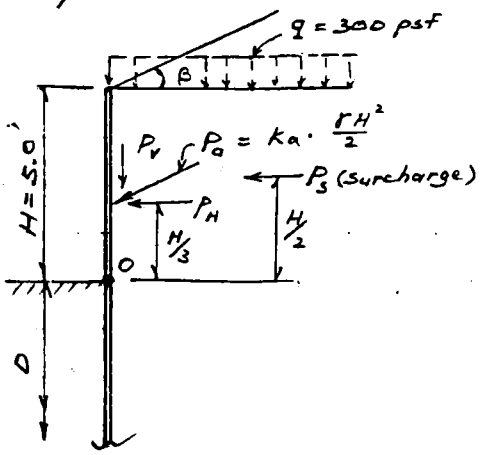
$P_a = 0.5(120)\frac{(5.0)^2}{2} = 750$ #

$P_H = P_a \cos\delta = 750(0.956) = 717$ #

$P_S = 0.3qH = 0.3(300)5.0 = 450$ # ($\beta = 0°$)

$M_o = P_H(H/3) + P_S(H/2) = 717(1.67) + 450(2.5)$

$= 2,322$ #-'



Analyze the sheet piles as slabs on elastic foundation and assume medium dense silty sand.

From Ref. 3 (p. 505)

$K_s = 24{,}000 \sim 48{,}000 \ kN/m^3$

$= 153 \sim 306 \ kip/ft^3$

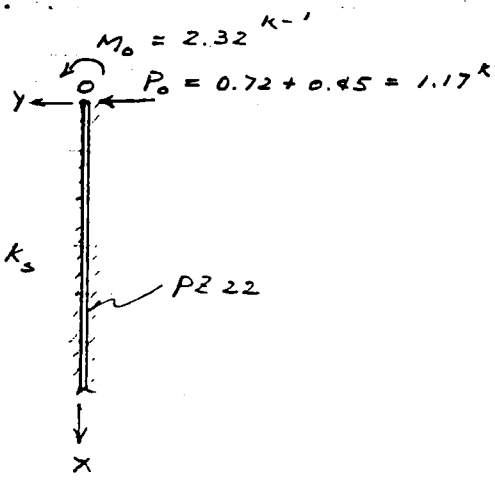
Use $K_s = 230 \ kip/ft^3$

For sheet pile PZ22 (Ref. 1)

$E = 30 \times 10^6 \ psi = 4.32 \times 10^6 \ ksf$

$I = 154.7 \ in^4 = 84.4 \ in^4/ft \ wall$

$= 4.07 \times 10^{-3} \ ft^4/ft \ wall$



From Ref 4.

$$\lambda = \sqrt[4]{\frac{K_s}{4EI}} = \sqrt[4]{\frac{230}{4(4.32)10^6(4.07)10^{-3}}}$$

$= 0.2391 \ ft^{-1}$

From Ref. 2. the depth of penetration "D" in medium dense soil should be 1.25H. Adding 20% for safty, $D = 1.2(1.25H) = 7.5'$.

The embedded portion of sheet pile will be treated as long beam for approximation:

From Ref. 4 (p. 24 ~ 25).

$$\begin{cases} y = \dfrac{2P_o\lambda}{K_s} D_{\lambda x} + \dfrac{2M_o\lambda^2}{K_s} C_{\lambda x} & \text{(deflection)} \\ p = K_s y = 2P_o\lambda D_{\lambda x} + 2M_o\lambda^2 C_{\lambda x} & \text{(bearing pressure)} \\ Q = P_o C_{\lambda x} + 2M_o\lambda B_{\lambda x} & \text{(shear)} \\ M = \dfrac{P_o}{\lambda} B_{\lambda x} + M_o A_{\lambda x} & \text{(Moment)} \end{cases}$$

Since $D_{\lambda x} = C_{\lambda x} = 1$ @ $X = 0$, y_{max} occurs @ $X = 0$

$$y_{max} = \frac{2\lambda}{K_s}(P_o + M_o\lambda) = \frac{2(0.2391)}{230}[1.17 + 2.32(0.2391)]$$

$= 0.0036' = 0.04''$ ... small

Bending :

$X = 0$, $M_0 = 2.32^{k-'}$

$X = 1.5'$, $\lambda x = 0.36$, $B_{\lambda x} = 0.2457$, $A_{\lambda x} = 0.8986$

$$M_1 = \frac{P_0}{\lambda} B_{\lambda x} + M_0 A_{\lambda x}$$

$$= \frac{1.17}{0.2391}(0.2457) + 2.32(0.8986) = 3.29^{k-'}$$

$\lambda x = \frac{\pi}{4}$, $X = 3.28'$, $B_{\lambda x} = B_{max} = 0.3224$, $A_{\lambda x} = 0.6448$

$$M_3 = \frac{1.17}{0.2391}(0.3224) + 2.32(0.6448) = 3.07^{k-'}$$

$\therefore M_{max} \doteq M_1 = 3.29^{k-'}$

For ASTM A328 PZ 22 section (Ref. 5)
Allowable bending per foot of wall $= 38^{k-'} > 3.29^{k-'}$ O.K

F. S. (Bending) $= \frac{38.0}{3.29} = 11.6$

Conclusions :

1. The sheet piling should be located as far away from the USTs as possible to minimize vibration during pile driving that could potentially disturb the UST foundation. This design assumed the sheet piles to be at grade elevation EL. 145' as shown in Ref. 1. The height of soil behind the sheet pile is estimated to be 5.0'(H).

2. The depth of penetration of sheet piles should be about 1.25 H plus 20 percent additional depth for safety (Ref. 2). A penetration depth of 7.5' is reccommended. The total length of sheet piles would be about 12.5'. The bottom of sheet piles is above the silty clay layer.

3. The PZ 22 section is adguate for the load imposed with a safety factor greater than 11.

Attachment (Ref. 2)

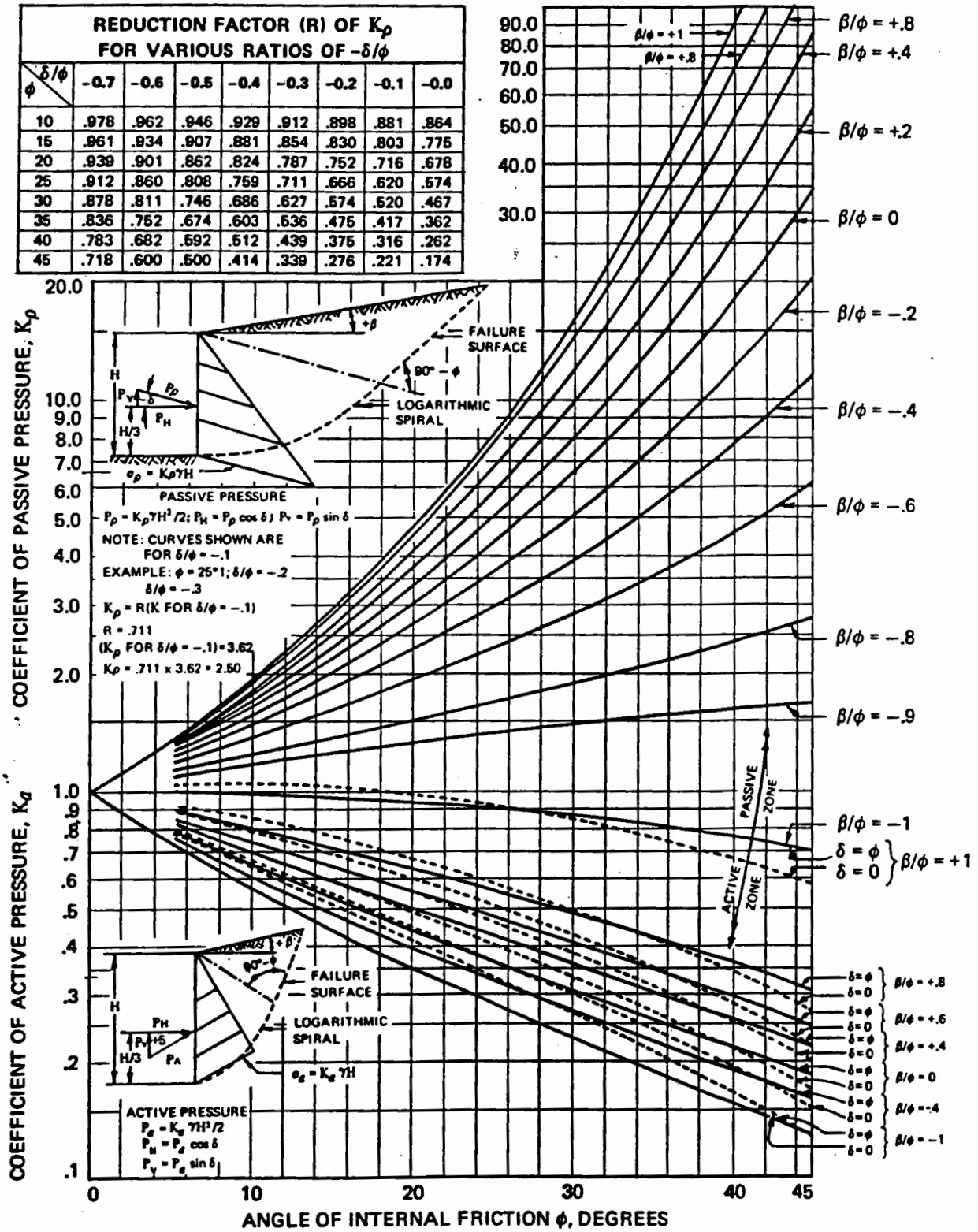


Fig. 5(a) — Active and passive coefficients with wall friction (sloping backfill) (after Caquot and Kerisel[21])

At point b the piling does not move and would be subjected to equal and opposite at-rest earth pressures with a net pressure equal to zero. The resulting earth pressure is represented by the diagram oabc. For the purpose of design, the curve abc is replaced by a straight line dc. The point d is located so as to make the sheet piling in a state of static equilibrium. Although the assumed pressure distribution is in error, it is sufficient for design purposes.

The distrubution of earth pressure is different for sheet piling in granular soils and sheet piling in cohesive soils. Also, the pressure distribution in clays in likely to change with time. Therefore, the design procedures for steel sheet piling in both types of soils are discussed separetely.

Cantilever Sheet Piling in Granular Soils — A cantilevered sheet pile wall may be designed in accordance with the principles and assumptions just discussed or by an approximate method based on further simplifying assumptions shown in Figure 15.

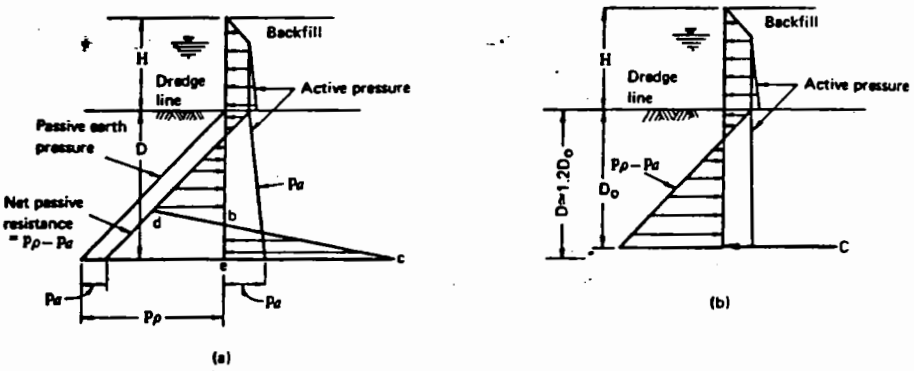


Fig. 15 — Design of cantilever sheet piling in granular soils: (a) conventional method; (b) simplified method. (after Teng[1])

For cases of two or more layers of soil, the earth pressure distributions would be somewhat different due to the different soil properties; however, the design concept is exactly the same. Lateral pressures should be calculated using the curved failure surface (log spiral) method as shown in Figure 5 (a).

Conventional Method — The conventional design procedure for granular soils is as follows:

1. Assume a trial depth of penetration, D. This may be estimated from the following approximate correlation.

Standard Penetration Resistance, *N* Blows/Foot	Relative Density of Soil, D_d	Depth of Penetration*
0-4	Very loose	2.0 H
5-10	Loose	1.5 H
11-30	→ Medium dense	→ 1.25 H
31-50	Dense	1.0 H
+50	Very dense	0.75 H

*H = height of piling above dredge line.

2. Determine the active and passive lateral pressures using appropriate coefficients of lateral earth pressure. If the Coulomb method is used, it should be used conservatively for the passive case. The resulting earth pressure diagram for a homogeneous granular soil is shown in Figure 16 where the active and passive pressures are overlain to pictorially describe the resulting soil reactions.

Attachment (Ref. 3)

Using the FEM and computer program B-9 allows you to make a parametric study rapidly (vary pile section I, k_s, embedment depth D, anchor rod location, and so on). You will generally find that the preceding suggestions for k_s will give reasonable values for pile bending and node soil pressure. Deflections are highly dependent on the flexural rigidity EI of the pile *and* k_s, so if you want a reliable dredge line value you have to input a carefully chosen k_s. Keep in mind that exact values are not possible, for too many variables are beyond the designer's control. What is desired is enough output data to make a design with reasonable confidence that the wall will serve its intended purpose.

The FEM allows you to consider nonlinear effects using the term X_{max} identified in Sec. 9-6 and used in Example 13-1 following. A program should do these things (as incorporated into B-9):

1. Allow adjustment of the dredge line springs to account for driving or excavation damage to the soil
2. Remove node springs when the computed $X_i > X_{max}$ and recycle

13-4 STABILITY NUMBERS FOR SHEET-PILE WALLS

13-4.1 Stability Numbers and Safety Factors

The concept of stability number (or safety factor) for sheet-pile walls is somewhat a misnomer, since it is not clear just what it means. For this discussion it is more convenient to use the term *safety factor* (SF) rather than *stability number*, which implies the ratio of system resistance/system failure effects. In classical sheet-pile wall design it has been common to do one of the following:

1. Divide the Rankine (or Coulomb) K_p by a SF for the soil below the dredge line. Some designers might use K_a larger than the Rankine or Coulomb value as well.
2. Arbitrarily increase the computed embedment depth by some factor, say, 1.2 to 1.3.

The author suggests that a more rational method is needed to estimate probable wall safety. This is done as follows:

1. Do a wall analysis using the existing conditions to find the depth required such that any depth increase does not change the dredge line deflection (at least within some tolerance of, say, 2 to 3 mm). This depth D_1 is all that is required for stability for the given load conditions.
2. Next make trial runs with the depth increased several arbitrary amounts (perhaps 0.5, 1.0, 1.5 m). Make additional analyses and make a table of dredge line displacements versus these depths and the depth from step 1.
3. From an inspection of the table from step 2, choose an arbitrary new depth of embedment D_{new}. Assume a loss of dredge line so the new depth is more than the dredge line loss, or

$$D_{new} > D_1 + \text{dredge line loss}$$

4. Now revise a copy of the original FEM data set to show the new dredge line location and new depth (compute additional active pressure values that are in the dredge line soil). Because the dredge line loss is probably attributable to erosion, it may not be necessary to reduce k_s of the first one or two nodes for driving or other damage but look at the

Attachment (Ref. 4) 8

From the four quantities y, θ, M, and Q we can select two and ascribe any value to them, establishing in this way the conditions for an end. From these four quantities six different types of end support can be derived, a circumstance which, if we consider both ends of the beam, permits of twenty-one different types of beams. Of these, six will be symmetrical, and of those six three have been investigated above. For the remaining three symmetrical beams the analysis can be carried out in the same manner, the general solution being resolved into two pairs of simultaneous equations. But when we deal with different end conditions at the two ends (a situation which admits of fifteen types of beams), such simplification is not possible, and, as a rule, all four equations of the type expressing the four end conditions (see [30]) will have to be solved simultaneously.

17. *Classification of Beams according to Stiffness*

We have seen that it was the λl quantity which characterized the relative stiffness of a beam on an elastic foundation. This λl quantity determines the magnitude of the curvature of the elastic line and defines the rate at which the effect of a loading force dies out in the form of a damped wave along the length of the beam. According to these λl values we may classify beams into three groups:

I. Short beams: $\lambda l < \pi/4$;
II. Beams of medium length: $\pi/4 < \lambda l < \pi$;
III. Long beams: $\lambda l > \pi$.

This classification is made from a practical point of view, since it offers the possibility of using approximations and of neglecting certain quantities in particular instances.

For beams belonging to group I we can neglect, in most practical problems, the bending deformation of the bar, since this deformation will be so small as to be negligible compared with the deformation produced in the foundation. Hence, computing beams of $\lambda l < \pi/4$, we can assume them to be absolutely rigid; consequently, the position which they take on the foundation, when subjected to loading, can be determined from simple considerations of statics.

Group II comprises the situations in which accurate computation of the beams is necessary. The characteristic of this group is that a force acting at one end of the beam has a finite, and not negligible, effect at the other end. Consequently, when a beam of such length is derived from the infinitely long one, the countereffect which the end-conditioning forces have on each other has an important role, and no approximation is advisable.

Beams belonging to group III have a λl value such that the countereffect of the end-conditioning forces on each other is a diminishing one. When investigating one end of the beam, we may assume that the other end is infinitely far away. Forces applied at one end will have a negligible effect at the other. In other words, λl is so large that we can take in all the formulas $A_{\lambda l} = B_{\lambda l} = C_{\lambda l} = D_{\lambda l} = 0$, which greatly simplifies the computation.

SECTION 02315

EXCAVATION AND FILL
06/96

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 33	(1993) Concrete Aggregates
ASTM C 136	(1995; Rev. A) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 698	(1991) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m))
ASTM D 1140	(1992) Amount of Material in Soils Finer Than the No. 200 (75-Micrometer) Sieve
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft (2,700 kN-m/m))
ASTM D 2321	(1989) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1995) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1909	Fertilizer

CORPS OF ENGINEERS (COE)

COE EM-385-1-1	(1992) Safety and Health Requirements

1.2 DEFINITIONS

1.2.1 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.2 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding [0.375] [_____] cubic meter [1/2] [_____] cubic yard in volume Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.3 Cohesive Materials

Materials ASTM D 2487 classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

1.2.4 Cohesionless Materials

Materials ASTM D 2487 classified as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines have a plasticity index of zero.

1.2.5 [Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.]

1.3 SUBMITTALS

Submit the following in accordance with section entitled "Submittal Procedures."

1.3.1 [SD-04, Drawings

a. Supporting system drawings

1.3.1.1 Required Drawings

Submit drawings and calculations by a registered professional engineer. Drawings shall include material sizes and types, arrangement of members, and the sequence and method of installation and removal.]

1.3.2 [SD-05, Design Data

a. Supporting system calculations

1.3.2.1 Required Data

Submit drawings and calculations by a registered professional engineer. Calculations shall include data and references used.]

1.3.3 SD-08, Statements

[a. Supporting systems work plan]

[b. Dewatering work plan]

[c. Blasting work plan]

Submit 15 days prior to starting work.

1.3.4 SD-12, Field Test Reports

a. Fill and backfill test

b. Select material test

c. Porous fill test for capillary water barrier

d. Density tests

1.4 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.5 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

[c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.]

[d. Ground water elevation is [_____] meter feet below existing surface elevation.]

[e. Material character is indicated by the boring logs.]

[f. Bermuda limestone and coral will be encountered in most excavations.]

[g. Guantanamo Bay limestone and coral will be encountered in some excavations.]

[h. Hard materials [and rock] [will not] [will] be encountered [in [_____] percent of the excavations] [at [_____] meter feetbelow existing surface elevations]].

i. [Blasting will not be permitted. Remove material in an approved manner.]

[j. Blasting will be permitted. Blasting shall be conducted in accordance with COE EM-385-1-1, and Federal, State, and local safety regulations. Submit for approval a blasting plan, including calculations for overpressure and debris hazard, prepared and sealed by a registered professional engineer. Blasting mats shall be provided, and non-electric blasting caps shall be used. Notify the Contracting Officer 24 hours prior to blasting.]

PART 2 PRODUCTS

2.1 SOIL MATERIALS

Free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and [frozen,] deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

2.1.1 Common Fill

Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location.

2.1.2 Backfill and Fill Material

ASTM D 2487, classification GW, GP, GM, [GC,] SW, SP, SM, [SC] with a maximum ASTM D 4318 liquid limit of [35] [_____], maximum ASTM D 4318 plasticity index of [12] [_____], and a maximum of 25 percent by weight passing ASTM D 1140, 75 micrometers No. 200 sieve.

2.1.3 Topsoil

[Provide as specified in Section 02921, "Turf."]

[Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than 25 mm one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.]

2.1.4 Select Material

ASTM D 2487, classification GW, GP, SW, SP with a maximum of 10 percent by weight passing ASTM D 1140, 75 micrometers No. 200 sieve.

2.2 POROUS FILL FOR CAPILLARY WATER BARRIER

ASTM C 33 fine aggregate grading with a maximum of 3 percent by weight passing ASTM D 1140, 75 micrometers No. 200 sieve, or coarse aggregate Size 57, 67, or 77 and conforming to the general soil material requirements specified in paragraph entitled "Soil Materials."

2.3 BORROW

[Obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property.]

[Obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property, except that borrow materials conforming to [common fill] [and] [fill and backfill material] [_____] may be obtained from the Government borrow pit. The Government borrow pit is located [as indicated] [within a haul distance of [_____] kilometers miles from the work site]. If the Government borrow pit is used, the Contractor shall perform clearing, grubbing, and stripping required for providing access to suitable borrow material. Dispose of materials from clearing and grubbing operations [off Government property] [at the Government landfill indicated]. Strip top 300 mm 12 inchesof soil material from borrow area and stockpile. After removal of borrow material, regrade borrow pit using stockpiled soil material to contours which will blend in with adjacent topography. Maximum side slopes shall be two horizontal to one vertical. Excavation and backfilling of borrow pit shall ensure proper drainage.]

[Borrow material obtained from the Government borrow pit shall be pit site crushed. Provide equipment to excavate, crush to the specified size, and transport.]

2.4 BURIED WARNING AND IDENTIFICATION TAPE

[Polyethylene plastic] [and] [metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic] warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 75 mm 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

[Yellow:]	[Electric]
[Yellow:]	[Gas, Oil; Dangerous Materials]
[Orange:]	[Telephone and Communications]
[Blue:]	[Water Systems]
[Green:]	[Sewer Systems]
[White:]	[Steam Systems]
[Gray:]	[Compressed Air]

Other

2.4.1 [Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.08 mm 0.003 inch. Tape shall have a minimum strength of 10.3 MPa 1500 psi lengthwise, and 8.6 MPa 1250 psi crosswise, with a maximum 350 percent elongation.]

2.4.2 [Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.10 mm 0.004 inch. Tape shall have a minimum strength of 10.3 MPa 1500 psi lengthwise and 8.6 MPa 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 920 mm3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.]

2.5 DETECTION WIRE FOR NON-METALLIC PIPING

Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG.

2.6 [MATERIAL FOR RIP-RAP

[Bedding material] [Grout] [Filter fabric] and rock conforming to [these requirements] [DOT] [SSS-[_____]] State Standard for construction indicated.]

2.6.1 [Bedding Material

Consisting of sand, gravel, or crushed rock, well graded, [or poorly graded] with a maximum particle size of 50 mm 2 inches. Material shall be composed of tough, durable particles. Fines passing the 75 micrometers No. 200 standard sieve shall have a plasticity index less than six.]

2.6.2 [Grout

Composed of cement, water, an air-entraining admixture, and sand mixed in

proportions of one part portland cement to [two] [_____] parts of sand, sufficient water to produce a workable mixture, and an amount of admixture which will entrain sufficient air to produce durable grout, as determined by the Contracting Officer. Mix grout in a concrete mixer. Mixing time shall be sufficient to produce a mixture having a consistency permitting gravity flow into the interstices of the rip-rap with limited spading and brooming.]

2.6.3 [Rock

Rock fragments sufficiently durable to ensure permanence in the structure and the environment in which it is to be used. Rock fragments shall be free from cracks, seams, and other defects that would increase the risk of deterioration from natural causes. The size of the fragments shall be such that no individual fragment exceeds a weight of [68] [_____] kg [150] [_____] pounds and that no more than 10 percent of the mixture, by weight, consists of fragments weighing 0.91 kg 2 pounds or less each. Specific gravity of the rock shall be a minimum of [2.50] [_____]. The inclusion of more than trace [1 percent] [_____] quantities of dirt, sand, clay, and rock fines will not be permitted.]

PART 3 EXECUTION

3.1 SURFACE PREPARATION

3.1.1 Clearing and Grubbing

Unless indicated otherwise, remove trees, stumps, logs, shrubs, and brush within the [clearing limits] [_____]. Remove stumps entirely. Grub out matted roots and roots over 50 mm 2 inches in diameter to at least 460 mm 18 inches below existing surface.

3.1.2 Stripping

Strip existing topsoil to a depth of [100] [_____] mm [4] [_____] inches without contamination by subsoil material. Stockpile topsoil separately from other excavated material and locate convenient to finish grading area.

3.1.3 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

3.1.3.1 Proof Rolling

Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. [After stripping,] proof roll the existing subgrade of the [building] [_____] with six passes of a 13.6 meter tons 15 ton, pneumatic-tired roller. Operate the roller in a systematic manner to ensure the number of passes over all areas, and at speeds between 4 to 5.5 kilometers per hour 2 1/2 to 3 1/2 miles per hour. [When proof rolling under buildings, the building subgrade shall be considered to extend 1.5 m 5 feet beyond the building lines, and one-half of the passes made with the roller shall be in a direction perpendicular to the other passes.] Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Contracting Officer. Rutting or pumping of material shall be undercut [as directed by the Contracting Officer] [to a depth of [_____] mm inches] and replaced with [fill and backfill] [select] material. [Bids shall be based on replacing approximately [_____] square meters square yards, with an average depth of [_____] mminches at various locations.]

3.2 PROTECTION

3.2.1 Protection Systems

Provide shoring, bracing, [cribbing,] [underpinning,] and sheeting in accordance with COE EM-385-1-1 [, except that banks may be sloped only when approved by the Contracting Officer]. [Provide additional supporting systems where indicated.]

3.2.2 Drainage and Dewatering

Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.2.2.1 Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. Provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein.

3.2.2.2 Dewatering

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 interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 0.9 m 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least [_____] m feet below the working level.

[Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly.] [Measure and record performance of dewatering system at same time each day by use of observation wells or piezometers installed in conjunction with the dewatering system.] [Relieve hydrostatic head in previous zones below subgrade elevation in layered soils to prevent uplift.]

3.2.3 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. [The Contractor shall contact the [Public Works Department] [_____] for assistance in locating existing utilities.] [The Contractor shall scan the construction site with electromagnetic and sonic equipment and mark the surface of the ground where existing underground utilities are discovered.]

3.2.4 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. ~~Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water.~~

with weight of the bulldozer

Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Refill with [backfill and fill material] [select material] ~~[porous fill]~~ and compact ~~to [95] [_____] percent of [ASTM D 698] [ASTM D 1557] maximum density. Unless specified otherwise, refill excavations cut below indicated depth with [backfill and fill material] [select material] [porous fill] and compact to [95] [_____] percent of [ASTM D 698] [ASTM D 1557] maximum density.~~

3.3.1 Structures With Spread Footings

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Fill overexcavations with concrete during foundation placement.

3.3.2 Pile Cap Excavation and Backfilling

Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the Contracting Officer. Backfill and compact overexcavations and changes in grade due to pile driving operations to 95 percent of ASTM D 698 maximum density.

3.3.3 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement.

3.3.4 [Hard Material [and Rock] Excavation

Remove hard material [and rock] to elevations indicated in a manner that will leave foundation material in an unshattered and solid condition. Roughen level surfaces and cut sloped surfaces into benches for bond with concrete. Protect shale from conditions causing decomposition along joints or cleavage planes and other types of erosion. Removal of hard material [and rock] beyond lines and grades indicated unless previously authorized by the Contracting Officer will not be grounds for a claim for additional payment.]

3.4 FILLING AND BACKFILLING

Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.

3.4.1 Common Fill Placement

Provide for general site [and under [porous fill of] pile-supported structures]. Place in ~~[150] [_____] mm~~ [6] [6] inch lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Finish to a smooth surface by blading, ~~rolling with a smooth roller, or both.~~ with the bulldozer blade

3.4.2 Backfill and Fill Material Placement

Provide for paved areas and under concrete slabs, except where select material is provided. Place in [150] [_____] mm [6] [_____] inchlifts. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against the structure.

3.4.3 Select Material Placement

Provide under [porous fill of] structures not pile supported. Place in [150] [_____] mm [6] [_____] inch lifts. Backfill adjacent to structures shall be placed as structural elements are completed and accepted.

Backfill against concrete only when approved. Place and compact material to avoid loading upon or against structure.

3.4.4 Porous Fill Placement

Provide under floor slab on a compacted subgrade. Place in [100] [_____] mm [4] [_____] inch lifts.

3.4.5 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact backfill under structures and paved areas in [150] [_____] mm [6] [_____] inch lifts to top of trench and in [150] [_____] mm [6] [_____] inch lifts to 300 mm one footover pipe outside structures and paved areas.

3.4.5.1 Bedding Requirements

Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide ASTM D 2321 materials as follows:

a. Class I: Angular, 6 to 40 mm 0.25 to 1.5 inches, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

b. Class II: Coarse sands and gravels with maximum particle size of 40 mm 1.5 inches, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.

3.5 BURIED WARNING AND IDENTIFICATION TAPE

Provide buried utility lines with utility identification tape. Bury tape 300 mm 12 inches below finished grade; under pavements and slabs, bury tape 150 mm 6 inches below top of subgrade.

3.6 BURIED DETECTION WIRE

Bury detection wire directly above non-metallic piping at a distance not to exceed 300 mm 12 inches above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 0.9 m 3 feet of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over it's entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

3.7 COMPACTION

Expressed as a percentage of maximum density. Determine in-place density of existing subgrade; if required density exists, no compaction of existing subgrade will be required. [Density requirements specified herein are for cohesionless materials. When cohesive materials are encountered or used, density requirements may be reduced by 5 percent.]

3.7.1 General Site

Compact underneath areas designated for vegetation and areas outside the

1.5 meter 5 foot line of the structure to [85] [_____] percent of [ASTM D 698] [ASTM D 1557].

3.7.2 Structures, Spread Footings, and Concrete Slabs

Compact top 300 mm 12 inches of subgrades to [95] [_____] percent of [ASTM D 698] [ASTM D 1557]. Compact [common fill] [fill and backfill material] [select material] to [95] [_____] percent of [ASTM D 698] [ASTM D 1557].

3.7.3 Porous Fill for Capillary Water Barrier

Compact with two passes of a hand-operated, plate type vibratory compactor.

3.7.4 Adjacent Area

Compact areas within 1.5 m 5 feet of structures to [90] [_____] percent of [ASTM D 698] [ASTM D 1557].

3.7.5 Paved Areas

Compact top 300 mm 12 inches of subgrades to [95] [_____] percent of [ASTM D 698] [ASTM D 1557]. Compact fill and backfill materials to 95 percent of [ASTM D 698] [ASTM D 1557].

3.7.6 Airfield Pavements

Compact top 600 mm 24 inches below finished pavement or top 300 mm 12 inches of subgrades, whichever is greater, to [100] [_____] percent of ASTM D 1557 ; compact fill and backfill material to [100] [_____] percent of ASTM D 1557.

3.8 FINISH OPERATIONS

3.8.1 Grading

Finish grades as indicated within 30 mm one-tenth of one foot. Grade areas to drain water away from structures. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.8.2 Seed

[Provide as specified in Section 02921, "Turf."]

[Scarify existing subgrade. Provide ~~100 mm 4~~ 6 inches of topsoil for newly graded finish earth surfaces and areas disturbed by the Contractor. [Additional topsoil will not be required if work is performed in compliance with stripping and stockpiling requirements.] [If there is insufficient on-site topsoil meeting specified requirements for topsoil, provide topsoil required in excess of that available.] Seed shall match existing vegetation. Provide seed at 2.5 kg per 100 square meters 5 pounds per 1000 square feet. Provide CID A-A-1909, Type I, Class 2, 10-10-10 analysis fertilizer at 12.2 kg per 100 square meters 25 pounds per 1000 square feet. [Provide commercial agricultural limestone of 94-80-14 analysis at 34.2 kg per 100 square meters 70 pounds per 1000 square feet.] Provide mulch and water to establish an acceptable stand of grass.]

3.8.3 Protection of Surfaces

Protect newly graded areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.9 DISPOSITION OF SURPLUS MATERIAL

[Waste in Government disposal area [indicated] [which is located within a haul distance of [_____] kilometers miles.] [Remove from Government property] surplus or other soil material not required or suitable for

filling or backfilling, and brush, refuse, stumps, roots, and timber.]

3.10 FIELD QUALITY CONTROL

3.10.1 Sampling

Take the number and size of samples required to perform the following tests.

3.10.2 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

3.10.2.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the 75 micrometers No. 200 sieve; ASTM D 4318 for liquid limit and for plastic limit; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

3.10.2.2 Select Material Testing

Test select material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the 75 micrometers No. 200 sieve; ASTM D 698 or ASTM D 1557for moisture density relations, as applicable.

3.10.2.3 Porous Fill Testing

Test porous fill in accordance with ASTM C 136 for conformance to gradation specified in ASTM C 33.

3.10.2.4 Density Tests

Test density in accordance with ASTM D 1556, or ASTM D 2922 and ASTM D 3017. When ASTM D 2922 and ASTM D 3017 density tests are used, verify density test results by performing an ASTM D 1556density test at a location already ASTM D 2922 and ASTM D 3017tested as specified herein. Perform an ASTM D 1556 density test at the start of the job, and for every 10 ASTM D 2922 and ASTM D 3017density tests thereafter. Test each lift at randomly selected locations every [200] [_____] square meters [2000] [_____] square feet of existing grade in fills for structures and concrete slabs, and every [250] [_____] square meters [2500] [_____] square feet for other fill areas and every [200] [_____] square meters [2000] [_____] square feet of subgrade in cut.

-- End of Section --

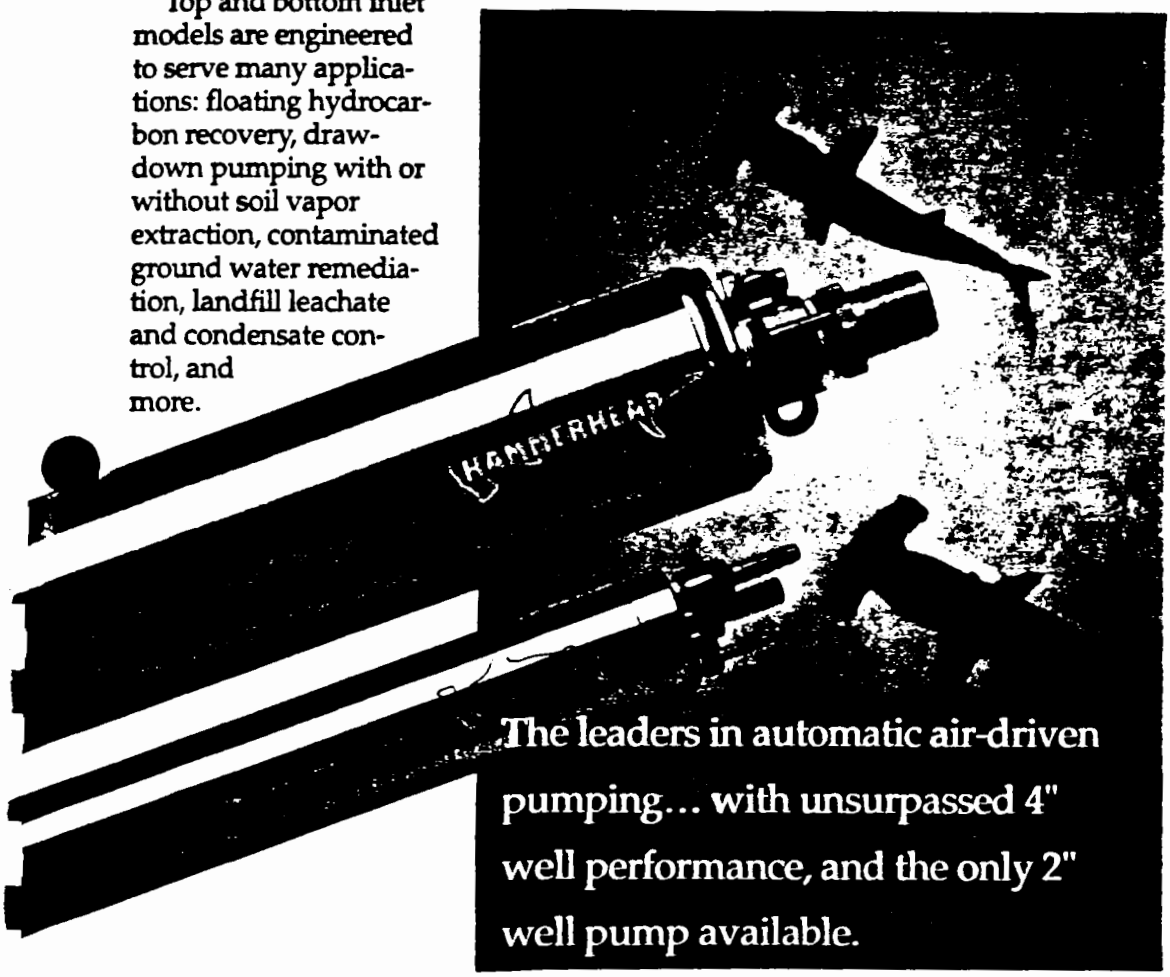
▼GED DATA SHEET
CODE 1221 REV 9-94
SHEET 1 OF 6
1-800-624-2026
FAX 1-313-995-1170

HammerHead™ High Performance Automatic Air-Driven Pumps

THE HIGHEST PERFORMANCE AIR-DRIVEN PUMPS

The HammerHead™ system (patent pending) includes controllerless air-driven pumps for extreme situations—high flow (over 14 GPM/54 LPM), deep wells or high discharge head (to 300'/90 m), and the only successful automatic pump for small diameter wells (2"/50 mm). They also deliver superior performance for more typical cleanup pumping projects.

Top and bottom inlet models are engineered to serve many applications: floating hydrocarbon recovery, drawdown pumping with or without soil vapor extraction, contaminated ground water remediation, landfill leachate and condensate control, and more.



The leaders in automatic air-driven pumping... with unsurpassed 4" well performance, and the only 2" well pump available.

THE AUTOMATIC ADVANTAGE

All HammerHead pumps give you the full advantage of advanced controllerless operation. They sense liquid level internally, running when there's enough to pump, and shutting down automatically when well levels drop too low—without cycle timers, electrical equipment, downwell probes, or level controls at the wellhead.

This simplicity makes installation and startup much easier. Operation is truly hands-off. There's no need to balance and re-balance the system in response to well yield or level fluctuations. Each pump in a system automatically adjusts performance to its own well conditions.

HammerHead pumps are more efficient than conventional pneumatic pumps, conserving on air usage and delivering higher flow. The pump is always either refilling or discharging. Because this is controlled downwell, the air line to the pump stays pressurized; no time or air is wasted venting and repressurizing it every cycle.

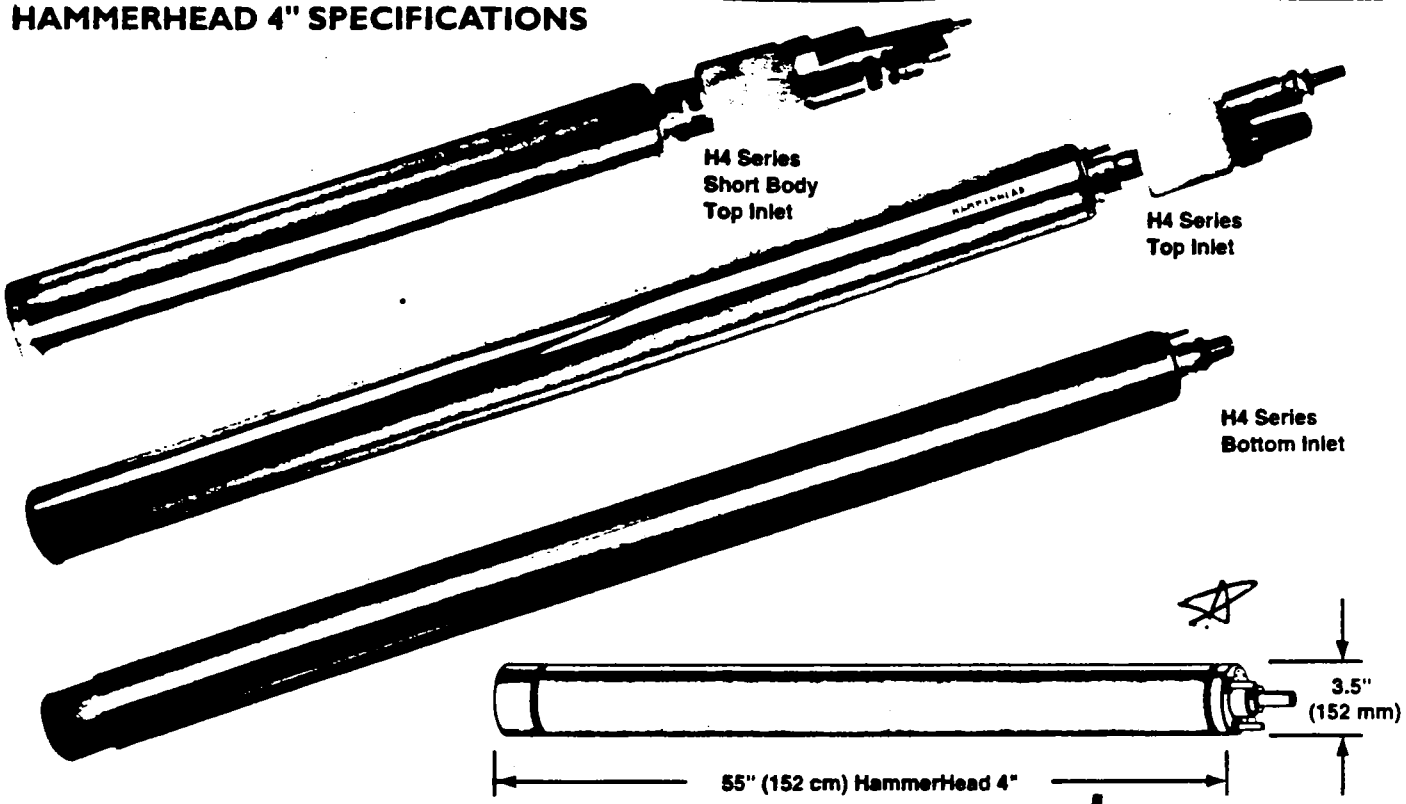
SUPERIOR RELIABILITY AND EASY MAINTENANCE

Reliable, high-clearance design is engineered to a new standard in HammerHead pumps. Critical parts are solid investment castings for superior strength and chemical resistance.

Oversized, self-cleaning ball check valves in the liquid path provide optimum flow and prevent clogging by solids or viscous substances. Even the Hammer Drive air valving uses this self-cleaning ball-and-seat mechanism, as well as positive action magnetic assist for dependable operation in any conditions, even with substandard air quality.

And if you ever need to disassemble a HammerHead pump, it's easy to take apart—and maintenance can be performed right in the field, not in a shop or at the factory.

HAMMERHEAD 4" SPECIFICATIONS



	H4 Series Bottom Inlet	H4 Series Top Inlet	Short H4, Top Inlet
Model No.	H45SSB, H45SEB, HF45SSB, HF45SEB	H45SET, HF45SET	HF43SET
Pump Type	Positive Air Displacement	Positive Air Displacement	Positive Air Displacement
Inlet	Bottom	Top	Top
O.D.	3.5" (89 mm)	3.5" (89 mm)	3.5" (89 mm)
Length	55" (140 cm)	60" (152 cm)	42" (105 cm)
Weight	23.5 lbs. (10.7 kg)	24.0 lbs. (10.9 kg)	16.0 lbs. (7.3 kg)
Materials	Stainless steel construction, with Teflon® inlet and discharge check balls, stainless steel or epoxy float, Viton O-rings	Stainless steel, Q-Tal & brass construction, with Teflon® inlet and discharge check balls, epoxy float, Viton O-rings	Stainless steel, Q-Tal & brass construction, with Teflon® inlet and discharge check balls, epoxy float, Viton O-rings,
Fittings: Type	Standard—Barb Optional—Quick Connects	Standard—Barb Optional—Quick Connects	Standard—Barb Optional—Quick Connects
Sizes: Liquid Discharge	3/4" (19 mm) O.D. (H45SSB, H45SEB) or 1-1/4" (32 mm) O.D. (HF45SSB, HF45SEB) tubing standard*	3/4" (19 mm) O.D. (H45SET) or 1-1/4" (32 mm) O.D. (HF45SET) tubing standard*	1-1/4" (32 mm) O.D. tubing standard*
Air Supply	3/8" (9 mm) O.D. Tubing	3/8" (9 mm) O.D. Tubing	3/8" (9 mm) O.D. Tubing
Exhaust	1/2" (13 mm) O.D. Tubing	1/2" (13 mm) O.D. Tubing	1/2" (13 mm) O.D. Tubing
Pump Stroke	0.8 gal. (2850 ml.)	0.8 gal. (2850 ml.)	0.32 gal. (1200 ml.)
Operating pressure range	10-160 psi (70-1,100 kPa)	10-160 psi (70-1,100 kPa)	10-160 psi (70-1,100 kPa)
Maximum lift	300 ft. (90 m)	300 ft. (90 m)	300 ft. (90 m)
Maximum flow rate	14+ GPM (54+ LPM) HF45SSB, HF45SEB	11+ GPM (41+ LPM) HF45SET	10 GPM (38 LPM)
Minimum submergence	42" (107 cm) above pump bottom	Top Inlet Port— 58" (147 cm) above bottom of pump	Top Inlet Port— 38" (97 cm) above bottom of pump
Density of pumped liquid	1.0 g/cc (stainless float); 0.7 g/cc up (epoxy float)	0.7 g/cc up	0.7 g/cc up
Cap sizes**	4", 6", and 8" (100, 150, & 200 mm) diameter (standard and vacuum seal)	4", 6", and 8" (100, 150, & 200 mm) diameter (standard and vacuum seal)	4", 6", and 8" (100, 150, & 200 mm) diameter (standard and vacuum seal)

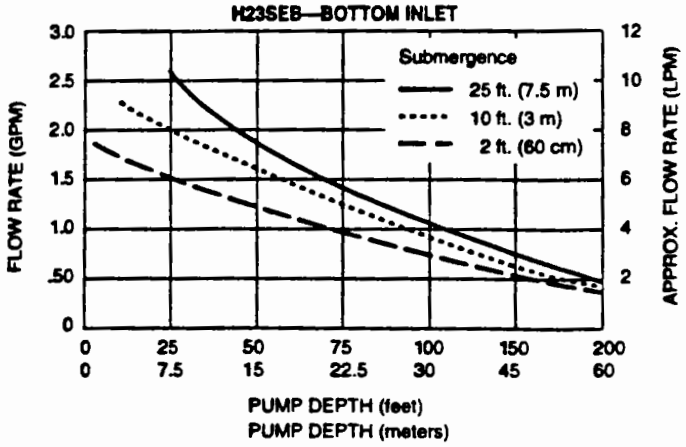
* Note: Pumps are available with tubing or hose; quick disconnect fittings are available on request. Hose sizes are: 1" (25 mm) I.D. discharge, 3/8" (9 mm) I.D. air supply, 3/8" (9 mm) I.D. exhaust.

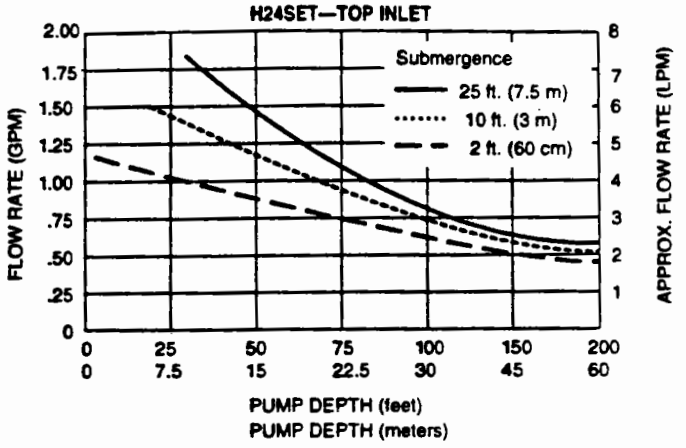
** Special caps available.

HAMMERHEAD FLOW PERFORMANCE CURVES

H2 SERIES

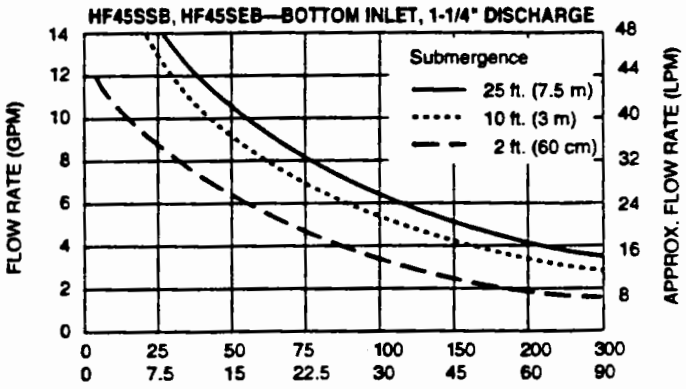
100 psi (700 kPa) drive air pressure was supplied for all pump depths.

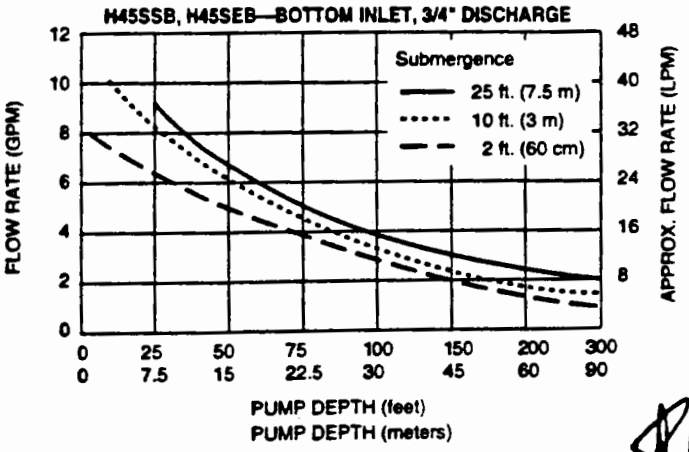


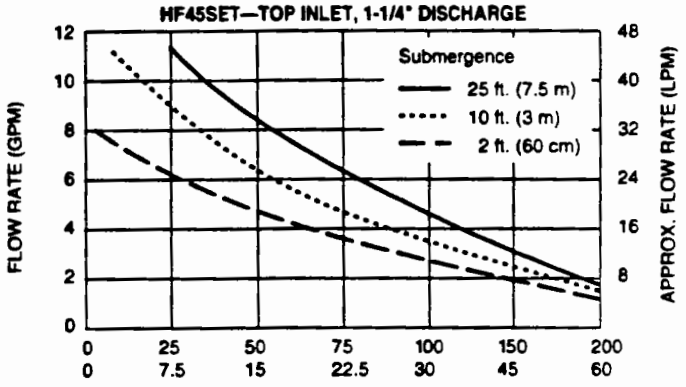


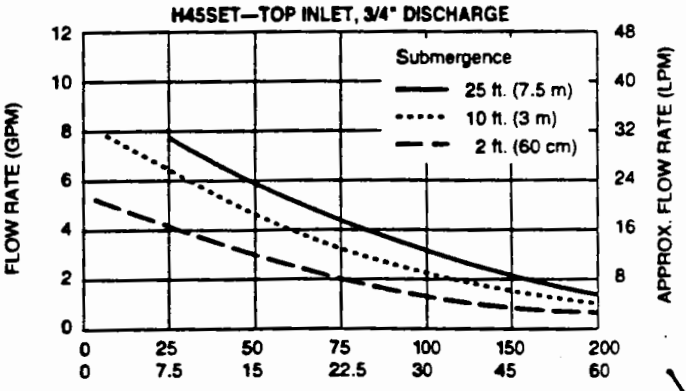
H4 SERIES

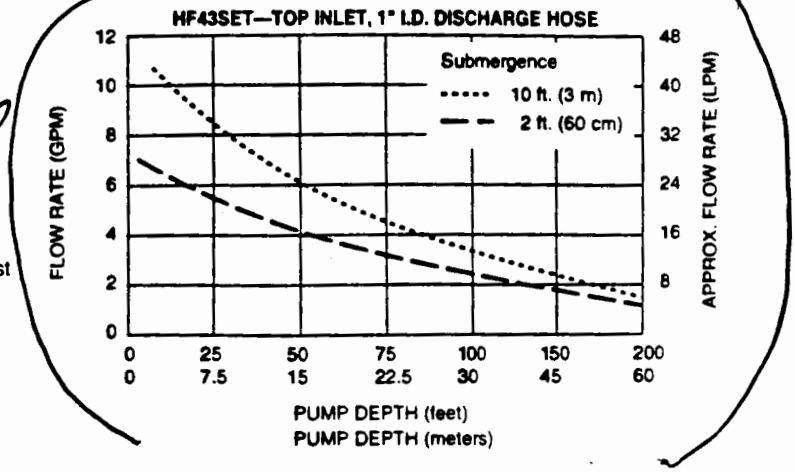
100 psi (700 kPa) drive air pressure was supplied for all pump depths less than 150 feet (45 meters); 160 psi (1,100 kPa) drive air pressure was supplied for all greater pump depths.











NOTE: Pump depth is measured down from the top of the well casing to the top of the pump fittings. Submergence is measured up from the lowest inlet point on the pump inlet to the top of the static water or product in the well.

JACKETED TUBING OR OPTIONAL HOSE SETS

QED's exclusive Jacketed Tubing, with a continuous nylon sheath, helps prevent hangups and loops, makes installation easier (especially in narrow or obstructed casing), and is lightweight with exceptional chemical resistance, outside and in.

Tubing sets are supplied cut to custom lengths. Jacketed tubing and sheath are both Nylon 12, which doesn't swell in water and provides excellent resistance to most liquids and cleanup conditions, including hydrocarbons, fuels, and alkalies. For extremes of acidity, consult QED for alternative.

Two tubing packages are available for H4 series pumps. The standard SPTUBE provides flow rates up to 8 GPM with H45SSB, H45SEB, and H45SET models. The high flow MAXTUBE increases maximum flow up to 14+ GPM with HF45SSB, HF45SEB, and HF45SET pumps.

The MINTUBE set serves both H2 series pumps.

Hoses and quick-connects are available for all models, including the short-body HF43SET (see "Accessories" for details).

Model	SPTUBE	MAXTUBE	MINTUBE
Description	Contains 4 tubes—discharge, exhaust, air supply, and bubbler tubing*	Contains 3 tubes—discharge, exhaust and air supply	Contains 3 tubes—discharge, exhaust, and air supply
Discharge O.D.	3/4" (19 mm)	1-1/4" (32 mm)	1/2" (13 mm)
Exhaust O.D.	1/2" (13 mm)	1/2" (13 mm)	3/8" (9 mm)
Air Supply O.D.	3/8" (9 mm)	3/8" (9 mm)	1/4" (6 mm)
Bubbler O.D.	1/4" (6 mm)	—	—
Min. Bend Radius	7" (18 cm)	12" (30 cm)	6" (15 cm)
Max. Pressure	325 psi (2,250 kPa)	165 psi (1,150 kPa)	360 psi (2,500 kPa)
†Max. Cont. Length	200' (60 m)	150' (45 m)	250' (75 m)

*Bubbler tubing is used for referenced depth measurement. More information on this is supplied with custom wellhead completion packages.

† These are maximum lengths that can be shipped via UPS. For longer continuous lengths, consult QED.

HAMMERHEAD CAPS AND ACCESSORIES

NOTE: each cap, flange and accessory kit comes with an illustrated instruction sheet.

Standard Caps

Vacuum Caps

STANDARD (SLIP-FIT) CAPS

MODEL**	PUMP MODEL	WELL DIAM.	DESCRIPTION
S2M	H23SEB, H24SET	2" (50 mm)	MINTUBE
S4M	H23SEB, H24SET	4" (100 mm)	MINTUBE
S4S	H45SSB, H45SEB, H45SET	4" (100 mm)	SPTUBE
S6S	H45SSB, H45SEB, H45SET	6" (150 mm)	SPTUBE
S8S	H45SSB, H45SEB, H45SET	8" (200 mm)	SPTUBE
S4L ‡	All HF4 pumps	4" (100 mm)	HOSE
S6L ‡	All HF4 pumps	6" (150 mm)	HOSE
S8L ‡	All HF4 pumps	8" (200 mm)	HOSE
S4X	All HF4 pumps	4" (100 mm)	MAXTUBE
S6X	All HF4 pumps	6" (150 mm)	MAXTUBE
S8X	All HF4 pumps	8" (200 mm)	MAXTUBE

VACUUM CAPS

MODEL**	PUMP MODEL	WELL DIAM.	DESCRIPTION
V2M	H23SEB, H24SET	2" (50 mm)	MINTUBE
V4M	H23SEB, H24SET	4" (100 mm)	MINTUBE
V4S	H45SSB, H45SEB, H45SET	4" (100 mm)	SPTUBE
V6S	H45SSB, H45SEB, H45SET	6" (150 mm)	SPTUBE
V8S	H45SSB, H45SEB, H45SET	8" (200 mm)	SPTUBE
V4X	HF45SSB, HF45SEB, HF45SET	4" (100 mm)	MAXTUBE
V6X	HF45SSB, HF45SEB, HF45SET	6" (150 mm)	MAXTUBE
V8X	HF45SSB, HF45SEB, HF45SET	8" (200 mm)	MAXTUBE

**Add F after Model Number to include Filter/Regulator/Gauge with cap.
‡ Hose option to be sold with support line (cable or rope).

ACCESSORIES

MODEL	PUMP MODEL	DESCRIPTION
37000	All Models	Pump Cycle Counter (for Flow Totalization)
L374	All Models	Tank Full Shutoff
37050	H4 Series	Kit - Regulator/Gage - H2, H4, Solo II
KIH2ST	H23SEB	Kit - Top Inlet Conversion - H2
KIH2SB	H24SET	Kit - Bottom Inlet Conversion - H2
KIH4ST	H4 Bot. Inlet	Kit - Top Inlet Conversion - H4
KIH4SB	H4 Top Inlet	Kit - Bottom Inlet Conversion - H4
CH52	H4 Bot. Inlet	Can - 2' (60 cm) Length (Leachate)
95067	H4 Series	HammerHead O&M Manual
95081	H2 Series	HammerHead O&M Manual
SPTOOLS	All Models	Clamp Tool, Tube Cutter

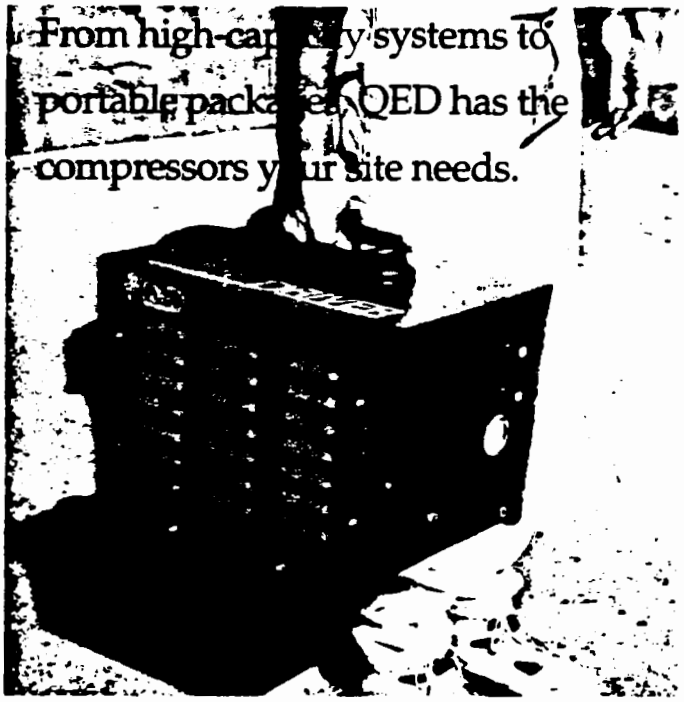
MODEL	PUMP MODEL	DESCRIPTION
37058	H4 Series	Kit - Cable Attachment
37060	H4 Series	Cable - 3/16" (5 mm) S.S. - order by ft.
37207	H4 Series	Rope - 3/8" (9 mm) Polypro. - order by ft.
37212	H4 Series	Cable Sling Assembly
37216	HF4 Series	Hose - 1" (25 mm) I.D. Discharge (Black)
37217	HF4 Series	Hose - 3/8" (9 mm) I.D. Air Supply (Red)
37218	HF4 Series	Hose - 3/8" (9 mm) I.D. Exhaust (Gray)
37208	HF4 Series	Kit - Quick Connect - Discharge/Air Supply -
37209	HF4 Series	Kit - Quick Connect - Discharge/Air Supply -
36824	All Models	Flow Throttle Valve

Air Compressors

FULL-FEATURED, RELIABLE AIR SOURCES

If you don't already have a suitable air supply on-site, QED can provide a cost-effective, high-efficiency compressor package integrated with the rest of your pumping system. Put our experience in supplying compressors for hundreds of cleanup and treatment systems to work for you.

What will you get from QED? A top-quality compressor, engineered to be a precise match for your system requirements, at an extremely competitive price. From numerous manufacturers' product lines, we can locate the compressor model, options, and accessories needed for optimum service under your site conditions. Most systems are configured to meet standard NEMA 1 requirements, but we often deliver equipment rated NEMA 3R for outdoor use, and can supply any other rating up to NEMA 7 on request.



ECONOMICAL RECIPROCATING COMPRESSORS

For most small to medium-sized installations, we will specify a leading brand reciprocating-type compressor. In the range up to 15 HP, these horizontal (or vertical), tank-mounted, two-stage compressors are the most efficient, least-costly choice. A full list of common features for flexible, trouble-free operation includes: built-in receiver tank, factory set pressure switch, combination oil coalescing filter and pressure regulator with gage, electronic tank drain, low oil shutoff safety switch, OSHA-approved belt guard, and dual control operation. Many options are available, including a variety of air dryers.

HIGH-EFFICIENCY SCREW COMPRESSORS

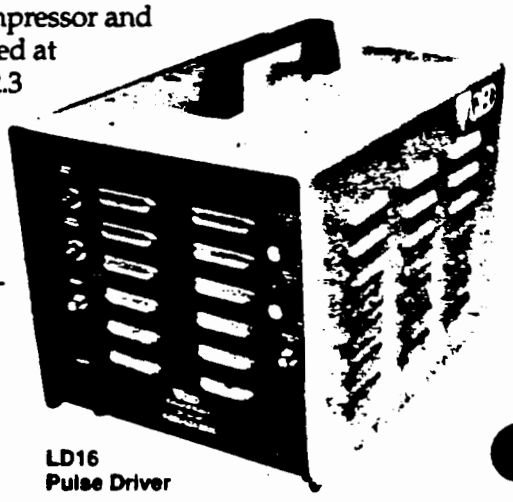
Better economy for larger sites is provided by screw compressors. These compact, powerful units deliver higher energy efficiency, much quieter operation, and higher capacities (up to over 2,000 SCFM).

Another advantage is their 100% (continuous) duty cycle. Unlike reciprocating compressors, which must be over-sized to compensate for their 50% on - 50% off duty cycle, screw compressors are most efficient and run best in continuous use. Standard equipment includes automatic dual control, numerous protective shutoff devices and gages, a sophisticated air/coolant system, and easy maintenance features, all piped and wired into a complete, vibration-engineered, sound-suppressing package with many options.

COMPACT, ON-THE-SPOT POWER FOR FAST RESPONSE

Pulse Driver™ compressor/controllers provide a quick, easily-transportable air source, with built-in electronic controller and tank-full shutoff*, for rapid deployment at remote sites. Each unit powers a Seeker or Eliminator pump system for fast response that can help limit contaminant spread in the early stages of a cleanup, reducing the scope and expense of further efforts.

Rugged Pulse Driver construction can take tough workloads in harsh conditions, with a continuous-duty rated compressor and diaphragm rated at 20,000 hours (2.3 years). The compact units are easily hand-carried to the site and need only standard 115 volt AC power to operate.

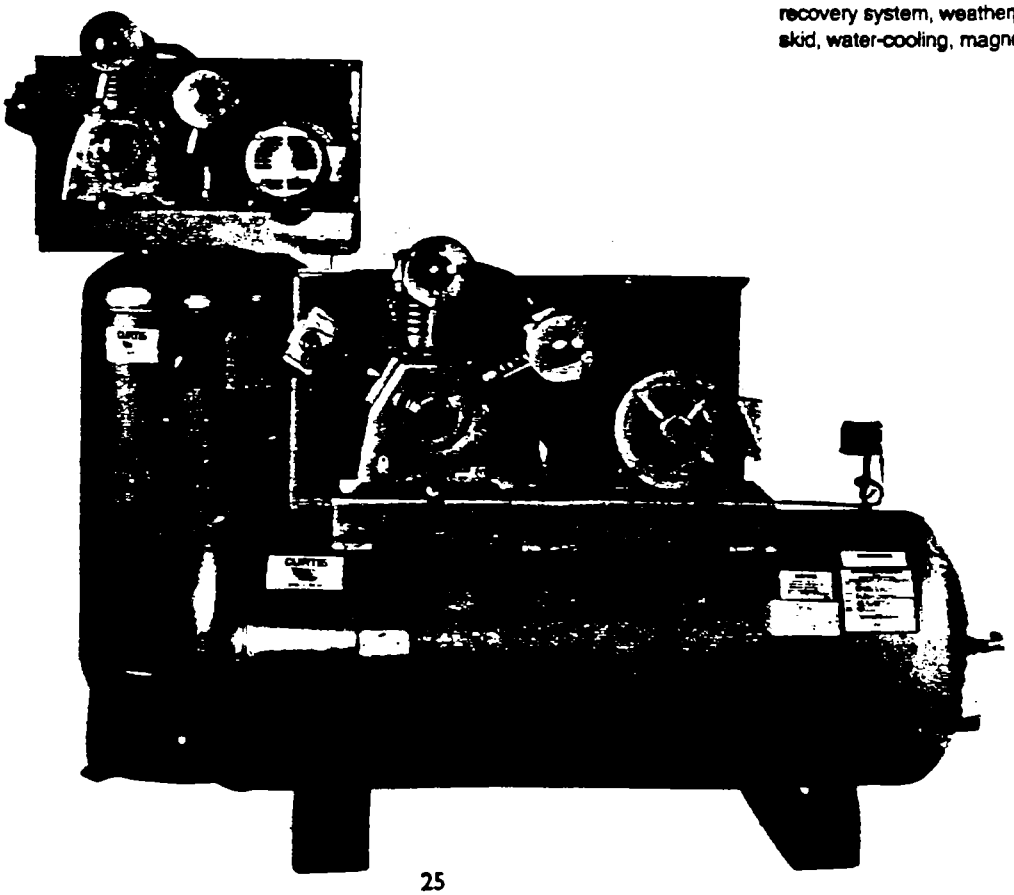


LD16
Pulse Driver

*Also available without tank-full shutoff

COMPRESSOR SPECIFICATIONS

Compressor Model(s)	Pulse Driver™ Model LD16	Various	Various
Type	Piston	Reciprocating	Screw
Output	1.6 SCFM@0 psi/0.3 SCFM@55 psi (2.7 m³/h@0 kPa/0.5 m³/h@380 kPa)	Range: 6.8-45.5 SCFM @100 psi (11.5-77 m³/h@700 kPa) Model "5": 16.9 SCFM (29 m³/h) Model "7": 24.0 SCFM (41 m³/h)	Range: 11.5-2,090 SCFM@110 psi (19.5-3,550 m³/h@760 kPa) Model "6": 21 SCFM (36 m³/h)
Duty Cycle	100% on	50% on/50% off	100% on
Maximum Pressure	55 psi (380 kPa)	150 psi (1,030 kPa)	190 psi (1,310 kPa)
Maximum lift/TDH	50' (15 m)	300' (90 m)	400' (120 m)
Motor	1/3 HP (0.25 kw)	Range: 2-15 HP (1.5-11.2 kw) Model "5": 5 HP (3.7 kw) Model "7": 7.5 HP (5.6 kw)	Range: 3-475 HP (2.2-355 kw) Model "6": 5 HP (3.7 kw)
Power	110 VAC, 60 Hz, 1 phase 230/460 VAC, 60 Hz, 3 phase	Range: 115/230 VAC, 60 Hz, 1 phase (other voltages available) Model "5": 115/230 VAC (230/460 VAC optional) Model "7": 230/460 VAC	Range: 230/460 VAC, 60 Hz, 3 phase Model "6": Same as above
Dimensions (LxWxH)	16x12x12" (40x30x30 cm)	Range: 66.5x18.5x45"—73x28x60" (169x47x114 cm—185x71x152 cm) Model "5": 68x24.5x50" (173x62x127 cm) Model "7": 68x24.5x50" (173x62x127 cm)	Range: 21x22x25"—144x77x80" (53x57x64 cm—366x196x204 cm) Model "6": 21x22x25" (53x57x64 cm)
Weight	40 lbs. (18 kg)	Range: 449-1,379 lbs. (204-626 kg) Model "5": 616 lbs. (280 kg) Model "7": 616 lbs. (280 kg)	Range: 243-12,560 lbs. (110-5,700 kg) Model "6": 243 lbs. (110 kg)
Tank Size	None	Range: 80-120 gal. (300-450 l) included Model "5": 120 gal. (450 l) Model "7": 120 gal. (450 l)	Range: 5-2,200 gal. (19-8,300 l) recommended Model "6": 30 gal. (113 l)@110 psi 20 gal. (76 l)@145-190 psi
Options, Extras	Includes tank-full shutoff (available without) and pump cycle controller, adaptor for Seeker Mate modular controller (used with LP1501 Seeker pump).	Motor starter, belt guard-mounted air-cooled aftercooler (required w/air dryer options), Hankison refrigerated or desiccant air dryer.	205 psi (1,410 kPa) pressure, Quadro control (reduces energy cost), remote air intake filter (for excessive dust). Larger model options: super soundproof casing, heat recovery system, weatherproof casing, skid, water-cooling, magnetic starter.



Reciprocating compressors are available with horizontal or vertical tanks.

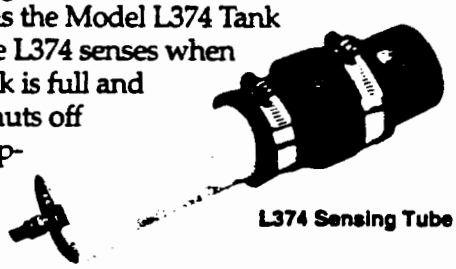
QED DATA SHEET
CODE 1284 REV 9-94
SHEET 1 OF 1
1-800-624-2026
FAX 1-313-995-1170

Flow Control Accessories

SIMPLE, FAIL-SAFE TANK-FULL SHUTOFF PROVIDES POSITIVE PROTECTION FROM SPILLS

Recovery rates from many wells fluctuate, making it difficult to predict how long it will take for a storage tank to fill. At remote or unstaffed sites, this may require frequent unnecessary visits for inspection, or increase the danger of accidental overflow.

The solution is the Model L374 Tank Full Shutoff. The L374 senses when the recovery tank is full and automatically shuts off the pump air supply, avoiding overflow, conserving air and preventing the system from turning on again until an empty container is connected.

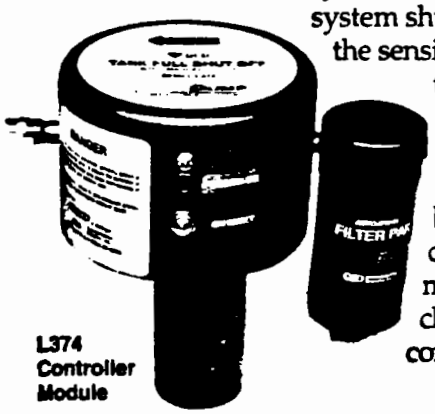


L374 Sensing Tube

The L374 is connected between the air source and the pump(s) or controller(s). The sensing tube assembly threads into a standard 2" NPT fitting on the recovery tank or barrel.

The startup/reset procedure is fail-safe. The on/reset button must be depressed for initial startup and after each shutoff cycle to activate pumping. The system shuts off again unless the sensing tube is connected to an empty tank.

The L374 is inherently reliable with no floats to hang up or bubblers that could clog. It can control as many as 10 pumps discharging into the same container.



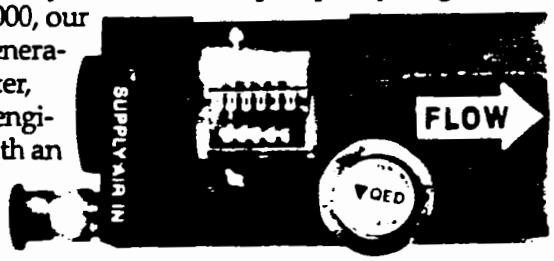
L374 Controller Module

EASY, ACCURATE FLOW TOTALIZATION WITH PROVEN PUMP CYCLE COUNTER

Conventional fluid meters are not reliable for measuring the pulsing type of flow produced by pneumatic displacement pumps. In the past, this made it difficult to totalize flow for site management, reporting or regulatory requirements.

Now with the Model 37000 Pump Cycle Counter, accurate flow measurement is easy for users of QED's controllerless Hammerhead and Solo II pumps. These pumps deliver a consistent volume of liquid with each stroke. Counting the pump cycles and multiplying by the stroke volume gives the flow total.

In addition, dividing the pump cycles by the time intervals tells you how fast the pump is cycling. The model 37000, our second-generation counter, has been engineered with an adjustable air flow valve appropriate for a wider range of site conditions. Because it works on the compressed air line, the counter is ideal for cold weather applications where typical water flow meters have potential freezing problems. Remote display capability is also available; please inquire.



QED cycle counters have been widely accepted and proven in use on a large variety of cleanup and landfill sites. In fact, our initial innovation was such a success the competition was buying counters for its customers.

TANK-FULL SHUTOFF SPECIFICATIONS:

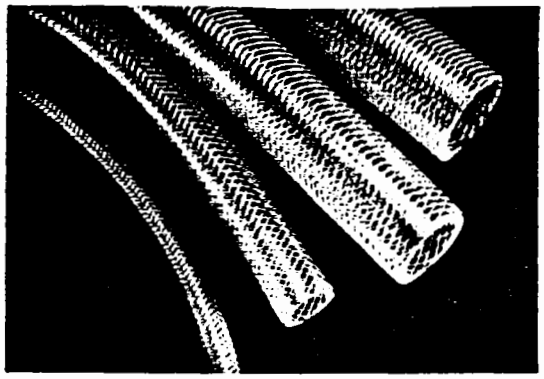
Model No.: L374
Dimensions: Control module 8.25" H x 10.5" W x 6.5" D (21 x 27 x 16.5 cm); sensing tube 1.88" O.D. x 37" (94 cm) L
Weight: Control module 6 lbs.(2.7 kg), sensing tube 1 lb. (.45 kg)
Temperature Range: 35° - 180° F (2°-82°C)
Pressure Range: 40-100 psi (275-700 kPa)
Maximum Flow: 40 SCFM @ 100 psi (68 m³/h @ 700 kPa) (runs up to 10 pumps)
Connection Thread Size: Air tubing 1/4" NPT; sensing tube 2" NPT
Maximum Air Tube Length: 250' (75 m)
Connections Included:
1/2" O.D. tubing x 1/4" NPT - 2 ea.
1/4" I.D. hose (3/8" O.D. nylon tubing) x 1/4" NPT - 2 ea.
SS hose clamps - 2 ea.
1/4" Phillips-head mounting screws - 2 ea.

CYCLE COUNTER SPECIFICATIONS:

Model No.: 37000
Dimensions: 2.25" H x 4.5" W x 2.13" D (5.7 x 11.4 x 5.4 cm)
Materials: anodized aluminum, brass, plastic
Weight: 1 lb. (.45 kg) shipping weight
Temperature Range: 0° - 140° F (-18°- 60°C)
Maximum Pressure: 200 psi (1380 kPa)
Flow Capacity: Normal flow 5 SCFM (8.5 m³/h); maximum flow 20 SCFM (34 m³/h)
Number of Counts: 0 - 999,999
Connections Included:
1/8" male NPT air "in" connection.
1/8" female NPT air "out" connection.
1/8" brass street elbow - 2 ea.

BRAIDED POLYURETHANE HOSE

- Withstands oil, grease, fuels and many chemicals.
- Abrasion-resistant.
- Low-temperature flexibility.
- Contains no plasticizers.
- Resistant to weather, ozone, and radiation.
- Smooth inner and outer surfaces.



Far stronger than unreinforced tubing; it is an ether-based, not ester-based, urethane, providing superior resistance to moisture and fungus.

Its incredible low-temperature flexibility outperforms braid-reinforced vinyls as well. Because of the dual extrusion, barbed insert fittings (not compression type) are recommended.

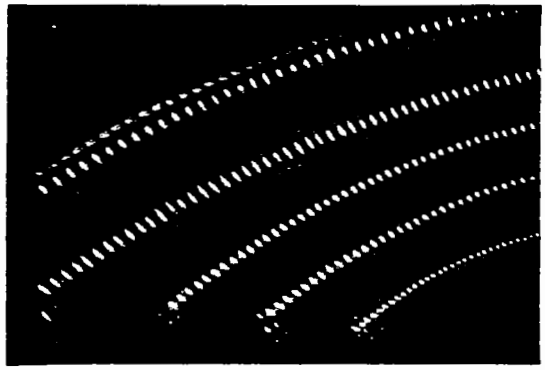
ORDER: 0580-(Size No.) BRAIDED POLYURETHANE HOSE, 100 ft. coils

Size No.	Nom. Size (in.)	Dimensions I.D. in. (mm)	Dimensions O.D. in.	Max. Work. Pressure (psi @ 70°F)	Full Coil Price/ Foot	Cut Lengths Increment Length*	Cut Lengths Price per Foot
-055	1/4	1/4 (6.35)	.472	250	$1.61	10	$2.09
-072	3/8	3/8 (9.53)	.630	190	2.22	10	2.88
-080	1/2	1/2 (12.7)	.748	150	2.77	10	3.58
-100	3/4	3/4 (19.1)	1.024	100	4.32	10	5.59
-110	1	1 (25.4)	1.300	80	6.06	10	7.84
-120	1-1/4	1-1/4 (31.8)	1.710	75	10.96	5	14.19
-130	1-1/2	1-1/2 (38.1)	1.929	50	11.98	5	15.50
-150	2	2 (50.8)	2.519	40	32.31	5	41.81

*Smallest cut increment available for a given tubing size.

HERCO-FLEX WIRE-REINFORCED PVC TUBING

- Spiral steel wire reinforcement incorporated within the walls of flexible PVC tubing.
- Made from non-toxic ingredients conforming to FDA standards. NSF approved for potable water.
- Kink- and crush-resistant.
- Handles both positive and negative pressures.
- Full vacuum transfer hose.



ORDER: 0518-(Size No.) WIRE-REINFORCED PVC TUBING

Size No.	Nom. Size (in.)	Dimensions I.D. in.	Dimensions O.D. in.	Max. Work. Pressure (psi @ 70°F)	Max. Work. Pressure (psi @ 122°F)	Vacuum Rating (in. Hg)	Coil Length (ft.)	Full Coil Price/ Foot	Cut Lengths Increment Length*	Cut Lengths Price per Foot
-055	1/4	1/4	13/32	250	80	29.8	100	$.63	10	$.79
-072	3/8	3/8	5/8	150	80	29.8	100	.88	10	1.10
-080	1/2	1/2	13/16	150	80	29.8	100	1.37	10	1.70
-100	3/4	3/4	1-1/8	150	65	29.8	100	2.51	10	3.13
-110	1	1	1-3/8	100	45	29.8	100	3.14	10	3.92
-130	1-1/2	1-1/2	2	100	35	29.8	50	6.33	5	7.92
-150	2	2	2-1/2	100	35	29.8	50	8.82	5	11.03

*Smallest cut increment available for a given tubing size. 1/4" – 1" tubing, 100 ft. coils. 1-1/4" – 2" tubing, 50 ft. coils.

...ing to determine the fac-
...at affect tubing life.

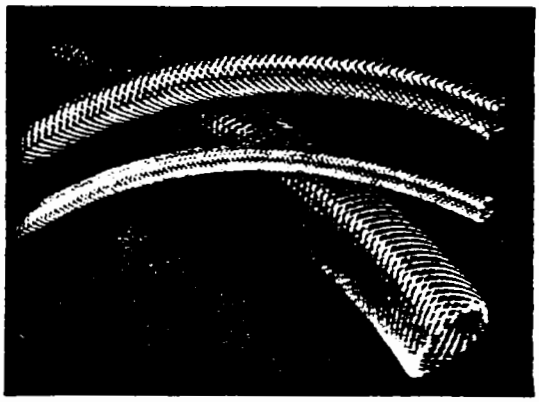
No tubing will last forever but by following some simple guidelines, tubing life can be extended.

Chemical Attack

One of the key factors affecting pump tubing performance is the fluid being transported. Chemical attack leads to absorption or swelling of the tubing, which will shorten tubing life. The chemical resistance to a specific fluid should always be determined.

Check our chemical resistance data on pages 170-171 first.

HERCO-BRAID TUBING & HERCO CHEMICAL HOSE



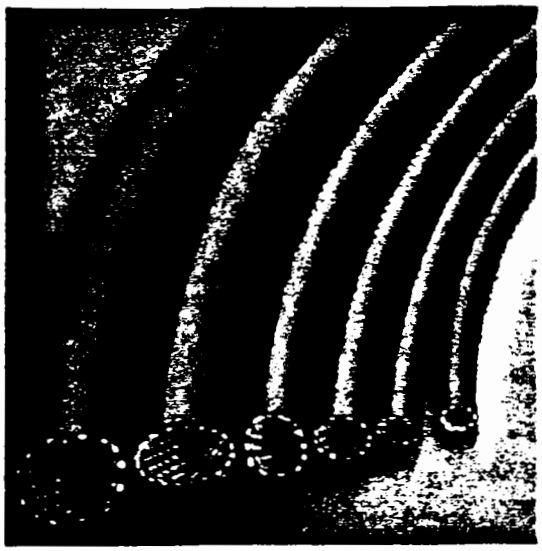
HERCO-BRAID CLEAR PVC TUBING

with nylon reinforcement

- Herco-Braid is perfect for continuous working pressures up to four times greater than unreinforced tubing.
- Completely bonded–it will not balloon, thus eliminating bursting and separating problems.
- Because the braid is within the wall, the outer and inner wall surfaces are smooth; thus sanitation and abrasion difficulties are eliminated. Its ultra-smooth bore reduces friction.
- Its food-grade resin assures you of purity.

HERCO-CHEMICAL BLACK PVC HOSE

with nylon reinforcement for handling corrosive solutions indoors and out



- **Chemical-resistant** to a broad range of corrosives: acids, alkalies, ultra-pure water and salt solutions.
- **Low cost:** Herco Chemical Hose offers the advantage of reinforced PVC tubing at a cost that is less than metal-reinforced suction and delivery hose.
- **Abrasion-free:** The tubing's reinforcement is within the wall– the bore and outer wall are completely smooth.

Both Herco-Braid and Herco Chemical Hose are rated for up to 180°F at zero pressure. The maximum temperature decreases as the pressures increase. Some chemicals will also adversely affect both the pressure and temperature ratings—check with your Ryan Herco Service Center.

ORDER INFORMATION: 0512-(Size No.) HERCO-BRAID FOOD GRADE
0514-(Size No.) HERCO CHEMICAL HOSE

Size No.	Nom. Size (In.)	Dimensions I.D. In. (mm)	Dimensions O.D. In. (mm)	Pressure (psi @ 70°F) Work	Pressure (psi @ 70°F) Burst	Full Coil Lgth. (ft.)	0512 Price per Foot Full Coil	0512 Price per Foot Increment Length*	0512 Price per Foot Cut Length	0514 Price per Foot Full Coil	0514 Price per Foot Increment Length*	0514 Price per Foot Cut Length
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	—
[illegible]	1/4	1/4 (6.35)	.500 (12.7)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
-072	3/8	3/8 (9.53)	.630 (16.0)	275	1100	100	.68	10	.86	.70	10	.88
-080	1/2	1/2 (12.7)	.748 (19.0)	200	800	100	.82	10	1.02	.86	10	1.07
-090	5/8	5/8 (15.9)	.905 (23.0)	200	800	100	1.16	10	1.45	—	10	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	1.293 (32.8)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.22	5	2.77
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
-130	1-1/2	1-1/2 (38.1)	1.930 (49.0)	75	300	50	4.69	5	5.86	4.91	5	6.14
-150	2	2 (50.8)	2.500 (63.5)	75	300	50	6.92	5	8.65	—	5	—

*Smallest cut increment available for a given tubing size.
Note: Use only insert type hose fitting with clamp.

Safety factor of 4-to-1 ratio of burst pressure to working pressure.

Check Out Our Web Site
www.ryanherco.com

97PG032

❶ SPEED ❷ ACCURACY ❸ COMPLETE

WATER SUCTION/DISCHARGE HOSE

Water Suction/Discharge PVC Hose

Lightweight but tough hose is constructed to withstand vacuum and discharge pressures . . . ideal for removing water from work areas.

Use it for transfer of semi-solids, mild sewage, and slurries. Its smooth bore offers minimal resistance to material flow.

CONSTRUCTION AND SPECIFICATIONS—Tube: PVC. Cover: Green, abrasion-resistant PVC. Reinforcement: Rigid thermoplastic helix. Vacuum Rating: 29.8" Hg for hose up to 4 inches; 28.0" for hose 5 inches and over. Temperature Range: –10° F to +158° F.

Maximum continuous lengths are listed in table below. Please order hose in 5-ft. increments.

Hose ID	Hose OD	Working Pressure	Max. Cont. Length	No.	NET/FOOT Cut Lgth.	NET/FOOT Full Lgth.
1"	1.23"	86 psi	100'	5293K36	$1.04	$0.87
1½"	1.52"	79 psi	100'	5293K39	1.33	1.11
1½"	1.78"	72 psi	100'	5293K41	1.46	1.22
2"	2.38"	72 psi	100'	5293K42	2.10	1.76
2½"	2.92"	72 psi	100'	5293K43	3.31	2.77
3"	3.41"	62 psi	100'	5293K44	3.98	3.34
4"	4.50"	55 psi	100'	5293K45	6.65	5.58
5"	5.56"	33 psi	60'	5293K46	9.11	7.69
6"	6.67"	33 psi	60'	5293K47	11.86	10.11
8"	8.83"	28 psi	20'	5293K48	18.89	16.14

Hi-Flex Water Suction/Discharge Plastic Hose

Flexible and resilient, this smooth-bore hose handles air, liquids, and light bulk materials and resists most acids and alkalies. Hose is not pressure rated. Medium-weight version will handle a light vacuum. Screw-on couplings are sold separately.

CONSTRUCTION AND SPECIFICATIONS—Tube: Plastic (ethylene copolymer). Reinforcement: External plastic helix. Couplings: Screw-on vinyl cuffs. Temperature Range: –20° F to +150° F.

Maximum continuous length is 50 feet. Please order hose in 5-ft. increments.

Hose ID	Hose OD	Hose NET/FOOT No.	1-49	50-Up	Screw-On Couplings No.	NET EACH 1-9	NET EACH 10-Up
LIGHTWEIGHT HOSE—Silver-on-black color.							
⅜"	1⅝"	5290K51	$1.89	$1.41	5290K81	$1.84	$1.37
¾"	1¼"	5290K11	1.79	1.49	5290K31	1.80	1.80
⅞"	1⅝"	5290K52	1.94	1.82	5290K82	2.02	1.88
1"	1⅝"	5290K12	2.09	1.72	5290K32	2.08	1.73
1¼"	1⅝"	5290K13	2.19	1.83	5290K33	2.33	1.94
1½"	1⅝"	5290K14	2.84	2.20	5290K34	2.86	2.22
MEDIUM-WEIGHT HOSE—Beige-on-black color.							
1¼"	1⅝"	5290K21	$2.32	$1.93	5290K41	$2.33	$1.94
1½"	2⅛"	5290K22	3.25	2.71	5290K42	2.66	2.22
2"	2½"	5290K23	4.14	3.45	5290K43	5.27	4.39
2½"	3"	5290K24	5.36	4.48	5290K44	5.67	4.73
3"	3½"	5290K25	6.29	5.24	5290K45	7.44	6.20
3½"	4"	5290K53	7.28	6.07	5290K63	8.38	6.98
4"	4½"	5290K26 ♦	7.84	6.53	5290K46	12.33	10.28

♦ Maximum continuous length is 10 feet.

Heavy-Duty Water Suction/Discharge Vinyl Hose

Hardwall hose is built to handle the tough jobs. Put it to work in foundries, water and sewage plants, refineries, chemical plants, dairies, paper mills, mines, quarries, and more. Hose won't crush or kink and resists mild acids, alkalies, and some light chemicals. Each size has a full vacuum rating. We sell hose without couplings, and hose assemblies which include couplings.

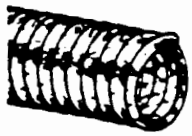
CONSTRUCTION AND SPECIFICATIONS—Tube: Thermoplastic vinyl nitrile. Cover: Blue, abrasion-resistant, thermoplastic vinyl nitrile (ribbed for a sure grip and reduced drag). Reinforcement: Polyester interwoven with helical-wound steel wire. Couplings: Brass M x F, NPT. Temperature Range: –20° F to +160° F.

HOSE ASSEMBLIES—Available in economical 15-ft., 25-ft., and 50-ft. lengths as well as in custom lengths. To order a custom-length assembly, please specify the custom-length base price part number, and the length required.

HOSE—Maximum continuous length is 50 ft. Please order in 5-ft. increments.

Hose ID	Hose OD	Working Pressure	HOSE ASSEMBLIES 15-Ft. Length M x F Couplings No.	NET EACH	25-Ft. Length M x F Couplings No.	NET EACH	50-Ft. Length M x F Couplings No.	NET EACH	Custom Length Base Price; M x F No.	NET EACH	HOSE No.	NET/FOOT 1-49	NET/FOOT 50-Up
1½"	2"	300 psi	5651K61	$75.48	5651K65	$108.10	5651K71	$199.66	5651K31	$20.15	5651K11	$3.85	$3.26
2"	2½"	300 psi	5651K62	109.51	5651K66	158.41	5651K72	295.07	5651K32	34.95	5651K12	5.75	4.86
2½"	3"	300 psi	5651K63	133.25	5651K67	187.21	5651K73	340.17	5651K33	45.50	5651K13	8.45	6.46
3"	3½"	250 psi	5651K64	181.27	5651K68	249.47	5651K74	445.04	5651K34	76.13	5651K14	8.25	6.98
4"	4½"	200 psi	5651K81	254.76	5651K82	343.67	5651K83	597.01	5651K35	126.00	5651K15	10.91	9.23

Clear-View Water Suction/Discharge PVC Hose



Semi-clear sidewalls allow you to make quick visual checks of material flow.

High-pressure, full-vacuum hose resists abrasion and is perfect for water drainage applications. It has a smooth bore for unrestricted water flow.

CONSTRUCTION AND SPECIFICATIONS—Tube: Semi-clear PVC. Reinforcement: Braided PVC with clear or safety-orange raised PVC helix. Vacuum Rating: 28" Hg. Temperature Range: –13° F to +158° F. FDA hose materials meet FDA and 3-A nontoxic standards.

Maximum continuous lengths are listed in table. Please order in 5-ft. increments.

Hose ID	Hose OD	Working Pressure	Max. Cont. Length	FDA-CLEAR HELIX No.	NET/FOOT 1-24	NET/FOOT 25-Up	SAFETY-ORANGE HELIX No.	NET/FOOT 1-24	NET/FOOT 25-Up
1¼"	2.01"	125 psi	100'	45815K21	$3.83	$3.13	45815K51	$3.09	$2.53
2"	2.58"	125 psi	100'	45815K22	4.80	3.93	45815K52	3.71	3.04
3"	3.60"	125 psi	100'	45815K23	6.42	5.35	45815K53	5.23	4.28
4"	4.72"	100 psi	100'	45815K24	10.82	8.02	45815K54	7.60	6.34
6"	7.17"	50 psi	50'	—	—	—	45815K55	16.74	13.86
8"	9.33"	50 psi	25'	—	—	—	45815K56	21.47	18.17
								1-19	20-Up
10"	11.63"	36 psi	20'	—	—	—	45815K57	$37.27	$31.84

Water Suction EPDM Rubber Hose

Wire and cord reinforcement gives this flexible supply line the strength to handle full vacuum, pressure, and gravity service while its smooth bore allows unrestricted water flow. We sell hose without couplings, and hose assemblies which include couplings.

CONSTRUCTION AND SPECIFICATIONS—Tube and Cover: Black EPDM blend. Reinforcement: Two layers of heavy-duty textile cords separated by a high-tensile-strength steel wire helix, all embedded in rubber. Couplings: Brass M x F, NPT. Temperature Range: –40° F to +212° F.

HOSE ASSEMBLIES—Available in economical 25-ft. and 60-ft. lengths as well as in custom lengths. To order a custom-length assembly, please specify the custom-length base price part number, and the length required.

HOSE—Maximum continuous length is 60 ft. Please order in 5-ft. increments.

Hose ID	Hose OD	Working Pressure	HOSE ASSEMBLIES 25-Ft. Length M x F Couplings No.	NET EACH	60-Ft. Length M x F Couplings No.	NET EACH	Custom Length Base Price; M x F No.	NET EACH	HOSE No.	NET/FOOT 1-59	NET/FOOT 60-Up
1"	1½"	150 psi	5294K86	$96.86	5294K97	$203.01	5294K44	$9.65	5294K13	$4.86	$3.80
1¼"	1¾"	150 psi	5294K88	106.20	5294K99	218.68	5294K45	14.33	5294K16	4.84	4.09
1½"	2"	150 psi	5294K83	112.92	5294K93	234.86	5294K26	18.27	5294K75	5.20	4.39
2"	2½"	125 psi	5294K84	122.28	5294K94	252.54	5294K28	18.15	5294K17	5.56	4.69
2½"	3"	125 psi	5294K85	166.00	5294K95	389.00	5294K31	34.36	5294K19	8.06	7.33
3"	3½"	90 psi	5294K86	231.23	5294K51	460.21	5294K33	39.18	5294K11	8.42	7.66
4"	4½"	75 psi	5294K87	327.30	5294K52	627.33	5294K34	62.60	5294K23	12.94	10.78

HOT W

Hot Wat

A top performer in hot-water wash
tions. Choose Tornado for general a
Hurricane for the big jobs. Maximum co
is 100 ft. Please order in 5-ft. increm
TORNADO—Tube: PVC. Cover: Hig
low PVC. Reinforcement: Synthetic c
ture Range: –10° F to +180° F.
HURRICANE—Tube: SBR. Cover:
yellow vinyl nitrile. Reinforcement: C
Temperature Range: –40° F to +180°

High Pressure

Great for high-pressure washdown
down applications. Meets SAE 100R3 f
and pneumatic systems. We sell hose w
semblies which include couplings. C
SPECIFICATIONS—Tube: Neoprene rubber, r
pents, oil, and solvent-based sprays. C
highly resistant to oil, weather, and abr

Hose ID	Hose OD	Working Pressure
¼"	½"	1250 psi
⅜"	¾"	1125 psi
½"	1⅛"	1000 psi
¾"	1¼"	750 psi
1"	1½"	565 psi

Steam/

Also known as creamery and pape
low-pressure steam and hot-water wa
les, food-processing plants, and pape
couplings, and hose assemblies whi
STRUCTION AND SPECIFICATIONS—
Sanitary cream-white color SBR with
ment: Synthetic fabric. Couplings: Br

Hose ID	Hose OD	25-F M x F No.
½"	1⅝"	5286K
¾"	1¼"	5286K
1"	1⅞"	5286K
1¼"	1¼"	5286K

¾" Hose with Tapered Nozzle on One
¾" Hose with Tapered Nozzle on One

Re

Put this rugged hose to work handlin
veyor, and tank truck applications.
processing and dairy industries. We se
hose assemblies which include coupli
only. Do not alternate use between st
STRUCTION AND SPECIFICATIONS—
forcement: Braided, high-tensile-str
High-pressure, malleable-iron interloc

Hose ID	Hose OD	Working Pressure
STANDARD COVER		
½"	1.02"	250 psi
¾"	1.27"	250 psi
1"	1.52"	250 psi
1¼"	1.92"	250 psi
1½"	2.14"	250 psi
2"	2.66"	250 psi
OIL-RESISTANT COVER		
½"	1.02"	250 psi
¾"	1.27"	250 psi
1"	1.52"	250 psi
1½"	2.18"	250 psi
2"	2.66"	250 psi

Pressure-W

Designed especially to meet the tem
quirements of most pressure washers
We sell hose without couplings, and ho
include dichromate-plated steel MPT x
semblies are available in lengths listed
maximum continuous length of 100 ft.
increments.

MEDIUM PRESSURE—Tube: O
(RMA Class B). Cover: Black oil-resis
Class B). Reinforcement: Braided
Max. Temperature: +200° F.

HIGH PRESSURE—Tube: Oil-resi
Class B). Cover: Black synthetic rubbe
forcement: One wire braid. Max. Te

STEAM CLEANER—Tube: Heat
rubber. Cover: Black heat/oil-resista

Dewatering Pumps

Dewatering pumps are primarily used for draining drums, tanks, flooded rooms, flat roofs, shafts, and construction sites. Easy to move from site to site, pumps range in style from small electric and portable gasoline units to submersible units.

Light-Duty Electric-Powered Dewatering Pumps

LOW-FLOW MODEL—Portable utility pumps run on 115 VAC. Pumps up to 360 gph. Unit is self-priming 8 to 10 feet vertically, 25 feet horizontally, and drains down to ⅛". Shutoff head is 62 ft. Pump has ¾" garden hose threaded connections and a stainless steel shaft. Impeller, O-ring, and seal are Buna-N. Thermal overload protected motor is ⅓ hp, with a 5½-ft. cord and 3-prong grounded plug. Intake/strainer attachment and 6-ft. inlet hose are included. Pump weighs 5 lbs. and is 3½"H x 4⅜"W x 6½"L. Maximum temperature is 150° F. Materials in contact with solution are stainless steel, polyester, Buna-N, and bronze. UL listed.

No. 4193K11 ..... **NET EACH $88.86**

PUMP SERVICE KIT—Seal, retainer, O-ring, and impeller.

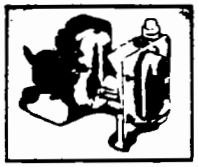
No. 4193K21 ..... **NET EACH $6.66**

HIGH-FLOW MODEL—Pumps up to 1320 gph. Great for sump boosting pressure to clear Pump self-primes in seconds and has open molded-plastic impeller and body with ¾" fpt connections ½-hp, 60-Hz, double-insulated 10-ft., 2-wire cord, intake strainer and garden hose adapters are included.

Pump is 7½"H x 5"W x 9⅛"L and weighs 12 lbs. Maximum temperature is 90° F. Materials in contact with solution are cast iron and ceramic.

Pump Performance, GPH at Head, Ft.						
40	50	70	90	Shutoff, Ft.	No.	NET EACH
1320	1230	1050	840	90	3962K11	$144.66

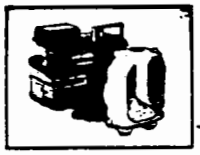
Light-Duty Gasoline-Powered Dewatering Pump



This self-priming centrifugal pump moves up to 1620 gph and is capable of suction lifts to 20 feet. It runs on a 0.7-hp, 21.2-cc, 2-cycle, 7000-rpm air-cooled gasoline engine with solid-state electronic ignition, automatic rewind starter, and a 16.9-oz. fuel tank. Runs 45-50 minutes on a full tank. Pump has a die-cast aluminum body and weighs only 11 pounds for easy portability. It has a carbon/ceramic shaft seal and 1" connection. Unit discharges through a standard Comes with spark arrestor, muffler, couplings, strainer and suction hose. Size is 9"H x 7½"W x 13"L. Maximum temperature is 160° F. Materials in contact with solution are die-cast aluminum and ceramic.

Pump Performance, GPH at Head, Ft.							
0	20	40	60	80	Shutoff, Ft.	No.	NET EACH
1620	1530	1290	960	420	90	5144K29	$1[illegible]

Medium-Duty Dewatering Pumps



Self-priming up to 20 feet, these pumps handle solids up to ⅜". They have cast-iron construction with a one-piece housing and a semi-open impeller that resists clogging. Mechanical seal is made of Buna-N, stainless steel, and ceramic. Pumps run on a 4-cycle, 3600-rpm gasoline engine with recoil start and 1[illegible] fuel tank.

Maximum temperature is 160° F. Materials in contact with solution are cast iron, Buna-N, stainless steel, and ceramic.

HP	Port, NPT	Ht. x Wd. x Lg.	Wt., Lbs.	Pump Performance, GPH at Head, Ft. 20	30	50	70	Shutoff, Ft.	No.	NET EACH
3	1½"	13½" x 14" x 17"	40	4500	4000	2450	___	70	43735K31	$[illegible]
3	2"	13" x 13¼" x 16¾"	62	7320	6720	5220	2400	76	43735K35	$[illegible]
5	2"	14½" x 14" x 17¾"	65	9000	8280	6540	4080	90	43735K39	$[illegible]

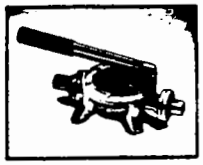
Heavy-Duty Dewatering Pumps

These self-priming centrifugal pumps inhale water in cellars, excavations, pits, and mines. They're made of aluminum with cast-iron impellers for continuous use. Shaft seals are self-lubricating. Built-in check valve assures a positive prime. Pumps have rubber feet and a tubular roll cage for easy handling and protection for the pump. Roll cage is 16"H x 18"W x 22"L.

Pumps run on a 4-cycle, air-cooled 3600-rpm with recoil start. They have a 3-quart fuel tank and run 2¼ hours when tank is full. Maximum temperature is 160° F. Materials in contact with solution are die-cast aluminum, cast iron, and stainless steel.

HP	Port, MPT	Wt., Lbs.	Pump Performance, GPH at Head, Ft. 30	50	70	90	Shutoff, Ft.	No.	NET EACH
3	2"	57	8,400	7,200	5,400	3,600	110	43145K77	$[illegible]
5	3"	71	13,200	10,800	7,800	4,800	109	43145K78	$[illegible]

Manual Dewatering Pumps



Self-priming pumps move over a liter with every stroke—up to 1800 gph without sparks or electricity. They handle granular and stringy solids without clogging. Pumps are capable of 12-ft. suction lift and have a 12-ft. shutoff head. Four legs provide versatile mounting. The Delrin-body pumps are injection molded. Aluminum-body pump is epoxy coated.

The anodized-aluminum handles have a nonslip grip. Accepts slip-on hose connections. Maximum temperature is 140° F. Materials in contact with solution is Buna-N diaphragm.

GPH	Pump Body	Port OD	Ht. x Wd. x Lg.	Wt., Lbs.	No.	NET EACH
600	Delrin	1"	4" x 5" x 10"	1¼	4332K17	$[illegible]
900	Delrin	1½"	4" x 5" x 10"	1½	4332K18	$[illegible]
1800	Aluminum	2"	5" x 8" x 14½"	5½	4332K19	$[illegible]

● Horizontal handle easily converts to vertical use.

12-Volt Dewatering Pumps

Self-priming noncorroding pumps go to work anywhere there's access to a 12-volt battery. Simply connect to battery terminals and you're ready to go (battery not included).

360-GPH MODEL—Use in open air and submersed. Pump fits into tight spots and operates in any position. Motor lifts water from 6 feet below pump when primed. Shutoff head is 6 ft. Intake has a bilge plate with strainer. Pump also includes an interchangeable plate with ½" npt male intake. Discharge is ⅜" npt male and accepts ⅝" ID hose. Unit runs on a 1.6-amp draw, 12-VDC motor. Designed for intermittent use up to 160° F. Materials in contact with solution are Delrin, stainless steel, and Buna-N.

600-GPH MODEL—Makes an excellent bilge pump. All pipe connections are plastic. Pump has 12-amp draw, 12-VDC, 10-ft. electrical cable with battery clips, 6-ft. garden hose with charge, couplings, and a strainer. Maximum temperature is [illegible]. Materials in contact with solution are polypropylene, polyacetal, stainless steel, Buna-N, brass, rubber, and ABS.

Description	Ht. x Wd. x Lg.	Wt., Lbs.	No.	NET EACH
360-GPH Pump	2⅛" x 2⅛" x 5½"	¾	8764K12	$[illegible]
600-GPH Pump	4⅜" x 4½" x 7¾"	7	4293K61	$[illegible]
Replacement Impeller Kit for 600-GPH Pump			4293K62	$[illegible]

...ethylene & Vinyl Film ...eeting

Polyethylene Film Sheeting

All purpose sheeting protects against dust, water, and chemicals. Ideal for construction enclosures, window coverings, storm windows and doors, water tank and pit liners, pipes and ducts, plus weather protection.

Polyethylene sheeting is also excellent as vapor barriers for walls, beams, ceiling, and subfloors.

Clear or black sheeting is available. For outdoor use, choose black sheeting because of its greater resistance to ultraviolet light.

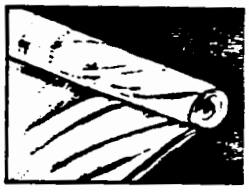
Width Ft.	Thick. Mils	Clear No.	Black No.	NET/ROLL
100-FOOT ROLLS				
3	4	8563K91	8563K82	$11.43
4	4	8563K92	8563K63	20.32
6	4	8563K93	8563K64	19.86
8	4	8563K41	8563K71	23.86
10	4	8563K42	8563K49	29.44
12	4	8563K11	8563K51	35.33
16	4	8563K13	8563K24	47.11
20	4	8563K14	8563K25	63.00
24	4	8563K43	8563K26	63.80
32	4	8563K16	8563K28	84.80
40	4	8563K81	8563K29	110.48
80-FOOT ROLLS				
10	4	8563K11	8563K21	16.21
12	4	8563K13		19.45
16	4	8563K15	8563K25	25.94
20	4	8563K17	8563K27	29.30
3	6	8563K94	8563K85	$17.89
4	6	8563K95	8563K66	23.45
6	6	8563K96	8563K67	30.58
8	6	8563K45	8563K84	38.15
10	6	8563K46	8563K52	46.18
12	6	8563K17	8563K53	54.22
16	6	8563K19	8563K31	64.91
20	6	8563K21	8563K32	81.14
24	6	8563K47	8563K33	97.37
32	6	8563K23	8563K35	117.81
40	6	8563K48	8563K36	169.36
10	6	8563K41	8563K51	94.86
12	6	8563K43	8563K53	29.82
16	6	8563K45	8563K55	39.76
20	6	8563K47	8563K57	44.83

Reinforced Woven Polyethylene Film Sheeting

Woven for extra strength and tear resistance, this all-weather sheeting is flexible, even at -80° F. Ideal for use as covering material, this non-absorbent sheeting is rot and mildew proof.

Sheeting is dimensionally stable. The tensile strength is 110/85 psi in all directions. The tear strength is 25/30 psi. Furnished in 100-foot rolls.

Clear or black sheeting is available. For outdoor use, choose black sheeting because of its greater resistance to ultraviolet light.



Width Ft.	Thick. Mils	Clear No.	Black No.	NET/ROLL
8	4	8552K31	8552K11	$76.40
10	4	8552K52	8552K22	95.49
12	4	8552K32	8552K12	105.03
16	4	8552K33	8552K13	140.05
20	4	8552K55	8552K25	175.07
24	4	8552K34	8552K14	210.08
32	4	8552K59	8552K29	258.55
40	4	8552K36	8552K16	323.20

Cross-Laminated High Density Polyethylene Film Sheeting

Featuring a high tensile strength of 8000 psi, this sheeting assures exceptional resistance to impact, punctures, snagging, and tearing. It also resists cold cracking to -125° F.

Lightweight, moisture-resistant sheeting is ideal for use as protective floor coverings, heat and chill shields, and as vapor barriers between walls. Furnished in 100-ft. rolls. Furnished in white or black.

Width Ft.	Thick. Mils	White No.	Black No.	NET/ROLL
8	4	8718K14	8718K18	$71.67
12	4	8718K24	8718K28	107.53
16	4	8718K34	8718K38	135.95
20	4	8718K44	8718K48	164.27

Low Density/High Strength Polyethylene Film Sheeting

Manufactured from super-strength linear low density polyethylene (LLDPE), this 2-mil sheeting is stronger than conventional 4-mil sheeting.

Sheeting is furnished in a convenient dispenser box that measures 17⅜" long x 15¼" wide x 5¼" high—you can store it just about anywhere. A cutting tool is included.

Furnished in 100-foot rolls. Furnished in clear or black.

Width Ft.	Thick. Mils	Color	No.	NET/ROLL
10	2	Opaque White	8651K91	$23.86
10	2	Black	8651K94	23.86

Antistatic Pink Polyethylene Film Sheeting

Low density polyethylene won't hold a static charge and won't attract dust. Non-corrosive, humidity-resistant sheeting is ideal for use in static-sensitive areas, including electronic assembly plants, powder plants, clean rooms, and hospitals.

Sheeting surface resistivity is less than 1×10^{12} ohms/sq. Constant material meets the static decay requirements of MIL-B-81705 B and C, plus EIA 541. Furnished in 100-ft. and 800-ft. rolls.

Width Ft.	Thick. Mils	100-Ft. Rolls No.	NET/ROLL	800-Ft. Rolls No.	NET/ROLL
4	4	8564K31	$53.55	8564K41	$217.58
4	6	8564K51	73.61	8564K61	315.06

Antistatic Clear Vinyl Film Sheeting

Create antistatic and fire-retardant curtains for computer rooms, clean rooms, and areas with electronic equipment. Embedded with a diamond pattern of carbon scrim that grounds static charges, this heavy-duty, clear film is easy to see through. Ideal for areas where static build-up must be kept to a minimum.

Sheeting is CPAI Approved. It's also highly efficient for dust prevention and thermal isolation.

Film is 12 to 14 mil thick and 54" wide. Maximum roll length is 100 yards. Specify No. and linear yards required.

No.	NET/LINEAR YARD 1-4	5-Up
8714K57	$16.73	$13.96

Clear Vinyl Film Sheeting

Tough, waterproof, flexible, and easy-to-cut, this heavyweight sheeting features good optical clarity, insulating qualities, and wind resistance. It can be sewn and heat sealed.

UV stabilized for years of service, clear film is ideal for temperatures to -20° F. Excellent for appliance covers, draft shields, emergency window repairs, and splash mats. The 4 mil thickness provides good service; heavy-duty 8 mil thickness provides longer life.

Size Width x Length	4 Mils Thick. No.	NET/ROLL	8 Mils Thick. No.	NET/ROLL
36" x 25-ft.	8562K6	$16.30	8562K8	$29.82
48" x 25-ft.	8562K7	21.73	8562K9	39.26
36" x 150-ft.	8562K2	72.83	8562K4 ♦	99.47
48" x 150-ft.	8562K3	96.84	8562K5 ♦	92.63

♦ Roll length is 75 feet.

...e

...nate

- ...W Have ... of Glass ...ength ... ...ce
- Excellent Electrical Properties
- UL Rated as Burglar Resistant
- Thermoformable

...perating temperature is 180° F. Ideal for aircraft and structural components, machine ...guards and other safety devices, food service ...equipment, medical equipment, containers, ...signs, panels, and glazing.

...er, please specify No. 8680SK11 for gray color ...bronze color. In addition, please specify thickness ...d.

...H	48" x 48" No.	NET EACH	48" x 96" No.	NET EACH
...43	8574K81	$36.87	8574K71	$68.06
36.50	8574K82	53.00	8574K72	97.86
36.50	8574K83	53.00	8574K73	97.86
...75	8574K84	77.50	8574K74	143.03
...82	8574K85	97.63	8574K75	180.25
...27	8574K86	172.63	8574K76	318.49
...68	8574K87	243.37	8574K77	449.29
...63				
822.60				

...heets

...washing. Sheets are self-extinguishing.

...ailable in gray or bronze in thicknesses of ⅛", ...order, please specify No. 87115K11 for gray color ...bronze color. In addition, please specify thickness ...

...H	48" x 48" No.	NET EACH	48" x 96" No.	NET EACH
...07	8707K81	$124.80	8707K71	$230.40
...73	8707K82	182.87	8707K72	299.16
96.53	8707K83	178.22	8707K73	356.43
157.33	8707K84	290.46	8707K74	539.43
...97	8707K85	352.74	8707K75	655.09

...Tubes

...e FDA approved for food contact applications. ...1¾" to 2¼" (±.025"); 2½" to 6" (±.030"). Furnished ...ter, please specify No. and length.

...IET/FOOT	OD x ID	No.	NET/FOOT
...5	$3.22	2¾" x 2½"	8585K34	$7.23
...8	3.85	3" x 2¾"	8585K21	7.84
...8K17	4.56	3½" x 3¼"	8585K33	9.43
...8K18	4.89	4" x 3¾"	8585K22	12.00
...8K19	6.30	6" x 5¾"	8585K23	20.86

...rnished in 1-ft. increments up to a maximum ...except for sizes 2¼" diameter and larger, which have ...of 4 feet. To order, please specify No. and length.

...IET/FOOT	Dia.	No.	NET/FOOT
...	89.89	2¼"	8671K37	$38.47
...	12.89	2½"	8671K39	39.53
...	12.44	3"	8671K23	54.93
...	26.80	4"	8671K41	102.42

...Sheets and Rods

...to 2" (+.005" -.000"); 3" (+.030" -.000"). Rods are ...shed in 1-ft. increments up to a maximum length ...ft. To order, please specify No. and length.

...ACH	24" x 24" No.	NET EACH	24" x 48" No.	NET EACH
...85.50	85625K46	$165.50	85625K47	$331.04
...18.99	85625K56	236.99	85625K57	443.23
...15.73	85625K66	315.73	85625K67	586.36
...432.40	85625K76	432.40	85625K77	807.17
...570.96	85625K86	570.96	85625K87	1028.97

...ET/FOOT	Dia.	No.	NET/FOOT
...85.48	2"	85485K53	$26.55
...13.26	3"	85485K55	80.78

PVC SCHEDULE 80 FITTINGS

REDUCER FITTINGS

NOT RECOMMENDED FOR COMPRESSED AIR OR GASES.

		REDUCER BUSHINGS			REDUCER COUPLINGS	
SIZE CODE	SIZE	SPG x S No. 3837	SPG x T No. 3838	MT x T No. 3839	S x S No. 3829	T x T No. 3830
-098	3/4 x 1/4	—	1.67	4.26	—	—
-099	3/4 x 3/8	—	1.59	4.26	—	—
-101	3/4 x 1/2	0.91	1.67	3.52	3.47	3.60
-166	1-1/4 x 1/2	4.12	5.32	5.85	10.27	23.36
-167	1-1/4 x 3/4	4.12	5.32	5.85	10.27	11.45
-168	1-1/4 x 1	4.12	5.32	5.85	10.27	12.02
-247	2 x 1/2	7.99	8.16	10.11	12.14	35.99
-248	2 x 3/4	7.99	8.16	10.11	12.14	35.99
-249	2 x 1	7.99	8.16	10.11	12.14	23.68
-250	2 x 1-1/4	7.99	8.16	10.11	12.14	35.99
-336	3 x 1-1/4	21.98	31.92	—	—	—
-337	3 x 1-1/2	21.98	31.92	18.63	40.75	77.26
-338	3 x 2	21.98	31.92	18.63	29.79	57.87
-339	3 x 2-1/2	21.98	31.92	18.63	49.38	—

REDUCER TEES

ORDER: 3801-(Size No.) Reducer Tees, SxSxS

Size No.	Size (in.)	Price each
-168	1-1/4 x 1-1/4 x 1	10.6
-210	1-1/2 x 1-1/2 x 3/4	10.6
-211	1-1/2 x 1-1/2 x 1	10.6
-251	2 x 2 x 1-1/2	13.4
-338	3 x 3 x 2	24.7
-420	4 x 4 x 2	39.9

DEBURRING TOOL

A smooth, chamfered pipe end helps spread the so evenly as the pipe is joined. It deburs fast—one revolution produces a 3/32 bevel at a 15° angle in secc

ORDER: 8605-(Size No.) DEBURRING TOOL

-515, for pipe up to 2" dia. $1
-520, for 1-1/4"–4" pipe 5

8605-515

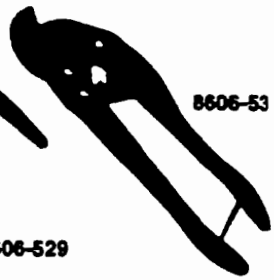
8605-520

SNIPPERS

- Cuts small pipe
- Schedule 40 or 80
- Cuts plastic tubing to 2.4" O.D.
- Quick, clean cuts
- Squeezing handles together and ratchet action make job easy especially in close quarters.

8606-527

8606-529



8606-53

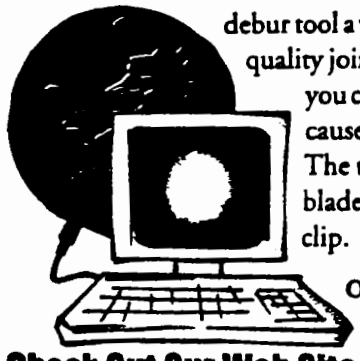
ORDER INFORMATION:

8606-527 SNIPPER, 1/8" – 3/4" . . . . . $55.
8606-529 SNIPPER, 1/8" – 1-1/4" . . . . . 65.
8606-531 SNIPPER, 1" – 2" . . . . . 140.
8606-528 Extra Blades for -527 Snipper . . . . . 21.
8606-530 Extra Blades for -529 Snipper . . . . . 25.
8606-532 Extra Blades for -531 Snipper 37

97PG08

POCKET DEBURRING TOOL

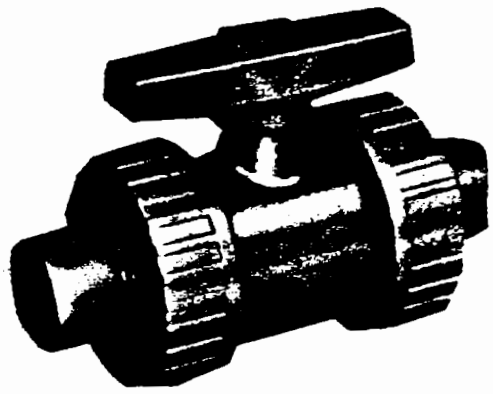
This handy pocket deburring tool is designed especially for removing internal burrs in small diameter fusible pipe like PVDF and polypropylene. As a companion to standard debur tools, you'll find the pocket debur tool a welcome addition for making high quality joints in small diameter systems since you can easily remove burrs which might cause excess material in the flow stream. The tool features a long-lasting carbide blade, aluminum handle, and pocket clip.



ORDER: 8605-530 POCKET DEBURRING TOOL . . . $5.28

TRUE-UNION BALL VALVES

+GF+ TOP OF THE LINE QUALITY & PERFORMANCE



All 3/8" to 2" actuated ball valves feature +GF+ Type 346 true-union ball valves for one reason: superior performance combined with a long life. For safety and reliability, make 346 your choice. PVC and CPVC valves are supplied with both socket and threaded end connectors; the polypro and PVDF shown below are supplied threaded only.

- Blowout-proof stem with two seals.
- PTFE Teflon seats for tight sealing, long service life.
- Backing O-rings provide a self-adjusting seal between the seat and floating ball.
- Access to all components—the ball, stem seats and seals—is provided by removing a single threaded seat carrier.
- May be field retrofitted with +GF+ actuator.

ORDER: TRUE-UNION BALL VALVE, Type 346

5002-(Size No.) PVC/VITON, soc. or thd.
5005-(Size No.) CPVC/VITON, soc. or thd.
5061-(Size No.) PVC/EPDM, soc. or thd.
5064-(Size No.) CPVC/EPDM, soc. or thd.
5007-(Size No.) POLYPRO/VITON, thd.
5016-(Size No.) PVDF/VITON, thd.

Material	Size No.	-003	-005	-007	-010	-012	-015	-020
	Size (in.)	3/8	1/2	3/4	1	1-1/4	1-1/2	2
PVC/Viton	Soc. or Thd.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PVC/Viton	Soc. or Thd.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PVC/EPDM	Soc. or Thd.	28.30	29.20	34.30	41.90	53.30	68.80	86.70
CPVC/EPDM	Soc. or Thd.	—	50.90	57.60	69.40	—	126.00	158.00
P/Viton	Thd. only	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
YGEF/Viton	Thd. only	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

CHEMTROL TRU-BLOC BALL VALVE

- Classic Tru-Bloc™ True-Union design.
- Available in PVC, CPVC, natural PVDF and black polypropylene.
- Sizes 1/2 inch through 3 inch.
- Viton or EPDM elastomers.
- Match Chemtrol Schedule 80 union fittings (1/2" - 2").
- Flanged valves available.

ORDER: PART NO. -(Size No.) CHEMTROL TRU-BLOC TRUE-UNION BALL VALVE

Part No.	Body Material	Seal Material	Size No.	-005	-007	-010	-012	-015	-020	-030 Soc. -130 Thd.	-040 Soc -140 Thc
			Size (in.)	1/2	3/4	1	1-1/4	1-1/2	2	3	4
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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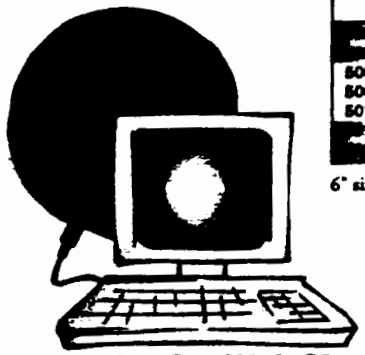
5004N(Size No.)	CPVC	Viton	Soc. & Thrd.	39.49	49.70	59.25	99.35	99.35	137.13	408.77	620.55
5063N(Size No.)	CPVC	EPDM	Soc. & Thrd.	36.90	45.13	53.82	90.32	90.32	125.16	367.92	558.60
5010N(Size No.)	PP	Viton	Threaded	34.59	40.76	51.32	85.80	85.80	116.03	300.41	509.15
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

6" size available. Contact your local Ryan Herco Service Center for details.



Check Out Our Web Site
www.ryanherco.com

97PG136-13

❶ SPEED ❷ ACCURACY ❸ COMPLETE

B•K FLUSH THREADED PVC

LARGE DIAMETER

LARGE DIAMETER THREADED PVC SCREEN				
4.5" SDR-17 SLOTTED SCREEN*				**Ship Wt**
TLS4.5-152	4.5" x 5'	Threaded PVC Slotted Screen	.020" slot	18 lbs
TLS4.5-202	4.5" x 10'	Threaded PVC Slotted Screen	.020" slot	36 lbs
5" PVC SLOTTED SCREEN* -SCH. 80				
TLS5-8152	5" x 5'	Threaded PVC Slotted Screen	.020" slot	18 lbs
TLS5-8202	5" x 10'	Threaded PVC Slotted Screen	.020" slot	36 lbs
6" PVC SLOTTED SCREEN* - SCH 40				
TLS6-152	6" x 5'	Threaded Slotted Screen	.020" slot	17.25 lbs
TLS6-202	6" x 10'	Threaded Slotted Screen	.020" slot	34.50 lbs
6" PVC WIRE-WRAPPED SCREEN* - SCH 40				
TLW6-151	6" x 5'	Threaded PVC Wire-Wrapped Screen	.010" slot	18.5 lbs
TLW6-152	6" x 5'	Threaded PVC Wire-Wrapped Screen	.020" slot	18.5 lbs
TLW6-201	6" x 10'	Threaded PVC Wire-Wrapped Screen	.010" slot	37 lbs
TLW6-202	6" x 10'	Threaded PVC Wire-Wrapped Screen	.020" slot	37 lbs
8" PVC SLOTTED SCREEN* - SCH 40				
TLS8-152	8" x 5'	Threaded Slotted Screen	.020" slot	28.15 lbs
TLS8-202	8" x 10'	Threaded Slotted Screen	.020" slot	56.30 lbs
10" PVC SLOTTED SCREEN* - SCH 40				
TLS10-152	10" x 5'	Threaded Slotted Screen	.020" slot	38.75 lbs
TLS10-202	10" x 10'	Threaded Slotted Screen	.020" slot	77.50 lbs
*OTHER SLOT SIZES AVAILABLE				

PVC SCHEDULE 80 FITTINGS

MATERIAL: PVC type 1, grade 1 (Cell Classification 1245-B) meets the specification for rigid PVC per ASTM-D-1784.

DIMENSIONS: Schedule 80 PVC fittings from your Ryan Herco Service Center meet or exceed the requirements of ASTM-D-2464 (threaded Schedule 80 PVC fittings) and D-2467 (socket Schedule 80 PVC fittings).

NOT RECOMMENDED FOR COMPRESSED AIR OR GASES

AVAILABLE IN PVC TYPE I GRAY ONLY (CELL CLASSIFICATION 12454B)

SIZE CODE				-002	-003	-005	-007	-010	-012	-015	-020	-025	-030	-040	-060	-080
			SIZE	1/4"	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"	6"	8"
Tee		3801	SxSxS													
		3805	TxTxT												—	—
90° Ell		3806	SxS	1.56	1.56	1.56	2.02	3.23	4.32	4.63	5.80	13.09	14.72	22.38	63.06	175.46
		3808	TxT	3.89	3.89	3.63	4.52	6.89	8.12	8.69	9.80	38.13	61.48	106.19	—	—
45° Ell		3817	SxS													
		3819	TxT												—	—
Couplings		3829	SxS	4.84	4.84	2.85	3.84	3.84	6.02	6.48	6.95	17.14	19.68	24.64	53.01	72.16
		3830	TxT	3.42	3.42	3.19	4.53	4.85	6.02	13.38	14.04	33.52	39.31	68.06	—	—
Female Adapter		3835	TxT												—	—
Male Adapter		3836	MPTxT	—											—	—
Cap		3847	S	3.60	3.60	2.78	2.92	5.19	6.27	6.27	12.38	25.28	29.59	49.90	75.60	159.39
		3848	T	3.47	3.47	3.47	3.90	4.89	5.84	6.67	13.09	26.18	30.82	54.26	—	—
Plug		3849	SPG	—	—							—			—	—
		3850	MPT												—	—
Union (Viton O-ring)		3857	SxS	10.86	10.86	5.82	7.39	8.45	16.76	18.97	25.71	136.35	47.86	86.71	—	—
		3858	TxT	11.72	11.72	6.78	8.45	12.86	23.97	29.68	45.86	157.86	116.83	136.11	—	—

QUICK-DISCONNECT FITTINGS

Quick-disconnecting and quick coupling ensures fast, positive, leakproof connections for hoses and pipes when handling chemicals, liquids and dry products, all without threading, twisting or using lugs. These fittings connect without tools and without strain in seconds.

The idea behind the use of quick-disconnect couplings is simple: You may order any adapter and coupler of the same size to give the desired combination of end connections. Simply insert the adapter into the coupler and pull down the cam arms to lock the assembly. When correctly coupled, the line pressure will not separate a quick-disconnect connection (when used within the recommended pressure limits).

MATERIAL

BODY: 30% glass-filled polypropylene, PVDF, or 316 stainless steel.

GASKET: Buna-N for bronze, aluminum and 316SS (also available in Viton-A, Teflon and neoprene.); EPDM only for polypro and PVDF.

MALE ADAPTER

Size No.	Price Each PP 1301	316 SS 1315	PVDF 1341	Pipe Thread NPT
-005	$3.31	$31.35	$30.16	1/2
-007	3.31	31.35	30.16	3/4
-010	3.89	34.88	31.20	1
-015	4.17	45.05	34.84	1-1/2
-020	5.46	48.79	37.44	2
-030	18.78	99.08	82.68	3
-040	N/A	149.85	N/A	4

FEMALE ADAPTER

Size No.	Price Each PP 1302	316 SS 1316	PVDF 1342	Pipe Thread NPT
-005	$2.96	$27.29	$26.52	1/2
-007	2.96	27.29	26.52	3/4
-010	3.09	27.50	28.08	1
-015	3.79	29.53	36.92	1-1/2
-020	4.32	34.29	39.00	2
-030	10.94	88.32	70.20	3
-040	N/A	122.03	N/A	4

SHANK ADAPTER

Size No.	Price Each PP 1303	316 SS 1317	PVDF 1343	Accepts I.D. Hose
-005	$3.31	N/A	$30.16	1/2
-007	3.31	29.28	30.16	3/4
-010	3.89	30.12	32.24	1
-015	4.17	35.42	34.84	1-1/2
-020	5.22	38.20	37.44	2
-030	12.85	76.34	82.80	3
-040	N/A	147.07	N/A	4

MALE COUPLER

Size No.	Price Each PP 1304	316 SS 1318	PVDF 1344	Pipe Thread NPT
-005	$7.32	$43.17	$37.39	1/2
-007	7.32	43.17	37.39	3/4
-010	8.04	48.10	42.90	1
-015	9.54	58.15	50.49	1-1/2
-020	11.80	67.50	56.52	2
-030	19.16	131.82	95.63	3
-040	N/A	176.28	N/A	4

FEMALE COUPLER

Size No.	Price Each PP 1305	316 SS 1319	PVDF 1345	Pipe Thread NPT
-005	$7.32	$43.92	$38.43	1/2
-007	7.32	43.92	38.43	3/4
-010	8.04	47.35	43.42	1
-015	9.54	59.06	51.01	1-1/2
-020	11.80	67.84	58.08	2
-030	19.16	134.87	89.39	3
-040	N/A	177.89	N/A	4

SHANK COUPLER

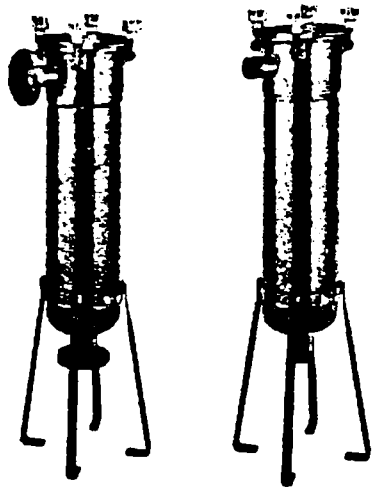
Size No.	Price Each PP 1306	316 SS 1320	PVDF 1346	Accepts I.D. Hose
-005	$7.32	N/A	$37.39	1/2
-007	7.32	42.37	37.39	3/4
-010	8.04	43.92	42.90	1
-015	9.54	51.95	51.01	1-1/2
-020	11.80	65.00	58.08	2
-030	19.16	113.96	89.39	3
-040	N/A	161.88	N/A	4

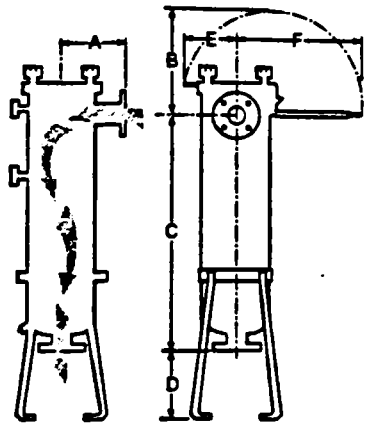
DUST CAP

Size No.	Price Each PP 1314	316 SS 1329	PVDF 1348	Accepts I.D. Hose
-005	$7.32	$33.20	N/A	1/2
-007	7.32	35.52	34.79	3/4
-010	8.04	41.14	40.82	1
-015	8.99	49.65	48.93	1-1/2
-020	11.80	62.65	55.48	2
-030	19.16	80.36	82.11	3
-040	N/A	103.31	N/A	4

No Matter What Your Application There's a Solution from R-P Products.

SE series



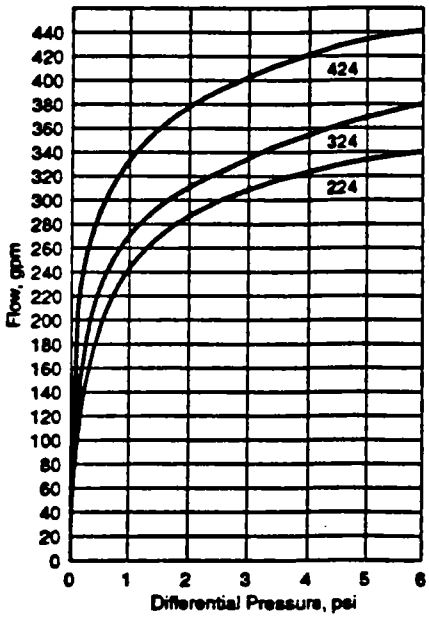


SE series single bag filters and strainers—for batch or intermittent service up to 150 psi

SE series single bag filters for batch or intermittent service are available with flanged or NPTE threaded inlet and outlet connections. This permits a unit to be permanently piped directly into the system. Single filters are standard with adjustable legs for easy installation. They are constructed to the material and structural specifications of ASME Section VIII and conform to OSHA design requirements. Non-code units are also available as off-the-shelf products. Designs for 300 psi available on request.

We guarantee shipment of these products within 5 days. Twenty-four hour shipment available.

Flow vs. differential pressure



These curves are for SE series bag filters only, and are based on flow of clear water at a minimum inlet pressure of 25 psi. Differential pressure will increase correspondingly with increase in solids loading. For more viscous liquids or at retentions of 10 micron or finer, differential pressure will be higher.

Operating limits

Maximum line pressure: 150 psi*
Maximum differential pressure: 150 psid
Maximum temperatures (continuous operation):

Media	
Polypropylene	180°F (82°C)
Bonded Polyester	220°F (104°C)
Nylon	275°F (135°C)
Polyester	300°F (149°C)
Woven Teflon**	370°F (188°C)
316SS Wire Mesh Inlay and Perforated Strainer Basket	450°F (232°C)
Nomex**	450°F (232°C)
Elastomers (seals/gaskets)	
Buna N	220°F (104°C)
White Neoprene	225°F (107°C)
Nordel** (EPT)	300°F (149°C)
Teflon	325°F (163°C)
High-Temperature Viton**	400°F (204°C)
Silicone	450°F (232°C)

*If operating pressures can exceed this limit, a pressure-relieving device must be installed or a 300 psi unit should be considered.
**Trademark of E. I. DuPont de Nemours and Company.

•Optional equipment: Pressure gauges, air vent, drain valve.

Model No.	Inlet/ Outlet Diameter	Dimensions (Legs Extended)						Shipping Weight (Approx.)		Surface Area Total
		A†	B	C	D	E	F	Carbon	Stainless	
224	2" (51 mm)	8 5/16" (211 mm)	14" (356 mm)	32 3/16" (818 mm)	11 3/4" (287 mm)	7" (178 mm)	16 5/16" (425 mm)	140 lb (63.5 kg)	100 lb (45 kg)	510 sq. in.†† (3,290 cm²)
324	3" (76 mm)							150 lb (68 kg)	110 lb (50 kg)	
424	4" (102 mm)							160 lb (72.5 kg)	120 lb (55 kg)	

†Dimension shown is for filter with flanged connection. Filter with threaded connection is 7 5/16" (186 mm).
††750 sq. in. and 1,000 sq. in. SE series units also available.

GENERAL DESCRIPTION

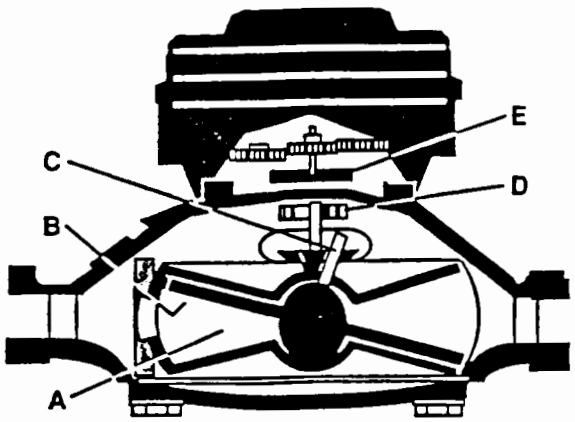
dger's RCDL positive displacement meters are one of the st cost effective methods in metering industrial fluids. e RCDL meter's simple but efficient design assures high accuracy and repeatability over the entire meter flow range.

ailable in five sizes, 1/2" through 2" for flows up to 170 GPM, these meters are extremely rugged and reliable. Maintenance is seldom required, but if necessary, takes ly a few minutes. All parts are designed and built of terials to meet your application, providing you with long life and a trouble-free, precision flow meter.

complement the RCDL meter line, Badger offers a com- ete line of accessories that includes totalizers, electro-mechanical and electronic transmitters, rate of flow licators and batch/process controllers.

ne metering principle, known as positive displacement, is based on the continuous filling and discharging of the asuring chamber. Controlled clearances between the c and the chamber insure precise measurement of each volume cycle. As the disc nutates, the center spindle ro- es a magnet, whose movement is sensed through the ter wall by a follower magnet or by various sensors. Each volution of the magnet is equivalent to a fixed volume of fluid, which is converted to any engineering unit of mea- re for totalization, indication or process control.

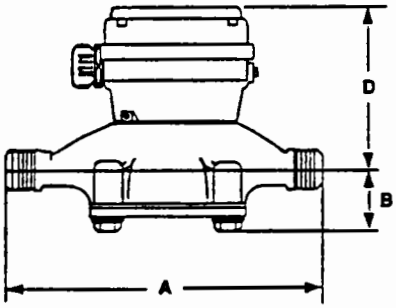
Figure 1.



Liquid flowing through the meter chamber (A) causes a disc (B) to nutate or wobble. This motion, in turn, results in the rotation of a spindle (C) and drive magnet (D). Rotation is transmitted through the wall of the meter to a second magnet (E) or varied style of sensor pickup.

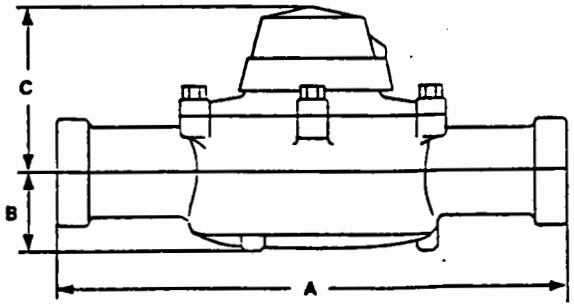
METER OPTIONS/SPECIFICATIONS

Meter with Transmitter



MODEL 25, 35 & 70

Meter with Register



MODEL 120 & 170

Meter Model	Meter Size Inches	Flow Range GPM	Housing Material	End Connections	DIMENSIONS (INCHES) Laying Length A	Center Line to Base B	Register Height C	Transmitter Height D	Approximate Weight Pounds
M 25	5/8	1/2 - 25	BZ or PL	NPT - Male	7.5	1.7	3.3	4.4	5
M 25	3/4	1/2 - 30	BZ or PL	NPT - Male	7.5	1.7	3.3	4.4	5
M 35	3/4	3/4 - 35	BZ	NPT - Male	9.0	1.7	3.6	5.0	6
M 40	1	3/4 - 50	PL	NPT - Male	10.75	1.9	3.8	5.5	5
M 70	1	1 - 70	BZ	NPT - Male	10.75	2.3	4.2	5.6	12
M 120	1 1/2	2 - 120	BZ	NPT - Female	12.62	2.4	4.6	6.0	20
M 170	2	2 - 170	BZ	NPT - Female	15.25	2.9	5.1	6.5	30

BZ = Bronze; PL = Plastic

del 25 is available with optional corrosion resistant internals with both housing materials; temperature limit with this option increased on the bronze housing model to 250° F.

Table 1 - Configuration and Specification Data for Model RCDL Disc Meters

UNPACKING AND INSPECTION

Upon receipt of meter, perform the following:

NOTE: If damage to the shipping container is evident, request the carrier to be present when meter is unpacked.

A. Carefully open the shipping container. Remove all the cushioning material surrounding the meter and carefully lift the meter from the container.

Retain all of the packing material for possible use in reshipment or storage of the meter.

B. Visually inspect the meter and the accessory device for any physical damage such as scratches, loose or broken parts, or any other damage that may have occurred during shipment of the product.

NOTE: If damage is found upon receipt of the equipment, request inspection by the carrier's agent within 48 hours of the delivery. Then file a claim with the carrier. A claim for the equipment damaged in transit is the responsibility of the customer.

INSTALLATION

Any special instructions required for the installation and/or electrical connection of any meter-mounted or free-standing accessory devices such as registers, pulse transmitters, and remote batch controllers, will be provided as a supplement to this manual.

A. Please read the following instructions to become familiar with the requirements and the recommended procedures involved.

CAUTION: The meter must be operated in an application within the specified temperature range to obtain optimum accuracy and prevent damage to any internal components.

1. Verify the fluid operating temperature range is compatible with the materials of construction of the meter received.

CAUTION: The life of the meter will be impaired if it is operated at flow rates in excess of those indicated in the product specifications.

2. If any solid material is present in the liquid, installation of a strainer is recommended upstream of the meter.

3. Locate the meter installation with consideration for sufficient space for cleaning and maintenance of the meter.

B. Review the overall dimensions (including laying length requirements) of the meter as listed in Table 1 of this manual on page 2. If necessary, consideration may also need to be given for height dimensions including the meter mounted accessory. Then proceed as follows:

1. Measure the overall length of the meter with the connection pieces attached to the inlet and outlet spuds of the meter.
2. Be sure to provide this proper gap length in the facility piping.

CAUTION: Excess gap length may cause excessive strain on connection assemblies.

3. Remove the connections and install one connection piece in each end of the facility pipe gap provided in step #2. Allow for the gaskets at the inlet and the outlet spuds of the meter.

4. Install the meter making sure that the flow arrow marking on the meter housing is in the correct relationship to the direction of the fluid flow in the system.

5. Tighten the meter connections.

Note instructions on packaging from connection assembly when tightening.

6. To relieve any possible strain on the facility piping that might be caused by the weight of any of the large size meters, it is recommended that consideration be given to incorporating a meter support to be placed under the housing of the meter.

To ensure that the meter has been properly installed and operational:

A. Slowly open the upstream valve to apply fluid pressure to the meter. Check the connections for any possible leakage. Retighten the connections as required.

B. Perform a functional test of the meter utilizing the adjustment and calibration procedures that are included later in this manual.

CHANGE GEAR CALIBRATION

If the accuracy test of a meter-accessory combination indicates that adjustment is required and change gears are the medium; proceed as follows:

A. Remove applicable Driver (Accessory) change gear and Driven (Meter) change gear.

NOTE: The number of teeth and outside diameter is stamped on each gear.

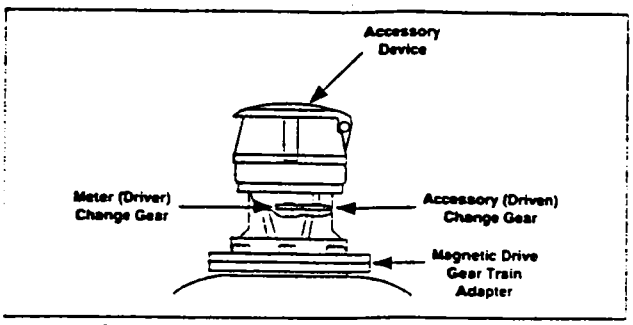


Figure 3 - Change Gear Locations on Model RCDL Meters

B. Calculate ratio of existing change gears as follows:

$$\text{Ratio} = \frac{\text{No. of Teeth on Accessory Change Gear}}{\text{No. of Teeth on Meter Change Gear}}$$

C. Calculate new change gear ratio required by multiplying the ratio of existing change gears by the percent-of-meter accuracy determined in the accuracy test.

Example

$$\text{Existing Change Gear Ratio} = \frac{42 \text{ Teeth}}{43 \text{ Teeth}} = .976$$

Meter Accuracy = 95%

$$\text{Corrected Change Gear Ratio} = .976 \times \frac{95}{100} = .927$$

D. If change gear charts are available, select a new change gear combination that matches corrected change gear ratio. If new gears are not available, submit order for corrective change gears to nearest Badger Meter Representative or contact the Industrial Division of Badger Meter, Inc.

NOTE: When ordering, specify serial number of meter, meter model and size, accessory device employed, number of teeth and diameter of existing change gears, and corrected change gear ratio required.

E. Observe the position of old change gears on spindles before removing. Install new change gears on meter and accessory spindles and assemble accessory to meter. Care should be taken to obtain full mesh when assembling accessory to meter gear train adapter. Note position information from old gears.

ELECTRONIC CALIBRATION

If electronic scaling is the accessory medium for calibration, see accessory technical brief for instructions.

SERVICING

The following instructions are for removal, inspection and installation of meter parts/assemblies. Refer to applicable illustrated parts list for part numbers of components and ordering information. Accessory service and repair procedures are provided in literature specific to that device.

METER ASSEMBLY

These procedures are for disassembly of the meter:

A. Shut off fluid flow to meter. Place container under meter and relieve fluid pressure in the meter by uniformly loosening bolts (bronze meter) or retaining ring (plastic meter). Fluid will run out into container.

B. Remove bolts or retaining ring while holding housing bottom in place. Remove housing bottom. Chamber assembly may drop from housing as bottom is removed.

C. If chamber assembly is out, set aside. If not, first remove chamber strap and then chamber assembly.

D. Remove meter screen. Inspect screen for dirt and corrosion. Clean or replace as necessary.

E. Inspect the chamber assembly:

1. Check the disc in the chamber assembly for warpage, cracks or wear. A severely worn disc can cause over delivery of the fluid being metered.

2. Check the thrust roller and thrust roller insert for excessive wear.

After inspection, clean or replace the chamber assembly as necessary. If chamber is worn or corroded, it is always recommended that the entire chamber and disc assembly be replaced.

F. Re-install housing chamber assembly, screen, chamber strap and bottom as follows:

1. Assemble screen in proper location.

2. Locate chamber assembly in proper orientation. Add chamber strap.

3. Position housing bottom with the correct seal. (Replacement of seal is always recommended.)

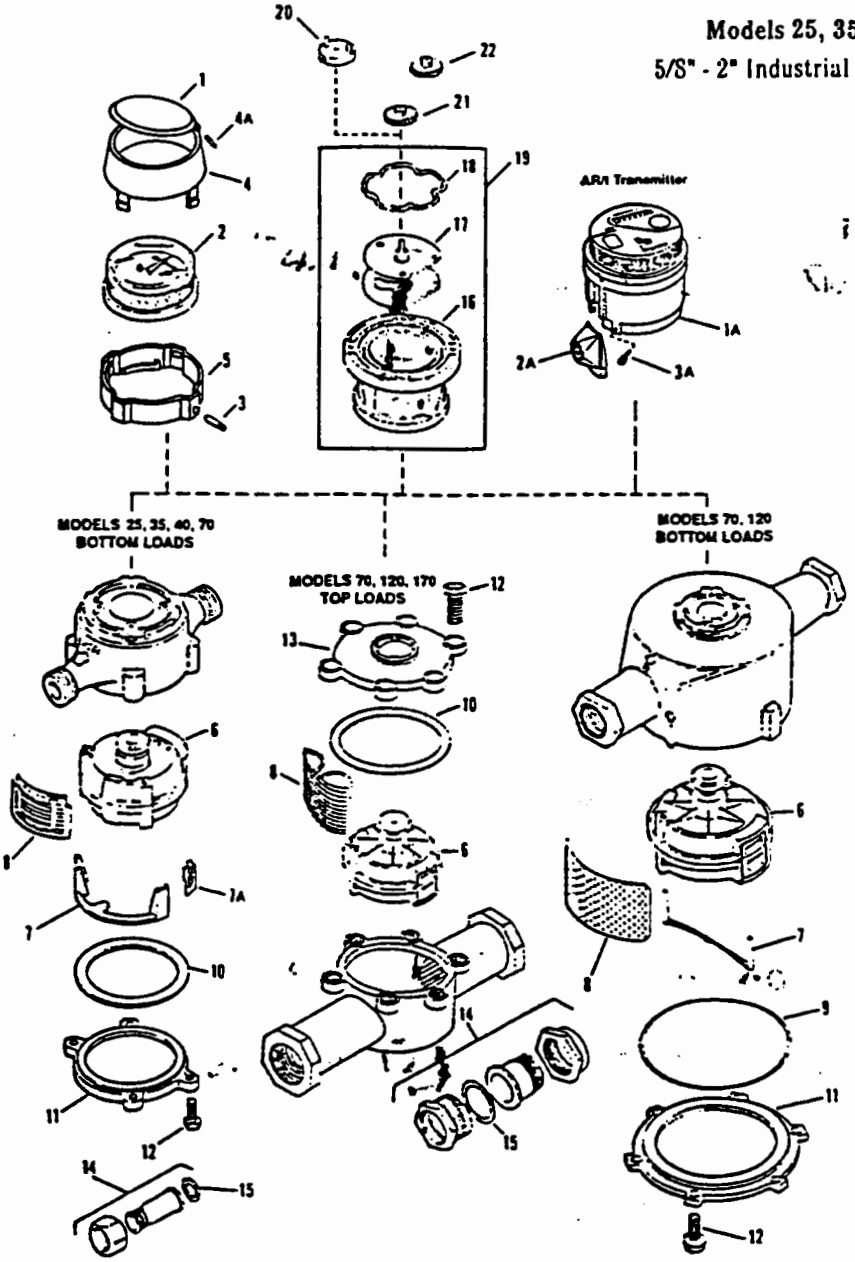
4. Assemble bolts or retaining ring and tighten.

ALTERNATIVE DISASSEMBLY METHOD FOR SERVICE

Loosen connection pieces slightly. Turn meter upside down, putting gravity on your side. This will help eliminate the possibility of the chamber assembly and/or screen component dropping during disassembly and causing damage.

RECALIBRATION

After repair or replacement of a meter component or assembly, perform the calibration check and adjustment procedure to ensure that the meter is properly calibrated and will operate in accordance with published specifications.



Item No.	Part Description
1	Register Cover, Plastic
	Register Cover, Bronze
1A	Pulse Transmitter AR/t
2	Register Assembly, Gallons
	Register Assembly, Liters/M3
2A	Conduit Adapter
3	Seal Screw
3A	Mounting Screw
4	Shroud Top
4A	Roll Pin
5	Shroud Bottom
6	Chamber & Disc Assy., Std.
	Chamber & Disc Assy., LCP
7	Chamber Retainer Strap
7A	Spring Clip (High Temp. Only)
8	Screen
9	Bottom Seal "O" Ring
10	Housing Gasket, Buna N
	Housing Gasket, Viton
11	Housing Bottom

Item No.	Part Description
12	Housing Bolt
13	Housing Top
14	Conn. Assembly (2) 1/2"
	Conn. Assembly (2) 3/4"
	Conn. Assembly (2) 1"
	Conn. Assembly (2) 1 1/2"
	Conn. Assembly (2) 2"
15	Conn. Washer (1) 1/2"
	Conn. Washer (1) 3/4"
	Conn. Washer (1)
16	Housing, Mach.
17	Gear Train (234:1)
17	Gear Train (30:1)
18	Retaining Ring
19	Gear Train Assy. (234:1)
19	Gear Train Assy. (30:1)
20	Coupling (Series 76 Reg.)
21	Change Gear, Driver
22	Change Gear Driven

Polyethylene TANKS

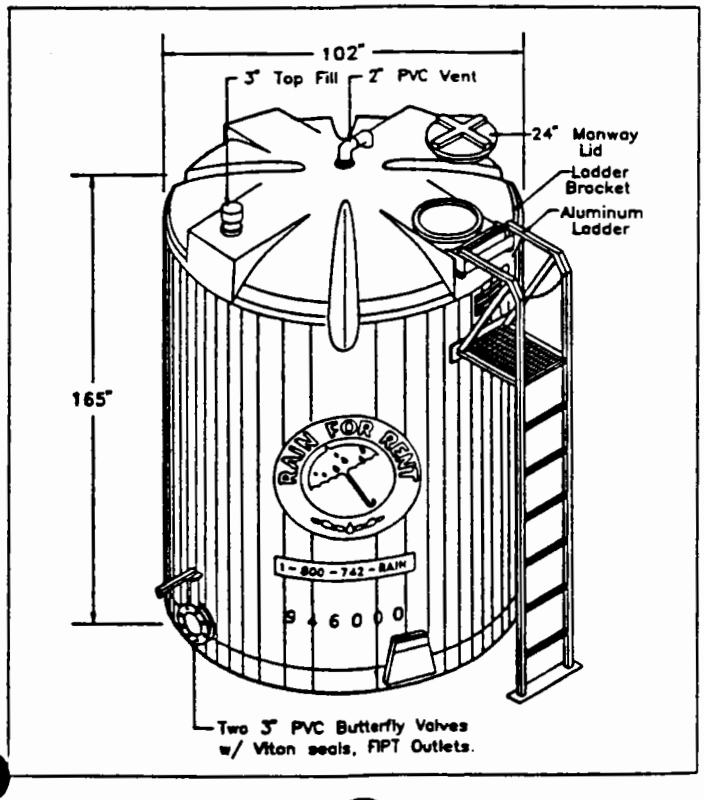
4,900 Gallon EZ KLEEN™ Storage Tank

Features:

- *Durable crosslinked polyethylene construction*
- *Highly chemical resistant*
- *EZ KLEEN™ tank with domed and sloped floor*
- *3" PVC inlet and outlet valves with Viton seals*
- *24" threaded manway*
- *Aluminum ladder with 24" work platform and safety chain*
- *Available with optional mixing units and baffles*
- *Easily transported without wide load permits*

4,900 Gallon Polyethylene Storage Tank

Tank Dimensions



Technical Information

EZ KLEEN™ 4,900 gallon crosslinked polyethylene storage tanks are durable, lightweight, compact and offer a wide range of chemical resistance. These tanks can be used to store waste water, storm water, caustics, acids, fertilizer, contaminated ground water and many other liquids. The EZ KLEEN™ sloped and domed floor allows any liquid residue in the tank to be easily flushed out. The 4,900 gallon tank is 8' or 8'6" in diameter and does not require a wide load permit for hauling. Tank weight is 1,625 lbs.

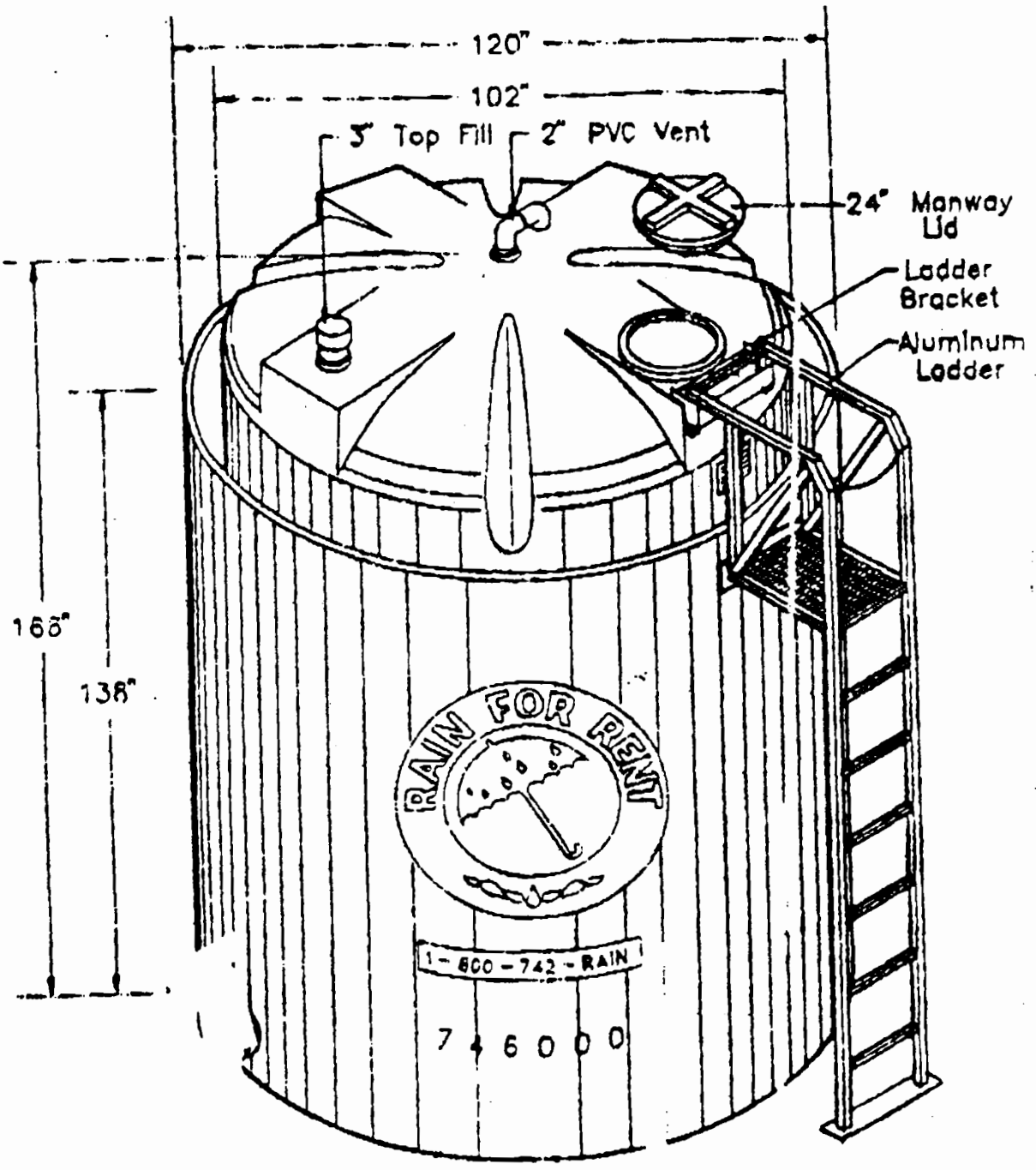
Material Specifications

High density crosslinked polyethylene construction with a wide range of chemical resistance (Chemical resistance charts are available). EZ KLEEN™ tank with domed and sloped floor. Two 3" PVC Butterfly valves with Viton seals. Aluminum ladder with 24" work platform and safety chain.

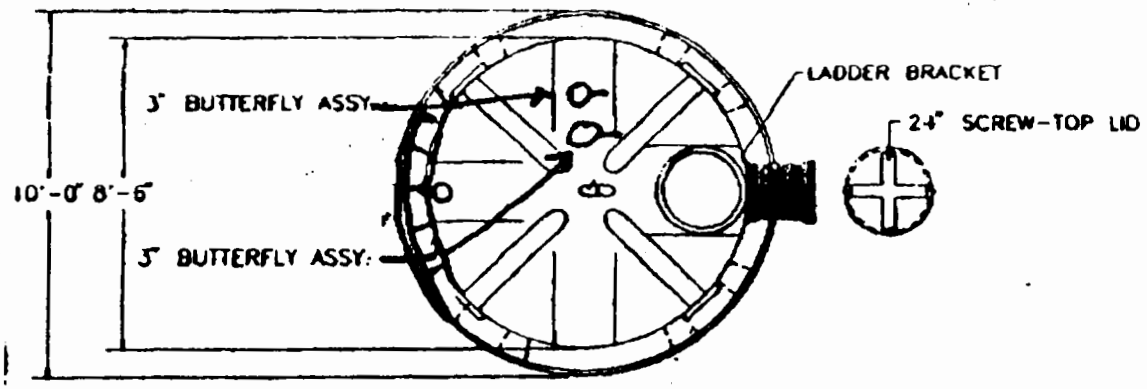
RENTAL TANKS
TEMPORARY HAZARDOUS LIQUID CONTAINMENT SYSTEMS

RAIN FOR RENT PO BOX 2248, BAKERSFIELD CA 93303
(800) 742-7246 (805) 399-9124 **FAX** (805) 393-1542

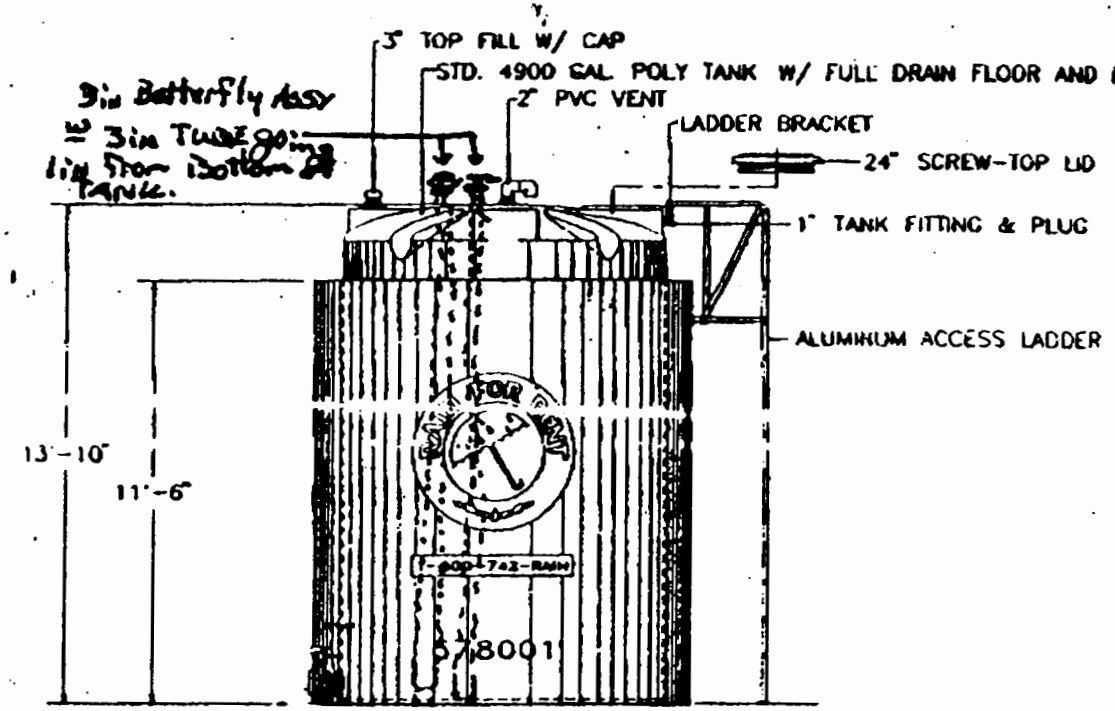
Post-it® Fax Note 7671	Date 12-16	# of pages ▶ 3
MIKE HEFFRON	From TERESA	
Co./Dept.	Co.	
Phone #	Phone #	
Fax #	Fax #	



4900 GALLON POLY-TANK

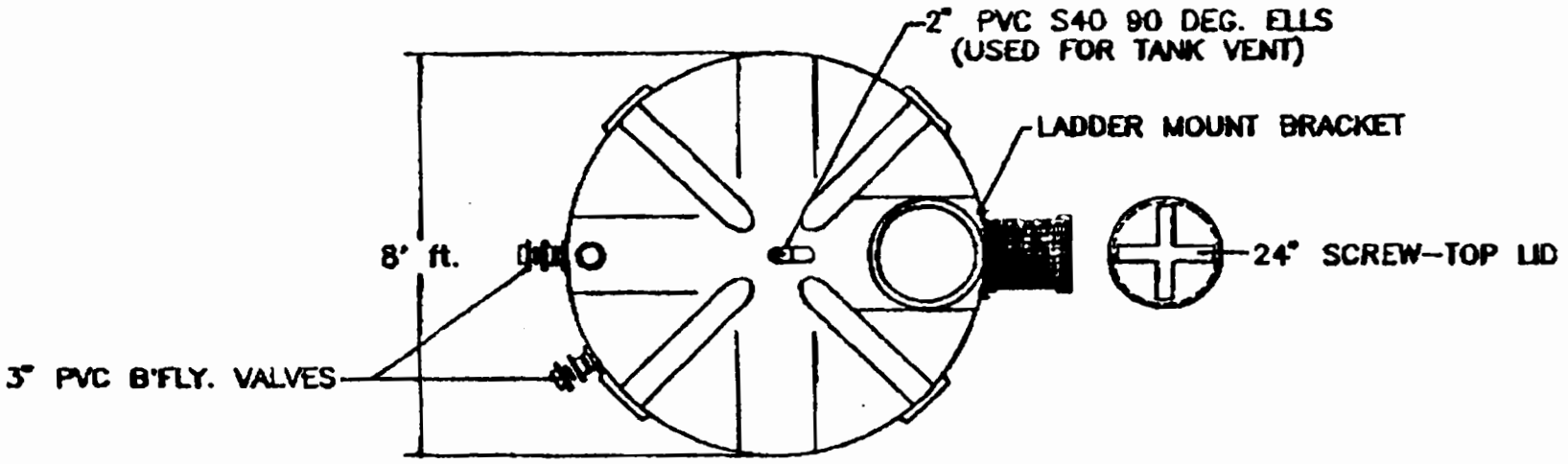


Tank Plan View

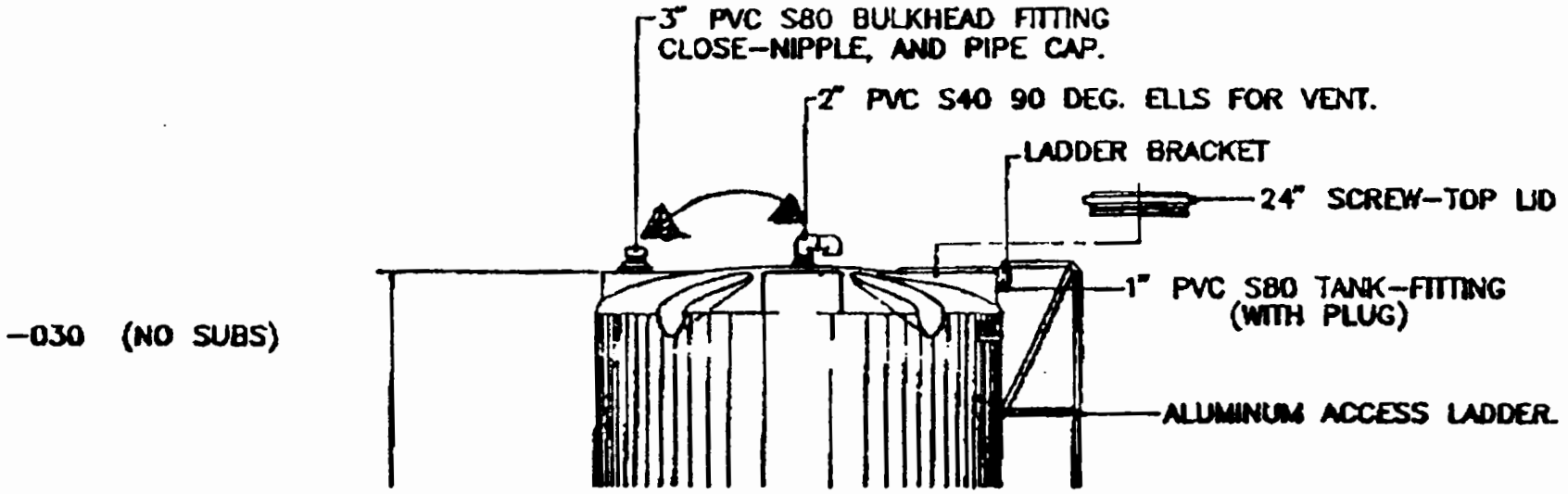


4900 Gal. Poly-Tank w/ Containment Assy.

4900 gal. Poly



Tank Plan View



-030 (NO SUBS)

HOSE

Assemblies

		NET EACH	
*	No.	1-5	6-Up
	5245K11	$7.93	$6.48
25'	5245K12	11.49	9.40
50'	5245K13	18.16	14.86
12'	5245K14	15.74	12.86
	5245K15	24.20	19.80
	5245K16	36.67	30.01
	5245K17	21.26	17.39
	5245K18	34.53	28.27
50'	5245K19	55.93	46.96

is 70-80% of overall hose length.

Assemblies

Hose gth.*	No.	NET EACH 1-3	4-Up
12'	5612K12	$24.12	$20.10
	5612K13	34.06	28.38
	5612K14	51.09	43.23
	5612K22	36.46	30.38
	5612K23	57.02	47.52
50'	5612K24	87.91	74.38
12'	5612K32	55.24	46.74
	5612K33	85.42	72.28
	5612K34	132.43	113.51

ombles

ose assemblies to your specific length
rrier hose plus the fittings which meet
acting hose helps eliminate twisting
t to abrasion and most chemicals.
)° F to +180° F. Working Pressure:
s include body, ferrule and insert,
es also include spring guard. Spring
for ¾" sizes.
70-80% of overall hose length.

H	NUT No.	NET EACH 1-9	10-Up
-Up			
$0.40	5644K41	$0.50	$0.40
.46	5644K42	.48	.38
.46	5644K43	.50	.40
.52	5644K44	.58	.46
.80	5644K45	.75	.60
.86	5644K46	1.40	1.12
	5644K47	2.00	1.60

ODY H	MALE ELBOW BODY No.	NET EACH 1-9	10-Up
-Up			
1.63	5644K81	$2.60	$2.17
1.63	5644K82	2.92	2.43
1.63	5644K83	2.92	2.43
2.00	5644K84	3.92	3.27
2.56	5644K85	4.32	3.60
3.17	5644K86	5.76	4.80

e Assemblies

se	No.	NET EACH 1-3	4-Up
	AIR-HOSE ASSEMBLIES		
	54635K1	$14.42	$11.80
	54635K2	16.16	13.24
	54635K3	18.31	14.96
'	54635K4	21.51	17.80
'	54635K5	25.51	20.87
	54635K6	29.40	24.06
	54635K7	26.60	21.76
	54635K8	31.73	25.96
	54635K9	36.11	29.55
'	54635K11	42.78	35.00
'	54635K12	51.48	42.13
'	54635K13	60.20	49.25

orking Pres.	No.	NET EACH 1-5	6-Up
HE AIR-HOSE ASSEMBLIES			
25 psi	51045K21	$14.33	$11.72
125 psi	51045K22	15.13	12.36
125 psi	51045K23	18.36	14.97
25 psi	51045K24	24.47	20.02
25 psi	51045K25	27.32	22.36
85 psi	51045K26	28.46	23.28
85 psi	51045K27	34.78	28.46

of overall hose length.

MASTER-CARR

WATER HOSE

General-Purpose Medium-Pressure SBR Water Hose

Medium-pressure wrapped hose handles most watering applications—excellent for water discharge. We sell hose without couplings, and hose assemblies which include couplings.

CONSTRUCTION/SPECIFICATIONS—Tube: SBR rubber. Cover: Black, abrasion-resistant wrapped SBR rubber. Reinforcement: 4-ply fabric, except as indicated. Couplings: Short-shank brass, NPT. Temperature Range: –40° F to +120° F.

HOSE ASSEMBLIES—Available in economical 25-ft. and 50-ft. lengths as well as in custom lengths. To order a custom-length assembly, please specify the custom-length base price part number, and the length required.

HOSE—Maximum continuous length is 50 feet. Please order in 5-ft. increments.

Hose ID	OD	Working Pressure	Coupling Sizes	HOSE ASSEMBLIES 25-Ft. Length M x F Couplings No.	NET EACH	50-Ft. Length M x F Couplings No.	NET EACH	Custom Length Base Price; M x F No.	NET EACH	HOSE No.	NET/FOOT 1-49	50-Up
1"	1 19/32"	150 psi	1" x 1"	5289K81	$84.32	5289K85	$149.01	5289K41	$6.65	5289K51	$3.96	$3.30
1¼"	1 53/64"	125 psi	1¼" x 1¼"	5289K82	99.43	5289K86	173.40	5289K42	15.70	5289K53	4.84	3.78
1½"	2"	125 psi	1½" x 1½"	5289K83	114.85	5289K87	201.29	5289K43	16.12	5289K55	5.30	4.42
1¾"	2 1/4"	120 psi								5289K57	4.92	4.10
2"	2 13/32"	100 psi	2" x 2"	5289K84	146.99	5289K88	258.54	5289K44	19.96	5289K59	6.84	5.70
2½"	2 7/8"	100 psi								5289K61◆	8.96	7.47
2½"	3"	80 psi	2½" x 2½"	5289K89	184.06	5289K91	314.86	5289K45	36.40	5289K63	8.06	6.72
3"	3 9/16"	75 psi	3" x 3"	5289K92	239.89	5289K93	396.64	5289K46	60.90	5289K67	9.86	8.22
3½"	4 1/16"	60 psi								5289K69	13.86	11.55
4"	4 5/8"	60 psi	4" x 4"	5289K94	379.51	5289K95	632.04	5289K47	89.80	5289K71	15.66	13.05
4½"	5 1/8"	50 psi								5289K73	17.92	14.93
5"	5 3/4"	50 psi	5" x 5"							5289K75	19.06	15.90
5½"	6 1/4"	125 psi								5289K76◆	20.06	41.73
6"	6 3/8"	150 psi	6" x 6"	5289K96	507.20	5289K97	819.90	5289K49	106.92	5289K79	19.84	16.38

◆ 5 ply ● 6 ply

High-Pressure SBR Water Hose

Designed for severe operating conditions in quarries, mines, and heavy construction work, this 1000-psi hose meets M.S.H.A.-1C-136 and is also known as mine-spray hose. It resists crushing, kinking, and oil mist and won't soften, swell, or flake. We sell hose without couplings, and hose assemblies which include couplings.

CONSTRUCTION AND SPECIFICATIONS—Tube: SBR rubber. Cover: Abrasion and oil-resistant yellow Hypalon rubber with wrapped finish. Reinforcement: Two-braid high-tensile-strength steel cabled wire. Couplings: M x F malleable iron NPT, bolt-interlocking clamp style. Temperature Range: –40° F to +200° F.

HOSE ASSEMBLIES—Available in economical 25-ft. and 50-ft. lengths as well as in custom lengths. To order a custom-length assembly, please specify the custom-length base price part number, and the length required.

HOSE—Maximum continuous length is 50 feet. Please order in 5-ft. increments.

Hose ID	OD	Working Pressure	Coupling Sizes	HOSE ASSEMBLIES 25-Ft. Length M x F Couplings No.	NET EACH	50-Ft. Length M x F Couplings No.	NET EACH	Custom Length Base Price; M x F No.	NET EACH	HOSE No.	NET/FOOT 1-49	50-Up
¾"	1 5/64"	1000 psi	¾" x ¾"	5630K43	$78.98	5630K53	$124.45	5630K32	$32.68	5630K12	$2.00	$1.67
1"	1 27/64"	1000 psi	1" x 1"	5630K44	92.63	5630K54	144.28	5630K33	42.10	5630K13	2.30	1.92
1½"	2 1/64"	1000 psi	1½" x 1½"	5630K46	160.71	5630K56	251.28	5630K37	71.79	5630K17	4.00	3.33
2"	2 9/16"	1000 psi	2" x 2"	5630K47	227.43	5630K57	357.11	5630K36	99.65	5630K16	5.80	4.83

Heavy-Duty Buna-N/SBR Blend Water Hose

Flexible, reinforced hose resists kinking and handles most any marine, automotive, and industrial water application. Rugged cover has good ozone and antifreeze resistance plus moderate oil resistance. Excellent for water-system draining. Please order in 5-ft. increments for sizes ¾" and up.

CONSTRUCTION AND SPECIFICATIONS—Tube: Buna-N (nitrile)/SBR blend. Cover: Black wrapped neoprene. Reinforcement: Synthetic fabric and tempered high-carbon-steel wire helix. Temperature Range: 0° F to +212° F.

Hose ID	OD	Working Pressure	Full Coil Length	No.	NET/FOOT Part. Coil	Full Coil
½"	1"	60 psi	12'	5297K31	$3.49	$2.95
¾"	1 1/16"	57 psi	60'	5297K32	3.55	3.00
1"	1 1/16"	52 psi	60'	5297K33	3.78	3.20
1¼"	1 1/16"	47 psi	60'	5297K34	3.96	3.35
1½"	1 7/16"	43 psi	60'	5297K35	4.44	3.75
1¾"	2 1/16"	40 psi	60'	5297K36	4.84	4.09
2"	2 5/16"	35 psi	60'	5297K37	5.62	4.75

Lay Flat PVC and Butyl Rubber Water-Discharge Hose

Kink- and twist-resistant hose stays flat until you're ready to use it. Stores easily and unrolls quickly. Use it for most washdown/cleanup applications. Please order in 5-ft. increments.

GENERAL DUTY—Lightweight, designed for low-pressure water discharge and drip irrigation. Tube and Cover: PVC. Reinforcement: Polyester-yarn spiral wrap. Temperature Range: +5° F to +170° F. Maximum length is 300 ft.

MEDIUM DUTY—Makes a super portable fire-hydrant-line hose. Tube and Cover: Premium PVC. Reinforcement: Two spiral plies and longitudinal synthetic cords. Temperature Range: +5° F to +170° F. Maximum length is 300 ft.

HEAVY DUTY—Also known as mill hose, this polyester-cover hose resists mildew and rot. It's well-suited for construction-pump discharge applications. Tube: Butyl rubber. Cover: 100% polyester. Temperature Range: –40° F to +120° F. Maximum length is 50 ft.

GENERAL DUTY—"True Blue" color Hose ID	Wall Thk.	Working Pressure	No.	NET/FOOT 1-99	100-Up
1½"	0.066"	80 psi	5295K33	$0.82	$0.43
2"	0.066"	80 psi	5295K35	.82	.51
2½"	0.078"	80 psi	5295K37	.94	.77
3"	0.078"	70 psi	5295K39	1.06	.88
4"	0.082"	70 psi	5295K41	1.45	1.21
6"	0.086"	50 psi	5295K43	2.43	2.02
8"	0.106"	45 psi	5295K45	4.36	3.62

MEDIUM DUTY—"Big Red" color Hose ID	Wall Thk.	Working Pressure	No.	NET/FOOT 1-99	100-Up
1½"	0.086"	200 psi	5310K33	$1.10	$0.90
2"	0.090"	175 psi	5310K35	1.36	1.13
2½"	0.094"	150 psi	5310K37	1.68	1.84
3"	0.098"	125 psi	5310K43	2.57	2.14
4"	0.110"	125 psi	5310K45	3.29	2.74
6"	0.118"	100 psi	5310K47	6.29	5.24

HEAVY DUTY—"Mill White" color Hose ID	Wall Thk.	Working Pressure	No.	NET/FOOT 1-49	50-Up
1"	0.125"	125 psi	5504K13	$1.14	$0.96
1½"	0.125"	150 psi	5504K15	1.12	.93
2"	0.156"	150 psi	5504K16	1.34	1.12
2½"	0.156"	150 psi	5504K17	1.94	1.61
3"	0.187"	150 psi	5504K19	2.19	1.83
4"	0.187"	150 psi	5504K21	3.85	3.04

Lay Flat High-Pressure Buna-N Rubber Water-Discharge Hose

Heavy-duty hose is ideal for the most demanding discharge and washdown applications. It also meets NFPA 1961 for fire-fighting attack hose. For fire hose and accessories, please see pages 880-882. We sell hose without couplings, and hose assemblies which include couplings. **CONSTRUCTION AND SPECIFICATIONS**—Tube and Cover: Petrochemical- and ozone-resistant yellow Buna-N (nitrile) rubber with heavy ribbing for good abrasion resistance. Reinforcement: Synthetic circular woven fiber. Couplings: Aluminum M x F, NST. Temperature Range: –36° F to +210° F.

HOSE ASSEMBLIES—Available in economical 50-ft. lengths as well as in custom lengths. To order a custom-length assembly, please specify the custom-length base price part number, and the length required.

HOSE—Maximum continuous length is 50 ft. Please order in 5-ft. increments.

Hose ID	Wall Thk.	Work Pres.	HOSE ASSEMBLIES 50-Ft. Length M x F Couplings No.	NET EACH	Custom Length Base Price; M x F No.	NET EACH	HOSE No.	NET/FOOT 1-49	50-Up
1"	0.100"	300 psi	45845K171	$112.89	45845K71	$17.14	45845K81	$2.31	$1.96
1½"	0.110"	300 psi	45845K172	132.84	45845K72	18.57	45845K82	2.76	2.34
2"	0.130"	300 psi	45845K174	171.84	45845K74	25.71	45845K84	3.83	2.96
2½"	0.140"	300 psi	45845K175	203.73	45845K75	30.71	45845K85	4.18	3.54
3"	0.140"	300 psi	45845K176	270.18	45845K76	73.57	45845K86	4.71	3.96
4"	0.145"	200 psi	45845K177	393.28	45845K77	147.14	45845K87	5.84	4.94
6"	0.150"	200 psi	45845K178	802.24	45845K78	215.00	45845K88	6.76	5.72

CETCO

GTM-115

Note: The influent concentrations used for these calculations were obtained from the most elevated concentrations of organics in the groundwater.

Clarion Media Design Criteria/Calculations

Contaminants	Concentration		Removal Efficiency	PPM Removed	ppm Remaining
Oil & Grease	____ ppm	x	95%		
Pentachlorophenol	____ ppm	x	95%		
Benzene	0.05 ppm	x	20%	0.010	0.04
Toluene	0.005 ppm	x	70%	0.0035	0.0015
Ethyl Benzene	0.05 ppm	x	90%	0.045	0.005
Xylene	0.3 ppm	x	95%	0.285	0.015
Diesel/#2 Fuel	71 ppm	x	90%	63.90	7.1
____	____ ppm	x	____		
Totals				64.25 ppm	7.16 ppm

* Removal efficiency data provided by CETCO, the manufacturer of the clay media. (PM-100)

Contaminant Loading

Total removed 64.25 ppm x 0.0000084 = 0.00054 pounds of organics/gallon

(10)

0.00054 Pounds of organics/gallon x GPM (flow rate) = 0.0054 pounds of organics/minute

0.0054 Pounds of ogranics/minute x 480 minutes operated/day = 2.59 pounds of organics/day

Media Consumption (50% absorption efficiency)

2.6 Pounds of organics/day ÷ 0.50 efficiency = 5 pounds media/day

____ Pounds of media/day x ____ operating days/year = ____ pounds of media/year

Estimated Bed Life – PC-24

(5)

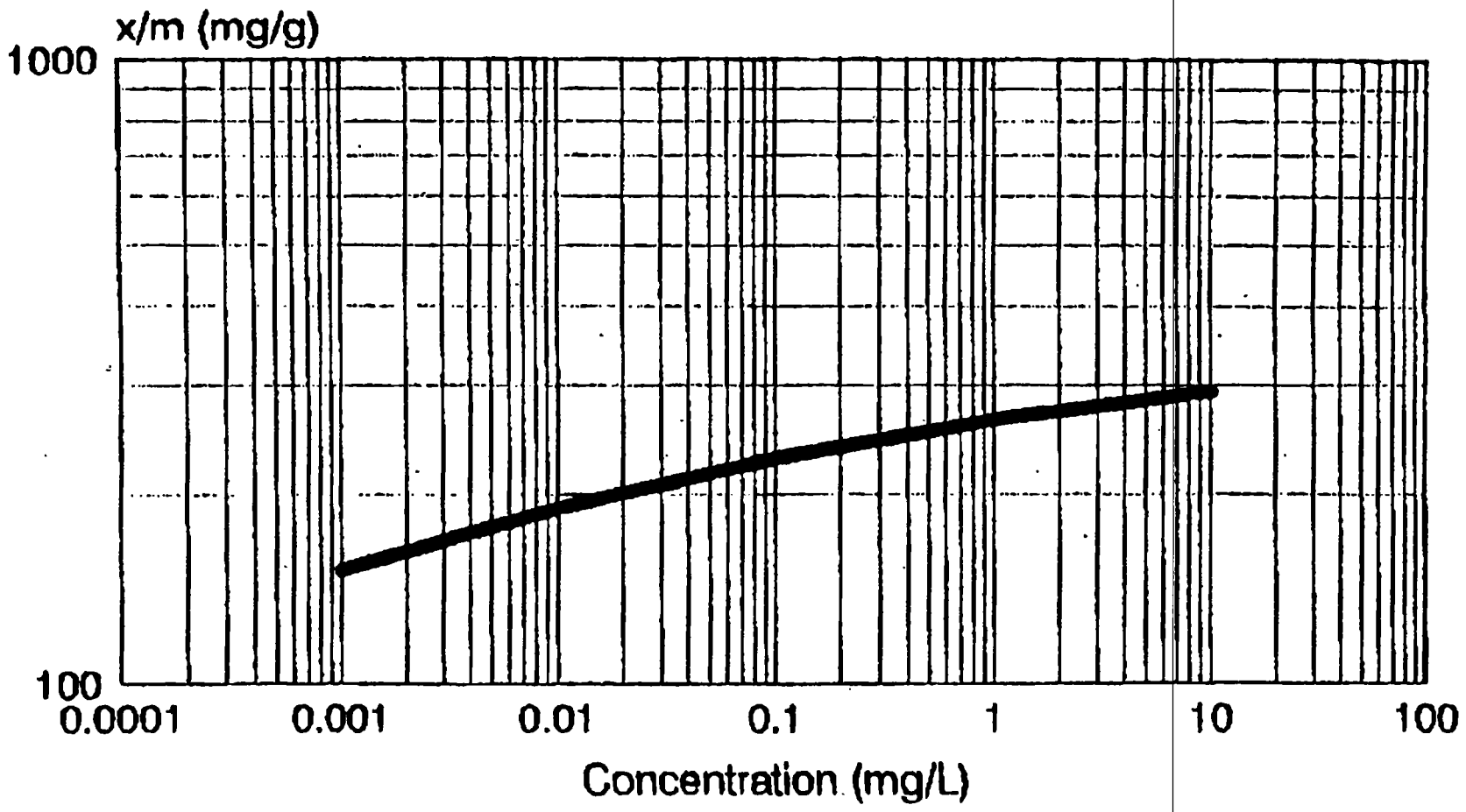
300 Pounds of media in vessel ÷ pounds of media/day = 60 days of bed life

Table 4-23. Water Solubility, Vapor Pressure, Henry's Law Constant, K_{oc}, and K_{ow} Data for Selected Chemicals (3) (Continued)

Chemical Name	CAS #	EPA	Water Solubility (mg/L)	Vapor Pressure (mm Hg)	Henry's Law Constant (atm-m³/mol)	K_{oc} (mL/g)	K_{ow}
1,3-Dinitrobenzene	99-65-0		4.70E+02			1.50E+02	4.17E+01
4,6-Dinitro-o-cresol	534-52-1	HPP	2.90E+02	5.00E-02	4.49E-05	2.40E+02	5.01E+02
2,4-Dinitrophenol	51-28-5	HPP	5.60E+03	1.49E-05	6.45E-10	1.86E+01	3.16E+01
2,3-Dinitrotoluene	602-01-7		3.10E+03			5.30E+01	1.95E+02
2,4-Dinitrotoluene	121-14-2	HPP	2.40E+02	5.10E-03	5.09E-06	4.50E+01	1.00E+02
2,5-Dinitrotoluene	619-15-8		1.32E+03			8.40E+01	1.90E+02
2,6-Dinitrotoluene	606-20-2	HPP	1.32E+03	1.80E-02	3.27E-06	9.20E+01	1.00E+02
3,4-Dinitrotoluene	610-39-9		1.08E+03			9.40E+01	1.95E+02
Ethylbenzene (Phenylethane)	100-41-4	HPP	1.52E+02	7.00E+00	6.43E-03	1.10E+03	1.41E+03
Hexachlorobenzene (Perchlorobenzene)	118-74-1	HPP	6.00E-03	1.09E-05	6.81E-04	3.90E+03	1.70E+05
Hexachlorophene (Dermadex)	70-30-4		4.00E-03			8.10E+04	3.47E+07
Nitrobenzene	98-95-3	HPP	1.90E+03	1.50E-01	2.20E-05	3.60E+01	7.08E+01
2-Nitrophenol (o-Nitrophenol)	88-75-5	HPP	2.10E+03				5.75E+01
4-Nitrophenol (p-Nitrophenol)	100-07-7	HPP	1.60E+04				8.13E+01
m-Nitrotoluene (Methylnitrobenzene)	99-08-1		4.98E+02				2.92E+02
Pentachlorobenzene	608-93-5		1.35E-01	6.00E-03		1.30E+04	1.55E+05
Pentachloronitrobenzene (Quintozene)	82-68-8		7.11E-02	1.13E-04	6.18E-04	1.90E+04	2.82E+05
Pentachlorophenol	87-86-5	HPP	1.40E+01	1.10E-04	2.75E-06	5.30E+04	1.00E+05
Phenol	108-95-2	HPP	9.30E+04	3.41E-01	4.54E-07	1.42E+01	2.88E+01
Pyridine	110-86-1		1.00E+06	2.00E+01			4.57E+00
Styrene (Ethenylbenzene)	100-42-5	HSL	3.00E+02	4.50E+00	2.05E-03		
1,2,3,4-Tetrachlorobenzene	634-66-2		3.50E+00	4.00E-02		1.80E+04	2.88E+04
1,2,3,5-Tetrachlorobenzene			2.40E+00	7.00E-02		1.78E+04	2.88E+04
1,2,4,5-Tetrachlorobenzene	95-94-3		6.00E+00	5.40E-03		1.60E+03	4.68E+04
2,3,4,6-Tetrachlorophenol	58-90-2		7.00E+00	4.60E-03		9.80E+01	1.26E+04
→ Toluene (Methylbenzene)	108-88-3	HPP	5.35E+02	2.81E+01	6.37E-03	3.00E+02	5.37E+02
1,2,3-Trichlorobenzene	87-61-6		1.20E+01	2.10E-01	4.23E-03	7.40E+03	1.29E+04
1,2,4-Trichlorobenzene	120-82-1	HPP	3.00E+01	2.90E-01	2.31E-03	9.20E+03	2.00E+04
1,3,5-Trichlorobenzene	108-70-3		5.80E+00	5.80E-01	2.39E-02	6.20E+03	1.41E+04
2,4,5-Trichlorophenol	95-95-4	HSL	1.19E+03	1.00E+00	2.18E-04	8.90E+01	5.25E+03
2,4,6-Trichlorophenol	88-06-2	HPP	8.00E+02	1.20E-02	3.90E-06	2.00E+03	7.41E+03
1,2,4-Trimethylbenzene (Pseudocumene)	95-63-6		5.76E+01	2.03E+00	5.57E-03		
Xylene (mixed)	1330-20-7	HSL	1.98E+02	1.00E+01	7.04E-03	2.40E+02	1.83E+03
m-Xylene (1,3-Dimethylbenzene)	108-38-3		1.30E+02	1.00E+01	1.07E-02	9.82E+02	1.82E+03
o-Xylene (1,2-Dimethylbenzene)	95-47-6		1.75E+02	6.60E+00	5.10E-03	8.30E+02	8.91E+02
p-Xylene (1,4-Dimethylbenzene)	106-42-3		1.98E+02	1.00E+01	7.05E-03	8.70E+02	1.41E+03
Polyaromatic Hydrocarbons							
Acenapthene	83-32-9	HPP	3.42E+00	1.55E-03	9.20E-05	4.60E+03	1.00E+04
Acenaphthylene	208-96-8	HPP	3.93E+00	2.90E-02	1.48E-03	2.50E+03	5.01E+03
Anthracene	120-12-7	HPP	4.50E-02	1.95E-04	1.02E-03	1.40E+04	2.82E+04
Benz(c)acridine	225-51-4		1.40E+01			1.00E+03	3.63E+04
Benzo(a)anthracene	56-55-3	HPP	5.70E-03	2.20E-08	1.16E-06	1.38E+06	3.98E+05
Benzo(b)fluoranthene	205-99-2	HPP	1.40E-02	5.00E-07	1.19E-05	5.50E+05	1.15E+06
Benzo(k)fluoranthene	207-08-9	HPP	4.30E-03	5.10E-07	3.94E-05	5.50E+05	1.15E+06
Benzo(g,h,I)perylene	191-24-2	HPP	7.00E-04	1.03E-10	5.34E-08	1.80E+06	3.24E+06
Benzo(a)pyrene	50-32-8	HPP	1.20E-03	5.60E-09	1.55E-06	5.50E+06	1.15E+06
2-Chloronaphthalene	91-58-7	HPP	6.74E+00	1.70E-02	4.27E-04		1.32E+04
Chrysene	218-01-9	HPP	1.80E-03	6.30E-09	1.05E-06	2.00E+05	4.07E+05
Dibenz(a,h)anthracene	53-70-3	HPP	5.00E-04	1.00E-10	7.33E-08	3.30E+06	6.31E+06
1,2,7,8-Dibenzopyrene	189-55-9		1.01E-01			1.20E+03	4.17E+06
7,12-Dimethylbenz(a)anthracene	57-97-6		4.40E-03			4.76E+05	8.71E+06
Fluoranthene	206-44-0	HPP	2.06E-01	5.00E-06	6.46E-06	3.80E+04	7.94E+04
→ Fluorene (2,3-Benzidene)	86-73-7	HPP	1.89E+00	7.10E-04	6.42E-05	7.30E+03	1.58E+04

Isotherm: Naphthalene Loading

on F300 Carbon



Computer Estimate

CALGON
CALGON CARBON CORPORATION

Carbon Calculations - Liquid Phase

Information Needed

Flow Rate 10 gpm Contaminants 0.74 ppm Effluent Limit _____ ppm

Calculate lbs. per day of contaminants in the wastestream

flow rate 10 gpm x concentration 0.74 ppm x $\frac{0.012 \text{ lbs./day}}{\text{gpm.ppm}}$ = 0.088 lbs./day of contaminant

Calculate GAC usage, using isotherm data

0.088 lbs./day of contaminant = 2.5 lbs./day GAC used

3.5 % GAC Loading (from isotherm) = USE BENZENE ISOTHERM FOR MOST CONSERVATIVE RESULTS.

Factor interference from background organics

Typically, background organics are only 1-2 ppm.

Determine Capacity Reduction from chart below

2.5 lbs./day GAC used x 1.25 (percent reduction) = 3.1 Total lbs./day GAC used

Determine Minimum Vessel Diameter (check PIBs)

Hydraulic loading 4 gpm/sq.ft.

$\frac{\text{flow rate} \_\_\_\_ \text{gpm}}{\text{4 gpm/sq.ft.}}$ = _____ sq.ft.

Determine Minimum Contact Time

Determine % removal, then find Contact Time from chart below

1 - $\frac{\text{Target concentration} \_\_\_\_ \text{ppm}}{\text{influent concentration} \_\_\_\_ \text{ppm}}$ X 100 = _____ % removal

Determine Minimum Bed Volume

_____ gpm x _____ min. contact time x $\frac{\text{cu.ft.}}{\text{7.48 gal.}}$ = _____ cu.ft.

13 cu.ft. x $\frac{7.48 \text{ gal}}{\text{cu.ft}}$ x $\frac{1 \text{ min}}{10 \text{ gal}}$ = ≥ 10 min CONTACT TIME

In liquid phase adsorption, it is recommended to use at least two beds in series.

_____ cu.ft. + 2 beds = _____ cu.ft. each.

Check vessel PIBs for minimum bed volume, and considering flow rate, select minimum vessel size.

Estimate Bed Life

$\frac{\text{\_\_\_\_\_ lbs. of carbon per vessel}}{\text{\_\_\_\_\_ lbs./day of GAC used}}$ = _____ days of bed life

Effects of Background Organics on Adsorption

Contaminant Level	Capacity Reduction
.15ppm	5%
1.5 ppm	20%
0.15 ppm	30%
0.015 ppm	50%

Rule of Thumb Carbon Contact Time

Removal %	EBCT (min)
90	7.5
95	10
99	12.5 - 15
99.9	15 - 20
99.99	20 - 25

FOSTER WHEELER ENVIRONMENTAL CORPORATION

BY MH DATE 12/9/97 SHEET ____ OF ____

CHKD. BY ____ DATE ____ OFS NO. ____ DEPT. NO. ____

CLIENT ____

PROJECT Naval Weapons Station - Earle

SUBJECT Building 556 Remediation

BTEX MASS BALANCE USING ACTIVATED CARBON (BENZENE ISOTHERM)

10 minute Contact Time ⟶ ≈ 95% Removal Efficiency
-or- 5% of Contaminant Remaining

* Based on carbon manufacturer's removal efficiency v.s. contact time estimates

	Concentration After Clay Absorbtion Units		Anticipated Effluent Concentrations
Benzene	32 ppb	× 5%	1.6 ppb
Ethylbenzene	0.2 ppb	× 5%	0.01 ppb
Toluene	4 ppb	× 5%	0.2 ppb
Xylene	0.5 ppb	× 5%	0.025 ppb

United States
Environmental Protection
Agency

Office of Research and
Development
Washington, DC 20460

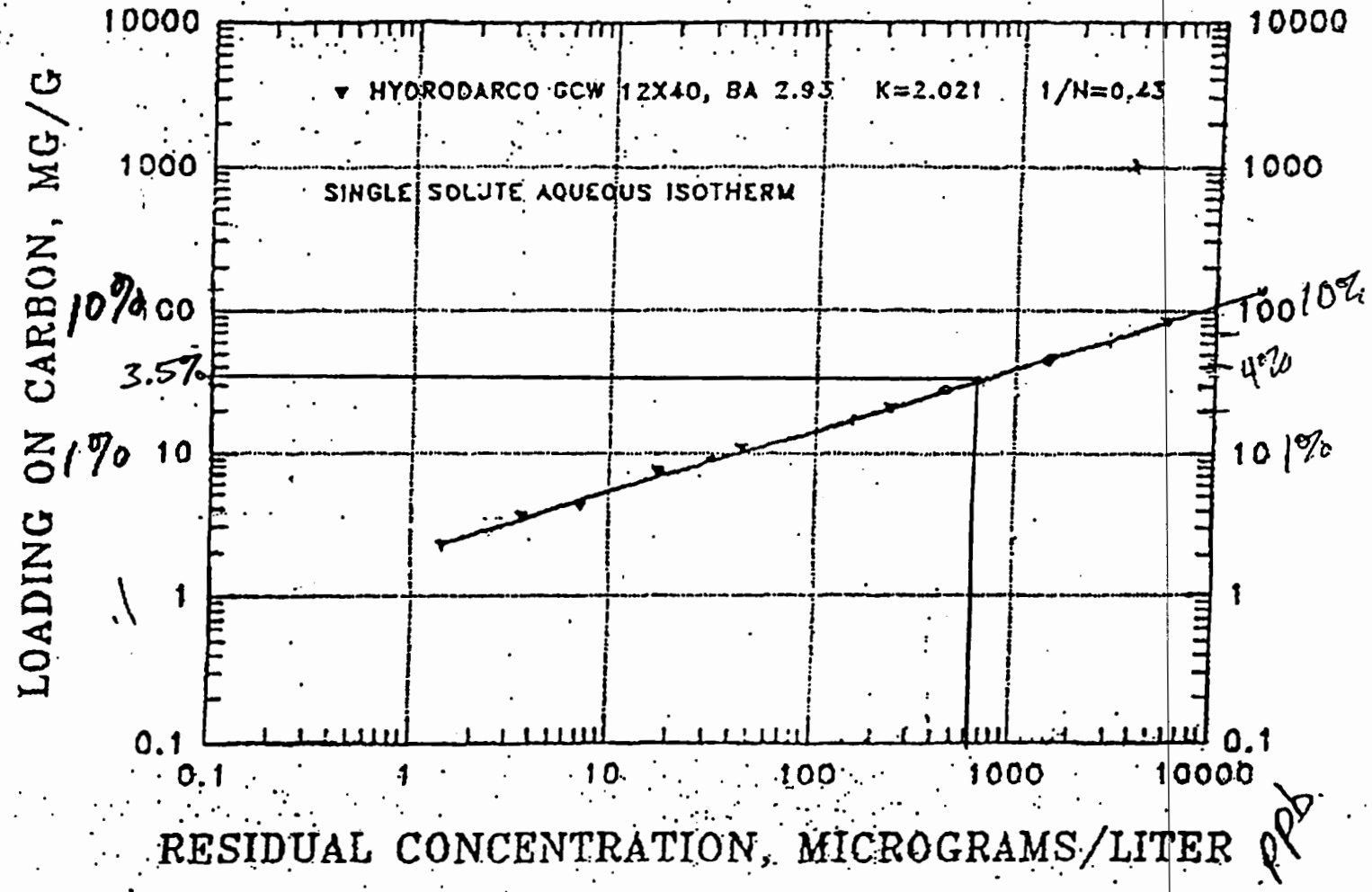
EPA/625/R-94/005
January 1995

EPA

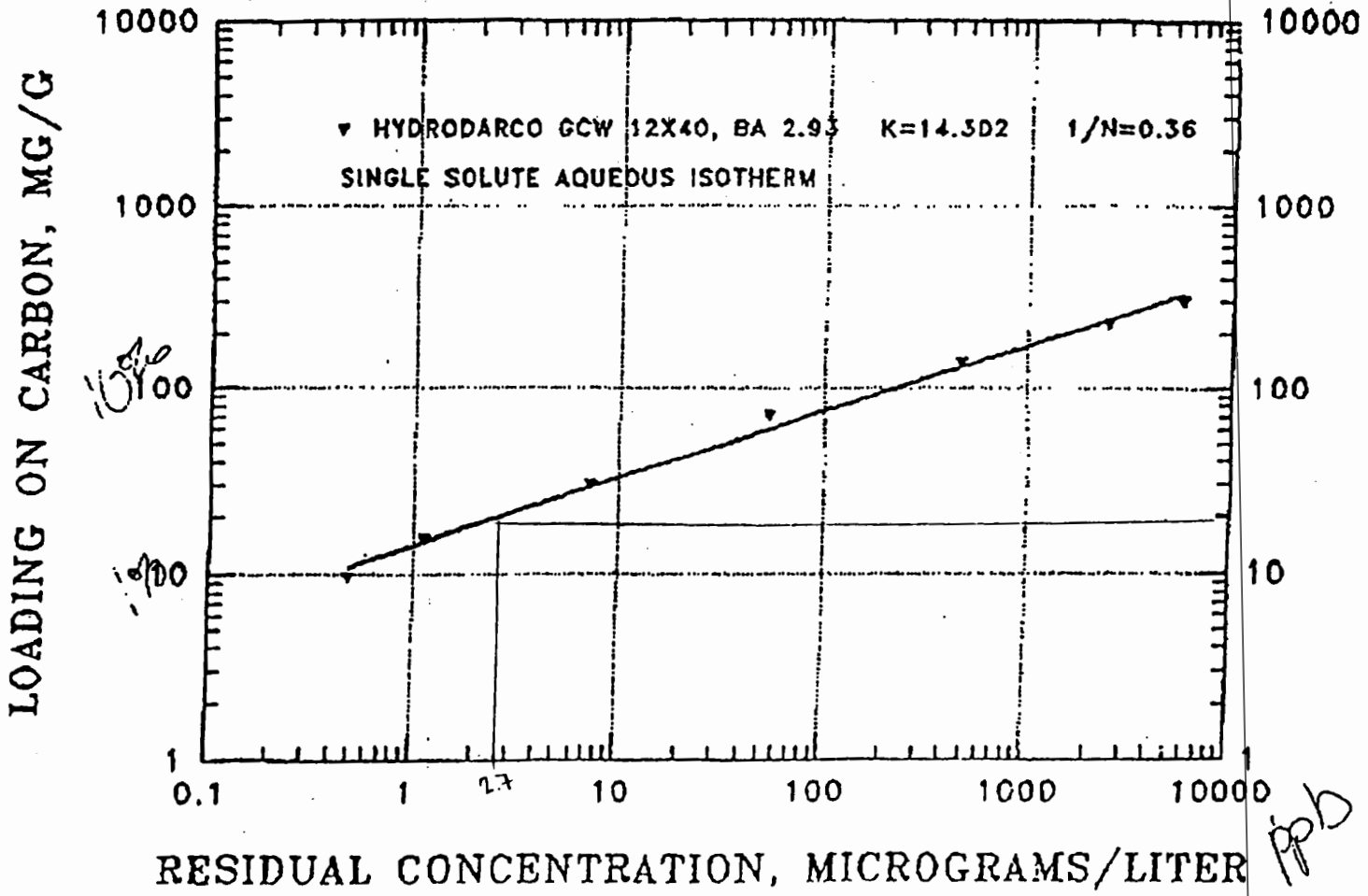
Manual

Ground-Water and LeachateTreatment Systems

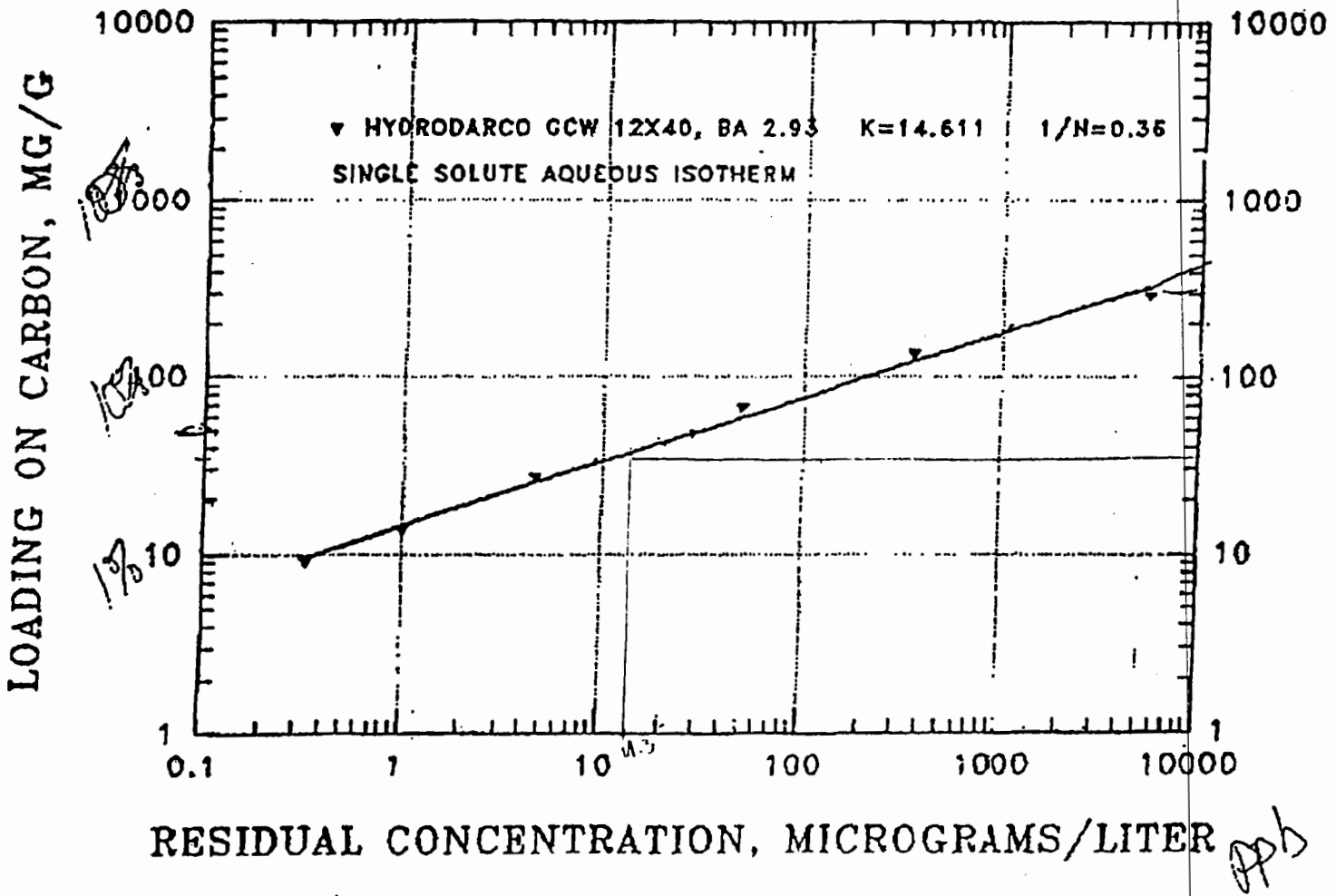
BENZENE



ETHYLBENZENE



O-XYLENE



EPA/625/R-94/005
January 1995

Manual

Ground-Water and Leachate Treatment Systems

Center for Environmental Research Information
Office of Research and Development
U.S. Environmental Protection Agency
Cincinnati, Ohio 45268

Table 4-4. Treatability Data for Benzene

Physical/Chemical Treatability Data: Reported Removal Efficiency (%)

Influent Conc. Range	AirS		GAC		IE	RO		ChPt	ChO_x		FIL	UV	
>100–1,000 mg/L		F		F	NA		F	NA			NA		F
		P		P			P						P
		B		B			B						B
>10–100 mg/L		F		F			F						F
	45	P 1		P			P						P
	90	B 1	65	B 1			B						B
>1–10 mg/L	95	F 1	95 - 99+	F 2		90	F 1						F
		P		P			P						P
		B		B			B		8 - 10	B 2			B
>100–1,000 µg/L	>90 - 99+	F 2	>90	F 1		90	F 1						F
	>90 - 99+	P 3		P		75	P 1						P
		B		B			B						B
0–100 µg/L	30	F 1	0 - >75	F 6		95	F 1		>85 - 90	F 2			F
		P		P		15	P 1					>80	P 1
		B		B			B					50	B 1

Biological Treatability Data: Reported Removal Efficiency (%)

Influent Conc. Range	ASG		AS/PC		AFF	
>100–1,000 mg/L	99+	F 1		F		F
		P		P		P
				B		B
>10–100 mg/L	99+	F 1		F		F
		P		P		P
		B		B		B
>1–10 mg/L	99+	F 4		F		F
	99+	P 1		P		P
	95	B 1		B		B
>100–1,000 µg/L	70 - 99+	F 15		F		F
	99+	P 1	>95	P 1		P
	99+	B 2	99+	B 2		B
0–100 µg/L	>20 - >95	F 9		F	95	F 1
	40 - 99+	P 3	>75	P 1		P
	95	B 1	>80	B 1		B

KEY:

AFF	aerobic fixed film (including trickling filters and/or rotating biological contactors)
AirS	air stripping
ASG	aerobic suspended growth (including activated sludge, aerated lagoons, and/or sequencing batch reactors)
AS/PC	activated sludge/powdered carbon
ChO_x	oxidation (chlorine, ozone, peroxide)
ChPt	chemical precipitation
Fil	filtration
GAC	granular activated carbon
IE	ion exchange
NA	not applicable (or incidental removal only)
NDF	no data found
RO	reverse osmosis
UV	ultraviolet radiation (including ozone, peroxide, or both)

Number of studies from which data were extracted:
F = full-scale
P = pilot-scale
B = bench-scale

Note: All data in this table are from EPA/RREL Treatability Database and are rounded to the lowest multiple of five.

Table 4-12. Treatability Data for Ethylbenzene

Physical/Chemical Treatability Data: Reported Removal Efficiency (%)

Influent Conc. Range	AirS		GAC		IE	RO		ChPt	ChO_x		FIL	UV	
>100–1,000 mg/L		F		F	NA		F	NA		F	NA		F
		P		P			P			P			P
		B		B			B			B			B
>10–100 mg/L		F		F			F			F			F
	99+	P 1		P			P			P			P
		B		B			B			B			B
>1–10 mg/L		F		F		95	F 1			F			F
	95	P 1		P			P			P			P
		B	85	B 1			B		5 - 10	B 2			B
>100–1,000 µg/L	>95	F 1	>90 - >95	F 2			F			F			F
		P		P			P			P			P
		B		B			B			B			B
0–100 µg/L	35 - >90	F 3	35 - >55	F 4			F			F			F
	>90	P 1	>50	P 1		70 - 90	P 2			P			P
		B		B			B		0	B 1		>10 - >45	B 2

Biological Treatability Data: Reported Removal Efficiency (%)

Influent Conc. Range	ASG		AS/PC		AFF	
>100–1,000 mg/L		F		F		F
		P		P		P
		B		B		B
>10–100 mg/L	99+	F 1		F		F
		P		P		P
	99+	B 1		B		B
>1–10 mg/L	>95 - 99+	F 5		F		F
		P		P		P
		B		B		B
>100–1,000 µg/L	80 - 99+	F 12		F	90	F 1
	75 - >95	P 6		P	70	P 1
	99+	B 2	99+	B 1		B
0–100 µg/L	>40 - 99+	F 21		F	90	F 1
	>95 - 99+	P 2	>75	P 1	>95	P 1
	99+	B 1	>75 - 99+	B 2		B

KEY:

AFF	aerobic fixed film (including trickling filters and/or rotating biological contactors)
AirS	air stripping
ASG	aerobic suspended growth (including activated sludge, aerated lagoons, and/or sequencing batch reactors)
AS/PC	activated sludge/powdered carbon
ChO_x	oxidation (chlorine, ozone, peroxide)
ChPt	chemical precipitation
Fil	filtration
GAC	granular activated carbon
IE	ion exchange
NA	not applicable (or incidental removal only)
NDF	no data found
RO	reverse osmosis
UV	ultraviolet radiation (including ozone, peroxide, or both)

Number of studies from which data were extracted:
- F = full-scale
- P = pilot-scale
- B = bench-scale

Note: All data in this table are from EPA/RREL Treatability Database and are rounded to the lowest multiple of five.

Table 4-18. Treatability Data for Toluene

Physical/Chemical Treatability Data: Reported Removal Efficiency (%)

Influent Conc. Range	AirS		GAC		IE	RO		ChPt	ChO_x		FIL	UV	
>100–1,000 mg/L		F	0 - 95	F 2	NA			NA			NA		F
		P		P			P						P
		B		B			B						B
>10–100 mg/L	99+	F 1	99+	F 1			F						F
	90 - 99+	P 2	99+	P 1			P						P
	90	B 1		B			B						B
>1–10 mg/L	95 - 99+	F 2		F		95	F 1						F
		P		P			P						P
		B	80	B 1			B		5 - 15	B 2			B
>100–1,000 µg/L	99+	F 1	40 - >95	F 3		90	F 1						F
		P		P			P						P
		B		B			B		0	B 1		>95	B 1
0–100 µg/L	30 - >95	F 3	>30 - >95	F 4			F						F
	95 - >95	P 2		P		85	P 1						P
		B		B			B					>70	B 1

Biological Treatability Data: Reported Removal Efficiency (%)

Influent Conc. Range	ASG		AS/PC		AFF	
>100–1,000 mg/L		F		F		F
	99+	P 1		P		P
		B		B		B
>10–100 mg/L	99+	F 2		F		F
		P		P		P
	99+	B 1		B		B
>1–10 mg/L	95 - 99+	F 16		F		F
	99+	P		P		P
	95	B 1	99+	B 1		B
>100–1,000 µg/L	0 - 99+	F 22	99+	F 1	>95	F 2
	60 - 99+	P 6	>90	P 1		P
	>95 - 99+	B 2	99+	B 1		B
0–100 µg/L	>50 - 99+	F 22		F	95 - >95	F 4
	>25	P 1	>95	P 1		P
		B	>90	B 1		B

KEY:

AFF	aerobic fixed film (including trickling filters and/or rotating biological contactors)
AirS	air stripping
ASG	aerobic suspended growth (including activated sludge, aerated lagoons, and/or sequencing batch reactors)
AS/PC	activated sludge/powdered carbon
ChO_x	oxidation (chlorine, ozone, peroxide)
ChPt	chemical precipitation
Fil	filtration
GAC	granular activated carbon
IE	ion exchange
NA	not applicable (or incidental removal only)
NDF	no data found
RO	reverse osmosis
UV	ultraviolet radiation (including ozone, peroxide, or both)

Number of studies from which data were extracted:
F = full-scale
P = pilot-scale
B = bench-scale

Note: All data in this table are from EPA/RREL Treatability Database and are rounded to the lowest multiple of five.

Table 4-21a. Treatability Data for m-Xylene

Physical/Chemical Treatability Data: Reported Removal Efficiency (%)

Influent Conc. Range	AirS		GAC		IE	RO	ChPt	ChO_x		FIL	UV
>100–1,000 mg/L		F		F	NA	NDF	NA		F	NA	NDF
		P		P					P		
		B		B					B		
>10–100 mg/L		F		F					F		
		P		P					P		
		B		B					B		
>1–10 mg/L		F		F					F		
		P		P					P		
		B		B				10 - 45	B 2		
>100–1,000 µg/L		F	>95	F 1					F		
		P		P					P		
		B		B					B		
0–100 µg/L	15 - 25	F 2	20 - >90	F 3					F		
	>70	P 1		P					P		
		B		B					B		

Biological Treatability Data: Reported Removal Efficiency (%)

Influent Conc. Range	ASG		AS/PC		AFF
>100–1,000 mg/L		F		F	NDF
		P		P	
		B		B	
>10–100 mg/L		F		F	
		P		P	
		B		B	
>1–10 mg/L	99+	F 3		F	
		P		P	
		B		B	
>100–1,000 µg/L		F		F	
		P		P	
		B		B	
0–100 µg/L	>5 - >95	F 3		F	
		P		P	
		B	>70	B 1	

KEY:

AFF	aerobic fixed film (including trickling filters and/or rotating biological contactors)
AirS	air stripping
ASG	aerobic suspended growth (including activated sludge, aerated lagoons, and/or sequencing batch reactors)
AS/PC	activated sludge/powdered carbon
ChO_x	oxidation (chlorine, ozone, peroxide)
ChPt	chemical precipitation
Fil	filtration
GAC	granular activated carbon
IE	ion exchange
NA	not applicable (or incidental removal only)
NDF	no data found
RO	reverse osmosis
UV	ultraviolet radiation (including ozone, peroxide, or both)

Number of studies from which data were extracted:
F = full-scale
P = pilot-scale
B = bench-scale

Note: All data in this table are from EPA/RREL Treatability Database and are rounded to the lowest multiple of five.

Table 4-26. Summary of Carbon Adsorption Capacities (5)

Compound	Adsorption Capacity (mg/g)[a]
Acenaphthene	190
Acenaphthylene	115
Acetophenone	74
2-Acetylaminofluorene	318
Acridine orange	180
Acridine yellow[b]	230
Acrolein	1.2
Acrylonitrile	1.4
Adenine[b]	71
Aldrin	651
4-Aminobiphenyl	200
Anethole[b]	300
o-Anisidine[b]	50
Anthracene	376
Aroclor 1221	242
Aroclor 1232	630
Benzene	1.0
alpha-Benzene hexachloride (alpha-BHC)	303
beta-Benzene hexachloride (beta-BHC)	220
gamma-Benzene hexachloride (gamma-BHC) (Lindane)	256
Benzidine dihydrochloride	220
Benzo(k)fluoranthene	181
3,4-Benzofluoranthene	57
Benzoic acid	0.76
Benzo(g,h,i)perylene	11
Benzo(a)pyrene	34
Benzothiazole[b]	120
Bis(2-chloroethoxy)methane	11
Bis(2-chloroisopropyl)ether	24
Bis(2-ethylhexyl)phthalate	11,300
Bromoform	20
4-Bromophenyl phenyl ether	144
5-Bromouracil	44
Butylbenzyl phthalate	1,520
N-Butylphthalate	220
Carbon tetrachloride	11
Chlordane	245
Chlorobenzene	91
p-Chloro-m-cresol	124
Chloroethane	0.59
2-Chloroethyl vinyl ether	3.9
Chloroform	2.6
2-Chloronaphthalene	280
1-Chloro-2-nitrobenzene	130
2-Chlorophenol	51
4-Chlorophenyl phenyl ether	111
5-Chlorouracil[b]	25
Cyclohexanone[b]	6.2
Cytosine[b]	1.1
Dibenzo(a,h)anthracene	69
Dibromochloromethane	4.8
1,2-Dibromo-3-chloropropane	53
1,2-Dichlorobenzene	129
1,3-Dichlorobenzene	118
1,4-Dichlorobenzene	121
3,3-Dichlorobenzidine	300
Dichlorobromomethane	7.9
Dichlorodiphenyldichloroethylene (DDE)	232
Dichlorodiphenyltrichloroethane (DDT)	322
1,1-Dichloroethane	1.8
1,2-Dichloroethane	3.6
1,2-trans-Dichloroethene	3.1
1,1-Dichloroethylene	4.9
2,4-Dichlorophenol	157
1,2-Dichloropropane	5.9
1,2-Dichloropropene	8.2
Dieldrin	606
Diethyl phthalate	110
4-Dimethylaminoazobenzene	249
N-Dimethylnitrosamine	6.8×10^{-5}
2,4-Dimethylphenol	78
Dimethylphenylcarbinol[b]	210
Dimethyl phthalate	97
4,6-Dinitro-o-cresol	169
2,4-Dinitrophenol	33
2,4-Dinitrotoluene	146
2,6-Dinitrotoluene	145
Diphenylamine	120
1,1-Diphenylhydrazine	135
alpha-Endosulfan	194
beta-Endosulfan	615
Endosulfan sulfate	686
Endrin	666
Ethylbenzene	53
Ethylenediaminetetraacetic acid	0.86
Fluoranthene	664
Fluorene	330
5-Fluorouracil[b]	5.5
Guanine[b]	120
Heptachlor	1,220
Heptachlor epoxide	1,038
Hexachlorobenzene	450
Hexachlorobutadiene	258
Hexachloroethane	97
Isophorone	32

Table 4-26. Summary of Carbon Adsorption Capacities (5) (Continued)

Compound	Adsorption Capacity (mg/g)[a]	Compound	Adsorption Capacity (mg/g)[a]
4,4'-Methylene-bis-(2-chloroaniline)	190	Thymine[b]	27
Methylene chloride	1.3	Toluene	28
Naphthalene	132	1,2,4-Trichlorobenzene	157
alpha-Naphthol	180	1,1,1-Trichloroethane	2.5
beta-Naphthol[b]	200	1,1,2-Trichloroethane	5.8
alpha-Naphthylamine	160	Trichloroethene	28
beta-Naphthylamine	150	Trichlorofluoromethane	5.6
p-Nitroaniline[b]	140	2,4,6-Trichlorophenol	155
Nitrobenzene	68	Uracil[b]	11
4-Nitrobiphenyl	370	p-Xylene	85
2-Nitrophenol	99	**Not Adsorbed**	
4-Nitrophenol	76	Acetone cyanohydrin	
N-Nitrosodiphenylamine	220	Adipic acid	
N-Nitrosodi-n-propylamine	24	Butylamine	
p-Nonylphenol	250	Choline chloride	
Pentachlorophenol	150	Cyclohexylamine	
Phenanthrene	215	Diethylene glycol	
Phenol	21	Ethanol	
Phenylmercuric acetate	270	Hexamethylenediamine	
Styrene	120	Hydroquinone	
1,1,2,2-Tetrachloroethane	11	Morpholine	
Tetrachloroethene	51	Triethanolamine	
1,2,3,4-Tetrahydronaphthalene	74		

[a] Adsorption capacities are calculated for an equilibrium concentration of 1.0 mg/L at neutral pH.
[b] Compounds prepared in "mineralized" distilled water containing the following composition:

Ion	Conc. (mg/L)	Ion	Conc. (mg/L)
Ca^{++}	100	Cl^-	177
K^+	12.6	SO_4^{--}	100
Mg^{++}	25.3	Alkalinity	200
Na^+	92	PO_4^{--}	10

After the test plan has been developed, bench-scale jar tests should be performed in accordance with the test plan. Consideration should be given to technology selection and proper treatment sequence after a review of the characterization data is complete.

For most treatment steps, a series of small-scale jar tests can be performed to select effective treatment chemicals and to determine an appropriate range of dosages and reaction times for further tests. Standardized bench tests are then performed on larger volumes (usually 1 L) to obtain design factors that are effective in the planning and design of pilot plant and full-scale treatment equipment. Based on these test results, a larger sample is commonly treated to provide sufficient sample for the next treatment step. Preparation of treated samples for the performance of a standardized bench test always starts with raw sample, and the preliminary treatment tests are performed in such a manner as to minimize the inadvertent loss of sample components important for the evaluation of data from the bench test.

4.4.2.2 Optimization Testing

In-depth optimization testing on the selected processes or treatment trains should be provided before the equipment is selected. This additional test sequence provides further insights into how the technology will react under varying water characteristics and flow rates. Also, operating parameters can be evaluated to improve performance and/or reduce costs. To achieve this level of testing, it may be necessary to initiate pilot plant testing.

4.4.2.3 Design Verification

Data derived from treatability studies are very useful for full-scale treatment system design. Chemical doses, pH, settling rates, oxygen requirements, air-to-water ratios,

ANALYTICAL RESULTS OF GROUNDWATER AT BUILDING 566, NAVAL WEAPONS STATION-EARLE

TABLE 3-4

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS - AOC 566

CTO 206 UST REMEDIAL INVESTIGATION REPORT

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	566/1-MW-01		566/1-MW-02		566/1-MW-03		566/1-MW-04		566/1-MW-05		566/1-MW-06		566/1-MW-07		NJDEP
LOCATION:	566/1-MW-01		566/1-MW-02		566/1-MW-03		566/1-MW-04		566/1-MW-05		566/1-MW-06		566/1-MW-07		Groundwater
DEPTH (FEET):															Quality
LABORATORY I.D.:	2519728		2519729		2519731		2519730		2520365		2520368		2519732		Standard *
MISCELLANEOUS	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L
diesel/#2 fuel	n/a		n/a		n/a		71000		n/a		n/a		48000		-
SEMIVOLATILES	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L
2,4-dimethylphenol	9.0	U	9.0	U	2.0	J	4.0	J	10.0	U	9.0	U	4.0	J	100
2-methylnaphthalene	9.0	U	9.0	U	9.0	U	200		140		9.0	U	230		-
2-methylphenol	9.0	U	9.0	U	9.0	U	10.0	U	3.0	J	9.0	U	9.0	U	-
4-methylphenol	9.0	U	9.0	U	9.0	U	10.0	U	4.0	J	9.0	U	9.0	U	-
acenaphthene	9.0	U	9.0	U	9.0	U	7.0	J	5.0	J	9.0	U	8.0	J	400
acenaphthylene	9.0	U	9.0	U	9.0	U	1.0	J	10.0	U	9.0	U	2.0	J	-
anthracene	9.0	U	9.0	U	9.0	U	1.0	J	10.0	U	9.0	U	2.0	J	2000
butylbenzylphthalate	9.0	U	9.0	U	9.0	U	10.0	UJ	10.0	UJ	9.0	UJ	1.0	J	100
carbazole	9.0	U	9.0	U	9.0	U	7.0	J	8.0	J	9.0	U	8.0	J	-
di-n-butylphthalate	9.0	U	9.0	U	9.0	U	10.0	U	10.0	U	9.0	U	9.0	U	900
dibenzofuran	9.0	U	9.0	U	9.0	U	5.0	J	2.0	J	9.0	U	6.0	J	-
diethylphthalate	9.0	U	9.0	U	9.0	U	10.0	U	10.0	U	9.0	U	9.0	U	-
fluorene	9.0	U	9.0	U	9.0	U	11.0	J	5.0	J	9.0	U	14.0		300
isophorone	9.0	U	9.0	U	9.0	U	10.0	U	10.0	U	9.0	U	9.0	U	100
naphthalene	9.0	U	9.0	U	2.0	J	130		74.0		9.0	U	140		-
phenanthrene	9.0	U	9.0	U	9.0	U	14.0		1.0	J	9.0	U	19.0		-
phenol	9.0	U	2.0	J	9.0	U	10.0	U	10.0	U	9.0	U	9.0	U	4000
pyrene	9.0	U	9.0	U	9.0	U	10.0	UJ	10.0	UJ	9.0	UJ	1.0	J	200
T.I.C. semivolatiles	18.0	NJ	150	NJ	340	NJ	1100	NJ	680	NJ	70.0	NJ	2560	NJ	-

NOTES:

* -- NJDEP Groundwater Quality Standards, February 1993.

E -- Value exceeds NJDEP cleanup criteria.

J -- Value is considered estimated due to exceedance of technical quality control criteria or because result is less than the Contract Required Quantitation Limit (CRQL)

NJ -- Result is considered tentatively identified with an estimated concentration because tentatively identified compounds are uncalibrated.

X -- MDL/PQL exceeds remedial standard.

U -- Value is a non-detected result as reported by the laboratory or as qualified based upon blank contamination.

UJ -- Non-detected result is considered estimated due to exceedance of technical quality control criteria.

TABLE 3-4

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS - AOC 566

CTO 206 UST REMEDIAL INVESTIGATION REPORT

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	566/1-MW-01	566/1-MW-02	566/1-MW-03	566/1-MW-04	566/1-MW-05	566/1-MW-06	566/1-MW-07	NJDEP
LOCATION:	566/1-MW-01	566/1-MW-02	566/1-MW-03	566/1-MW-04	566/1-MW-05	566/1-MW-06	566/1-MW-07	Groundwater
DEPTH (FEET):								Quality
LABORATORY I.D.:	2519728	2519729	2519731	2519730	2520365	2520368	2519732	Standard •
VOLATILES	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
2-butanone	10.0 U	10.0 U	50.0 U	3.0 J	10.0 U	10.0 U	10.0 U	300
4-methyl-2-pentanone	10.0 U	10.0 U	50.0 U	10.0 U	10.0 U	10.0 U	10.0 U	400
benzene	10.0 X U	12.0 E	50.0 X U	11.0 E	10.0 X U	3.0 E J	11.0 E	1.00
carbon disulfide	10.0 U	1.0 J	50.0 U	10.0 U	10.0 U	10.0 U	10.0 U	-
ethylbenzene	10.0 U	6.0 J	50.0 U	47.0	10.0	10.0 U	47.0	700
toluene	10.0 U	10.0 U	50.0 U	2.0 J	1.0 J	10.0 U	2.0 J	1000
xylene (total)	10.0 U	12.0	50.0 X U	290 E	73.0 E	10.0 U	300 E	40.0
T.I.C. volatiles	10.0 UJ	10.0 UJ	50.0 UJ	610 NJ	330 NJ	18.0 NJ	640 NJ	-

NOTES:

- • – NJDEP Groundwater Quality Standards, February 1993.
- E – Value exceeds NJDEP cleanup criteria.
- J – Value is considered estimated due to exceedance of technical quality control criteria or because result is less than the Contract Required Quantitation Limit (CRQL).
- NJ – Result is considered tentatively identified with an estimated concentration because tentatively identified compounds are uncalibrated.
- X – MDL/PQL exceeds remedial standard.
- U – Value is a non-detected result as reported by the laboratory or as qualified based upon blank contamination.
- UJ – Non-detected result is considered estimated due to exceedance of technical quality control criteria.

TABLE 3-4

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS - AOC 666

CTO 206 UST REMEDIAL INVESTIGATION REPORT

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	566/1-MW-08		566/1-MW-09		566/1-MW-10		Average	---	---	---	NJDEP
LOCATION:	566/1-MW-08		566/1-MW-09		566/1-MW-10		Concentration	---	---	---	Groundwater
DEPTH (FEET):											Quality
LABORATORY I.D.:	2519733		2519734		2520369						Standard *
MISCELLANEOUS	ug/L		ug/L		ug/L		ug/L				ug/L
diesel/#2 fuel	8000	U	n/a		n/a		12,700				-
SEMIVOLATILES	ug/L		ug/L		ug/L		ug/L				ug/L
2,4-dimethylphenol	9.0	U	10 0	U	9.0	U	4.2				100
2-methylnaphthalene	6.0	J	150	J	140		88.4				-
2-methylphenol	9.0	U	10.0	U	9.0	U	4.4				-
4-methylphenol	9.0	U	2.0	J	9.0	U	4.2				-
acenaphthene	9 0	UJ	2 0	J	4 0	J	5.3				400
acenaphthylene	9 0	UJ	10.0	UJ	1.0	J	4.6				-
anthracene	9.0	UJ	10 0	UJ	9 0	U	5.0				2000
butylbenzylphthalate	9.0	UJ	10.0	UJ	9.0	UJ	7.2				100
carbazole	9.0	UJ	3.0	J	3.0	J	5.6				-
di-n-butylphthalate	1.0	J	10.0	UJ	9.0	U	4.8				900
dibenzofuran	9.0	UJ	2.0	J	3.0	J	4.5				-
diethylphthalate	9.0	UJ	2.0	J	9.0	U	4.8				-
fluorene	9 0	UJ	1.0	J	6.0	J	6.4				300
isophorone	9 0	UJ	1.0	J	9 0	U	4.7				100
naphthalene	5.0	J	110	J	100		57.4				-
phenanthrene	9.0	UJ	1.0	J	7.0	J	6.9				-
phenol	9 0	U	1.0	J	9 0	U	4.0				4000
pyrene	9 0	UJ	10.0	UJ	9 0	UJ	7.2				200
T.I.C. semivolatiles	270	NJ	780	NJ	960	NJ	692.8				-

NOTES:

* – NJDEP Groundwater Quality Standards, February 1993.

E – Value exceeds NJDEP cleanup criteria.

J – Value is considered estimated due tc exceedance of technical quality control criteria or because result is less than the Contract Required Quantitation Limit (CRQL).

NJ – Result is considered tentatively identified with an estimated concentration because tentatively identified compounds are uncalibrated.

X – MDL/PQL exceeds remedial standard.

U – Value is a non-detected result as reported by the laboratory or as qualified based upon blank contamination.

UJ – Non-detected result is considered estimated due to exceedance of technical quality control criteria.

TABLE 3-4

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS - AOC 566

CTO 206 UST REMEDIAL INVESTIGATION REPORT

NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE NUMBER:	566/1-MW-08	566/1-MW-09	566/1-MW-10	Average	---	---	---	NJDEP
LOCATION:	566/1-MW-08	566/1-MW-09	566/1-MW-10	Concentration	---	---	---	Groundwater
DEPTH (FEET):								Quality
LABORATORY I.D.:	2519733	2519734	2520369					Standard *
VOLATILES	ug/L	ug/L	ug/L	ug/L				ug/L
2-butanone	10.0 U	10.0 U	10.0 U	6.8				300
4-methyl-2-pentanone	10.0 U	1.0 J	10.0 U	6.6				400
benzene	1.0 J	22.0 E	7.0 E J	13.7				1.00
carbon disulfide	8.0 J	10.0 U	10.0 U	6.9				-
ethylbenzene	10.0 U	25.0	33.0	20.8				700
toluene	10.0 U	3.0 J	2.0 J	5.5				1000
xylene (total)	4.0 J	100 E	130 E	9.69				40.0
T.I.C. volatiles	51.0 NJ	160 NJ	440 NJ	231.9				-

NOTES:

* -- NJDEP Groundwater Quality Standards, February 1993.

E -- Value exceeds NJDEP cleanup criteria.

J -- Value is considered estimated due to exceedance of technical quality control criteria or because result is less than the Contract Required Quantitation Limit (CRQL).

NJ -- Result is considered tentatively identified with an estimated concentration because tentatively identified compounds are uncalibrated.

X -- MDL/PQL exceeds remedial standard.

U -- Value is a non-detected result as reported by the laboratory or as qualified based upon blank contamination.

UJ -- Non-detected result is considered estimated due to exceedance of technical quality control criteria.

Wetland Restoration Plan

The proposed remediation will impact approximately 0.01 acres of freshwater wetlands. The wetlands to be impacted occur in two ditches located to the south and southwest of Building 566 (Figure 2). These wetland areas are currently vegetated by emergent species. A December 8, 1994 wetland delineation, prepared by Brown and Root Environmental (BR Environmental), areas determined that the wetland ditches were vegetated by a mix of rushes (*Juncus* spp.) and fescue (*Festuca* sp.). An August 5, 1997 site investigation by Foster Wheeler Environmental Corporation (FWENC), determined that the ditches were predominantly vegetated by soft rush (*Juncus effusus*), burreed (*Sparganium americanum*), dark-green bulrush (*Scirpus georgianus*), and switch grass (*Panicum virgatum*). Common reed (*Phragmites australis*) was also dominant in sections of the ditches. During the December 8, 1994 and August 5, 1997 site investigations, water was observed at or near the surface of both ditches. Soils were classified during the 1994 site investigation and were determined to consist of a Manahawkin muck inclusion. The lower portion of the area adjacent to the ditches consisted of soils with an 8 to 10 inch surface layer of black organic muck on top of grayish brown sand.

Wetlands impacted during excavation of contaminated soils will be restored to original grade using clean fill and seeded with the following mix:

Species	Seeding Rate Pure Live Seed (PLS) (lb./acre)
Winter Wheat (*Triticum aestivum*)	90
or Winter Rye (*Secale cereale*)	56
Birdsfoot Trefoil (*Lotus corniculatus*)	6
~~Reed Canary Grass (*Phalaris arundinacea*)~~	~~10~~
Redtop (*Agrostis alba*)	3

Removed per NJDEP (See Attached Letter)

Birdsfoot trefoil shall be inoculated with a standard culture of nitrogen fixing bacteria not more than one year old and shall be specific for Birdsfoot trefoil. Material other than pure live seed shall comprise only nonviable seed, chaff, hulls, live seed of crop plants other than those specified, harmless inert matter and weed seeds except that weed seeds other than seed of noxious weeds will be permitted up to one percent of gross weight of each kind of seed.

Seeding shall be performed between March 15 and June 1 or August 15 and October 1. All disturbed areas will be graded and fertilized prior to seeding. The fertilizer shall be a 10-6-4 fertilizer containing a minimum of 10 percent nitrogen, 6 percent available phosphoric acid and 4 percent soluble potash. It shall be applied at a rate determined by laboratory test recommendations. Fertilizers and seed may be mixed together immediately before placing.

All seeded areas shall be mulched with straw. Mulch shall be spread uniformly in a continuous blanket of sufficient thickness to completely hide soil from view. Mulch may be spread before or not later than three days after seeding unless otherwise approved.

Anchorage to hold mulch in place may be applied by an approved method during or subsequent to mulching operation.

In addition to seeding, soft rush (*Juncus effusus*) will be planted at specific locations, as shown on the *Wetlands Mitigation Map* (Figure 3). Planting shall be performed between May 15 and September 30. Spacing for soft rush plants will be 1.5 foot on center which will allow for uniform aerial coverage within three years of planting. Soft rush shall be grown in 2" peat pots. Roots shall be white and developed through the sides and bottom of the peat pot. Peat pots shall be planted with a trowel. Peat pots shall be placed vertically in the dug hole. The soil shall be tamped to secure the plant in place and compact any air pockets.

State of New Jersey

Christine Todd Whitman
Governor

Department of Environmental Protection

Robert C. Shinn, Jr.
Commissioner

Land Use Regulation Program
PO Box 439
501 East State, 2nd Floor
Trenton, NJ 08625-0439
Tel. # (609) 292-1235 Fax # (609) 292-8115

DEC 09 1997

A. N. Kuntzleman
Department of the Navy
Northern Division
Naval Facilities Engineering Command
10 Industrial Highway
Mail Stop, # 82
Lester, PA 19113-2090

RE: Authorization for Freshwater Wetlands Statewide General Permit, Water Quality Certification and Waiver of Transition Area for Access;
File No.: 1331-90-0034.23
Applicant: Department of the Navy
Building # 566, Naval Weapons Station Earle
Block: # 56; Lot: # 1
Colts Neck Township, Monmouth County

Dear Ms. Kuntzleman:

The Land Use Regulation Program has reviewed the referenced application for a Statewide General Permit authorization pursuant to the requirements of the Freshwater Wetlands Protection Act Rules at N.J.A.C. 7:7A. The proposed activity is authorized by Statewide General Permit No. 4, which permits regulated activities, which are undertaken for the investigation, cleanup or removal of hazardous substances. This permit for activities in wetlands and/or open water includes a Water Quality Certificate for these activities.

Limit of Authorized Disturbance

Based on site plans consisting of one sheet entitled, "U.S. Navy RAC, Naval Weapons Station Earle, Building 566 UST Remediation, Figure 3 Wetlands Restoration Map", undated, and prepared by Foster Wheeler Environmental Corporation, the authorized activity involves the disturbance of 0.01 of an acre of wetlands and/or State open waters and associated transition area for the remediation of contaminated soils. Any additional disturbance of freshwater wetlands, State open waters or transition area shall be considered a violation of the Freshwater Wetlands Protection Act unless the activity is exempt or a permit

is obtained prior to the start of the disturbance from the Land Use Regulation Program.

Permit Conditions

The activities allowed by this authorization shall comply with the following conditions. Failure to comply with these conditions shall constitute a violation of the Freshwater Wetlands Protection Act (N.J.S.A. 13:9B-1 et.seq.).

Special Conditions

1. Fill material used to backfill excavated areas within the wetlands must replicate the existing soil characteristics and be obtained from a local source. The upper 8" of the excavation must be backfilled with top soil containing a high organic component.

2. The seeding specification for the wetlands restoration is to be revised to remove the reed canary grass.

In addition to the above conditions and the conditions noted at N.J.A.C. 7:7A 9.2 and 9.3, the following general conditions must be met for the activity authorized under this Statewide General Permit:

General conditions:

1. All fill and other earth work on the lands encompassed within this permit authorization shall be stabilized in accordance with "Standards for Soil Erosion and Sediment Control in New Jersey" to prevent eroded soil from entering adjacent waterways or wetlands at any time during and subsequent to construction.

2. This permit is revocable in accordance with DEP regulations and State law.

3. The issuance of this permit shall not be deemed to affect in any way other actions by the Department on any future application.

4. The activities shown on the approved plans shall be constructed and/or executed in conformity with any notes and details on said plans and any conditions stipulated herein.

5. No change in plans or specifications shall be made except with the prior written permission of the Department.

6. The granting of this authorization shall not be construed to in any way affect the title or ownership of the property, and shall not make the Department or the State a party in any suit or question of ownership of the property.

7. This permit is not valid and no work shall be undertaken pursuant to this authorization until all other required federal, state, and local approvals, licenses and permits necessary for commencement of work onsite have been obtained.

8. A complete, legible copy of this permit shall be kept at the work site and shall be exhibited upon request of any person.

9. The permittee shall allow the Program the right to inspect the construction site and also shall provide the Bureau of Coastal and Land Enforcement, NJDEP with written notification 7 days prior to the start of the authorized work.

10. This authorization is valid for five years from the date of this letter unless more stringent standards are adopted by rule prior to this date. The expiration date of the general permits issued by rule is March 16, 1998.

Transition Area

The wetlands affected by this permit authorization are of ordinary resource value and the standard transition area or buffer required adjacent to these wetlands is 0 feet. This General Permit includes a transition area waiver, which allows encroachment only in that portion of the transition area which has been determined by the Department to be necessary to accomplish the regulated activities. Any additional regulated activities conducted within the standard transition area on-site shall require a separate transition area waiver from the Program. Regulated activities within a transition area are defined at N.J.A.C. 7:7A-6.2(a).

Any additional prohibited activities conducted within the standard transition area on-site shall require a separate transition area waiver from the Program. Prohibited activities within a transition area are defined at N.J.A.C. 7:7A-6.2(a).

Appeal of Decision

In accordance with N.J.A.C. 7:7A-12.7, any person who is aggrieved by this decision may request a hearing within 30 days of the decision date by writing to: New Jersey Department of Environmental Protection, Office of Legal Affairs, Attention:

Adjudicatory Hearing Requests; PO Box 402, Trenton, NJ 08625-0402. This request must include a completed copy of the Administrative Hearing Request Checklist.

If you have any questions regarding this authorization, please contact Christopher M. Dolphin of our staff at (609) 984-0184. Please reference the above file number.

Sincerely,

Kurt R. Kalb
Supervisor, Monmouth Region
Bureau of Coastal Regulation

c.
Bureau of Enforcement
Municipal Clerk
Municipal Construction Official

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

METHODOLOGY FOR THE FIELD EXTRACTION/PRESERVATION OF SOIL SAMPLES WITH METHANOL FOR VOLATILE ORGANIC COMPOUNDS DECEMBER 1996

1.0 Scope and Application

1.1 This method describes the container preparation, field sampling and field extraction/preservation procedure to be used in conjunction with the analysis of soil samples for volatile organics. The applicable analytical methods are SW-846 methods 8010B, 8015A, 8020A, 8021A, 8240B and 8260A found in the most recently promulgated edition of USEPA's Test Methods For Evaluating Solid Waste and the most current version of the Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration, USEPA Contract Laboratory Program.

1.2 It is the labboratory's responsibility when analyzing samples obtained by this method to demonstrate internally that all cleanup criteria have been achieved. Should a laboratory know or suspect it has inadequate analytical sensitivity to meet any of the cleanup criteria, the laboratory shall not accept any samples unless the Department is notified in advance and the laboratory obtains approval.

2.0 Method Summary

2.1 Soil samples collected for volatile organic analysis must be handled in a manner which will minimize the loss of contaminants due to volatilization and biodegradation. Department experience and open literature indicate that, for the analysis of volatile organic compounds in soil, field extraction/preservation with methanol must be conducted to ensure that contaminants do not degrade or volatilize during sample handling and transport.

2.2 A small diameter soil core sampling device is used to collect a 10 gram (g) soil sample. The sample is extruded into a tared sample container, supplied by the laboratory performing the analysis, containing purge and trap grade methanol and surrogate compounds. The ratio of volume of methanol to weight of soil is 2.5:1. A portion of the methanol extract is combined with organic free reagent water and analyzed by purge and trap GC or GC/MS.

3.0 Sample Containers

3.1 The recommended sample containers are 60 ml (2 oz.) amber wide mouth packer bottle with a Teflon® lined screw cap, a 60 ml straight sided round bottle with a Teflon® lined screw cap, a 40 ml VOA vial with an open-top screw cap and a silicone rubber coated with Teflon® septa or other similar sample container. The use of larger volume containers will cause the layer of methanol over the sample to be minimized, making it difficult to extract an aliquot of methanol for analysis.

3.2 The standard 40ml VOA vial can be used, but the small mouth may not accommodate some core samplers. The VOA vial is also unstable and susceptible to spillage.

4.0 Sample Container Preparation

4.1 Label each sample container with a unique numerical designation.

4.2 Fill the sample container with 25 mls of demonstrated analyte free purge and trap grade methanol.

4.3 An actual analysis should be traceable to the methanol used in the sample containers on the day the sample containers were prepared.

4.4 Record the lot number of the methanol used in the preparation of the sample containers. This information can be used for future reference in the event of suspected contamination of the methanol.

4.5 Employing a syringe, add the appropriate surrogate compounds to the methanol based on the analytical method. For methods 8010B, 8015A, 8020A, and 8021A, add each surrogate compound to the methanol yielding a concentration of approximately 1500 ug/l in each sample container. For methods 8240B, 8260A and the Medium Level Soil/Sediment Sample procedure of the Contract Laboratory Program Statement of Work, add each surrogate compound to the methanol yielding a concentration of approximately 2500 ug/l in each sample container.

4.6 Immediately cap the container tightly and gently swirl.

4.7 Variations of the surrogate compounds may be used depending upon expected sample matrix interferences and contaminants.

4.8 Weigh each labeled sample container with the 25 mls of methanol and surrogate compounds to the nearest one tenth (0.1g) of a gram.

4.9 Record the weight in a bound logbook and on the chain of custody record with its corresponding numerical designation.

4.10 All sample containers must be supplied by the laboratory performing the analysis.

4.11 The prepared sample containers must be stored at 4° ±2°C before shipment. The sample containers should be prepared no more than fourteen (14) days prior to shipment. It will be the responsibility of the laboratory to ensure the integrity of the sample containers remain contaminant free.

5.0 Sample Collection Methodology

5.1 Soil sample collection for volatile organic analysis must be performed with the use of a decontaminated small diameter coring device. A modified 10-30 ml disposable syringe or commercially available small diameter tube/plunger sampler is acceptable. The small diameter coring device must be capable of collecting the required amount of sample from larger diameter core samplers (split spoons, etc.) or from freshly exposed soils.

5.2 Selection of the sample location for volatile organics must be based on the methods in the NJDEPE Field Sampling Procedures Manual, May, 1992 and the site specific sampling plan.

5.3 If a modified disposable syringe is used it can be prepared in-house by cutting off the injection tip. Depending upon the construction of the syringe, small air vents must be cut into the plunger or the rubber tip and retaining post must be removed. These alterations to the plunger will prevent air from being forced through or around the soil plug during subcoring and sample extrusion.

5.4 The small diameter core sampler must be capable of delivering the sample directly into the sample container. The outer diameter of the core sampler must be smaller than the inner diameter of the sample container to avoid loss of sample and ease the soil transfer process. The sample from the small diameter core cannot be transferred to a secondary container such as another sample bottle, zip lock bag, aluminum foil, etc. prior to placement into the sample container with the methanol preservative.

5.5 Use a small electronic balance or manual scale for measuring the weight of the soil in the syringe.

5.6 Tare weigh the small diameter core sampler.

5.7 Using a decontaminated coring device, collect 10g ±2g (8-12grams) of sample (wet weight). Wipe the outside of the subcoring device to remove any adherent soil. The plunger of the coring device can be pulled back or completely removed allowing the open barrel of the subcore to be inserted into the soil. Depending upon the soil texture, depth or moisture content, the subcore can be inserted straight into the soil, on an angle or multiple insertions can be performed to obtain the required sample weight.

5.8 Quickly weigh the sample while contained in the small diameter core sampler. Excess soil sample can be removed from the coring device by extruding a small portion of the core and cleaning away with a decontaminated trowel or spatula. If soil weight is below the weight limit, obtain additional sample. Reweigh after each addition or removal of sample to the subcore until the target weight is attained (8-12g). Analytical results from a sample exceeding the weight maximums and minimums may be rejected and thus require resampling.

5.9 When sampling soils consisting of similar textures and water content, sample weight can be estimated based on volume of previously weighed samples from sampling or practice core sampling to determine sample weights.

5.10 Immediately open the sample container and slowly extrude the soil core into the preweighed and prenumbered sample container supplied by the laboratory performing the analysis. Avoid splashing methanol out of the sample container. Do not immerse the small diameter soil coring device into the methanol.

5.11 Ensure the threads on the sample container and cap are free of soil particles. Use a clean brush or paper towel to remove the particles off the threads. The presence of soil particles compromises the seal of the container resulting in loss of methanol which may invalidate the sample.

5.12 Secure the lid of the sample container. Gently swirl the sample to mix and break up the soil aggregate until soil is covered with methanol. Do not shake.

5.13 Do not attach any additional adhesive backed labels or tape to the sample containers. Record sample numbers on container avoiding covering laboratory identification number. Labels with wire or rubber band attachments may be used provided they can be removed easily for sample weighing. Record laboratory and field

identification numbers on chain of custody and field notes.

5.14 The actual weight of soil will be determined by the laboratory performing the analysis.

5.15 Do not use or submit samples for analysis if any methanol has spilled from a sample container during shipment to the site or during sampling. Extra sample containers can be made available by the laboratory in case of accidental spillage of methanol in the field. The sample containers must be prepared in accordance with Section 4.0.

5.16 After sample collection, immediately return the containers to an iced cooler in an upright position. Sample containers can be placed in separate ziplock bags to protect other containers in case of leakage during transport. The laboratory sample number or field sample identification number may be placed on the bag and crossed referenced on the Chain of Custody. Do not place additional adhesive backed labels or tape on the sample containers. If any methanol is lost from a sample container upon arrival at the laboratory, the sample is invalid and resampling must be performed.

6.0 Moisture Determination

6.1 To report the sample results on a dry weight basis, collect one duplicate sample not preserved with methanol from each sample location for moisture determination. Tightly seal the container to prevent the loss of soil moisture. This sample does not require to be weighed or preserved with methanol. A small volume sample container (15 mls or less) may be used for this sample to avoid possible sample shortages.

6.2 Weigh a 5-10g portion of the sample in a tared crucible.

6.3 Dry the sample overnight at 103-105 ^{o}C. Allow to cool in a desiccator before reweighing.

6.4 Determine percent dry weight by the following formula:

$$\% \text{ dry weight} = \frac{\text{g of dry sample}}{\text{g of sample}} \times 100$$

6.5 Calculate sample concentration on a dry weight basis.

7.0 Quality Assurance/Quality Control Sample and Decontamination Requirements

7.1 Ambient Blank

7.1.1 An Ambient Blank is a QA/QC sample which will determine the potential contamination from ambient air during sampling procedures. This sample will provide a means to evaluate non-sample related contamination.

7.1.2 The Ambient Blank is prepared in the same manner as the sample containers described in Section 4.0. During sample collection, it is opened at the same time and next to the sample container and remains open during sample collection. It is closed at the same time as the sample container. It is performed at only one sample location in an area suspected of having the highest ambient contamination.

7.1.3 The collection of an Ambient Blank is not required when sampling is performed using the methanol extraction/preservation technique. It will be optional at the discretion of the site investigation team, or will be required on a site specific basis if previous elevated analytical results are suspected due to contamination from the sampling environment.

7.1.4 The minimum frequency of collection for Ambient Blanks must be at a rate of 10% the total number of samples collected throughout an event or one per sample shipment, whichever is less. The frequency of collection may be at a higher rate at the discretion of the investigation team based on site conditions.

7.1.5 Results of the Ambient Blank must be reported using a sample weight of 10g.

7.2 Field Blank

7.2.1 A Field Blank is a QA/QC sample which will determine potential contamination from sampling equipment used to collect and transfer samples from the point of collection to the sample container.

7.2.2 A Field Blank is performed by pouring demonstrated analyte free water from one sample container, over each piece of sampling equipment required for sample collection and into a separate set of identical sample containers. Additional information on Field Blanks can be found in the NJDEPE Field Sampling Procedures Manual, May 1992.

7.2.3 A Field Blank is not required when sampling with the methanol extraction/preservation technique. It is

optional, or will be required on a site specific basis if previous elevated analytical results are suspected due to cross contamination from sampling equipment.

7.3 Trip Blanks

7.3.1 A Trip Blank is a QA/QC sample which will determine additional sources of contamination that may potentially influence the samples. The sources of the contamination may be from the lab, sample bottles or during shipment.

7.3.2 A Trip Blank is prepared at the same time and in the same manner as the sample containers as described in Section 4.0. The Trip Blank must accompany the sample containers to the field and back to the laboratory along with the collected samples for analysis. It must remain sealed at all times until it is analyzed at the laboratory.

7.3.3 A Trip Blank is required when sampling with the methanol extraction/preservation technique. It will be required on a site specific basis if previous elevated analytical results are suspected due to cross contamination from sample shipment.

7.3.4 The frequency of collection for the Trip Blank must be at a rate of one (1) per sample shipment.

7.3.5 Results of the Trip Blank must be reported using a sample weight of 10g.

7.4 Duplicate Samples

7.4.1 Perform duplicate samples at a rate of five (5) percent (1 per 20 samples).

7.4.2 Duplicate samples must be obtained from the same location and soil type to minimize location as a potential source of variation in the analytical results. Separate core samples should be obtained for the sample and duplicate sample.

7.5 Sample and Sample Container Handling Time

7.5.1 Sample handling time is to control the length of time bottles are shipped to the site and held on site. The standard four (4) day handling time for sample containers and samples remains the same. Obtain additional information on handling times from Chapter 2 in the NJDEPE Field Sampling Procedures Manual, May 1992.

7.5.2 As stated in N.J.A.C. 7:26E-2.1(a)15, samples must be delivered to the laboratory no later than 48 hours

after sample collection.

7.6 Decontamination of Sampling Equipment

7.6.1 All equipment used for sampling must be decontaminated prior to use.

7.6.2 Decontamination of sampling equipment must follow the procedures in the NJDEPE Field Sampling Procedures Manual, May 1992 for soil sampling equipment. If modified disposable syringes are utilized, they should be discarded if the three step cleaning procedure will not remove the contamination since exposure to acetone may damage the sampling tool.

7.7 General Quality Assurance

7.7.1 Quality assurance requirements have been established to maintain sample integrity. Their primary objectives are to maintain the physical form and chemical composition of the sample and to prevent contamination from other sources or cause changes in contaminant concentrations. Chapter 2 in the NJDEPE Field Sampling Procedures Manual, May 1992, may be consulted for further details on other sampling QA/QC criteria and procedures.

8.0 Field Analysis

8.1 Field analytical methods may be employed during an investigation to aid in the selection or elimination of samples for laboratory analysis. When collecting samples for field analysis, collect a duplicate sample for laboratory analysis. This prevents returning to a sample location and resampling at a later time. Any methanol preserved samples not submitted for laboratory analysis are a hazardous waste and must be disposed of according to State and Federal regulations. To avoid this problem, the following procedure can be used:

8.1.1 Use the sampling method in section 5.0, use an EnCore® core sampler to obtain a duplicate sample for laboratory analysis. Store the soil for laboratory analysis in the core sampler by sealing the end(s) of the core with the end caps supplied with the EnCore sampler. Eliminate headspace in the sampler.

8.1.2 Label the core for lab analysis and immediately cool the sample. The core sample may be stored at 4°C on ice for a maximum of six (6) hours prior to preserving with methanol. This intermediate storage method can only be used if samples are field analyzed.

8.1.3 Perform the selected field analytical procedure

on the duplicate sample and document the field analysis in accordance with the NJDEP Field Analysis Manual, July 1994.

8.1.4 If soil from a sample location is selected for laboratory analysis, preserve the iced core sample with methanol. Samples must be preserved with methanol within the six (6) hour field holding time.

8.1.5 Use this procedure only when performing field analysis of the samples (ie. Field GC, Immunoassay, etc.).

9.0 Laboratory Analysis

9.1 Upon arrival of the sample at the laboratory, weigh the sample container to the nearest one tenth (0.1g) of a gram to determine the weight of soil placed in the sample container.

9.2 Subtract the weight of the container, methanol and surrogates from the total weight of the sample container with the soil sample. This gives the wet weight of the soil sample.

9.3 Proceed with the analysis of the sample using the "high concentration" methodology of the requested SW 846 analytical method or the "Medium Level Soil/Sediment Samples" procedure of the USEPA Contract Laboratory Program Statement of Work. In both instances, start the analytical procedure at the point where approximately 1ml of methanol extract is to be transferred to storage.

9.4 Using the non-methanol preserved duplicate sample, determine the dry weight of the sample.

10.0 Shipping Procedures

10.1 Methanol is considered a hazardous material therefore shipping of the sample containers is regulated by the U.S. Department of Transportation and the International Air Transport Association (IATA). The rules of shipment set in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179) and the current edition of the IATA Dangerous Goods Regulation must be followed when shipping methanol between the laboratory and the field. Consult the above documents or the shipping company for additional information.

10.2 The shipment of the quantity of methanol used for the sample preservation falls under the exemption for small quantities. A summary of the requirements for

shipping samples follows. Refer to the code for a complete review of the requirements.

10.2.1 The maximum volume of methanol in a sample container is limited to thirty (30) mls.

10.2.2 The sample container must not be full of methanol.

10.2.3 The sample container must be stored upright and have the lid held securely in place. The mechanism used to hold the cap in place must be able to be completely removed so weight is not added to the sample container.

10.2.4 Sample containers must be packed in a sorbent material capable of absorbing spills from leaks or breakage of the sample containers.

10.2.5 The maximum sample shuttle weight does not exceed 64 pounds.

10.2.6 The maximum volume of methanol per shipping container is 500mls.

10.2.7 The shipper must mark the sample shuttle in accordance with shipping dangerous goods in acceptable quantities.

10.2.8 The package must not be opened or altered until no longer in commerce.

11.0 Safety

11.1 Methanol is a toxic and flammable liquid. Therefore, methanol must be handled with all safety precautions related to toxic and flammable liquids. Inhalation of methanol vapors must be avoided. Vials should be opened and closed quickly during the sample preservation procedure. Methanol must be handled in a ventilated area. Use protective gloves when handling the methanol vials. Store methanol away from sources of ignition such as extreme heat or open flames. The vials of methanol should always be stored in a cooler with ice at all times.

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Instructions for Sample Collection for the Field Extraction/Preservation of Soil Samples with Methanol for Volatile Organic Compounds

1. Using the laboratory provided syringe, collect 10 grams of soil (+/- 2 grams). Remove any adherent soil from the outside of the syringe.

2. Quickly weigh the sample while still contained in the syringe.

3. Immediately open the methanol preserved 40ml sample vial and slowly extrude the core into it. Avoid splashing the methanol, and do not immerse the syringe in the Methanol.

4. Securely close the methanol preserved 40ml sample vial, ensuring that there are no soil particles on the threads of the vial or cap. Gently swirl the sample to mix and break up the soil until the soil is covered with methanol. **Do not shake.**

5. Collect a second small aliquot of sample for the Percent Solids Determination and place it into the small vial labeled "Percent Solids Vial" provided by the laboratory.

6. Do not attach any additional labels to the methanol preserved vials. Write field sample identifications on the labels attached to the vials by the laboratory. Do not write over the laboratory identification number and tare weight.

7 Record the laboratory and field sample identifications on the Chain of Custody Record form and field notes.

8. After collection, immediately return samples to an iced cooler in an upright position. Samples must be returned to the laboratory no later than 48 hours after collection.

QA/QC Samples:

1. Ambient Blank- The Ambient Blank is prepared by the laboratory in the same manner as the sampling vials. During sample collection, it is opened at the same time as, and next to, the sample container and remains open during sample collection. It is performed at one sampling point only, and should be in the location suspected of having the highest ambient contamination. The Ambient Blank determines the potential contamination from ambient air during sampling. This blank is not normally required for this type of sampling, but may be required on a site specific basis. **Frequency: 10% of the total number of samples collected during an event, or one per shipment, whichever is less.**

2. Field Blank- The Field Blank is taken by pouring Laboratory supplied analyte free water from one sample container, over the sampling equipment and into an identical receiving vial. The Field Blank determines the potential contamination from field sampling equipment. This blank is not normally required for this type of sampling, but may be required on a site specific basis. **Frequency:** See NJDEP Field Sampling Procedures Manual, May 1992.

3. Trip Blank- The Trip Blank is prepared by the laboratory in the same manner as the sampling vials. The Trip Blank must accompany the sample containers to the field and back to the laboratory. It must remain unopened at all times until it is analyzed by the laboratory. The Trip Blank determines additional sources of contamination that may occur during preparation and shipment of the samples. A Trip Blank is required for this type of sampling. **Frequency: 1 per sample shipment.**

4. Duplicate Samples- Duplicate samples must be taken from the same location and soil type to minimize location as a potential source of variation in analytical results. **Frequency: 5% (1 per 20 samples).**