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FREE PRODUCT REMOVAL TREATABILITY STUDY REPORT FOR TRUMBO POINT BACHELOR OFFICER QUARTERS BUILDING C-2076 WITH TRANSMITTAL LETTER NAS KEY WEST FL

9/18/2008

TETRA TECH NUS

TETRA TECH

AIK-08-0540

September 18, 2008

Project Number 00849 *via U.S. Mail*

Commander
Department of the Navy
NAVFAC SE
ATTN: Beverly Washington (Code OPAEVC)
P.O. Box 190010
North Charleston, South Carolina 29419-9010

Reference: CLEAN Contract No. N62467-04-D-0055
Contract Task Order No. 0083

Subject: Free Product Removal Treatability Study Report for The Trumbo Point Bachelor Officer Quarters, Building -2076, Rev. 0, Naval Air Station, Key West, Florida

Dear Ms. Washington:

I have enclosed a CD containing the PDF file for the Free Product Removal Treatability Study Report for The Trumbo Point Bachelor Officer Quarters, Building -2076, Rev. 0, Naval Air Station, Key West, Florida. This file is being sent to you via U.S. Mail to meet TtNUS's contractual obligation under CTO 0083. I am not expecting any comments on this document; however, I do expect the NAS Key West Partnering Team to perform an on-board review of this document during our next meeting.

Please call me at (803) 641-4943, if you have any questions regarding the enclosed report.

Sincerely,

C. M. Bryan
Project Manager

CMB:spc

c: Ms. Debra M. Humbert (Cover Letter Only)
Mr. R. Courtright, NAS Key West
Ms. T. Bolaños, FDEP
Mr. R. Demes, NAS Key West
Mr. E. Barham, NAS Key West
Mr. M. Perry/File
Files 00849-7.4.1

Tetra Tech NUS, Inc.
900 Trail Ridge Road, Aiken, SC 29803
Tel: 803.649.7963 Fax: 803.642-8454 www.tetratech.com

Comprehensive Long-term Environmental Action Navy

CONTRACT NUMBER N62467-04-D-0055

Rev. 0
09/15/08

Free Product Removal Treatability Study Report

for

The Trumbo Point Bachelor Officer Quarters, Building C-2076

Naval Air Station Key West
Key West, Florida

Contract Task Order 0083

September 2008

NAVFAC Naval Facilities Engineering Command
Southeast
NAS Jacksonville
Jacksonville, Florida 32212-0030

TETRA TECH NUS, Inc.

Rev. 0
09/17/08

FREE PRODUCT REMOVAL TREATABILITY STUDY REPORT

FOR

THE TRUMBO POINT BACHELOR OFFICER QUARTERS, BUILDING C-2076

NAVAL AIR STATION
KEY WEST, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command
Southeast
NAS Jacksonville
Jacksonville, FL 32212-0030

Submitted by:
Tetra Tech NUS
661 Andersen Drive
Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-04-D-0055
CONTRACT TASK ORDER 083

SEPTEMBER 2008

PREPARED UNDER THE SUPERVISION OF:	APPROVED FOR SUBMITTAL BY:
CHUCK BRYAN TASK ORDER MANAGER TETRA TECH NUS, INC. AIKEN, SOUTH CAROLINA	 DEBRA M. HUMBERT PROGRAM MANAGER TETRA TECH NUS, INC. PITTSBURGH, PENNSYLVANIA

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ACRONYMS

AC	Alternating Current
ACOE	U.S. Army Corps of Engineers
AFVR	Aggressive Fluid Vapor Recovery
AST	Aboveground Storage Tank
BBL	Blasland, Bouck, and Lee
bls	below land surface
BOQ	Bachelor Officer Quarters
CLEAN	Comprehensive Long-Term Environmental Action, Navy
CTO	Contract Task Order
DC	Direct Current
DRF	Discharge Reporting Form
EDB	Ethylene Dibromide
EGIS	Environmental Geographic Information System
EPA	United States Environmental Protection Agency
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
GCTL	Groundwater Cleanup Target Level
HASP	Health and Safety Plan
IDW	Investigation-Derived Waste
IRA	Initial Remedial Action
MLLW	Mean Lower Low Water
MNA	Monitored Natural Attenuation
MSL	Mean Sea Level
µg/L	Micrograms per Liter
MW	Monitoring Well
NAS	Naval Air Station
NAVFAC SE	Naval Facilities Engineering Command Southeast
Navy	United States Navy
OVA	Organic Vapor Analyzer
PPM	Parts Per Million
PWC	Public Works Center
QA/QC	Quality Assurance/Quality Control
RAP	Remedial Action Plan
SAR	Site Assessment Report
SCTL	Soil Cleanup Target Level

SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compound
TtNUS	Tetra Tech NUS, Inc.
UST	Underground Storage Tank
VOC	Volatile Organic Compound

1.0 INTRODUCTION

Tetra Tech NUS, Inc. (TtNUS) has been contracted by the Department of the Navy, Naval Facilities Engineering Command, Southeast (NAVFAC SE) to conduct a Treatability Study for recovery of free-phase petroleum product located in the subsurface formation behind Building C-2076, Trumbo Point Bachelor Officer Quarters (BOQ). This Treatability Study evaluates the effectiveness of various technologies for the extraction of free product from the soils and groundwater beneath the Trumbo Point BOQ. This Treatability Study was conducted under the Comprehensive Long-term Environmental Action Navy (CLEAN) IV Contract Number N62467-04-D-0055, CTO 083.

1.1 SITE HISTORY

Building C-2076, the Trumbo Point BOQ, is located in Section 32, Township 67S, Range 25E as represented in Figure 1-1. The site is near the intersection of Chevalier Avenue and Ely Street and encompasses much of the paved loading dock area south of the west wing of the BOQ building. The site topography is level and the elevation of the site is approximately 5 feet above mean sea level (MSL). The site is bounded on the north by Towers Avenue, on the east by Chambers Street, on the south by Chevalier Avenue, and on the west by Building C-2078, Building C-2081, and Ely Street. Within one-quarter-mile radius of the site are the Gulf of Mexico to the north and 200 yards to Garrison Bight to the east.

A 1,000-gallon JP-5 aboveground storage tank (AST) with secondary containment is on site, which is used to fuel the BOQ water heaters. The location of the aboveground storage tank is located near the southwest corner of the loading dock as noted in Figure 2-1. An aboveground propane tank is located southwest of the site. The underground free-phase petroleum plume was first discovered near a water line and valve pit adjacent to the current AST location. The release was reported to have emanated from an abandoned fuel line that was associated with a 100 gallon AST, formerly located on the southern portion of the site. This fuel line was located near the water valve pit; however, the exact location of the abandoned line is not known (BBL, 2000c, 2002).

The Navy discovered free petroleum product at the site on February 27, 1998, during a routine inspection of a water line valve pit [Public Works Center (PWC), 1999]. Consequently, the Public Works Department of NAS Key West submitted a Discharge Reporting Form (DRF) to the Florida Department of Environmental Protection (FDEP) on March 3, 1998. The estimated quantity of discharged free-phase product was reported to be less than 5 gallons. A second DRF was filed for the site on March 11, 1998, after a failure was found in a tightness test that was conducted on the underground piping from the AST. In the DRF it was indicated that the cause of the release was corroded piping and the product discharged

was JP-5 jet fuel. The failure of an active product line to pass a pressure test resulted in the line being abandoned (BBL, 2002).

During source removal activities in March 1998, approximately 55 cubic yards of contaminated soil and approximately 10 gallons of free product were removed in the vicinity of the valve pit. The excavation was south of the loading dock in the area of abandoned monitoring wells (MW) MW-X1 and MW-4 (Figure 1-2). Due to the proximity of the BOQ building and an active propane gas supply line, the excavation of the entire extent of impacted soils was not possible. A Source Removal Report was submitted to the FDEP by the Navy on October 14, 1998.

A site assessment was conducted by PWC Pensacola and a Site Assessment Report (SAR) was submitted to FDEP (PWC, 1999). This SAR concluded that diesel fuel free product probably remained on site, and the dissolved-phase groundwater petroleum hydrocarbon concentrations exceeded the groundwater cleanup target levels (GCTLs). Soil contamination exceeding the soil cleanup target levels (SCTLs) specified in Chapter 62-777, FAC for both the Residential Use Direct Exposure and Commercial/Industrial Use Direct Exposure was present. On-site soil analyses with an organic vapor analyzer (OVA) showed readings in excess of 1,000 parts per million (ppm) (PWC, 1999). FDEP approved the SAR on July 9, 1999, concurring with the recommendation to prepare a Remedial Action Plan (RAP) for the site.

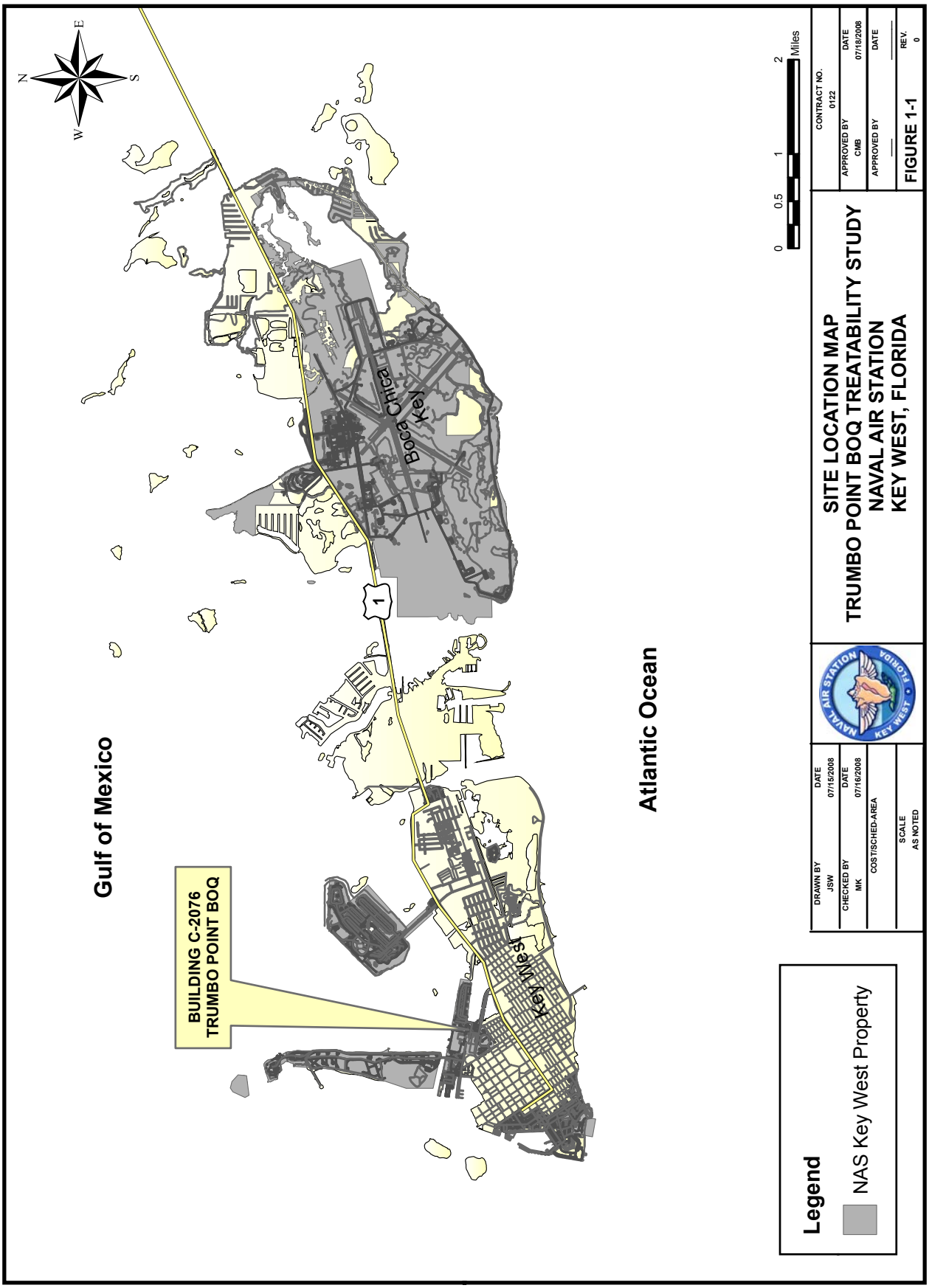
The RAP prepared for the site recommended conducting several short-term multi-phase extraction events until free product was no longer present in any of the monitoring wells (BBL, 2002). Multiphase extraction technology proved to be ineffective, however, due to the low transmissivity of the subsurface formations.

In May 2003, when groundwater was sampled to determine the level of contamination in the monitoring wells, exceedances of the GCTLs were detected in at monitoring wells, MW-5, MW-6, MW-7, and MW-18 (TtNUS 2006). Of the Volatile Organic Compound (VOCs) and Semi-Volatile Organic Compound (SVOCs) detected in the samples; only benzene, acenaphthene and naphthalene were detected above GCTLs. In addition, free product was observed only in MW-15, at approximately 0.5 feet in thickness.

1.2 SCOPE OF WORK

Free product extraction tests were performed at Building C-2076, Trumbo Point BOQ to characterize the thickness of the free product layer and determine the recovery potential of free product from the surficial aquifer. MW-15 was reassigned as a recovery well for the removal of free product and five recovery technologies were implemented during this Treatability Study. The effectiveness of each technology is evaluated in subsequent sections of this Treatability Study Report. Free product and groundwater levels were measured at the recovery well during each recovery event. Whenever there was free product

present in the well, removal and transfer procedures were performed, and waste was collected for disposal.


Gulf of Mexico
Atlantic Ocean
BUILDING C-2076
TRUMBO POINT BOQ
Boca Chica Key
Key West
1
N
E
S
W
0
0.5
1
2
Miles
Legend
NAS Key West Property
DRAWN BY
JSW
DATE
07/15/2008
CHECKED BY
MK
DATE
07/16/2008
COST/SCHED-AREA
SCALE
AS NOTED
NAVAL AIR STATION KEY WEST FLORIDA
SITE LOCATION MAP
TRUMBO POINT BOQ TREATABILITY STUDY
NAVAL AIR STATION
KEY WEST, FLORIDA
CONTRACT NO.
0122
APPROVED BY
CMB
DATE
07/18/2008
APPROVED BY
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DATE
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FIGURE 1-1
REV.
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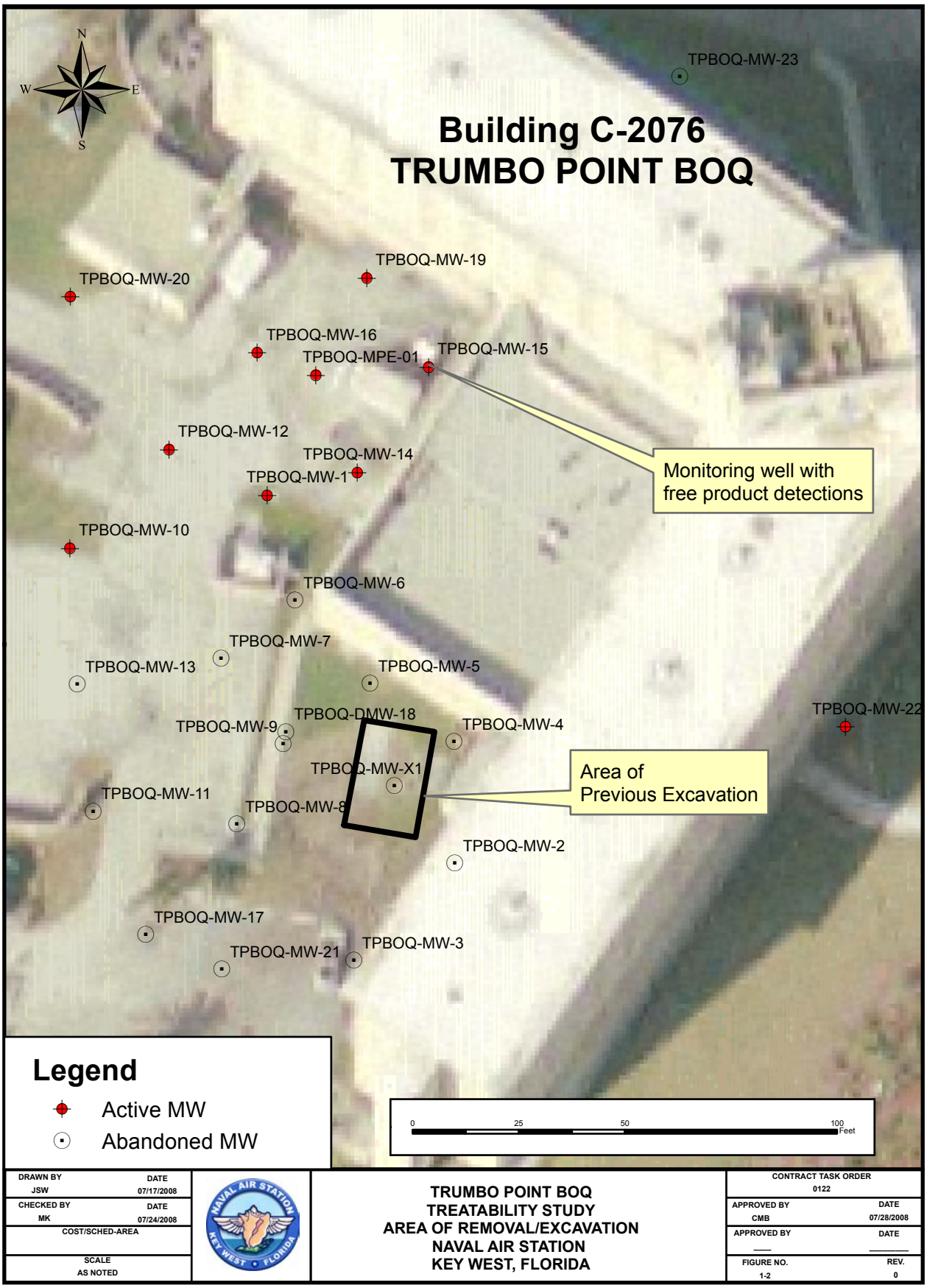


DRAWN BY: JSW	DATE: 07/17/2008	TRUMBO POINT BOQ TREATABILITY STUDY AREA OF REMOVAL/EXCAVATION NAVAL AIR STATION KEY WEST, FLORIDA	CONTRACT TASK ORDER: 0122
CHECKED BY: MK	DATE: 07/24/2008		APPROVED BY: CMB — DATE: 07/28/2008
COST/SCHED-AREA			APPROVED BY: ___ — DATE: ___
SCALE: AS NOTED			FIGURE NO.: 1-2 — REV.: 0

2.0 TREATABILITY STUDY CONCEPT AND OPERATIONS

A RAP for the Trumbo Point BOQ site was drafted in 2002 based on the data from investigations performed by PWC Pensacola and BB&L. The RAP called for free product removal using aggressive fluid vapor removal (AFVR) technology. It has since been determined, however, that AFVR is not an effective means of free product removal at the Trumbo Point BOQ site because of an unyielding condition of the subsurface materials throughout Trumbo Point and most particularly around Building C-2076. The highly-compacted clay material in the study area significantly slows the recovery of free product in the subsurface strata. Consequently, TtNUS was tasked with completing a Treatability Study for evaluating free product recovery rates using various technologies.

It has been determined from previous investigations that the existing monitoring well MW-15 is most often the site of the greatest amount of free product on the Trumbo Point BOQ site. Consequently, MW-15 was used as a recovery well for this Treatability Study. The location of the free product recovery well is near the northwest corner of the loading dock as presented in Figure 2-1.

2.1 TREATABILITY STUDY OBJECTIVE

The objective of this Treatability Study was to perform free product recovery on the former monitoring well MW-15 at Trumbo Point BOQ. The study began with a three month pretreatment period during the months of July, August and September, 2007. Baseline recovery data were obtained from a manual gauging and recovery method. During pretreatment, a disposable tube and check-valve type bailer was used as the baseline removal technology.

Following the three month pretreatment period, the Treatability Study commenced for a period of 6 months, from October 16, 2007 through March 24, 2008 and involved four different recovery technologies. During the treatment study, two manual recovery technologies, and two automated recovery technologies were tested for their effectiveness in removing free-phase product. The two manual technologies are:

- Peristaltic pump with rotational pinch rollers and disposable silicone tubing.
- The Spill Buddy Pro™ (Spill Buddy™) system; a portable reel-operated assembly system manufactured by Clean Earth Technology. This system includes a pump that is mounted on a reel that is connected to an intake and detection probe and is adjusted manually to the oil and water interface through audible feedback.

The automated control operated extraction systems are:

- Down-hole free product skimmer pump with activation and shutoff controls manufactured by Xitech™ Instruments.

- Magnum Spill Buster™ system manufactured by Clean Earth Technology, which is an automated reel-mounted, free-phase petroleum pumping system. On this reel assembly, a motor operates to automatically adjust the depth of the intake pump and probe to the oil and water interface.

The results from these field trials guided the selection of the control technology that is most appropriate for the site-specific conditions at the Trumbo Point BOQ.

2.2 TREATABILITY STUDY CONCEPTUAL MODEL AND APPROACH

The most efficient way to remove subsurface free-phase petroleum product is by direct extraction of the contaminant itself, providing that it can be recovered with a reasonable amount of effort (ACOE, 1999). Recovery rates normally depend on the ability of the subsurface formation to transmit free product. Two means of direct extraction of free-phase product are submersible pumps and skimmer pumps. While skimmer pumps generally extract free product only, submersible pumps remove both groundwater and free product. When there is a thicker layer of free product in the recovery well being released slowly by the subsurface formation, skimmer pumps have the advantage of producing less waste. When a thinner layer exists and the subsurface formations are more porous, submersible pumps are advantageous because they remove both free product and contaminated water from the recovery wells.

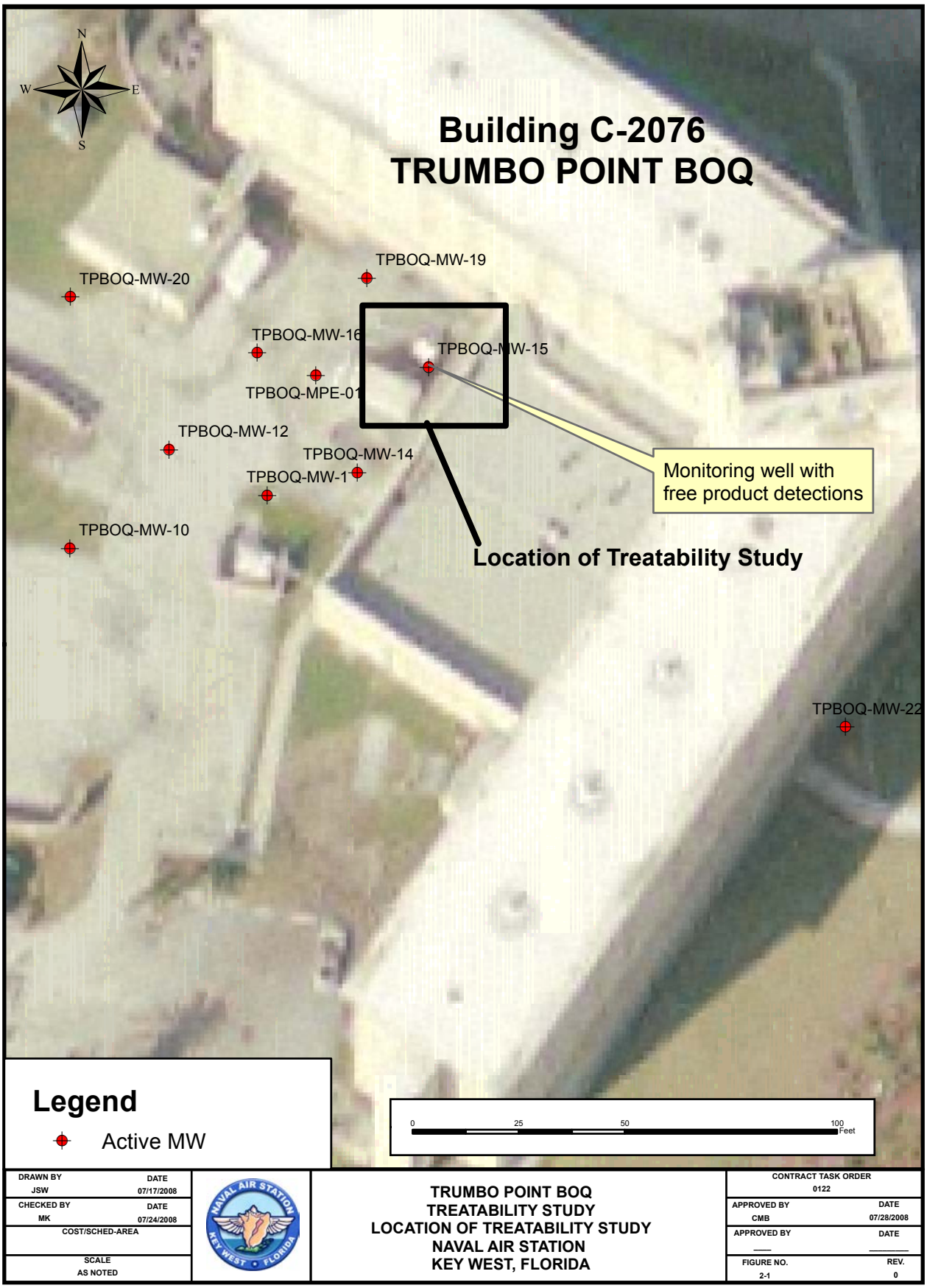
Due to the greater thickness of free-phase product layer typically found in MW-15, and the relatively unyielding condition of the subsurface formation, skimmer pumps are expected to be the most effective recovery technology. This study considers the operational efficiency of two automated skimmer type recovery systems. In the subsequent sections, the preferred technology based on the field trials is evaluated and selected. Based on the field trial data, a projected duration of the required remediation period is made. TtNUS performed this Treatability Study with the appropriate personnel from Navy (as the property owners), Morale Welfare and Recreation (a tenant organization in Building C-2076), and Navy Gateway Inns and Suites (operators of Building C-2076) to ensure ongoing activities at Building C-2076 were minimally affected by the performance of the field activities.

2.3 INVESTIGATION-DERIVED WASTE (IDW) HANDLING

Free product, groundwater, purge water, and decontamination water were containerized in drums and labeled, at a minimum, with the following: contents, date, source and NAS Key West generator number (FL 6170022952). All IDW was handled in accordance with the United States Environmental Protection Agency (EPA) guidance document “Management of Investigation-Derived Wastes during Site Inspections” (EPA, 1991). TtNUS managed and disposed of all IDW produced.

2.4 FREE-PHASE PRODUCT RECOVERY

This Treatability Study addresses the four technologies listed in Section 2.1 over a period of 160 days in the fourth quarter of 2007 and the first quarter of 2008. During this period, there were 116 treatment events that recorded the presence or absence of free-phase product in the recovery well. When free product was present, recovery activities were performed at the well. A total of 35 Gallons of free product were recovered during the Treatability Study. The quantity of free product that was removed was recorded and is compared to; the tidal Mean Lower Low Water (MLLW), and daily rainfall quantities as obtained for the Key West monitoring stations.


N
W
E
S
Building C-2076
TRUMBO POINT BOQ
TPBOQ-MW-19
TPBOQ-MW-20
TPBOQ-MW-16
TPBOQ-MW-15
TPBOQ-MPE-01
TPBOQ-MW-12
TPBOQ-MW-14
TPBOQ-MW-1
TPBOQ-MW-10
TPBOQ-MW-22
Monitoring well with free product detections
Location of Treatability Study
Legend
Active MW
0
25
50
100
Feet
DRAWN BY JSW
DATE 07/17/2008
CHECKED BY MK
DATE 07/24/2008
COST/SCHED-AREA
SCALE AS NOTED
TRUMBO POINT BOQ
TREATABILITY STUDY
LOCATION OF TREATABILITY STUDY
NAVAL AIR STATION
KEY WEST, FLORIDA
CONTRACT TASK ORDER 0122
APPROVED BY CMB
DATE 07/28/2008
APPROVED BY
DATE
FIGURE NO. 2-1
REV. 0

3.0 TREATABILITY STUDY IMPLEMENTATION AND RESULTS

3.1 TREATABILITY STUDY PROCEDURE

The three manual free product extraction technologies that were employed include the bailer, the peristaltic pump, and the Spill Buddy™ system. Equipment needed for these technologies were either stored on site within the recovery well or were removed upon completion of the recovery event for storage or disposal as IDW. The peristaltic pump and Spill Buddy™ system are powered by portable means (automobile or battery power) and were removed from the site after the recovery event had been completed. Peristaltic pump tubing and bailers were stored on site within the recovery well, providing they were in operable condition. The Spill Buddy™, Spill Buster™, and Xitech™ skimmer pump were removed and decontaminated after each daily event. Disposable bailers were discarded after the completion of each extraction event.

The two automated recovery technologies required mounting to the well. The Xitech™ skimmer pump is powered by either 110 volt alternating current (AC) or 12 volt direct current (DC). The system was left in place after each recovery event. The Magnum Spill Buster™ reel assembly required 110-volt AC and was mounted to the well casting while the controller and instrumentation were mounted to a support. The Magnum Spill Buster™ was either left in place or disassembled and removed after each free product recovery event.

3.1.1 Pretreatment Period

To determine baseline free-phase product thickness and recovery well production rates, pretreatment data were gathered using free product recovery with a hand bailer during the months of July, August, and September of 2007. This tube and check valve bailer was manually raised and lowered into the well until the entire free product layer was extracted. A total of 6.0 gallons of free product were recovered during the pretreatment period: 3.9 gallons in July, 1.5 gallons in August, and 0.6 gallons in September. This technology, while effective, was found to be labor-intensive and has the potential for excess groundwater removal and for petroleum contaminant release or spillage.

3.2 TREATABILITY SYSTEM OPERATION

Following the end of the pretreatment period in September, field trials of the recovery technologies began in October. During the months of October and November, a peristaltic pump was used to withdraw free-phase product from the recovery well. The peristaltic pump system consisted of an oil-water interface probe with silicon and polyethylene tubing that was inserted into the well. The intake of the polyethylene tubing was located at the sensor level of the oil-water interface probe, and was manually raised and lowered based on feedback from the interface probe. The peristaltic pump system was run until the free

product layer was extracted from the recovery well. A total of 8.9 gallons were recovered during the peristaltic pump field trial: 5.5 gallons in October and 3.4 gallons in November. That technology was more effective at removing free-phase product, less labor intensive and carried a lower potential for release and spillage than did the manual bailer. Also, considerably less water was extracted than with the manual check valve and tube bailer that was used during the pretreatment period. As such, the peristaltic pump system was more efficient than the bailer.

3.2.1 Xitech™ System

Following the field trial of the peristaltic pump, the Xitech™ system trial was implemented. The Xitech™ pump is a vacuum operated remote controlled interface recovery system. The system transferred free product through the collection intake by an induced 90 cubic feet per minute (cfm) vacuum pump. During the field trial of the Xitech™ system in December 2007, a total of 8.3 gallons of petroleum contaminant were removed from the recovery well. This technology proved to be more effective at recovering free product than either the bailer or the peristaltic pump. In addition to being more efficient, the Xitech™ system was also less labor intensive than either the bailer of the peristaltic pump. The system, however, was more complicated and required more apparatus to be configured.

3.2.2 Clean Earth Automated Magnum Spill Buster™ System

After the Xitech™ system trial, the Clean Earth Automated Magnum Spill Buster™ (Spill Buster™) system field trial was performed in January 2008. The Spill Buster™ system is an electric self sensing skimmer pump that is controlled by an auto-seeking motorized reel. The reel assembly is connected to the well head which is controlled by the fluid interface sensor mounted on the pump. The Spill Buster™ operates only when an oil / water interface is detected, and is designed to remove the petroleum product layer and excluded the recovery of water.

During the field trial of the Spill Buster™ system in January 2008, a total of 4.1 gallons of petroleum contaminant was removed from the recovery well. This technology proved to be an effective means of recovering free product and was efficient at removing free product without excess water. While the recovery volume from the Spill Buster™ System was about half of that of the Xitech™ System, it would become apparent in subsequent months that the free product plume was beginning to be depleted.

3.2.3 Clean Earth Automated Spill Buddy™ System

The final technology tested in this Treatability Study was the Clean Earth Spill Buddy™ that was implemented in February and March of 2008. The Spill Buddy™ system is a portable manual reel-operated skimmer pump that is hand controlled based on audible feedback from the oil / water interface probe. As such, the Spill Buddy™ operates with the same mechanism and sensors as the Spill Buster™, but without the motorized automatic adjusting reel. This design incorporates the simplicity and versatility

of the peristaltic pump interface probe configuration with the technologically advanced phase selection mechanism of the Spill Buster™. During the Spill Buddy™ field trial, a total of 7.7 gallons were recovered, with 5.9 and 1.8 gallons of free product recovered in February and March respectively.

While the quantities of free product recovered during the field trial of the Spill Buddy™ were less than those with the Xitech™ and peristaltic pump systems, it appears that the production capabilities of the well were continuing to decline, thus lowering the amount of available free product that could be recovered.

The results of the field trials of these five technologies are summarized in Table 3-1 where the recovered volumes of Free Product are compared with the lowest value of the MLLW. The MLLW is the average of the lower low water height of each observed tidal day at an individual station. The lowest observed MLLW values associated with the trial recovery technology are presented for comparison in this data summary.

3.3 TREATMENT STUDY DATA ANALYSIS

Data from the daily recovery events over the 160 day period from October 16, 2007 to March 28, 2008 are recorded and presented in Table 3-2. Also included are the daily MLLW and the cumulative precipitation over the 24-hour period that was recorded at the Key West International Airport. As presented in the table, there are six periods when no data are listed in the free product recovery data column. During these 6 periods, no free product recovery activities were conducted; however, data for the MLLW and precipitation populate the other columns. On days when free product recovery was performed, and no free product was present, the free product data for that day are reported as a 0. Recovery events were suspended when recovery volumes were 0 or when personnel were unavailable. The largest data gap is 16 days during the holiday period from December 20, 2007 through January 4, 2008.

Recovery data from Table 3-2 are graphically presented on Figure 3-1 with the event free product removed by ounce (oz) represented as the red points and lines, cumulative free product recovered in gallons as the green line. The recovery technologies are noted at the top of the chart, and chronologically ordered for the 160 day period. Cumulative free product recovered scale is on the left axis of the chart, while the event free product recovered scale is on the right side. Upon examination of this chart, it is apparent that while free product continued to be present in the recovery well, the maximum event recoveries for the periods decreased over time.

3.3.1 Tidal Effects on Free Product Recovery

Water table on Key West is influenced by tidal cycles, particularly in areas of close proximity to the tidal waters of the Gulf of Mexico and Atlantic Ocean. As discussed in Section 1.1, the BOQ is within one-

quarter-mile of the Gulf of Mexico, and groundwater in the area is subject to tidal influences. One tidal parameter that is regularly referred to is the MLLW, which represents the average of the lower low water height of each observed tidal day at an individual station.

A graphical representation of the MLLW in feet, with event free product removed, is presented in Figure 3-2. In this chart, the red points and lines represent the quantity of event free product removed. The blue line and points represent the daily MLLW data. The recovery technologies are noted at the top of the chart and chronologically ordered for the 160 day period. The daily MLLW data scale is on the left axis of the chart, while the event free product recovered scale is on the right side. Free product recovery data gaps are visible as breaks in the event free product lines; however continuous daily MLLW data are presented. An incline in the monthly tidal cycles of the MLLW occurs up to the Winter Solstice in December and decline after the Solstice.

For each month during the Treatability Study, the periods of greatest recoveries are preceded by the monthly minimum of the MLLW tidal cycle. The monthly low tidal cycle influences are particularly pronounced during the months of November, December, February, and March where the maximum monthly recovery amounts are preceded by the monthly low of the MLLW. During the months of October and January, additional influences appear to be acting upon the production of the recovery well. These additional influences are discussed further in the following paragraphs of this Section.

3.3.2 Precipitation and Meteorological Effects on Free Product Recovery

Precipitation quantity and tropical storms also influence water table depth at Key West. During the period of the Treatability Study, two tropical storms were occurring in the region of Key West Naval Air Station, Hurricane 14 (Noel, from October 24 through November 7) and Tropical Storm 15 (Olga, from December 10 through December 16). As shown in the tracking chart for the 2007 Hurricane Season (Appendix B) these two storms were in the region of Key West during the period of the Treatability Study. A graphical representation of the daily quantity of precipitation, MLLW, with event free product recovered, and the two tropical systems are presented in Figure 3-3. In this chart; the red points and lines represent the quantity of event free product removed, blue line and points represents the daily MLLW data, the green lines and points represent the quantity of precipitation in inches per day, and the period of tropical system occurrences are noted in the orange boxes.

As depicted on Figure 3-3, influences from Tropical System 14 had a suppressive effect on tidal cycle which depressed the higher tidal maximum on October 29 for the second 14 day period of the month of October. The tidal effect from this tropical system is believed to have contributed to the low recovery during the first group of treatment events in November. It is not expected that Tropical System 15 had a significant effect on recovery well production for the first period of events in January. This is shown by the relatively stable MLLW cycle during that period.

3.3.3 Free Product Recharge Effects on Free Product Recovery

As illustrated in Figures 3-1, 3-2, and 3-3, free product production decreased over time in 6 of the 7 groups of recovery events. As such, free product production is presumed to be influenced to a significant extent by recharge within the recovery well. The period of greatest free product recovery, as reported in Table 3-1 and depicted on Figure 3-1, was 8.6 gallons during the month of December. During this period the Xitech™ recovery system was being implemented in the field trial. In this same period there also occurred the two greatest tidal differentials observed over the study period of: 2.03 feet, in the second half of November, and 1.99 feet in the first half of December. An 11 day recharge period with no recovery activities occurred prior to the period of the highest recovery, and Tropical System 15 occurred simultaneously.

3.4 ANALYSIS SUMMARY

From data collected in the Treatability Study activities, local meteorological data, local tidal data, period of recharge, and technological system specifications, there appear to be several variables that influence the quantity of free product recovery at this site. Each variable has a dynamic influence on recovery volume based on their relative occurrence, duration, and strength during the period. While a precise multi-dimensional model is impartial, these data suggest that of the variables, local tidal cycles and period of recharge have the most significant impacts on free product recovery at the site.

TABLE 3-1

**TREATABILITY STUDY OPERATIONAL TECHNOLOGY SUMMARY
TRUMBO POINT BOQ
NAVAL AIR STATION
KEY WEST, FLORIDA**

Month	Free Product Recovered (Gallons)	MLLW (Feet) (1)	Recovery Technology
July	3.9	-0.42	Bailer
August	1.5	-0.18	Bailer
September	0.6	0.08	Bailer
October	5.5	-0.23	Peristaltic Pump
November	3.4	-0.42	Peristaltic Pump
December	8.3	-0.64	Xitech Automated
January	4.1	-0.52	Clean Earth Automated (Magnum Spill Buster)
February	5.9	-0.66	Spill Buddy Pro
March	1.8	-1.07	Spill Buddy Pro
Treatability Study	29.0		October through March
Total (2)	35.0		Including Pretreatment Period July, August and September

(1) MLLW is the "Mean Lower Low Water" Tide elevation at station 8724580 Key West (Source: NOAA.GOV)
(2) Including ball and check valve manual bailer pretreatment period recovery

TABLE 3-2

TREATABILITY STUDY FREE PRODUCT RECOVERY PARAMETERS
TRUMBO POINT BOQ
NAVAL AIR STATION
KEY WEST, FLORIDA
PAGE 1 OF 4

Date	Free Product Recovered (oz) (1)	MLLW (ft) (2)	Daily Precipitation (in) (3	Average Precipitation (in) (4)
October 16, 2007	0	0.40		
October 17, 2007	0	0.49		
October 18, 2007	20	0.55		
October 19, 2007	31	0.58	1.13	1.13
October 20, 2007	50	0.58	5.02	3.08
October 21, 2007	61	0.59	0.01	2.05
October 22, 2007	25	0.62	0.05	1.69
October 23, 2007	19	0.63	0.15	0.07
October 24, 2007	24	0.35	1.4	0.53
October 25, 2007	22	0.06	1.52	1.02
October 26, 2007	104	-0.16	0.52	1.15
October 27, 2007	118	-0.27	0.03	0.69
October 28, 2007	113	-0.26		0.28
October 29, 2007	109	-0.15	0.12	0.08
October 30, 2007	12	0.03		0.12
October 31, 2007	0	0.22		0.06
November 1, 2007	0	0.39		
November 2, 2007		0.52		
November 3, 2007		0.61		
November 4, 2007		0.68		
November 5, 2007	0	0.73		
November 6, 2007	0	0.57		
November 7, 2007	0	0.41		
November 8, 2007	0	0.30		
November 9, 2007	0	0.17		
November 10, 2007	23	0.11		
November 11, 2007	5	2.05		
November 12, 2007	0	2.11		
November 13, 2007	0	2.09		
November 14, 2007	0	2		
November 15, 2007	0	1.83		
November 16, 2007	44	1.58	0.02	0.02
November 17, 2007	45	1.24		0.02
November 18, 2007	38	0.88		0.02
November 19, 2007	31	0.57		
November 20, 2007	26	0.44		
November 21, 2007	65	0.58		
November 22, 2007	20	0.97		
November 23, 2007	136	1.5		
November 24, 2007	0	2.02		
November 25, 2007		2.37		
November 26, 2007		2.47		
November 27, 2007		2.34	0.33	0.33

TABLE 3-2

TREATABILITY STUDY FREE PRODUCT RECOVERY PARAMETERS
TRUMBO POINT BOQ
NAVAL AIR STATION
KEY WEST, FLORIDA
PAGE 2 OF 4

Date	Free Product Recovered (oz) (1)	MLLW (ft) (2)	Daily Precipitation (in) (3	Average Precipitation (in) (4)
November 28, 2007		2.03	0.11	0.22
November 29, 2007		1.62	0.24	0.23
November 30, 2007		1.2		0.18
December 1, 2007		0.85		0.24
December 2, 2007		0.61		
December 3, 2007		0.52		
December 4, 2007		0.55		
December 5, 2007		0.68		
December 6, 2007	0	0.89		
December 7, 2007	34	1.13		
December 8, 2007	92	1.4	0.07	0.07
December 9, 2007	81	1.64		0.07
December 10, 2007	112	1.84	0.01	0.04
December 11, 2007	57	1.96		0.01
December 12, 2007	81	1.97		0.01
December 13, 2007	76	1.87	0.38	0.38
December 14, 2007	147	1.65	0.13	0.26
December 15, 2007	90	1.31		0.26
December 16, 2007	88	0.89	0.02	0.17
December 17, 2007	93	0.45		0.20
December 18, 2007	106	0.1		0.20
December 19, 2007	0	-0.02		
December 20, 2007		0.15		
December 21, 2007		0.59		
December 22, 2007		1.17		
December 23, 2007		1.72		
December 24, 2007		2.08		
December 25, 2007		2.19		
December 26, 2007		2.06		
December 27, 2007		1.76		
December 28 2007		1.37	0.01	
December 29, 2007		0.96		
December 30, 2007		0.6		
December 31, 2007		0.29		
January 1, 2008		0.15		
January 2, 2008		0.15		
January 3, 2008		0.26		
January 4, 2008		0.48		
January 5, 2008	0	0.76		
January 6, 2008	83	1.09		
January 7, 2008	24	1.41	0.02	0.02
January 8, 2008	63	1.67		0.02
January 9, 2008	26	1.83		0.02

TABLE 3-2

TREATABILITY STUDY FREE PRODUCT RECOVERY PARAMETERS
TRUMBO POINT BOQ
NAVAL AIR STATION
KEY WEST, FLORIDA
PAGE 3 OF 4

Date	Free Product Recovered (oz) (1)	MLLW (ft) (2)	Daily Precipitation (in) (3	Average Precipitation (in) (4)
January 10, 2008	34	1.83	0.1	0.10
January 11, 2008	37	1.68	0.17	0.14
January 12, 2008	58	1.38		0.14
January 13, 2008	551	0.97		0.17
January 14, 2008	33	0.5	0.01	
January 15, 2008	0	0.06		
January 16, 2008	0	-0.24		
January 17, 2008	0	-0.3		
January 18, 2008	0	-0.007		
January 19, 2008	0	0.4		
January 20, 2008	0	0.97	0.09	0.09
January 21, 2008	0	1.47		0.09
January 22, 2008	0	1.79	0.06	0.08
January 23, 2008	0	1.87		0.06
January 24, 2008	0	1.75		0.06
January 25, 2008	44	1.48		
January 26, 2008	31	1.14		
January 27, 2008	7	0.77	0.06	0.06
January 28, 2008	38	0.43		0.06
January 29, 2008	0	0.16		0.06
January 30, 2008	0	-0.01		
January 31, 2008		-0.04		
February 1, 2008		0.05		
February 2, 2008		0.24		
February 3, 2008		0.53		
February 4, 2008	67	0.86		
February 5, 2008	78	1.21		
February 6, 2008	71	1.52		
February 7, 2008	67	1.69		
February 8, 2008	68	1.7		
February 9, 2008	77	1.51		
February 10, 2008	67	1.16		
February 11, 2008	72	0.71		
February 12, 2008	88	0.25	0.72	0.72
February 13, 2008	12	-0.12	1.02	0.87
February 14, 2008	0	-0.33		0.87
February 15, 2008	0	-0.31		1.02
February 16, 2008	0	-0.05		
February 17, 2008	0	0.39		
February 18, 2008	0	0.88		
February 19 2008	0	1.3	0.07	0.07
February 20, 2008	0	1.55		0.07
February 21, 2008	0	1.63	0.06	0.07

TABLE 3-2

TREATABILITY STUDY FREE PRODUCT RECOVERY PARAMETERS
TRUMBO POINT BOQ
NAVAL AIR STATION
KEY WEST, FLORIDA
PAGE 4 OF 4

Date	Free Product Recovered (oz) (1)	MLLW (ft) (2)	Daily Precipitation (in) (3	Average Precipitation (in) (4)
February 22, 2008	0	1.54		0.06
February 23, 2008	0	1.34		0.06
February 24, 2008	29	1.06		
February 25, 2008	29	0.76		
February 26, 2008	13	0.46		
February 27, 2008	0	0.21	0.36	0.36
February 28, 2008	0	0.04		0.36
February 29, 2008	12	-0.02		0.36
March 1, 2008	16	0.02		
March 2, 2008	3	0.17		
March 3, 2008	0	0.4		
March 4, 2008		0.72		
March 5, 2008		1.07	0.01	
March 6, 2008		1.38	0.04	0.03
March 7, 2008		1.58		0.03
March 8, 2008		1.58	0.46	0.25
March 9, 2008		1.37		0.46
March 10, 2008		1.01		0.46
March 11, 2008	0	0.58	0.47	0.47
March 12, 2008	31	0.18		0.47
March 13, 2008	40	-0.1		0.47
March 14, 2008	39	-0.22		
March 15, 2008	24	-0.15		
March 16, 2008	17	0.08		
March 17, 2008	8	0.43		
March 18, 2008	4	0.81		
March 19, 2008		1.14		
March 20, 2008		1.34		
March 21, 2008	8	1.41		
March 22, 2008	27	1.37	0.46	0.46
March 23, 2008	7	1.24	0	0.23
March 24, 2008	6	1.05	0	0.15

Note:
(1) Blanks represent periods where free product recovery was not conducted and 0 represents no Free-Phase product present in the recovery well.
(2) MLLW is the "Mean Lower Low Water" Tide elevation at Station 8724580 Key West. (Source: NOAA.GOV)
(3) Daily precipitation is the sum or the 24-hourly precipitation values ending with hour 24, for Key West International Airport Weather-Bureau-Army-Navy (WBAN) Station number 12836. (Source: NOAA.GOV)
(4) Average precipitation is the running average of the 3-day period ending 3 days after the reported date. Blanks represent no precipitation and these values are not included in the averaging period.

oz = ounce
ft = feet
in = inches

FIGURE 3-1
EVENT FREE PRODUCT RECOVERY VOLUME AND TOTAL VOLUME VS. TIME
TREATABILITY STUDY
TRUMBO POINT BOQ, NAVAL AIR STATION
KEY WEST, FLORIDA

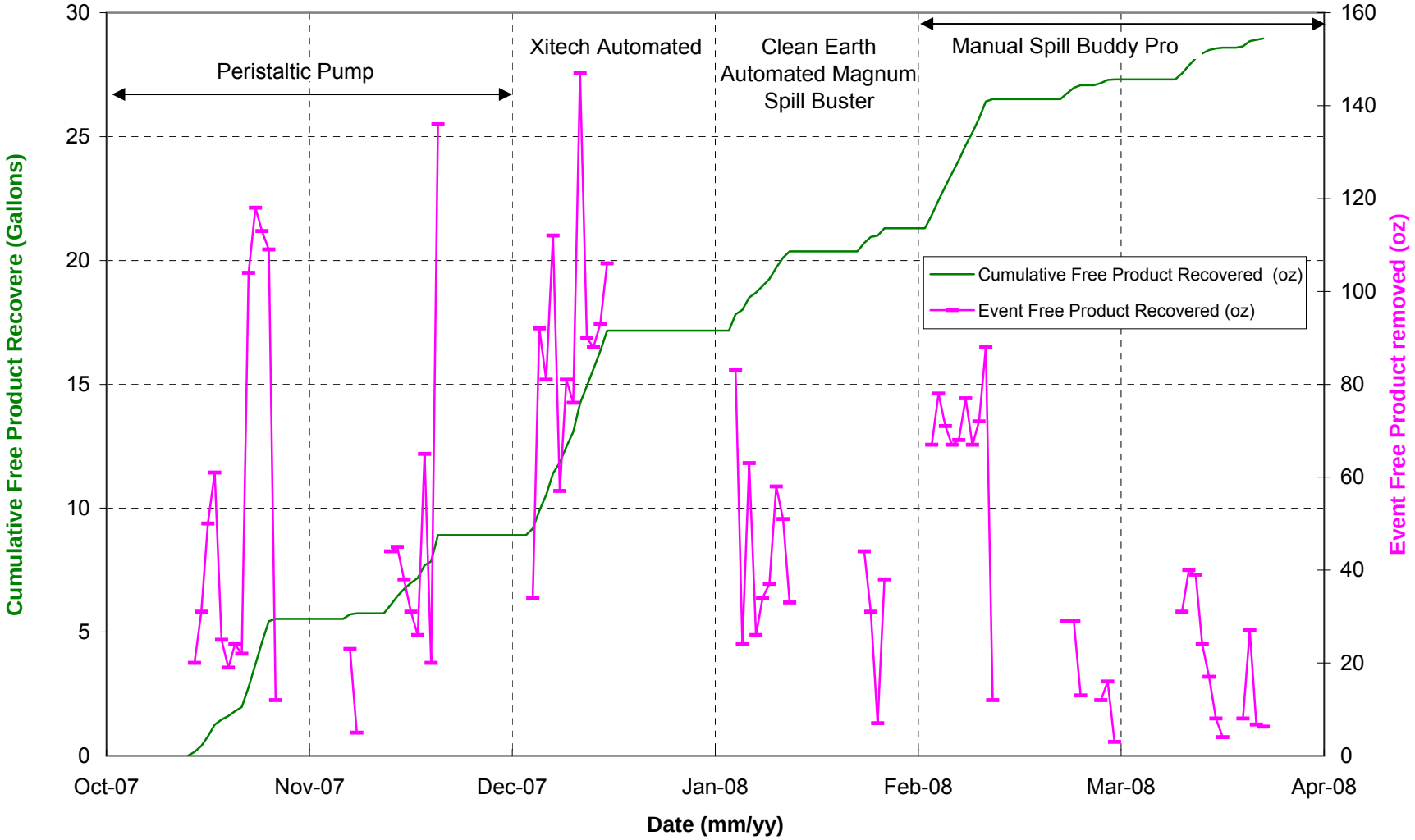


FIGURE 3-2
TREATABILITY STUDY
EVENT FREE PRODUCT RECOVERY VOLUME AND RECORDED LOW TIDAL CYCLE VS. TIME
TRUMBO POINT BOQ, NAVAL AIR STATION
KEY WEST, FLORIDA

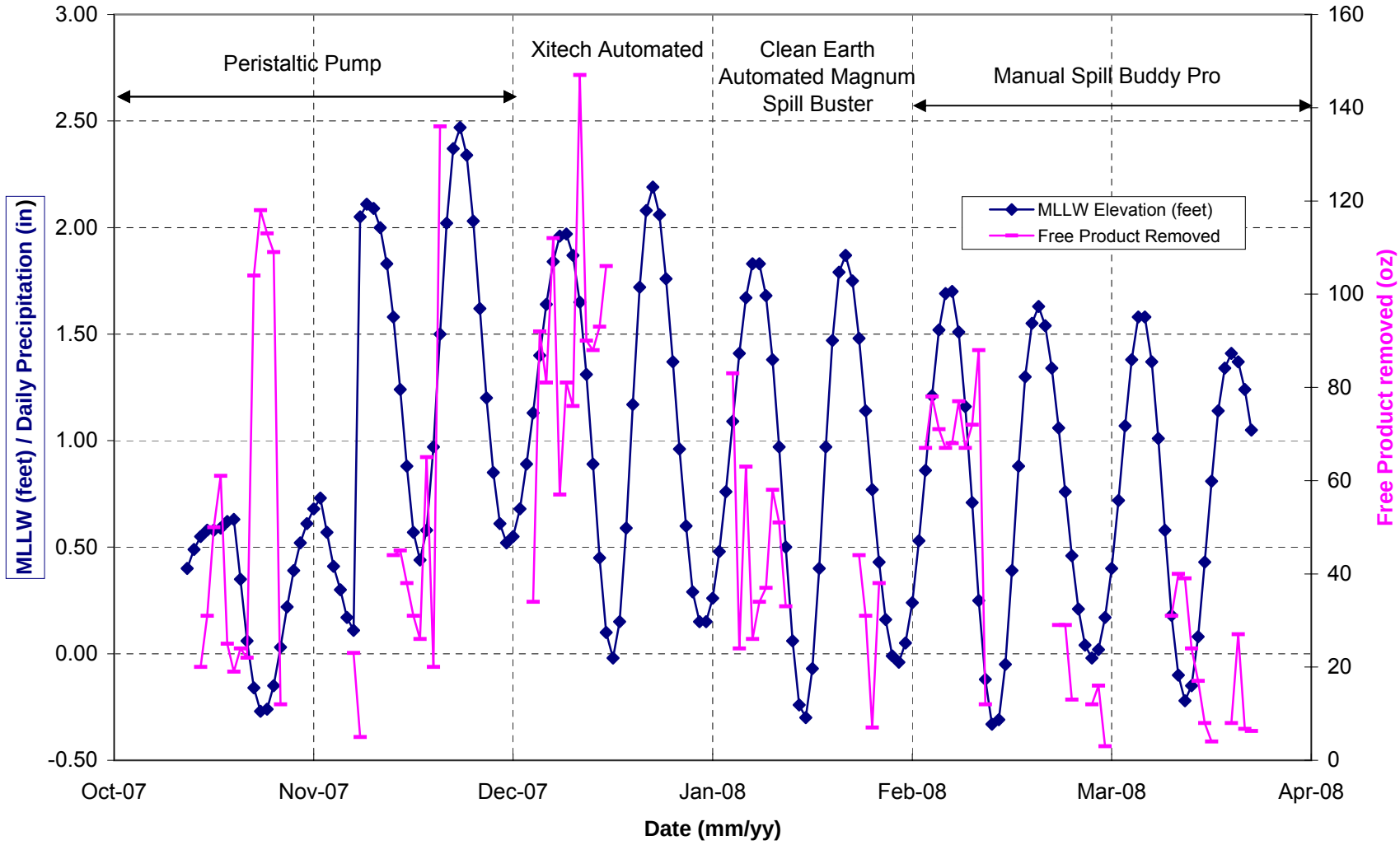
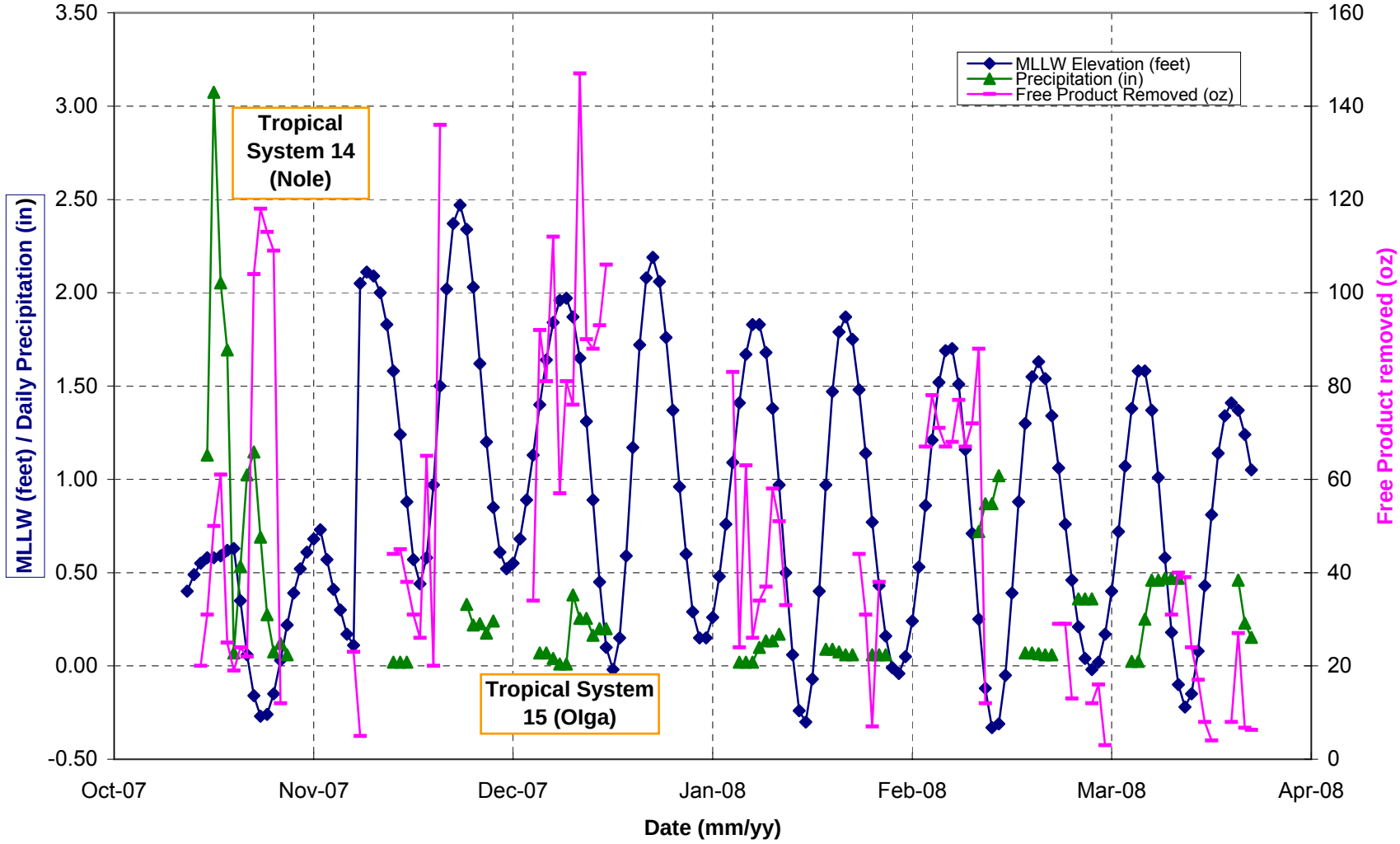


FIGURE 3-3
EVENT FREE PRODUCT RECOVERY VOLUME, RECORDED LOW TIDAL CYCLE AND DAILY PRECIPITATION VS. TIME
TREATABILITY STUDY
TRUMBO POINT BOQ, NAVAL AIR STATION
KEY WEST, FLORIDA



4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

This report summarizes the results to date of the Treatability Study for free product recovery in the subsurface formation behind Building C-2076, Trumbo Point BOQ. This Treatability Study evaluates the effectiveness of various technologies for the extraction of free product from the soils and groundwater beneath the Trumbo Point BOQ. It was found that the Spill Buddy™ is the most effective technology for removing the free product layer from the recovery well, formerly designated as MW-15, at this site.

It was found that there are four variables that influence free product recovery at the site. These variables are: local conditions for meteorology, local tidal cycle, period of recharge, and technological system specifications. Of these four variables it appears that local tidal cycles and period of recharge have the most significant impacts on free product recovery at the site.

4.1.1 Predicted Free Product Recovery

As presented in Figures 3-1, 3-2, and 3-3 of the previous section, recovery volumes declined over time. During the 160 day period of the Treatability Study, 35.0 gallons of free product were recovered. A linear regression was performed on recovery volumes-versus-time and an average rate of decline of 7.2 ounces per day per month (oz/day-month) was derived. Based on the total amount of free product recovered of 29 gallons or 3712 oz, over the 160 day period, the average rate of recovery was 23.2 oz/day. Extrapolating into the future, the time required to remove the entire quantity free product in the recovery well is predicted to be 120 days or 4 months.

This estimate is based on the average rate of decrease in recovery per day, and is intended as an approximation of the time to complete remediation. It is likely that the actual time required to remediate this well may be greater, as the rate of decline becomes more asymptotic when the quantity of free product approaches zero.

The actual recovery rate versus predicted recovery rate is presented graphically in Figure 4-1. As depicted on this chart, actual free product rates of recovery deviate further from the predicted rate at the beginning of the Treatability Study period when the rate of recovery volumes were greater. As the actual quantity of free product recovery decreases, the deviation from the predicted recovery rate decreases as well.

To resolve the differential in actual recovery rate between the beginning and end periods of the Treatability Study, an additional analysis was performed. In this scenario, the predicted rate of recovery was segmented to the period before the December 2007 recharge break and after the break. As depicted

in Figure 4-2, during the pre-December 2007 recharge events, the segmented average recovery rate increased with time; while after the break the recovery rate decreased. Deviation from these segmented rates is significantly less than in the single regression scenario and the projected time required to remediate the site is also decreased.

The linear regressions presented in Figures 4-1 and 4-2 are based exclusively on recovery rate with respect to time, and do not account for any of the other variables: MLLW, precipitation, recharge periods, or recovery technology. Such a multidimensional model is out of the scope of this investigation, and would not necessarily provide a more accurate representation than is offered in these linear representations.

4.2 RECOMMENDATIONS

The following recommendations are presented based on the Treatability Study results:

- Implement the selected technology and resume selective free product extraction at the recovery well until the free product is no longer present. It is recommended that the recovery events be scheduled to follow the occurrence of the monthly low MLLW for the area. The Clean Earth Spill Buddy™ is recommended as the treatment technology based on its simplicity of use, robust technological design, versatility, and selectivity of recovery medium.

- It is recommended that free product delineation be performed in the area of the recovery well. There are no data regarding the horizontal extent of the free product layer. As such, it is recommended that additional investigation be performed to define the limits of the free product plume within the subsurface formation. Upon approval of this Treatability Study Report, and appropriate resources committed to further investigation, it is recommended that a Work Plan be assembled. The Work Plan will make specific recommendations for the locations and quantity of monitoring wells required for this investigation. In addition, further delineation will provide access to remove or sequester the contaminant in the event that the free product plume has migrated outside the radius of the existing recovery well.

FIGURE 4-1
TREATABILITY STUDY PREDICTED ACTUAL RATE OF FREE PRODUCT EXTRACTION VS. TIME
TRUMBO POINT BOQ, NAVAL AIR STATION
KEY WEST, FLORIDA

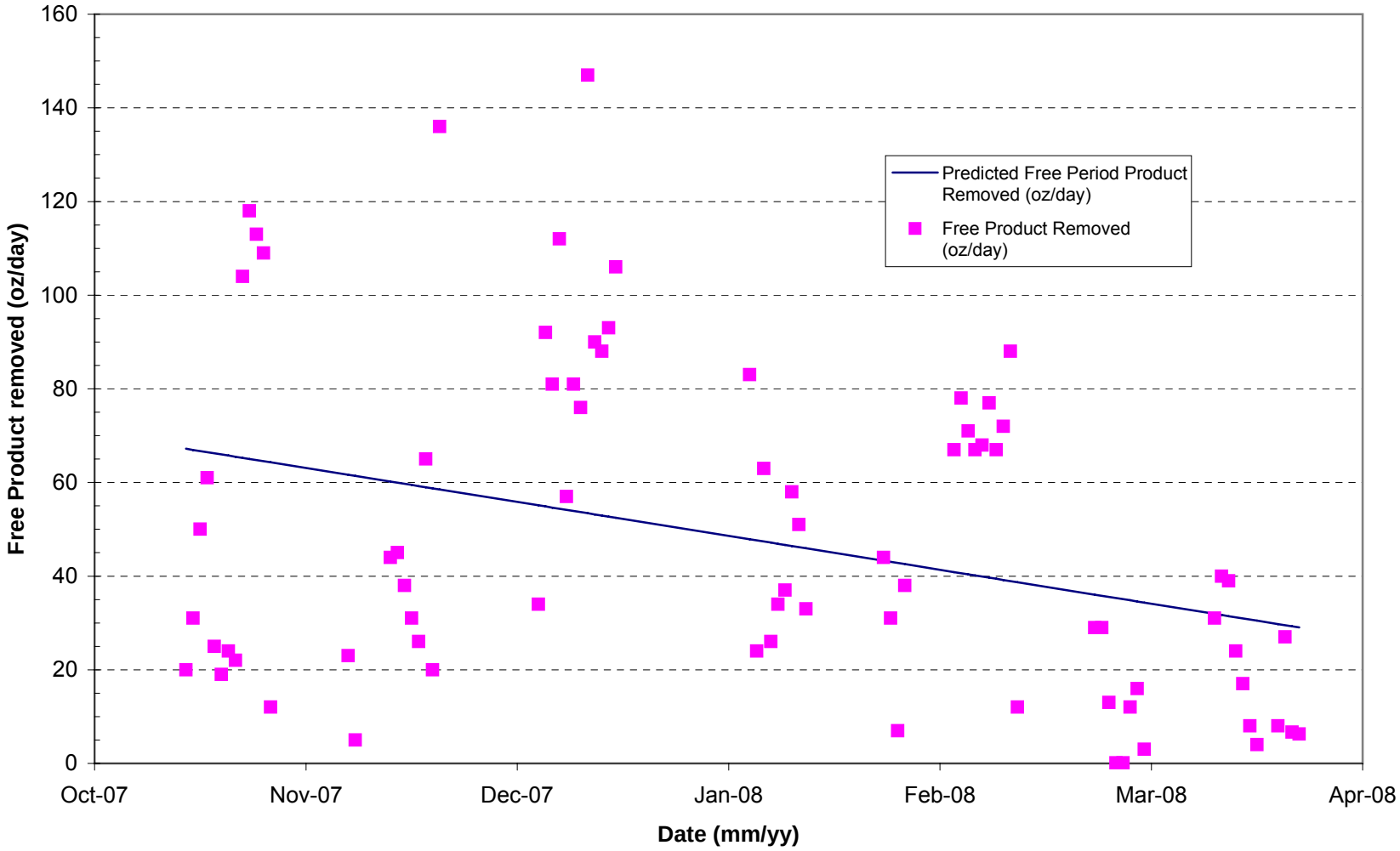
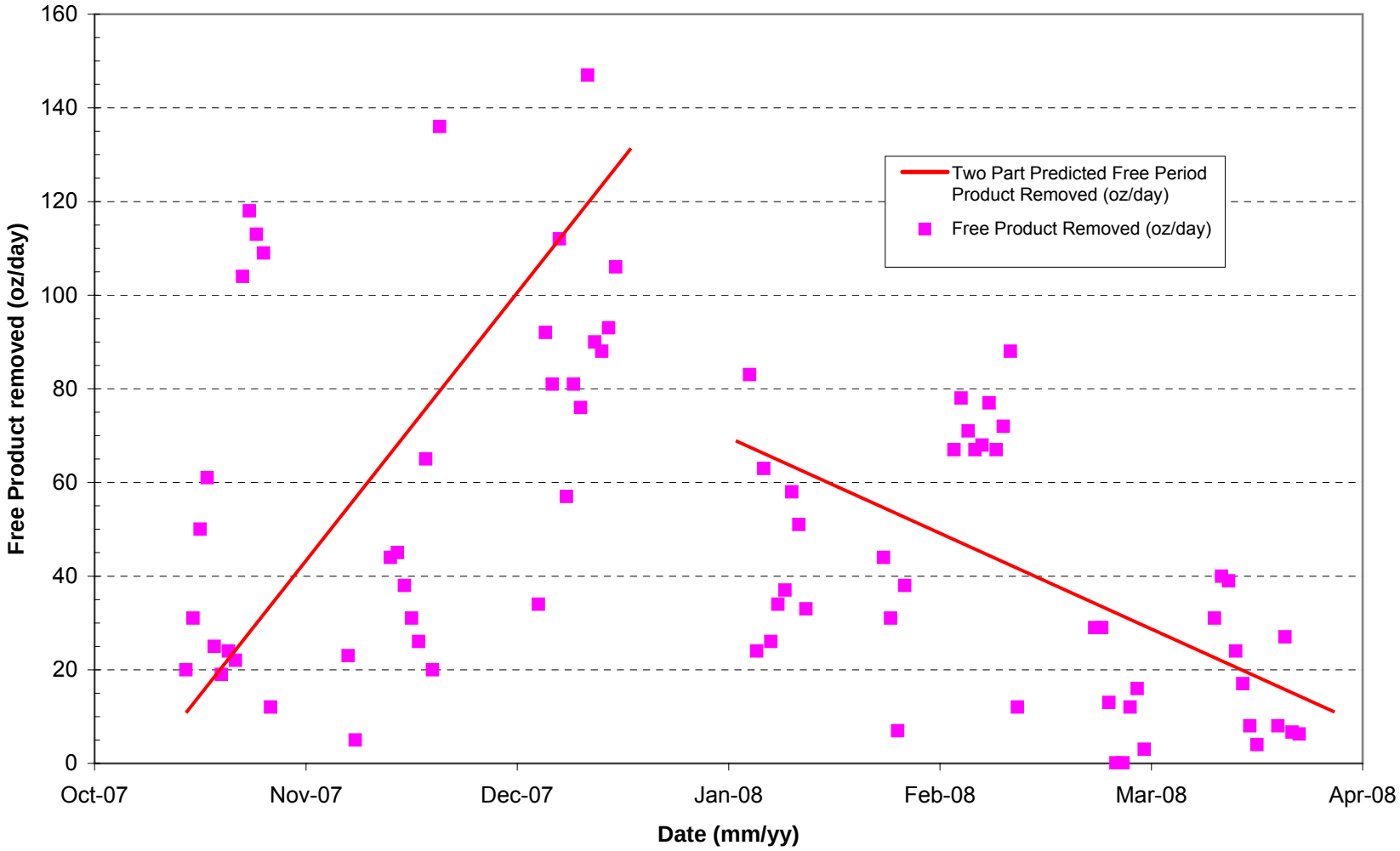


FIGURE 4-2
TREATABILITY STUDY TWO PART PREDICTED ACTUAL RATE OF FREE PRODUCT EXTRACTION VS. TIME
TRUMBO POINT BOQ, NAVAL AIR STATION
KEY WEST, FLORIDA



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APPENDIX A

TREATMENT TECHNOLOGY MANUFACTURER SPECIFICATIONS

Bailers

100% Teflon® Reusable Bailers

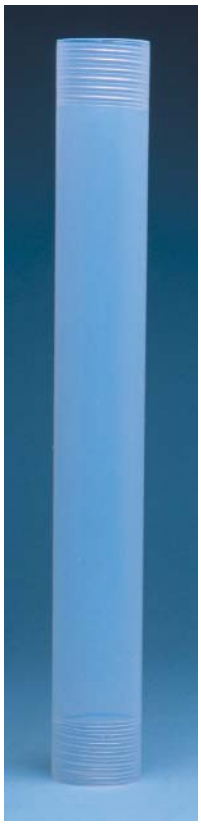
The Teflon® reusable water sampling bailers are made of chemically inert, 100% virgin Teflon® fluoropolymer resin. Bailers are available with a complete set of mix and match interchangeable components making them ideal in all groundwater sampling applications.

FEATURES

- **Standard Top**
  The opening is "V" notched for accurate pouring. The rounded thread design allows easy, complete cleaning.
- **Bailer Body**
  The standard body is 1 7/8" and is available in 1 ft., 2 ft. and 3 ft. lengths. Bailers are also available in ¾" and 1" O.D. for use in 1", 1¾" or 1 ½" diameter wells.
- **Standard Bottom**
  Precision ground check valve stays confined to the bottom section to prevent loss. Special seat design prevents leakage and premature opening when emptying.
- **Increased versatility**
  The Point Sampling top offers an added check valve that isolates samples taken at specific depths. The Controlled Flow Bottom controls the flow rate from slow "drip" to rapid empty. High speed Sample Transfer Devices are available in several configurations.
- **Sampling Alternative**
  Low cost Teflon® Economy Bailers are also available. They are easily disassembled for cleaning.

Standard Top

Point Source Top



Bailer Body

Standard Bottom

Bottom Emptying

CONFIGURATIONS

1-3/4" diameter	
Volume capacity	350, 700, or 1050 cc
Materials	Teflon®
Standard top & bottom	1, 2 & 3 ft length
Standard top & bottom emptying bottom	1, 2 & 3 ft length
Standard top & controlled flow bottom	1, 2 & 3 ft length
Point sampling top & standard bottom	1, 2 & 3 ft length
Point sampling top &controlled flow bottom	1, 2 & 3 ft length
1" diameter	
Volume capacity	80, 160 or 240 cc
Materials	Teflon®
Standard top & bottom	1, 2 & 3 ft length
Standard top & controlled flow bottom	1, 2 & 3 ft length
3/4" diameter	
Volume capacity	60, 120 or 180 cc
Materials	Teflon®
Standard top & bottom	1, 2 & 3 ft length
Standard top & controlled flow bottom	1, 2 & 3 ft length
3" diam. "Big Bailer"	
Available in	3 ft length
Volume capacity	3,300 cc
Materials	Teflon®
Connections	Precision machined rounded Threads

Controlled Flow Bottom

Coupling

Geotech Environmental Equipment, Inc.
2650 East 40th Avenue • Denver, Colorado 80205
(303) 320-4764 • **(800) 833-7958** • FAX (303) 322-7242
email: sales@geotechenv.com website: www.geotechenv.com

Peristaltic Sampling Pumps

Geopump™ Peristaltic Pumps

The Geotech Series I and II Geopump™ Peristaltic Pumps are designed for single and multi-stage pressure or vacuum pumping of liquids. The Geopump is ideally suited for field sample removal from shallow wells and all surface water sources or laboratory use.

FEATURES

- **Exceptional field durability**
- **Operate from 60 to a maximum of 600 RPM**
- **Delivery rate of 1.67 ml per revolution**
- **Operate to a depth of 27 feet at sea level**
- **Variable speed control**
- **Reversible flow feature for back-flushing**
- **Disposable and dedicated tubing means controlled costs and no decontamination issues**

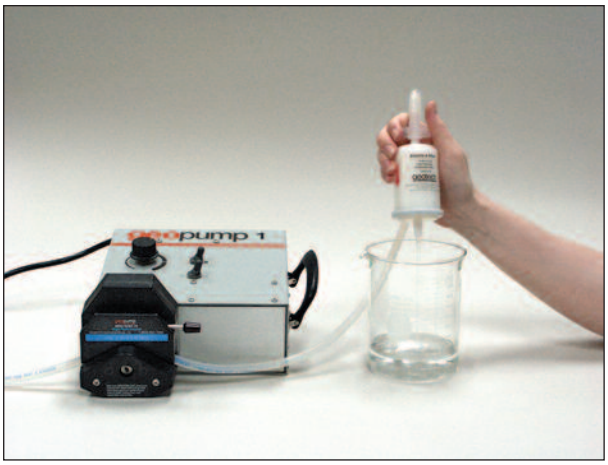
OPERATION

The Geotech Peristaltic Pumps operate by mechanical peristalsis, so the sample only comes in contact with the tubing. This allows for sample integrity as well as easy cleaning and replacement. With the optional stainless steel tubing weight, tubing can be lowered to a specific depth without curling or floating on the surface of the water. Geopumps operate from any external 12 VDC or 120 VAC power source.

SERIES I Geopump™ Peristaltic Pumps are available in AC only, DC only, or an AC/DC combination. These units have one pumping station which can be piggy-backed for multi-station pumping. They have variable speeds ranging from 60 RPM to 350 RPM.

SERIES II Geopump™ Peristaltic Pumps are available in AC only, DC only, or an AC/DC combination. They have two pumping stations which can also be piggy-backed for multi-station pumping. The first pumping station has a variable speed of 30 to 300 RPM and the second station 60 to 600 RPM.

Geopump™ Peristaltic Pump Series II with EZ-load 2 pump head (optional), 5 ft tubing, carrying case and power cord



Geopump™ Peristaltic Pump Series I with EZ-load 2 pump head (optional) and dispos-a-filter capsule

Geotech Environmental Equipment, Inc.
2650 East 40th Avenue • Denver, Colorado 80205
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email: sales@geotechenv.com website: www.geotechenv.com

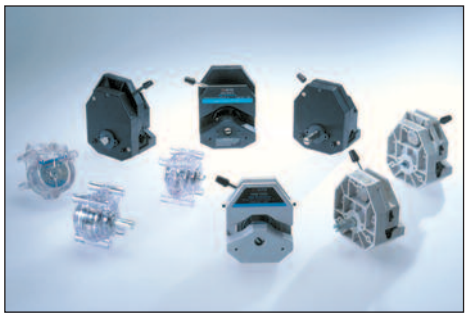
Peristaltic Sampling Pumps

Geopump™ Peristaltic Pump Specifications

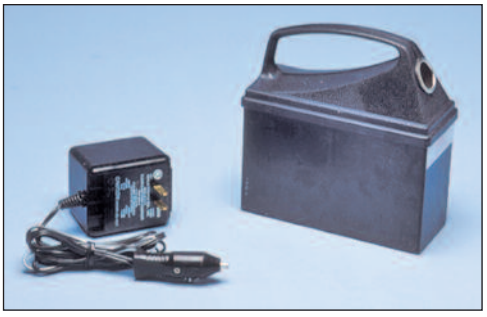
Operating range	Suction from 27 feet at sea level
Principle of operation	Mechanical peristalsis
Dimensions	3.5 x 8 x 8 inches
Power source	Any external 12 V DC or 120 V AC
Power cord	12 V DC adapter cord or standard AC power cord
Power cord length	AC cord: 8 feet; DC cord: 15 feet
Range of speed: Series I	60 to 350 rpm
Range of speed: Series II	First pumping station 30 to 300 rpm second pumping station 60 to 600 rpm
Speed control	Stepless variable speed control
Liquid delivery rate	1.67 ml per revolution
Pumping options	Pressure or vacuum (reversible flow)
Pump head rotor	Cold rolled steel
Warranty	1 year
Basic system kit	Geopump (as specified), 5ft of tubing, power cord (as specified), field case, and manual. Pump head sold separately: standard, easy-load 1, easy-load 2, or quick load.

Accessories

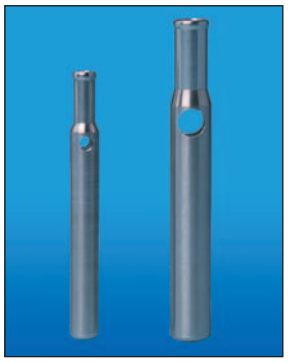
- Quick Load pump head
- Easy Load pump head
- Silicone tubing
- Tygon tubing
- Other tubing
- Stainless steel tubing weight
- Custom length power cord
- Geotech Back Flushing Membrane Filter Holder
- Geotech In-line Dispos-a-filter
- Rechargeable battery
- Battery charger
- Optional stainless steel rotor for pump
- Additional power cords
- Carrying case



Geopump™ pump heads (easy-load, standard, quick load) shown with small and large shaft



Geopump™ Modular Battery and Charger



Geopump™ Tubing Weights

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Xitech's DNAPL Pumps

DNAPL Recovery Pump

This **2" Smart Pump** was designed to recover low viscosity DNAPLs like TCE. The **2" Smart Pump** is completely resistant to all solvents, easily fits into a 2" schedule 40 well or larger, has a pumping rate up to 12 GPH, operating well depth of 200 feet, and requires no above ground controls to operate. Maximum air requirements are .5 CFM @ 125 PSIG, and air quality requirements are 5-10 Microns.

U.S. Patent # 5,326,458

Model ADJ201
Pumping range: .1 GPH - 12 GPH
Size: 1.8" diameter x 9 inches long
Weight: 3 pounds

DNAPL Recovery Pump

This **4" Smart Pump** was designed to recover high viscosity DNAPLs like Coal-Tar. The **4" Smart Pump** is completely resistant to all solvents, easily fits into any 4" well or larger, has a pumping rate up to 60 GPH, operating well depth of 200 feet, and requires no above ground controls to operate. The maximum air requirements are .5 CFM @ 125 PSIG, and air quality requirements are 5-10 Microns.

U.S. Patent # 5,326,458

Model ADJ1100
Pumping range: .1 GPH - 60 GPH
Size: 3.5" diameter x 9 inches long
Weight: 8 pounds

www.xitechinc.com

toll free
888-867-9483

Xitech's Single-Well Controllers

Skimmer Controller Low Cost

The **2500ES Electronic Controller** is suited for controlling up to 2 Skimmers, provides intermittent skimming, has continuous electronic monitoring of the high level tank shutoff sensor, displays total run time of system, and operates on a DC or AC power source. The electronic high level shutoff assembly has a three way product sample valve, double containment fitting for the product line, and includes a high tank shutoff assembly.

Model 2500ES Controller
Pumping times in minutes: 1, 3, 5, 10, 20, 30, 60, continuous
Pumping cycles per day: 1, 3, 6, 12, 24, 48
Pumping cycles beyond a day: 2 days, 3 days, 4 days, 5 days, 6 days, 7 days

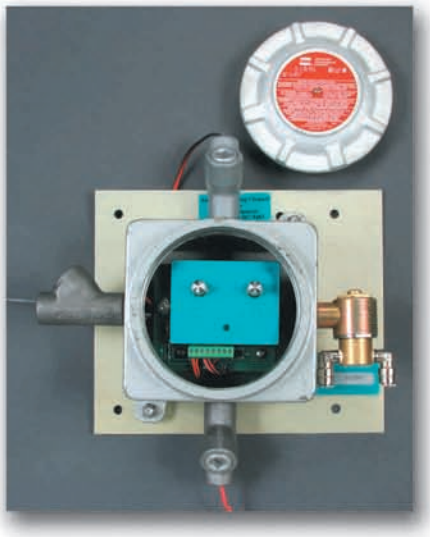
Skimmer Status Light Displays:
RED is tank full
GREEN is waiting to run
BLINKING GREEN is running

Elapsed pumping time in hours and minutes

Power: 12 volt DC & 110 AC or 12 volt DC & 220 AC
Maximum air pressure: 125 PSI
Size: 8 inches x 6 inches x 4 inches outdoor enclosure
Weight: 6 pounds

Skimmer Controller Explosion Proof

The **2550ES Explosion Proof Controller** has similar features to the 2500ES and can be installed in all hazardous areas. The **2550ES** uses only UL approved devices and is rated to be operated in all Class I, Division 1 areas. This controller can operate up to 2 skimmers, has continuous electronic monitoring of the high level tank shutoff switch, and provides intermittent pumping control for the ADJ Skimmers. The 2550ES can be operated with AC or DC power.



Model 2550ES Controller
Rated for Class I, Div 1 areas
Pumping times in minutes: 1, 3, 5, 10, 20, 30, 60, continuous
Pumping cycles per day: 1, 3, 6, 12, 24, 48
Pumping cycles beyond a day: 2 days, 3 days, 4 days, 5 days, 6 days, 7 days

Skimmer Status Light Displays:
RED is tank full
GREEN is waiting to run
BLINKING GREEN is running

Power: 12 volt DC, 110 AC, or 220 AC
Maximum air pressure: 125 PSI
Size: 8 inches x 8 inches x 6 inches
Weight: 38 pounds

toll free
888-867-9483

Skimmer Controller Programmable

The **3000ES Programmable Timer** brings absolute operating control over any Xitech skimmer. This skimmer controller is an excellent choice for remote solar powered operations due to is ability to be programmed for day-time operations. The **3000ES** software is very user friendly and fast to program. The interval programming software enables users to select up to 24 start times in a day, up to 99 minutes of run time for each start time, and up to 30 days delay for one interval. The **3000ES** also keeps tract of total run time of the skimmer, includes a manual operation choice for easy direct control of the skimmer, and includes a high tank shutoff assembly.

Model 3000ES Controller
Programmable intermittent control: 24 start times with up to 99 minutes of run time

30 Days delay for one interval

Visual indicator displays tank full condition

Battery backed program memory

Power: 12 volt DC & 110 AC or 12 volt DC & 220 AC
Maximum air pressure: 125 PSI
Outdoor enclosure
Size: 8 inches x 6 inches x 4 inches
Weight: 6 pounds

www.xitechinc.com

Clean Earth Technology
North Ferrisburgh
VT 05473-7089

Manufacturer and worldwide distributor of groundwater remediation equipment and accessories

Call 802.425.3710
Fax:.802.425.2896

(info@cleanearth.biz)

Call 802.425.3710

Fax:.802.425.2896

(info@cleanearth.biz)

Magnum Spill Buster

1. Summary of Product -

The Magnum Spill Buster™ is an automated free phase petroleum contamination pumping system. It is specifically designed to remove NAPL petroleum product from the water table via a 2" or larger diameter well. Its unique auto-seeking device allows the pump intake to automatically follow the elevation of the oil/water interface as it fluctuates throughout the entire length of the well. The Magnum Spill Buster will not pump any amount of water.

The system can be wired to 115 VAC or 230 VAC power or is capable of true 24 VDC deep cycle battery/solar panel operation for remote site locations.

Optional water depression can be added to the system through a Clean Earth Technology Water Depression Module and a Grundfos Redi-Flo 3 water pump. The Magnum is also very compatible with vacuum extraction systems when a dual phase recovery system is desired.

The Magnum Spill Buster™ system is composed of three interactive modules:

The Magnum Spill Buster™ **Control Box** coordinates and displays the condition of the system operation. The control box also allows certain system parameters to be varied and provides an RS-485 communications port for connection to up to 256 other units and a Personal Computer (PC) up to 3,000 ft. away.

The NEMA 4 weatherproof enclosure with its connector "pouch" (shown at right with its protective cover) provides easy access to the cables, adjustable controls, and AC. wiring.

Cable terminations within the connector pouch utilize our unique, size-coded SLIMLINE connectors that pull through underground conduits easily and are color-coded for intuitive placement. They are extremely rugged and very easy to clean.

The **Auto Seeker** is a small, motorized, reel assembly installed on the wellhead. It automatically raises and lowers the probe to follow the NAPL interface through the entire depth of the well. This makes the system operation highly efficient even with large changes in the level of the ground water. The cable fully winds onto the Auto Seeker, allowing the system to freely operate in a vault as small as 24" x 24" x 22" deep.

This self-winding feature also means that routine maintenance of the product pump is a matter of pushing a button to reel the probe to the top of the wellhead- eliminating the need to haul an oil-covered cable up by hand to spread out all over the ground.

The 1.93" diameter probe contains a small but powerful 12vdc electric product pump, as well as the patented ALPHA-ARRAY™ interface sensors. These are multiple field array, all solid state, monolithic, non-contact, fluid-interface sensors that are a spin-off of spacecraft fuel gauging developed for NASA. The use of this interface sensor in the environmental industry is unique. Since it is a non-contact sensor, it is highly immune to fouling, which is a problem with virtually all other types of sensing methods (including conductive, float, optical and even radio frequency methods).

Also included with every standard system:

- **A Recovery Tank Overflow Sensor with 30' of cable**
- **30' Set of Auto Seeker and Probe cable extensions**
- **50' of nylon discharge tubing with bung**

2. Features and Benefits-

- **All-modular system installs in 20 minutes**

- **Pumps only product; the water stays behind- no costly, messy, surface separation**
- **Keeps on pumping through temperatures -40 to +600C**
- **24/7 automatic operation yields steady, impressive, results**
- **Quiet & low profile- doesn't draw attention in public places**
- **Speedy, no-fuss maintenance**
- **Uses less power to operate than a 60 watt bulb**
- **Technical support from the designer and manufacturer is only a phone call away**

3. Accessories -

- **Immediate Response Box -**

The Immediate Response Box (I.R. Box) is a rugged plastic box that contains a Magnum Spill Buster system. The I.R. Box provides an extremely portable system to start removal of product in a 2" or larger well with minimal equipment set-up. A large forged shackle is attached on one end of the box for security.

The I.R. Box can easily be carried in a small pick-up or van. The basic setup involves mounting the Auto Seeker onto the well head, connecting the product tank discharge tube and overflow sensor to the product tank, and connecting the Auto Seeker and Probe signal cables to the Control Panel mounted in the I.R. Box.

The system is powered by 115VAC from an extension cord or is hard-wired, or cables can be provided to operate the system from a 24 volt deep cycle battery setup (2 12 volt batteries connected in series).

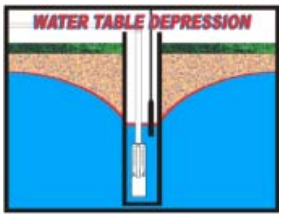
- **Solar Panel Charging Option -**

For sites with no utility connection available, batteries with a photovoltaic recharging system (solar panels) can fully power the Magnum Spill Buster. The Solar Panel Charging system includes the panels, a heavy-duty frame and mounting hardware, deep-cycle batteries, waterproof control box with regulator, and custom cabling. Configuration of the charging system (size and number of panels) primarily depends on the location of the site and the amount of sunlight available. The duty cycle, or percentage of time the system will run, is also determined by the amount of product present at the site.

- **Water Depression Option -**

A secondary water pump can be used to create a huge hydraulic funnel that pulls product towards the well from greater distances than are attainable with product skimming alone.

The result looks something like this:



Dual pump product recovery operation can be accomplished with the Magnum Spill Buster System plus a Water Depression Control Module and a Grundfos Redi-Flo 3 SQE-NE pump sized to your well (minimum well diameter required is 4 inches). The Magnum Water Depression system is designed specifically to take advantage of all the features of the Grundfos Redi-Flo 3 SQE-NE pump.

Grundfos Redi-Flo 3 pump
With NEC fittings

Water Depression Control Module

This Module obtains its water level signals and control logic from the Magnum system control box and in turn controls water flow by using the soft start feature of the Grundfos pump to turn it on and off. Clean Earth Technology offers this line of Grundfos submersible pumps with NEC fittings to safely bring the high level AC voltage through the recovery

zone to the pump.

A set of normally open contacts is provided for use with a safety override probe, which will shut down the water pump when closed.

- **Site Master Monitoring and Control Software -**

The Magnum Spill Buster may be operated individually or under an optional network control. The network capabilities are provided such that the user may monitor and, if desired, control many Magnums from a single, central location (up to 3,000 feet from the site). The physical layer configuration used by Clean Earth Technology is the industry standard RS-485 differential, multi-drop protocol. This standard provides an inexpensive and robust physical connection to up to 256 units. To this Clean Earth technology has added the simple-to-use Site Master Network software program.

The Site Master, or host, is a Windows application. It can be operated on any system running Microsoft Windows, and configures with a standard RS-485 communications engine. It can also operate as a stand-alone software package. The Site Master polls the Magnum system (slave) continuously to update the current operating status. The status of every unit on the network is displayed on the computer screen for easy monitoring. The operator can change the parameters of a unit or control the unit directly through the graphical user interface of the Site Master.

4. System Specifications -

The Complete Magnum Spill Buster™ System includes:
Magnum Spill Buster™ Control Box, Magnum Spill Buster™ Probe with 50' cable, Auto Seeker with 30' cable set, Recovery Tank Overflow Sensor with 30' cable and Recovery Tank bung, 50' nylon NAPL discharge tubing.

Input Power
115 VAC or 230 VAC, 100 Watts max. or 24 VDC, 75 watts max.
with optional battery cable and deep discharge batteries.

Operating Temperature Range
-40 to +140 degrees F or
-40 to +60 degrees C

Fluids:
Most hydrocarbons, floaters (LNAPLS) or sinkers (DNAPLS) **Exception:** The Magnum Spill Buster is not compatible for use with Halogenated Hydrocarbons.

Viscosity Ranges
Standard Pump- 0 to 10cp at 700 F
Optional Medium Viscosity Pump- Up to 25cp

Pumping Rate
Up to 45 GPH (171 LPH) @ 0 PSI (Zero depth and no discharge back pressure.)
Or Up to 15 GPH (57 LPH) @ 50 PSI (50' deep and 25 PSI discharge back pressure.)

Standard Well Depth
50'. max.

Maximum Well Depth
150' on special order with 150' down-well cable.

Minimum Well Head Clearance for AUTO SEEKER
24" X 24" X 22" deep

Probe Dimensions
1.9" dia. x 16" long (cable dia. including the discharge tube is 0.5")
Standard Probe cable length is 50'.

Control Box Dimensions
14" wide x 19" high x 6" deep. An additional 10" is required below for cable exit and an additional 14" is required in front and to the left for door swing.

Standard Cable Length
30' from Control Box to well head

NAPL Recovery Tank Overflow Sensor
Threads into a standard 2" barrel bung. Standard cable length is 30'.

Total system Weight
67 lbs.

Clean Earth Services, Hazardous Waste Site, Magnum Spill Buster, Spill Buddy, Spill Buddy Pro,
Maine, ME, New Hampshire, NH, Vermont, VT, Massachusetts, MA, Rhode Island, RI, Connecticut, CT, New England, USA, Worldwide

Clean Earth Technology
North Ferrisburgh
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Manufacturer and worldwide distributor of groundwater remediation equipment and accessories

Call 802.425.3710
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(info@cleanearth.biz)

Clean Earth Technology Products

Magnum Spill Buster

What sets it apart?

Spill Buddy

Spill Buddy Pro

Hazardous Env. Safety Review

Site Evaluation Guide

Clean Earth Technology Services

Services Summary

RMA Form Download

FAQ's

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Spill Buddy

1. Summary of Products:

The **Spill Buddy** is a compact, manual, free product skimming system, designed to operate on site to skim quantities of product (LNAPL or DNAPL). The Spill Buddy's operation is based on the state-of-the-art ALPHA-ARRAY™ sensors in the probe that detect the interface between the product and the water. An audible feedback signals the user to keep the pump positioned in the product layer, and allows product skimming with virtually no water pumped (dependent on operator's reaction time in turning off the pump after hearing the audible signal for water).

The compact probe with enclosed pump easily fits into wells as small as 2" in diameter. The rugged, lightweight, and convenient Spill Buddy can skim up to 0.7 gallons of product per minute. Spill Buddy also has a self contained, rechargeable battery for the sensor electronics and pump. The battery is rechargeable from a 12 VDC source (car battery or cigarette lighter socket-optional) or the wall transformer provided with the unit. Spill Buddy will operate for up to one hour of continuous pumping (approx. 40 gallons) per charge.

The standard length down-well probe is 50 feet (15 meters), but a 100 foot (30 meters) probe is also an option for deeper wells.

Spill Buddy Pro

The **Spill Buddy Pro** combines an interface meter with the Spill Buddy's free product skimming capability. The integrated measuring tape and audible feedback allow the user to determine the distance to the product surface, the depth of the product, and then to pump the accumulated product. It averages about 0.5 gallons of product per minute (approximately 35 gallons in an hour of continuous pumping).

The Spill Buddy Pro's interface tape is marked in tenths and hundredths of feet; metric tapes are also available. The standard English unit includes a 50 foot down-well probe; the standard metric unit has a 15 meter probe. A 75 foot (23 meters) probe is also an option.

2. Features and Benefits -

- **Compact and lightweight - won't weigh you down.**
- **Self-contained battery operation, with convenient option to re-charge in vehicle between sites.**
- **Keeps pumping water to a bare minimum (unless desired!).**
- **Guides operator to interface with audible signals- eliminates guesswork.**
- **Spill Buddy Pro can take your interface readings and then pump available product, all in one step!**

3. Accessories -

- **Optional 100 foot down-well probe for the Spill Buddy**
- **Optional 75 foot down-well probe for the Spill Buddy Pro**
- **Optional replacement battery**
- **Optional Power Socket Charger ("cigarette lighter" jack)**

4. System Specifications -

The Complete Spill Buddy or Spill Buddy Pro includes:
Portable reel with 50 feet (15 meters) of down-well tubing and pump with water interface detector (Spill Buddy Pro also has a product surface sensor, and built-in interface measurement tape); 120 VAC wall transformer charger, and 10 feet of nylon NAPL discharge tubing.

Minimum skimming thickness:
0.1 inch with no water pumped
0 inches with a small amount of water pumped

Pumping rate:
Approx. 0.7 gpm for Spill Buddy
Approx. 0.5 gpm for Spill Buddy Pro

Pumping head:
100 ft

Pumping time:
1 hour continuous pumping per battery charge (approx. 40 gallons of Product)

Battery:
12VDC, 5 Amp hours sealed lead acid (included) (We recommend a second battery for a backup on site)

Battery charger:
Wall transformer. A cigarette-lighter jack is available as an option for charging between sites.

Fluids:
Most hydrocarbons, floaters (LNAPLS) or sinkers (DNAPLS) Exception: The Spill Buddy and Spill Buddy Pro are not compatible for use with Halogenated Hydrocarbons.

Viscosity Ranges
Standard Pump- 0 to 10cp at 700°F
Optional Medium Viscosity Pump- Up to 25cp

Operating temperature: 0° to 130°F ambient temperature

Size: 18 1/2"H x 15"W x 8 1/2"D

Weight: 19 lbs (with battery)

Hazardous Env. Safety Review | Site Evaluation Guide | Magnum Spill Buster | Spill Buddy | Spill Buddy Pro | What sets it apart? | Groundwater Remediation Site Map

Clean Earth Services, Hazardous Waste Site, Magnum Spill Buster, Spill Buddy, Spill Buddy Pro,
Maine, ME, New Hampshire, NH, Vermont, VT, Massachusetts, MA, Rhode Island, RI, Connecticut, CT, New England, USA, Worldwide

APPENDIX B

2007 ATLANTIC HURRICANE SEASON

NATIONAL HURRICANE CENTER

ATLANTIC • CARIBBEAN • GULF OF MEXICO • HURRICANE TRACK CHART

2007

NUMBER	TYPE	NAME	DATE
1	ST	ANDREA	MAY 9-11
2	T	BARRY	JUN 1-2
3	T	CHANTAL	JUL 31-AUG 1
4	H	DEAN	AUG 13-23
5	T	ERIN	AUG 15-17
6	H	FELIX	AUG 31-SEP 5
7	T	GABRIELLE	SEP 8-11
8	T	INGRID	SEP 12-17
9	H	HUMBERTO	SEP 12-14
10	T	JERRY	SEP 23-24
11	H	KAREN	SEP 25-29
12	H	LORENZO	SEP 25-28
13	T	MELISSA	SEP 28-30
14	H	NOEL	OCT 28-NOV 2
15	T	OLGA	DEC 11-12

Hurricane (H)
Tropical Storm (T)
Tropical Depression
+-+-+ Extratropical
Wave/Low
Subtropical Depression
Subtropical Storm (ST)
● Position at 0000 UTC
○21 Position/date at 1200 UTC
5 Tropical Cyclone Number

Lambert Conformal Conic
true at 20° and 40° North