

Headquarters U.S. Air Force

LNAPL Characterization and Recovery at Diego Garcia



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Excellence**

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Integrity - Service - Excellence



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Overview

- Background
 - Bioslurper -- Bioremediation/Bioventing
 - Pit 49 & Pump House
 - Pit 32 & AO-15 Area
 - Portable System
 - Costs and Status
 - Lesson Learned on Fuel Recovery
 - Additional Information
 - Questions?
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PUMP HOUSE

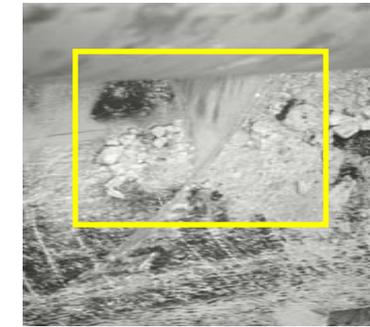
Pit 49

Pit 32



Spills

Pit 49: 1991 →



← **Pit 32: 1997**

Pump House: 1998

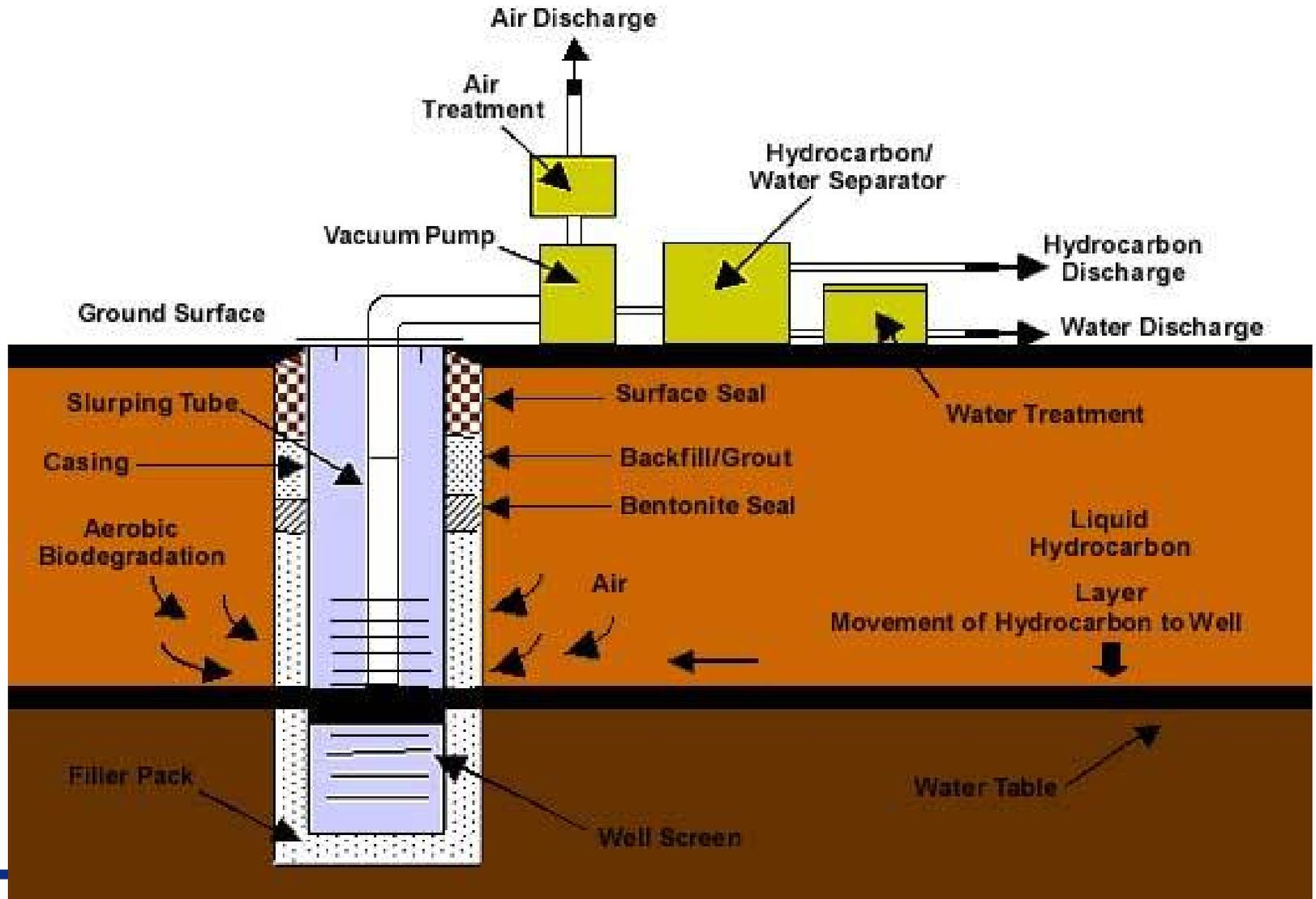
Tank 906 →





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BIOSLURPING SYSTEM





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Bioslurping Bioremediation / Bioventing

Phase 1: 2 – 3 years

- Removes free JP-5
- Follow with air injection (Bioventing)
 - Enhances biodegradation of residual JP-5 in soil
- Natural attenuation
 - Removes trace amounts of any dissolved JP-5

Phase II: 5 – 6 years

- Continued monitoring
 - Ensures complete degradation of dissolved JP-5
 - Ensures no contamination of drinking water
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Dissolved BTEX

Sample	Date	Benzene	Toluene	Ethylbenzene	Total Xylenes
MCL		5	1,000	700	10,000
Oli Water Separator Discharge					
906 (OWS)	28-Aug-2000	1.9	19.2	12.5	132.6
Chute Tower	28-Aug-2000	6.59	3.81	64.2	61.52
Chute Tower	4-Jan-2001	3.32	5.66	78.7	74.03
Sampling Wells Within Free-Product Areas					
DG-S2-30	9-Oct-1995	8.3	0	50.6	0
DG-S2-30	3-Feb-1997	5.5	0	55.1	0
DG-S2-30	5-Sep-1997	7	0	0	53.6
DG-S2-30	11-May-2000	7.9	BLQ	49.5	1.6
DG-S2-30	28-Aug-2000	21.9	3.85	55.1	1.42
DG-S2-30	4-Jan-2001	14.5	4.06	67.7	4.25
DGWP-14	7-Oct-1998	6.6	0	50.7	19.7
DGWP-16	7-Oct-1998	9.9	0	47.4	51.6
L-14 (Pit 32)	7-Oct-1998	8.5	0	76.8	1.5
RW-16 (Leak)	4-Jan-2001	21.2	5.22	49.3	14.95
RW-5	7-Oct-1998	2.9	0	24.4	1.3
RW-5	11-May-2000	2	ND	36.7	1.8
RW-5	4-Jan-2001	ND	0.79	3.13	1.19
JP-4 at Hill AFB, Utah		5,600	5,870	955	9,050

BLQ = Below Quantification Level (1 part per billion)

ND = Non-detect

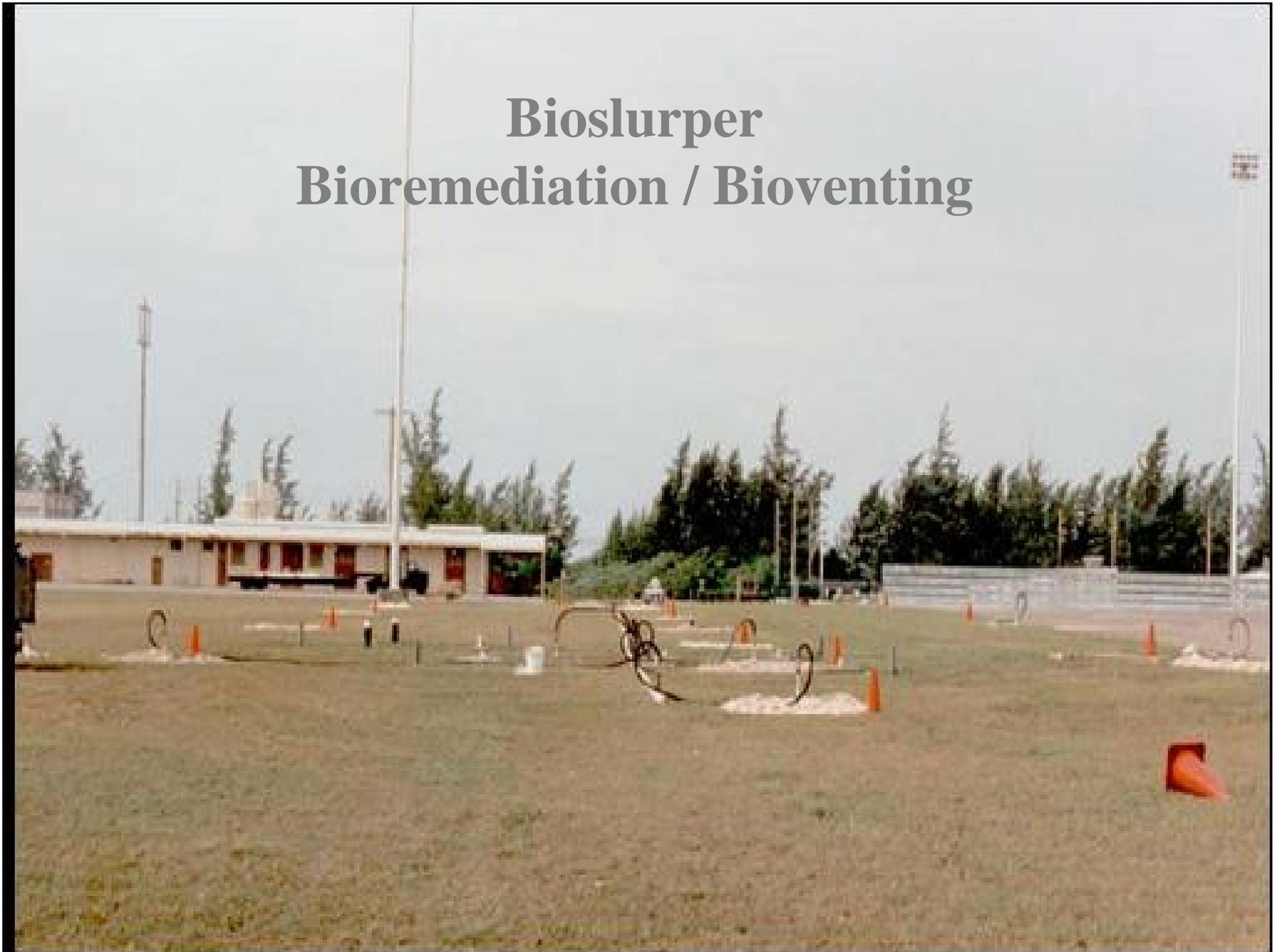


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Pit 49 & Pump House

- **Liquid Ring Pumps**
 - Two at 10 HP
 - One at 15 HP
 - **28,947 gallons recovered in CY 2000-2001**
 - **73,438 gallons recovered 1996-1999**
 - **100K+ gallons total recovered**
 - **Ramp Area**
 - Six recovery wells in grass area installed in March 1996
 - Converted to bioventing in August 2000, using 12 wells
 - Ten wells in ramp installed in January 1997
 - 55 more wells connected during CY 2000
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Bioslurper Bioremediation / Bioventing



Pit 49 & Pump House





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Pit 49 Ramp Piping

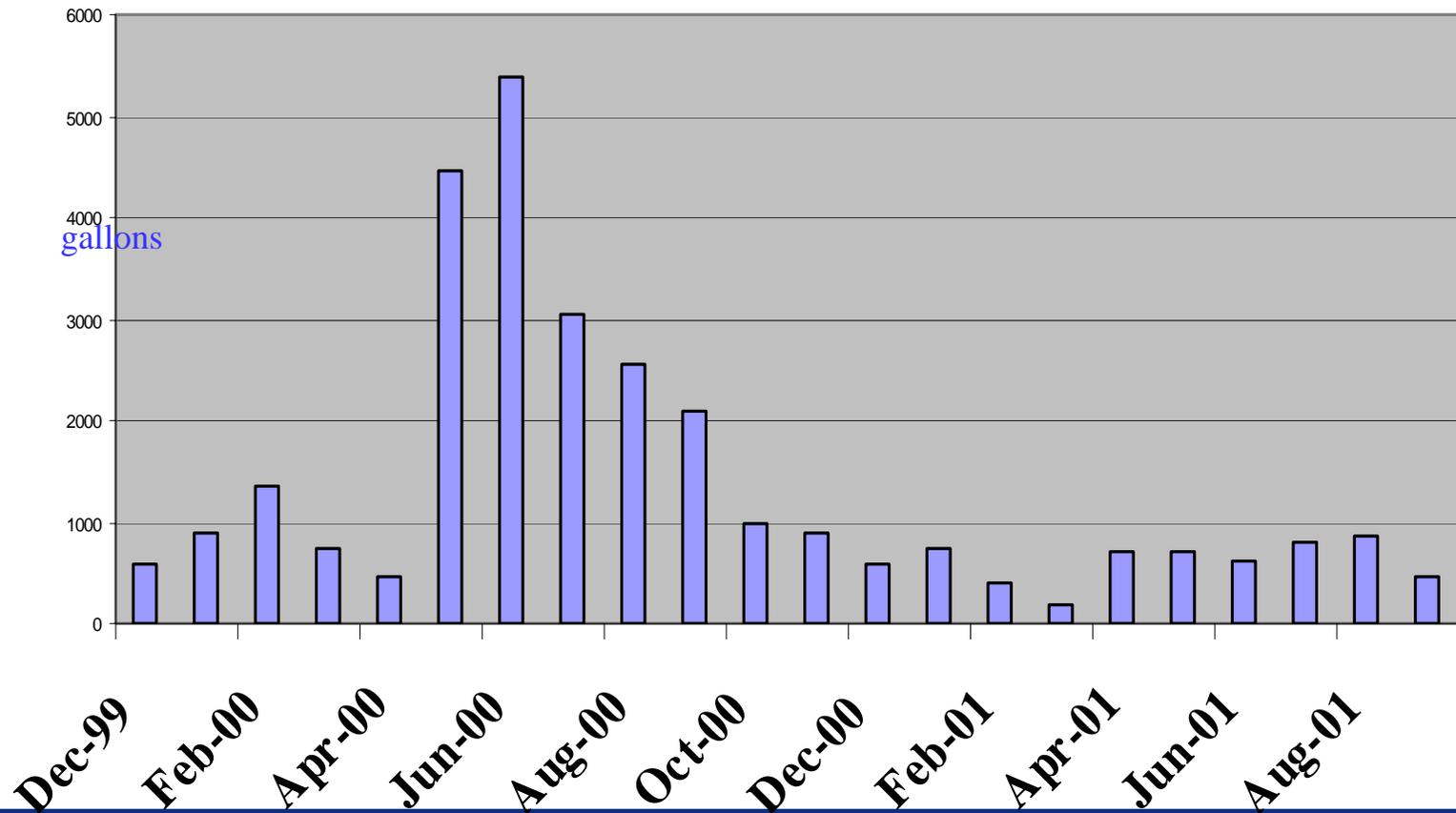




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Pit 49: Amount Recovered

December 1999 – September 2001



1 gallon = 3.79 liters



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Pit 32, AO-15 Area

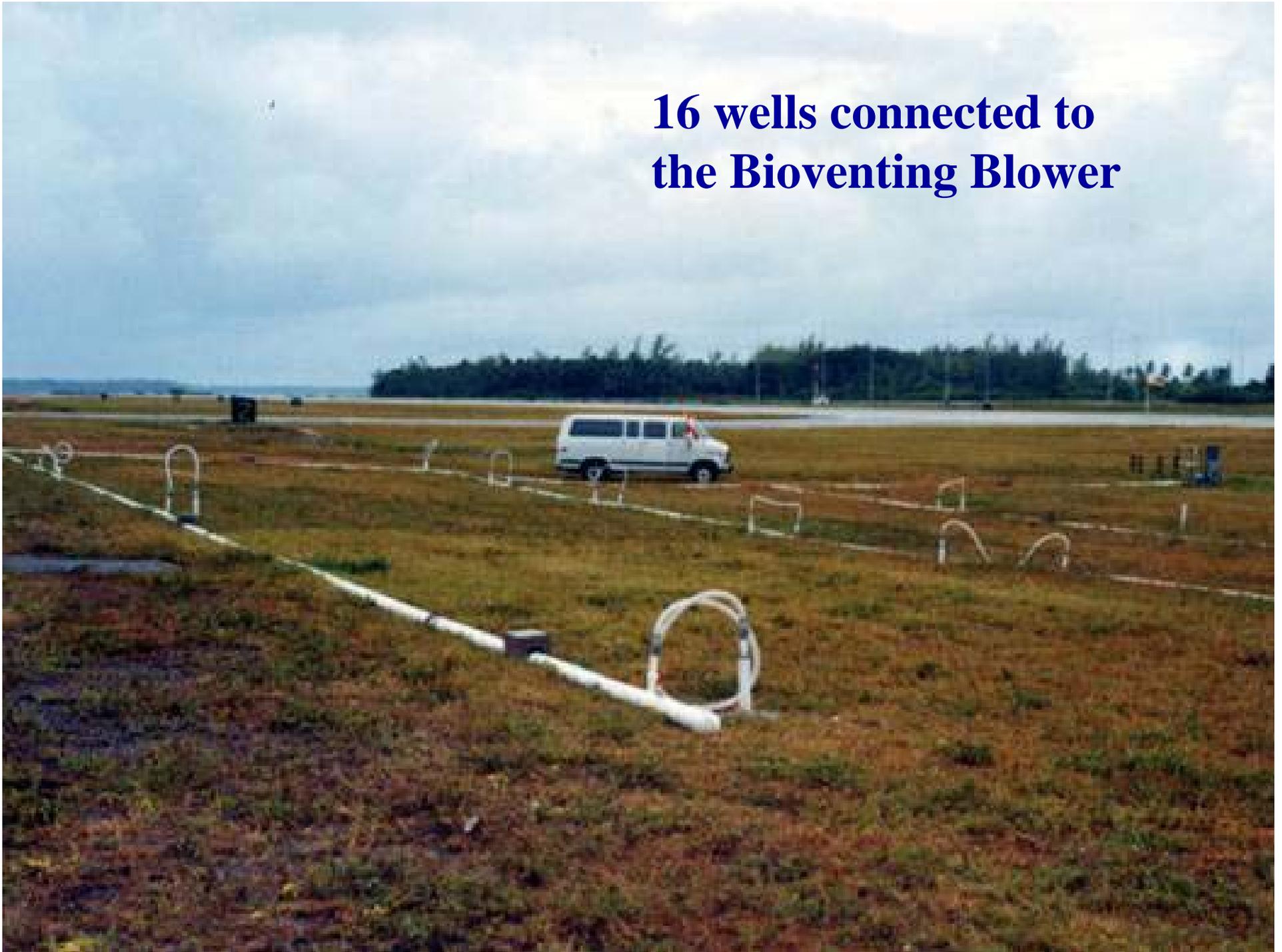
- **Pit 32**
 - **16 wells connected to bioventing blower;
June – December 2000**
 - **Ramp Area**
 - **7 ½ HP bioslurper pump installed in July 2000**
 - **14 Recovery Wells**
 - **3,177 gallons recovered by the end of
September 2001**
-

Bioventing Blower



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**16 wells connected to
the Bioventing Blower**





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Pit 32 Ramp Area Bioslurper pump



- **Simple installation using gravity flow:**
 - from pump to oil-water separator tanks
 - to reclaimed fuel storage (red) tank
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Portable System

- **Operation ENDURING FREEDOM** required removal of the ramp recovery systems 7K feet of piping
 - Easily accomplished within two days
 - **February 2003: trailer-mounted bioslurper on site and operational**
 - **Between February and October 2003, approximately 300 gallons of fuel recovered**
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**Portable System operating behind
KC 135**



10/03/2003



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Costs and Status

- **Total cost approximately \$380K.**
 - **System maintenance and operating costs have approximated \$40K per year.**
 - **Active fuel recovery is ending.**
 - **A monitoring program is being established to allow water production to restart in the vicinity of the spill sites.**
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Fuel Recovery Lessons Learned

- Thickness of product in well correlates poorly with actual thickness in formation or recovery potential
 - Recovery potential is typically highest during sustained low water levels
 - Multi-site Air Force study, 1994-1999 – 32 sites
 - Little fuel is recoverable from most sites. Of 32 sites studied, only 7 were found worthy of recovery operations and only 3 of the 7 recovery systems operated more than 2 months before recovery dropped off.
 - Bioslurping was found to be more effective than most other technologies.
 - Simple baildown testing over a 24 hour period was effective at evaluating fuel recovery potential of a site.
 - Pilot testing recommended if baildown tests indicate potential for fuel recovery. Use trailer mounted equipment.
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Fuel Recovery Lessons Learned

- Avoid complex systems or permanent construction for systems. Most will need to operate for a year or so at the most. Place piping on the surface, use PVC piping etc. Avoid vapor or water treatment. Use sanitary sewer for waste water or reinject water at site
 - Liquid phase recovery potential between 5 – 25 % of original volume released
 - Most sites start or end up with bioventing systems
 - Volatile fuel sites often start with bioslurping or soil vapor extraction, but end with bioventing
 - All sites end with risk-based decision making and natural attenuation
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Additional Information

- **AFCEE website**

 - www.afcee.brooks.af.mil

- **Bioslurping information**

 - **Follow the links from the AFCEE home page to:**

 - **Products and Services**

 - Technology Transfer

 - Programs and Initiatives

 - **Or access a roadmap directly at:**

 - www.afcee.brooks.af.mil/products/techtrans/roadmaps.asp

- **Contact:**

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