

AP - 59

**AMENDED VADOSE ZONE
WORK PLAN**

DATE:

6-12-07

AP-59

Amended Vadose Zone
Work Plan

6-12-07

R. T. HICKS CONSULTANTS, LTD.

901 Rio Grande Blvd NW ▲ Suite F-142 ▲ Albuquerque, NM 87104 ▲ 505.266.5004 ▲ Fax: 505.266-0745

June 12, 2007

RECEIVED

Edward Hansen
NMOCD
1220 South St. Francis Drive
Santa Fe, New Mexico 87505
Via E-mail

JUN 18 2007

Oil Conservation Division
1220 S. St. Francis Drive
Santa Fe, NM 87505

RE: F-35 SWD & G-35 SWD, T17S, R35E; NMOCD Case #: AP-59, Minor Modification to Vadose Zone Remedy

Dear Mr. Hansen,

Your May 24th e-mail response to our April 23rd summary of additional work at the above-referenced sites states:

Rice Operating Company must submit a revised Vadose Zone Remedy within 30 days to the NMOCD that includes a design that will prevent further infiltration through the contaminated vadose zone at these sites.

We propose the following minor modifications to our remedy plan:

- To prevent vapor-phase migration of volatile hydrocarbons from the vadose zone to ground water, ROC will install two passive soil vapor extraction wells installed from the surface to the capillary fringe at each site with wind driven turbines. Specifications for these wells are included in Appendix A.
- Installation of a geosynthetic clay liner (GCL) above the high chloride mass and below the proposed ET barrier. Specifications for this design modification are included in Appendix B.

The passive vapor venting system will also provide additional remediation of the vadose zone through accelerated volatilization and removal of hydrocarbons. The GCL will immediately prevent further infiltration through the zone of impact while the ET Barrier provides a robust long-term remedy. With these improvements we are confident that the proposed vadose zone remedy meets the criteria set forth in Rule 19, specifically:

19.15.1.19.B.(1) The vadose zone shall be abated so that water contaminants in the vadose zone will not *with reasonable probability* contaminate ground water or surface water, in excess of the standards in Paragraphs (2) and (3) below, through leaching,

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percolation, or other transport mechanisms, or as the water table elevation fluctuates.

And

19.15.1.7.A (1) Abate or abatement shall mean the investigation, *containment*, removal or other mitigation of water pollution [emphasis added]

Thank you for your time and consideration. We look forward to your response.

Sincerely,
R.T. Hicks Consultants, Ltd.

A handwritten signature in cursive script that reads "Katie Lee".

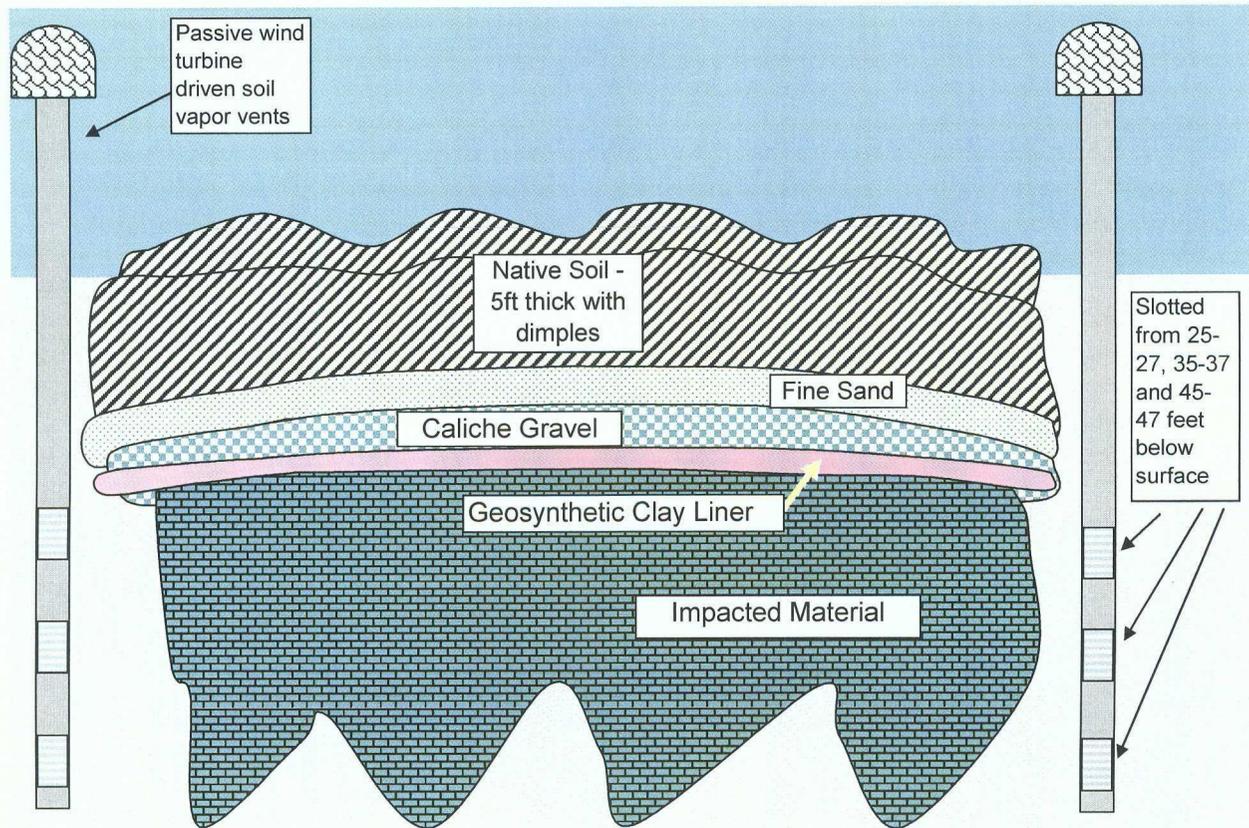
Katie Lee
Staff Scientist

Copy: Rice Operating Company

June 12, 2007

Appendix A – Passive Vapor Extraction Well Design

The attached logs show the proposed locations of well slots and the red dots on the site sketches indicate the proposed locations of these wells. Information on the proposed roof vents also follows. A simple diagram of the proposed vents is given below.



**R T Hicks
Consultants Ltd**

P O Box 7624
Midland, TX 79708
(432) 528-3878

LITHOLOGIC LOG (SOIL BORING)

MONITOR WELL NO.: SB-F1 & 1A
SITE ID: Vacuum F-35 / G-35
SURFACE ELEVATION: 0.00
CONTRACTOR: Harrison & Cooper, Inc.
DRILLING METHOD: Air-Rotary
INSTALLATION DATE: 4/16/07
WELL PLACEMENT: Within Pit (8 ft bgs)
COMMENTS: Lat. 32° 47' 34.4" North, Long. 103° 25' 49.1" West

TOTAL DEPTH: 52.0 Ft (below original surface)
CLIENT: Rice Operating Company
COUNTY: Lea County
STATE: New Mexico
LOCATION: T-17-S, R-35-E, Sec. 35 (F)
FIELD REP.: Dale Littlejohn
FILE NAME: \Vac F & G-35\Lithlogs

4" SV well	Lithology	SAMPLE DATA					DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE SORTING, ROUNDING, CONSOL., DIST. DEATURES
		PHOTO	DEPTH	TYPE	PID	Cl (Lab)		
Proposed Soil Vapor Well with slots 25-27, 35-37 and 45-47 feet below surface								CALICHE AND SAND Grayish brown caliche covered by 1/2 foot of brown silty top soil. Sand brown, very fine grain, with very large caliche gravel (70 to 80% sand). Description and photo from walls of excavation (surface to 16 ft bgs).
							5	
							10	
			10-12	Cuttings	620 ppm	90 mg/kg		
							15	
			15-17	Split Spoon	1,398 ppm	89 mg/kg		
							20	
							25	
			20-22	Cuttings	445 ppm	84 mg/kg		
							30	
			25-27	Split Spoon	1,556 ppm	361 mg/kg		
							35	
			30-32	Cuttings	552 ppm	404 mg/kg		
							40	
			35-37	Split Spoon	1,365 ppm	701 mg/kg		
					45			
	40-42	Split Spoon	1,672 ppm	994 mg/kg				
					50			
	45-47	Split Spoon	1,684 ppm	1,105 mg/kg				
					55			
	50-52	Split Spoon	1,796 ppm	1,560 mg/kg				

Soil moist, with mud on drill pipe.

TD = 52 Feet

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LITHOLOGIC LOG (SOIL BORING)

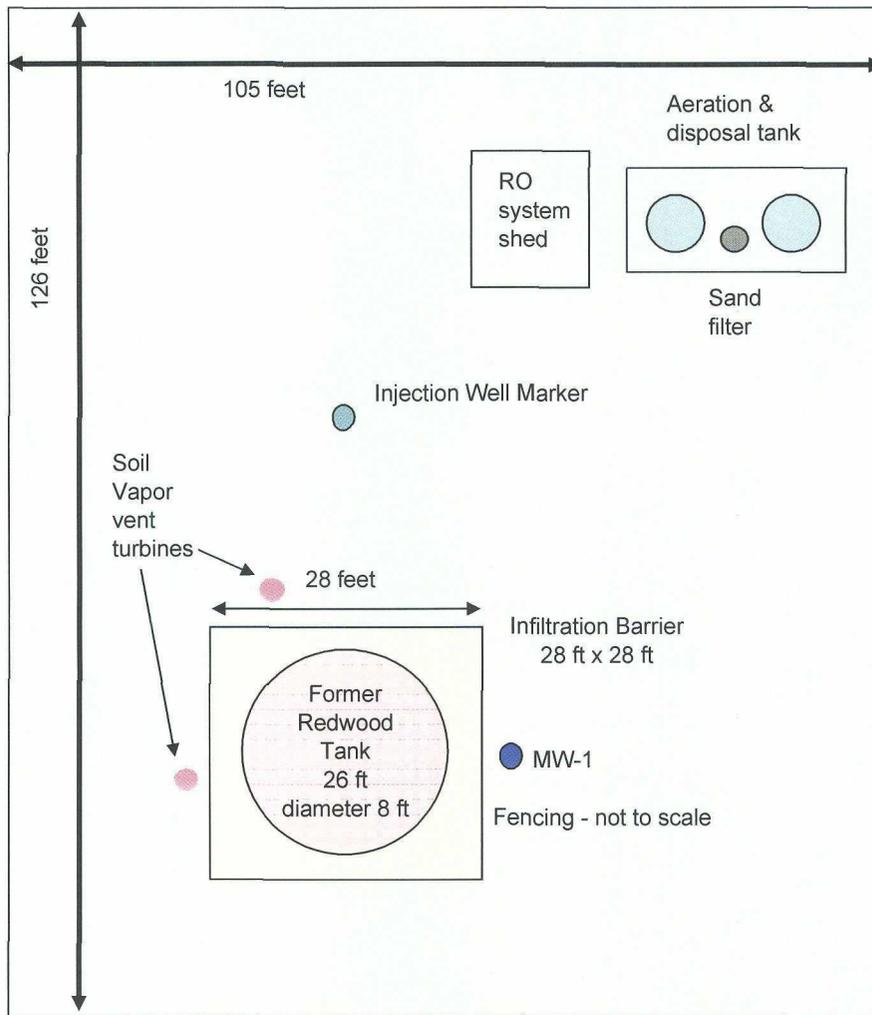
MONITOR WELL NO.: SB-G1
SITE ID: Vacuum F-35 / G-35
SURFACE ELEVATION: 0.00
CONTRACTOR: Harrison & Cooper, Inc.
DRILLING METHOD: Air-Rotary
INSTALLATION DATE: 4/16/07
WELL PLACEMENT: Within Pit (5 ft bgs)
COMMENTS: Lat. 32° 47' 34.9" North, Long. 103° 25' 34.4" West

TOTAL DEPTH: 47.0 Ft (below original surface)
CLIENT: Rice Operating Company
COUNTY: Lea County
STATE: New Mexico
LOCATION: T-17-S, R-35-E, Sec. 35 (G)
FIELD REP.: Dale Littlejohn
FILE NAME: \Vac F & G-35\Lithlogs

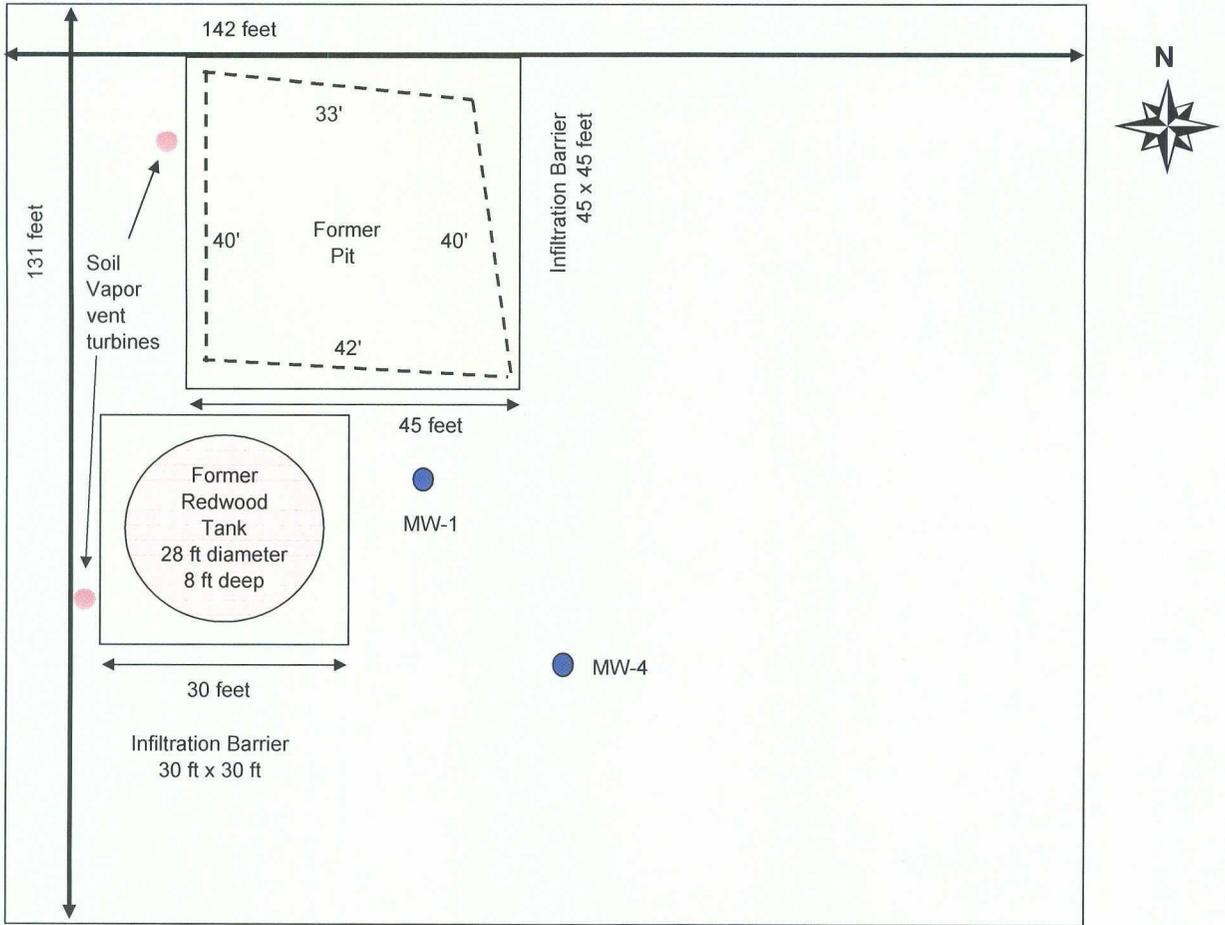
4" SV well	Lithology	SAMPLE DATA					DEPTH	LITHOLOGIC DESCRIPTION: LITHOLOGY, COLOR, GRAIN SIZE SORTING, ROUNDING, CONSOL., DIST. DEATURES	
		PHOTO	DEPTH	TYPE	PID	CI (Lab)			
Proposed Soil Vapor Well with slots 25-27, 35-37 and 45-47 feet below surface								SILTY CLAY Grayish brown with some caliche covered by small gravel (SWD well pad). Description and photo from walls of	
								SILTY SAND Brown with some caliche. Description and photo from walls of excavation (surface to 5 ft bgs).	
		5							
			10-12	Split Spoon	1,048 ppm	303 mg/kg	10	SILTY CLAY Grayish black (discolored), with some caliche.	
			15-17	Split Spoon	1,296 ppm	366 mg/kg	15	SILTY SAND Light greenish gray, very fine grain, with some very small gravel.	
			20-22	Split Spoon	1,188 ppm	668 mg/kg	20		
			25-27	Cuttings	58.7 ppm	456 mg/kg	25	SANDSTONE (quartzite) gray, fine crystalline, well cemented, very hard drilling.	
			30-32	Split Spoon	46.4 ppm	3,804 mg/kg	30	SAND Light brown, very fine-grain, well-sorted, angular.	
			35-37	Split Spoon	184 ppm	2,570 mg/kg	35	SAND Brown to reddish brown, fine-grain, well-sorted, sub-rounded.	
40-42			Split Spoon	1,243 ppm	2,499 mg/kg	40			
		45-47	Split Spoon	1,645 ppm	2,849 mg/kg	45			

Soil moist, with mud on drill pipe.

TD = 47 Feet

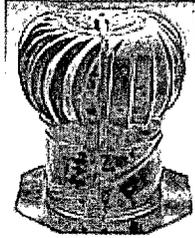


F-35 Footprint map



Footprint map at G-35 site

Attic Aire™ Wind Turbines



Externally Braced Wind Turbine and Base

A non-electric alternative to ventilation, these vents use the natural force of wind and air pressure to spin and vent out stale attic air. They do it with a series of specially shaped vanes that catch the wind and provide rotary motion. This pulls hot, humid air from the attic. Turbine vents provide a low-cost ventilation alternative in areas where wind speeds of at least 5 mph are typical.

- Air Vent's Attic Aire™ wind turbines are available in both internally and externally braced styles
- Patented Delrin® bearings assure long-lasting, quiet operation with no metal parts to squeak
- Two-piece base fits roof pitches from 3/12 up to 12/12
- Large flashing allows for easy installation
- Galvanized steel or aluminum construction in 12- and 14-inch sizes
- Colors: Mill, Black, Brown and Weatherwood

Benefits:

- Provide year-round ventilation
- Low cost and high efficiency make them an extremely popular ventilation component

Design Considerations:

- Like roof vents, turbines must always be used with adequate soffit venting to meet minimum ventilation code requirements
- Homeowners should not be instructed to cover turbines in winter weather because that would prevent ventilation
- You'll need to replace your turbine vent when it stops spinning, because properly functioning turbine vents spin with the slightest wind

<http://www.airvent.com/homeowner/products/staticVents-windTurb.shtml>

June 12, 2007

Appendix B – Final Design of Infiltration Barrier

The schematic design of the infiltration barrier is presented above. Information regarding the proposed GCL layer is included below.



Product Data Sheet

GSE STANDARD PRODUCTS

Bentofix[®] EC GCL

Bentofix[®] "EC" geosynthetic clay liner (GCL) is a lightly needlepunched reinforced composite comprised of a uniform layer of granular sodium bentonite encapsulated between a woven and a nonwoven geotextile. It is intended for use on relatively flat slope surfaces where minimal internal shear strength is required.

Product Specifications

GEOTEXTILE PROPERTIES	TEST METHOD	FREQUENCY	VALUE (ENGLISH)	VALUE (SI)
Product Code			BFIX1000EC	
Cap Nonwoven, Mass/Unit Area	ASTM D 5261	1/200,000 ft ² (1/20,000 m ²)	3.0 oz/yd ² Typical	100 g/m ² Typical
Carrier Scrim Woven, Mass/Unit Area	ASTM D 5261	1/200,000 ft ² (1/20,000 m ²)	3.1 oz/yd ² Typical	105 g/m ² Typical
BENTONITE PROPERTIES				
Swell Index	ASTM D 5890	1/100,000 lb (50,000 kg)	24 ml/2 g min	24 ml/2 g min
Moisture Content	ASTM D 4643	1/100,000 lb (50,000 kg)	12% max	12% max
Fluid Loss	ASTM D 5891	1/100,000 lb (50,000 kg)	18 ml max	18 ml max
FINISHED GCL PROPERTIES				
Bentonite, Mass/Unit Area ⁽¹⁾	ASTM D 5993	1/40,000 ft ² (1/4,000 m ²)	0.75 lb/ft ² MARV	3.66 kg/m ² MARV
Tensile Properties, Tensile Strength ⁽⁴⁾ Grab Strength ⁽²⁾ Grab Elongation ⁽²⁾	ASTM D 6768 ASTM D 4632 ASTM D 4632	1/40,000 ft ² (1/4,000 m ²)	30 lb/in MARV 80 lb Typical 100% Typical	5 kN/m MARV 354 N Typical 100% Typical
Peel Strength ⁽³⁾	ASTM D 6496 ASTM D 4632	1/40,000 ft ² (1/4,000 m ²)	0.8 lb/in Typical 5 lb Typical	140 N/m Typical 22 N Typical
Hydraulic Conductivity ⁽⁴⁾	ASTM D 5887	1/Week	5 x 10 ⁻¹¹ m/sec max	5 x 10 ⁻¹¹ m/sec max
Index Flux ⁽⁴⁾	ASTM D 5887	1/Week	1 x 10 ⁻⁸ m ³ /m ² /sec max	1 x 10 ⁻⁸ m ³ /m ² /sec max
Internal Shear Strength ⁽⁵⁾	ASTM D 6243	Periodically	100 psf Typical	4.8 kPa Typical
ROLL DIMENSIONS				
Width x Length ⁽⁶⁾	Typical	Every Roll	15.5 ft x 150 ft	4.7 m x 45.7 m
Area per Roll	Typical	Every Roll	2,325 ft ²	216 m ²
Packaged Weight	Typical	Every Roll	2,600 lb	1,179 kg

NOTES:

- ⁽¹⁾Oven-dried measurement. Equates to 0.84 lb/ft² (4.1 kg/m²) when indexed to a 12% moisture content.
- ⁽²⁾Measured at maximum peak, in weakest principal direction. Elongation is provided for reference only.
- ⁽³⁾Modified to use a 4 in (100 mm) wide grip. The maximum peak of five specimens averaged.
- ⁽⁴⁾4 in (100 mm) wide sample, average of 5 specimens.
- ⁽⁵⁾Typical peak value for specimen hydrated for 24 hours and sheared under a 200 psf (9.6 kPa) normal stress.
- ⁽⁶⁾Roll widths and lengths have a tolerance of ±1%.

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DS044ec R03/07/06

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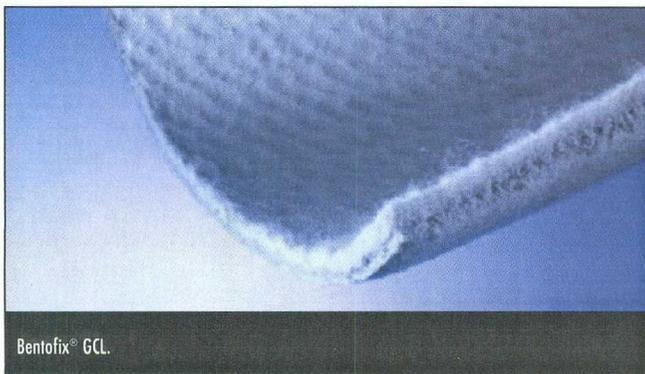
www.gseworld.com

Bentofix[®] Fabric Encased GCLs

FABRIC ENCASED GEOSYNTHETIC CLAY LINERS (GCLs)

Bentofix[®] GCL is produced by distributing a uniform layer of the sodium bentonite between two geotextiles. Fibers from the upper nonwoven geotextile are needlepunched through the layer of bentonite and incorporated into the lower geotextile (either a woven or a nonwoven). This process results in a strong mechanical bond between the fabrics. A proprietary heat treating process – the Thermal Lock process – is then used to modify and more permanently lock the needlepunched fibers into place.

The sodium bentonite clay utilized in Bentofix[®] GCL is a naturally occurring clay mineral that swells as liquid enters between its clay platelets. When hydrated under confinement, the bentonite swells to form a low permeability clay layer with the equivalent hydraulic protection of several feet of compacted clay. Unique properties, including increased internal shear resistance and long term creep resistance, make Bentofix[®] GCL ideal for a wide range of containment lining applications.



Bentofix[®] GCL.

NEEDLEPUNCHING MAKES A DIFFERENCE

By needlepunching fibers through the sodium bentonite clay layer, a completely uniform, reinforced GCL is produced with shear strength, creep resistance, and stability advantages important to any application.

HIGH SHEAR RESISTANCE

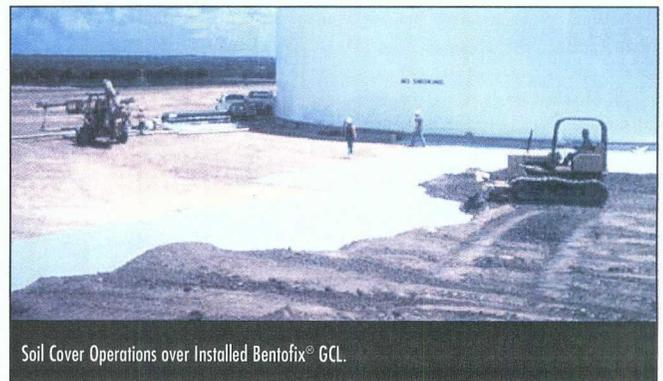
Needlepunching reinforces the otherwise weak layer of sodium bentonite clay. Unreinforced bentonite is susceptible to shear failure, even on gentle slopes. The Bentofix[®] GCL needlepunching process consistently reinforces the bentonite layer with thousands of high tenacity fibers that resist and transfer the shearing stresses into the encapsulating geotextiles.

UNIFORM BENTONITE CONTENT

The uniform confinement provided by the fibers from the needlepunching process resist lateral migration of the bentonite clay within the Bentofix[®] GCL in either the dry or hydrated state. As a result, a consistent bentonite content is preserved throughout the composite, in turn resulting in a consistent low permeability.

GREATER INSTALLATION DURABILITY

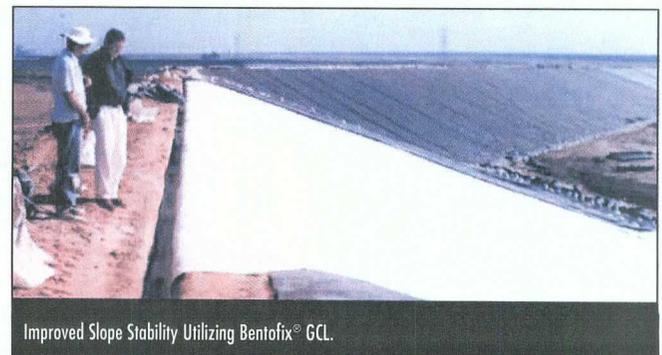
During installation, the needlepunched fibers hold the bentonite in place and prevent the GCL from separating. Bentofix[®] GCL is more durable over a wider range of installation conditions, and, because it is needlepunched, it can greatly reduce the adverse effects of premature hydration during installation.



Soil Cover Operations over Installed Bentofix[®] GCL.

SUPERIOR GCL SLOPE PERFORMANCE

With Bentofix[®] GCL, the clay component is no longer the limiting factor on side slopes. You can use Bentofix[®] GCL to replace compacted clay layers on steep side slopes and be assured of low permeability without sacrificing slope stability. The inherent confining stress from the needlepunching also improves the hydraulic properties of Bentofix[®] GCL under low confining stress applications.



Improved Slope Stability Utilizing Bentofix[®] GCL.

ASSURED QUALITY CONTROL

Because Bentofix® GCL is factory manufactured liner products, the controlled environment of the production facility allows for greater control over critical performance characteristics. The intensive manufacturing quality control program ensures consistent hydraulic and physical properties through the latest ASTM testing procedures.

The thorough manufacturing quality control minimizes the expensive and time consuming on-site quality assurance testing required for compacted clay liners. Bentofix® GCL provides consistent high quality performance.



Bentofix® Deployed in a Composite Bottom Liner System.

BENTOFIX® IS MORE VERSATILE THAN COMPACTED CLAY

Bentofix® GCL is part of an important trend toward the combined use of geosynthetics and clay materials in containment applications. In a typical composite liner system, GCL works synergistically with polyethylene and other geomembrane materials to maximize liner system efficiency.

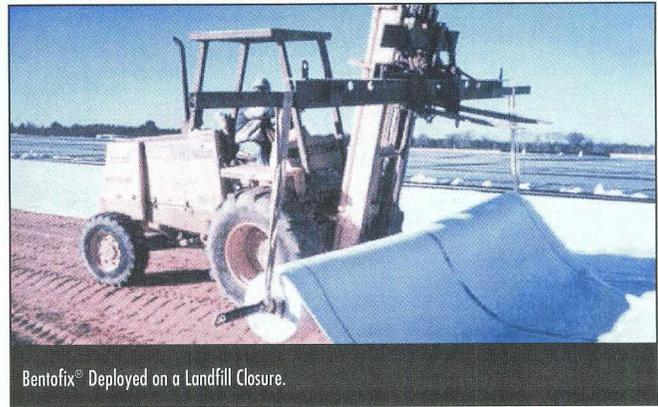
INCREASED AIRSPACE AND LINER EFFICIENCY

In a composite landfill liner system, Bentofix® GCL can, in many cases completely replace, or significantly reduce, the required thickness of the compacted clay layer. This results in less excavation and re-compaction as well as increased containment volume. And, in a landfill, increased airspace means increased revenues.

CAPS AND CLOSURES

Bentofix® GCL are ideally suited for use in landfill caps and closures. Used alone, or in conjunction with a geomembrane, Bentofix® GCL is resistant to the

deleterious effects of differential settlement and seasonal temperature fluctuations.



Bentofix® Deployed on a Landfill Closure.

BENTOFIX® IS EASY TO INSTALL

Bentofix® GCL is the widest fabric encased GCL in the industry. The widest width, coupled with available custom lengths, makes Bentofix® the most versatile GCL available.

Simple, cost-effective installation techniques make Bentofix® GCL a practical alternative to a compacted clay liner for a wide range of applications, including composite landfill liners, landfill caps, secondary containment, storm water and waste water impoundments, as well as canals, dams and reservoirs.



Deployment of Bentofix® GCL.

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AP022 Bentofix R03/13/06

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