NM - 59

GENERAL CORRESPONDENCE

YEAR(S): 1990

STATE OF NEW MEXICO

ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION

GARREY CARRUTHERS
GOVERNOR

POST OFFICE BOX 2088
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO 87504
(505) 827-5800

May 21, 1990

CERTIFIED MAIL
RETURN RECEIPT NO. P-918-402-252

Mr. J. A. Head, Area Manager
Texaco Producing, Inc.
P. O. Box 730
Hobbs, New Mexico 88240

RE: Centralized Storage Facility
Lea County, New Mexico

Dear Mr. Head:

The Oil Conservation Division (OCD) has received your application, dated May 7, 1990, for authorization to construct and operate a waste storage/disposal pit located in the SE/4 SE/4, Section 1, Township 18 South, Range 34 East, NMPM, Lea County, New Mexico. The pit will be double-lined and equipped with leak detection. The pit will temporarily store salt water from a flow from a salt section of the Permian zone during drilling operations. The water will subsequently be disposed of in approved Class II disposal wells.

The design and specifications of the proposed pit are adequate for the protection of ground water and the environment and are approved as proposed in your application.

Please be advised that this approval does not relieve you of liability should your operation result in actual pollution of surface or ground waters or the environment which may be actionable under other laws and/or regulations.

If you have any questions, please do not hesitate to call me at (505) 827-5884.

Sincerely,

Roger C. Anderson
Environmental Engineer

RCA/sl

cc: OCD Hobbs Office

May 7, 1990

New Mexico Oil Conservation Division
Mr. Roger Anderson
P. O. Box 2088
Santa Fe, New Mexico 87504-2088

Mr. Anderson,

An Application for Waste Storage/Disposal Pit Permit is submitted for your review. It is our understanding that water containing structures larger than ten acre-feet also require State Engineers Office approval. After your review, please forward a copy of the application to the State Engineers Office.

If there any questions or additional information required on the application, contact Mr. David Demel, of this office.

Sincerely,

J. A. Head
Area Manager

DMD/pc
Enclosures

File
Chrono

APPLICATION FOR WASTE STORAGE/DISPOSAL PIT PERMIT
NEW MEXICO OIL CONSERVATION DIVISION
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO

I. GENERAL INFORMATION

A. Name of Owner or Legally Responsible Party

Texaco Producing, Inc.
P.O. Box 730
Hobbs, New Mexico 88240

Attn: Mr. James Head

B. Name of Local Representative or Contact Person

See above

C. Location of Disposal Pit

The proposed location is a 5.99 acre tract located within the SE 1/4 of the NE 1/4 of Section 1, Township 18S, Range 34 East, N.M.P.M., Lea County, New Mexico. Please see attached plat, Exhibit "A", and topographic map, Exhibit "B", for further identification of the location.

D. Type of Operation

This facility is being built for temporary storage of salt water. The salt section of the Permian zone is charged with water. Texaco's developmental oilwell drilling program will cause penetration of this section, which has in the past resulted in a flow of salt water to the surface. The construction of this lined retention pit will allow drilling to proceed and will protect the grazing surface area and the Ogallala aquifer from salt water contamination. This salt water will be temporarily stored in this pit for subsequent disposal in salt water disposal wells in the area.

The pit will be double-lined, with a leak detection system and will have inlet and outlet pump structures for handling of the salt water.

E. Affirmation

"I hereby certify that I am familiar with the information contained in and submitted with this

application and that such information is true, accurate and complete to the best of my knowledge and belief."

J A Head
Signature

5/7/90
Date

J. A. Head
Printed name of person signing

Area Manager
Title

II. GENERAL DESCRIPTION

A. Proposed Operations

1. Storage Facility Description:

This facility is being built for temporary storage of salt water. The salt section of the Permian zone is charged with water. Texaco's developmental oilwell drilling program will cause penetration of this section, which has in the past resulted in a flow of salt water to the surface. The construction of this lined retention pit will allow drilling to proceed and will protect the grazing surface area and the Ogallala aquifer from salt water contamination. This salt water will be temporarily stored in this pit for subsequent disposal in salt water disposal wells in the area.

The pit will be double-lined, with a leak detection system, and will have inlet and outlet pump structures for handling of the salt water, as indicated in the enclosed drawing, Exhibit "C", Saltwater Retention Basin Piping Schematic. No other fluids will be allowed into the pit.

2. Technical Information:

a. Surface impoundments - This facility will store salt water on a periodic basis as it is produced during drilling activities. The facility will cover an area of 4.16 acres, to outside toe of slopes, and will have a maximum volume of approximately 162,000 barrels. The total pond depth will be 7 feet, with 2.5' being freeboard to allow for wave action. Thus, the actual water depth will not exceed 4.5' during use. The slope of the inside pond face shall be 3:1, horizontal to vertical ratio, and the outside face shall be 3:1.

The subsurface soils upon which this pit will be constructed consist of 24-26" of low plasticity clay and clay loam soils of the Portales-Stegall soil variety over soft caliche for most of the basin site. The extreme northwest corner of the basin site has about 6" of silty clay loam of the Kimbrough-Lea complex, underlain by hard indurated caliche.

To construct the basin, suitable subgrade

material will be scarified and recompacted in place to 95% of Standard Proctor density at ±4% of optimum moisture. Unsuitable materials shall be removed to a depth of 6" below finish subgrade and replaced with suitable imported subgrade material compacted to 95% of Standard Proctor density.

The primary liner for this facility will be 36 mil Hypalon. The secondary liner will be 30 mil PVC, treated with a biocide to prevent microorganism attack. Both liners are resistant to sunlight, fungus, algae, bacteria and salt water. Each liner will be laid in the pit by rolls and then seamed together. Please see Appendix A for specifications on the proposed liners. The leak detection system will be either a perforated PVC pipe and gravel system with 2" lateral lines and a 4" central line sloping at 1% to an external sump, or will consist of Contech C212 drainage composite, underlying the entire primary layer, which will drain to a 4" central line flowing to an external sump. Either system will allow free flow of leakage to the external detection sump.

There will be no runoff or runon as the pit will be self-contained and the drainage diverted away from the pit. The pits are in an area with gentle slopes and little drainage area upstream, thus involving no drainage problems.

b. Drying beds or other pits - There are no other structures of any type anticipated for this facilty.

c. Other on-site disposal - All salt water contained in this basin will be subsequently disposed of to salt water disposal wells in the area. Under emergency circumstances, such as detection of leakage, the basin may also be emptied to existing salt water disposal wells in the area. No other disposal system is necessary or desired.

3. Ancillary equipment

Other than the leak detection system, the only equipment that will be utilized as a part of this project will be inlet and outlet piping and a small internal sump for collection of particulate matter after periodic washdown of the basin. No other equipment is required.

B. Spill/Leak Prevention and Procedures

1. In as much as the pit will be double lined, and with the pit sloped to a sump, there will be no other containment or clean up apparatus necessary. If a leak is detected, fluid in the leak detection sump will be pumped back into the pit, and the pond will be emptied to salt water disposal wells in the area. The liner will then be repaired and the pond placed back into operation.

   The Oil Conservation Division will be notified within one working day of any leaks detected.

2. The leak detection system will be the only means by which leaks are to be detected. The leak detection sump will be inspected at least weekly. If leaks are detected, the procedure outlined in section B.1 will be followed.

B. Closure Plan

1. At the point in time when the facility is to be closed, the pit will be emptied to salt water disposal wells and cleaned. After cleaning, the pit liner will be salvaged for reuse, if an acceptable reuse exists. If no acceptable reuse exists, the liner will be buried beneath the material used to form the pit berms. In either case, the area will be recontoured to as near the original contours as is practical, and will then be reseeded.

III. SITE CHARACTERISTICS

A. Hydrologic Features

1. There are no bodies of water, streams or significant watercourses near the proposed site. There are nine (9) waterwells within one mile of the proposed site, as indicated on the enclosed drawing. Exhibit "D". Of those nine wells, three are for oilfield waterflood injection, two each are for potash mining operations and for stock watering, and two are for private water supply. These wells all draw water from the Ogallala Aquifer.

2. The total dissolved solids in the eight wells exhibiting normal readings at the last test varied between 330 and 732 mg/l, with an average reading of 630 mg/l. Water taken from CVU #3, which is approximately 1500' northeast of the

pit site, exhibited a very high chloride concentration (1598 mg/l) during the last water quality survey. This contamination was investigated by Texaco and the Hobbs District Office of the New Mexico Oil Conservation Division and was found to have originated from a casing leak in an oilwell in the area. Texaco and OCD have developed a set of two water recovery wells immediately north of the pit site to allow recovery and decontamination of the affected groundwater, and have also drilled some 23 monitor wells in the area to track the chloride contamination. A full report regarding this situation is currently being prepared by the Hobbs office of the OCD and should be available very soon for review. Please note that this chloride problem is unrelated to the need for, or proposed use of, the pit applied for herein.

3. All Ogallala groundwater in this area flows naturally to the southeast, although this flow direction is sometimes affected by producing waterwells in the area.

4. Enclosed as Appendix B are water quality analyses of all nine area waterwells. These analyses are performed on a quarterly basis by Martin Water Laboratories, Inc. of Midland, Texas for Texaco Producing, Inc. as an ongoing part of their area oilfield activities. These samples were made and tested during the last week of September and the first week of October, 1989.

B. Geologic Description of Pit Site

Attached as Appendix C are driller's logs for a portion of the 23 monitering wells that were recently drilled in the immediate area of the proposed pit site. The geologic information contained herein is derived from those logs and from commonly known general information about the Ogallala Aquifer in this area.

1. The soil types encountered were low plasticity and silty clays within a foot of the surface, underlain by thick layers of caliche and other rock. The rock layers are over the aquifer layer, which begins at a depth of approximately 120' to 140' and which consists of mostly sands and gravel. The base of the aquifer is at a depth of 225' to 240' and is hard rock commonly known as the "redbed".

2. The shallowest aquifer beneath the proposed pit is the Ogallala Aquifer, which begins at a depth of approximately 120' to 140'.

3. The aquifer materials are made up of sands and gravels with some mixture of clay, which are the types of materials commonly associated with alluvial deposits.

4. The rock at the base of the alluvium, the so-called "redbed", is at an approximate depth of 225' to 240' in this area.

C. Flood Protection

1. The flooding potential at the pit site with respect to major precipitation and/or runoff is minimal at best as the pond will be maintained with at least a 2-1/2' freeboard. The facility is located in such a location as to have very little upstream contributing drainage area and to allow easy diversion of stormwater to either side of the facility by use of drainage diversion ditches on the upstream side of the pond dikes. Attached is Appendix D, which shows the small contributing drainage area to the project site.

2. The top of the pond dikes are well out of any 100-year flood plain in the area.

3. The outside of the site will be checked after each major rainfall event. The OCD will be notified of any significant erosion found.

IV. ADDITIONAL INFORMATION

Inasmuch as this pit will be double-lined with impermeable synthetic liners, with an acceptable leak detection installed, additional information is not applicable.

V. GENERAL CONSTRUCTION REQUIREMENTS

A. Location

1. This pit is well out of any watercourses.

B. Design and Construction

1. This pit is not intended as an evaporation pit. All saltwater placed in the pit will be discharged to saltwater disposal wells.

2. Wave calculations were performed using the Molitor equation as found on page 23-5 of the "Standard Handbook for Civil Engineers" by Frederick S. Merritt. The maximum wave height calculated by this formula is 2.41'. Rounding off to the nearest higher tenth of a foot, the design freeboard was set at 2.5'. The wave type is non-breaking. Please refer to Appendix E for applicable calculations.

3. The inside and outside grades of the levee shall both be 3H:1V.

4. The top of the levee shall be eight feet wide to allow for ease of access.

5. The fluid to be stored in this pit is saturated salt water, totally free of hydrocarbons. It therefore has no chemical or biological oxygen demand and is not subject to creation of anaerobic bacteria. Conversations with Mr. Jerry Sexton of OCD in Hobbs confirmed these facts. Therefore, no aeration system is proposed for this pit.

C. Synthetically Lined Evaporation Pits

1. Materials

a. The liner will be flexible.

b. Not applicable

c. The liners shall be at least 30 mils thick and shall have good tear and puncture resistance qualities.

d. Both the primary and secondary liners will be resistant to hydrocarbons, salts, acidic and alkaline solutions, fungus, bacteria and rot. In addition, the primary liner will be resistant to ultraviolet light.

e. A double-lined system with a leak detection system between the liners will be installed.

2. Leak Detection System

a. The leak detection will be as per the design discussed below. The OCD district office in Hobbs will be notified at least 24 hours prior to primary liner installation.

b. The leak detection system to be used will be a drainage and sump system.

c. Not applicable.

d. The leak detection system shall consist of either a perforated PVC pipe and gravel system with 2" lateral lines and a 4" central line, all sloping at 1% slope to an external sump, or will consist of Contech C212 drainage composite underlying the entire primary liner, which will slope at 1% grade to a 4" PVC main line at the east side of the pit. In this case, the drainage composite would replace the traditional gravel pack and collection line systems. Since both systems are functionally equivalent, cost will determine which system is selected. Technical literature on the proposed drainage composite is included in Appendix F for review. The 4" PVC main line will drain at 1% slope to a corrosion-proof sump which will be located outside of the berm.

3. Preparation of Pit Bed for Installation of Liners

a. The bed of the pit and the inside and outside grades of the levee will be smooth, compacted to 95% of Standard Proctor, and free of holes, rocks, stumps, clods or other debris which could rupture the liner. The onsite characteristics should allow placement of the liner on prepared subgrade for a large portion of the pit site. Where existing material cannot be properly prepared, suitable foriegn material will be imported and placed beneath the liner.

b. An anchor trench will be excavated to a depth of 18" and a width of 12" around the full perimeter of the pit, and will be located 4 feet from the inside slope break.

4. Installation of Flexible Membrane Liners

a. The OCD office in Hobbs will be notified at least 24 hours prior to secondary liner installation.

b. The liner will be installed and the joints sealed in a manner pursuant to the manufacturer's specifications.

c. The liner will rest smoothly on the pit bed and inner face of the levee and shall be of sufficient size to extend to the bottom of the anchor trench and back out a minimum of two inches from the trench on the side furthest from the pond. Folds in the liner will be located in appropriate locations to compensate for temperature fluctuations.

d. Gas vents will be installed on each side of the pit. The liner will be resting on soils, either native or imported, which will be tested to verify that they are of a nature adequate to vent the subgrade. The vents will be located according to these guidelines and manufacturer's specifications.

e. Used casing or other suitable material will be used to anchor the liner into the anchor trench.

f. Not applicable

g. No sand or gravel layers will be placed on membrane liner material in this application, unless the traditional perf pipe and gravel leak detection system is used. In that event, all gravel placement will be accomplished in such a manner so as to not jeopardize the liner on which it is placed.

h. A suitable splash pad will be placed at the discharge point into the pit and will be designed to protect the liner from fluid forces.

D. Clay Lined Pits

Not applicable.

E. Skimmer Ponds/Tanks

Since the salt water to be discharged into this pit is not from an oil production zone, no oil or grease will enter the pit and no skimmer system will be necessary.

F. Fences and Signs

1. A fences will be constructed around the entire facility. The fence will be of sufficient strength to keep livestock out of the facility.

A minimum of 24' will be provided between the fence and the outside toe of the berm to allow for vehicle passage. All gates will be closed and locked at all times when the pond is not manned.

2. A sign at least 12" X 24" with a minimum of 2" letters will be placed at the facility entrance and will identify the owner/operator, location and emergency phone numbers.

G. Maintenance

1. The leak detection sump will be checked for leaks weekly.

2. Outside walls of all berms will be maintained so as to prevent erosion. After each rain, the pond perimeters will be walked out to inspect for washouts or other damage.

H. Contingency Plan

As mentioned earlier, if a leak is detected, the OCD will be notified within one working day. The sump will be continually pumped back into the pit that is leaking and the pit will be drained to existing salt water disposal wells. The liner tear will then be located and repaired and the pit placed back into operation.

Due to the configuration of the pit piping, no hydrocarbons will enter the pit. Therefore, there will be no possibility of anaerobic bacteria forming to create hydrogen sulfide gas or to necessitate an aeration system for this pit.

Appendix A

WATERSAVER PVC

MEMBRANE LINER ENGINEERING SPECIFICATION GUIDE

POLYVINYL CHLORIDE (PVC)

Property	Test Method	Specified Values				
Thickness mils (Nominal ±5%)	ASTM D-1593	20	30	40	50	60
Specific Gravity, min.	ASTM D 792	1.23	1.23	1.23	1.23	1.23
Tensile Strength, psi, min. (Breaking Factor, lbs./in. width, min.)	ASTM D 882	2300 46	2300 69	2300 92	2300 115	2300 138
Elongation, @ Break, % min.	ASTM D 882	325	350	400	450	450
Modulus @ 100% Elongation, psi, min. (lbs./in. width min.)	ASTM D 882	1000 (20.0)	1000 (30.0)	1000 (40.0)	1000 (50.0)	1000 (60.0)
Tear Resistance, lbs./in., min. (lbs., min.)	ASTM D 1004	300 (6.0)	300 (9.0)	300 (12.0)	300 (15.0)	250 (15.0)
Low Temperature, °F	ASTM D 1790	−15	−20	−25	−30	−30
Dimensional Stability, % change, max.	ASTM D 1204 (212°F, 15 min.)	3.5	3.5	3.5	3.5	3.5
Water Extraction % loss, max.	ASTM D 3083	0.35	0.35	0.35	0.35	0.35
Volatility % loss, max.	ASTM D 1203	0.90	0.70	0.50	0.50	0.50
Resistance to Soil Burial % change, max.	ASTM D 3083					
Tensile Strength		−5	−5	−5	−5	−5
Elongation, @ Break		−20	−20	−20	−20	−20
Modulus @ 100% Elongation		+20	+20	+20	+20	+20
Hydrostatic Resistance, psi, min.	ASTM D 751	60	85	110	150	175
Factory Seam Requirements*						
Bonded Seam Strength (factory seam, breaking factor, ppi width)	ASTM D 3083, Modified	36.8	55.2	73.6	92	110.4

*Factory bonded seam strength is the responsibility of the fabricator.

GENERAL REQUIREMENTS

.01 Scope:

The work covered by these specifications consists of furnishing and installing a polyvinyl chloride (PVC) plastic lining where shown on the drawings or directed by the Engineer. All work shall be done in strict accordance with the drawings and these specifications are subject to the terms and conditions of the contract. It is the intent of these specifications to ensure a first quality finished product is provided.

.02 Description of Materials:

PVC (polyvinyl chloride) lining shall consist of 72" (182 cm) minimum, widths of calendered polyvinyl chloride sheeting fabricated into large sections by means of special factory-bonded seams into a single panel, or into the minimum number of large panels required to complete the project, as supplied by WATERSAVER CO., INC., P.O. BOX 16465, DENVER, COLORADO 80216-0465 (303) 289-1818.

The materials supplied under these specifications shall be first quality products and manufactured specifically for the purposes of this work, and which have been satisfactorily demonstrated by prior use to be suitable and durable for such purposes. The manufacturer of the calendered rolls shall show, upon request where a minimum of 100,000,000 sq. ft. (9,290,227 sq. m.) of 72" (182 cm) minimum width material has been manufactured for lining hydraulic structures.

.03 Physical Characteristics:

PVC sheeting shall be formulated and manufactured domestically from 100% virgin polyvinyl chloride resin and be specifically compounded for use in hydraulic structures. Reprocessed or reground materials shall not be used. No factory set up or trim materials that are foreign to the virgin formulation shall be used. Only first quality phthalate and/or phosphate plasticizers shall be used. The use of water soluble formulation ingredients is prohibited.

The compound must contain a biocide at a viable formulation level. There shall not be any unmixed formulation ingredients. The sheeting shall contain no deep gas checks, no surface divots, no windows, and shall not exhibit cold flow. It must have good surface quality and be free of pinholes and blisters.

It shall be uniform in color, size, and thickness. The material shall have the minimum physical property characteristics, as outlined in the specifications. Certified test results showing that the sheeting meets or exceeds the specification shall be supplied upon request.

.04 Factory Fabrication:

Individual calendered widths of PVC shall be factory fabricated into large panels so as to minimize field seaming during installation. Factory fabricated seams shall have a minimum of one-half inch (½") nominal width. All factory fabricated seams shall have a strength of at least 80% of the specified sheet strength. The fabricator shall be experienced and shall show, upon request, where a minimum of 100,000,000 sq. ft. of material has been fabricated and successfully installed. Factory fabrication shall be by WATERSAVER CO., INC., P.O. BOX 16465, DENVER, COLORADO 80216-0465 (303) 289-1818.

.05 Packaging and Handling:

After factory fabrication, the panels shall be double accordion folded in both directions and packaged so as to minimize handling at the jobsite. Shipping boxes shall be water resistant, strong enough to prevent damage to the contents, and shall be banded to heavy duty wood pallets. Panels which have been delivered to the jobsite shall be unloaded and stored in their original, unopened containers in a safe dry area and protected from the direct heat of the sun. Whenever possible, a 6" minimum air space between the pallets should be provided, especially for an extended period of time. Pallets shall not be stacked.

.06 Installation:

General–Installation shall be performed by an authorized Installation Contractor who has previously installed a minimum of 2,000,000 sq. ft. (185,000 sq. m.) of this material or by a Contractor who has a Watersaver Field Representative in attendance. The surface (substrate) to receive the liner shall be smooth and free of sharp objects that could puncture the lining. All vegetation must be removed. A soil sterilant may be required at the discretion of the Engineer. The PVC lining shall be placed over the prepared surfaces to be lined in such a manner as to assure minimum handling. The panels shall be placed in such a manner as to minimize field seaming. Horizontal field seams on slopes shall be kept to a minimum.

The membrane shall be sealed to all concrete structures and other openings through the lining in accordance with details shown on the drawings submitted by the Contractor and approved by the Engineer. Factory fabricated pipe seals shall be used to seal all pipes penetrating the liner. Any portion of the lining damaged during installation shall be removed or repaired by using an additional piece of the same membrane as specified here-in. The liner shall be installed in a relaxed condition and shall be free of stress or tension upon completion of the installation. Stretching the liner to fit is not permissible.

.07 Protective Cover:

A nominal 12 inches (10" minimum) of approved cover material shall be placed over the PVC lining as shown on the drawings. Cover material shall be approved by the Engineer prior to placement. Soil containing sharp, jagged rocks, roots, debris or any other material, which may puncture the membrane, shall not be used as cover material.

The Contractor may choose the equipment and manner with which to place the cover over the liner, provided: the Contractor satisfactorily demonstrates to the Engineer that both the equipment and manner used to place the chosen cover material over the lining will not have any detrimental effects on the liner.

.08 Field Seams:

Field seams will be made to seal factory fabricated panels of PVC together in the field. Seams shall be formed by lapping the edges of panels a minimum of 6 inches (15 cm). The contact surfaces of the panels shall be wiped clean to remove all dirt, dust or other substance. Sufficient vinyl to vinyl bodied solvent shall be applied to the contact surfaces in the seam area, and the two surfaces pressed together immediately. Any wrinkles shall be smoothed out. Field seams shall have a strength of at least 80% of the specified sheet strength.

.09 Joints to Structures:

All curing compounds and coatings shall be completely removed from the joint area. Joining of PVC to concrete shall be made with vinyl to concrete bonding adhesive. Unless otherwise shown on the drawings, the minimum width of concrete to PVC joint shall be 6 inches (15 cm). In addition, mechanical attachment may be necessary.

.10 Repairs to PVC:

Any necessary repairs to the PVC shall be made with the lining material itself and cold applied vinyl to vinyl splicing adhesives. Patches should be cut so as to cover the area to be repaired by a minimum of 4" in all directions. Patches should be cut with rounded corners. The splicing adhesive shall be applied to the contact surface between the patch and the lining, and the two surfaces pressed together immediately. Any wrinkles shall be smoothed out.

.11 Quality of Workmanship:

All joints, on completion of the work, shall be tightly bonded. Any lining surface showing injury due to scuffing, penetration by foreign objects, or distress from rough subgrade, shall, as directed by the Engineer, be replaced or covered and sealed with an additional layer of PVC of the proper size. A Watersaver Field Service Representative will be required during the liner installation if the installation is not done by an authorized installer. The Contractor will bear the expense of this Field Service Representative. The Field Service Representative is not directly responsible for the quality of the work involved; such responsibility will be solely that of the Contractor.

SPECIFIC PVC FLEXIBLE MEMBRANE LINER INFORMATION

PVC membrane liners are the most widely used of all polymeric membranes for waste impoundments. They show good chemical resistance to many inorganic chemicals; however, the inclusion of organic solvents may limit their applicability (consult Watersaver Company, Inc. for specific applications). Special "Oil Resistant" (PVC-OR) grades of PVC are also available that possess a high resistance to oil and other organic hydrocarbon attack.

PVC liner materials are produced in roll form in various widths and thicknesses. Most liners are used as unsupported sheeting, but fabric reinforcement can be incorporated. PVC compounds contain 25% to 35% of one or more plasticizers to make the sheeting flexible and rubberlike. They also contain 1% to 5% of a chemical stabilizer and various amounts of other additives. The PVC compound should not contain any water soluble ingredients. There is a wide choice of plasticizers that can be used in PVC sheeting, depending upon the application and service conditions under which the PVC compound will be used. Plasticizer selection is an extremely important aspect of a PVC liner material, since the loss of plasticizer will result in a change in physical properties. There are three basic mechanisms for plasticizer loss: volatilization, extraction and microbiologic attack. The use of the proper plasticizers and an effective biocide can virtually eliminate microbiological attack and minimize volatility and extraction. The PVC polymer itself is not affected by these conditions.

The principal reason for loss of plasticizer is by volatilization in the heat of the sun rather than solution in the waste fluid. Carbon black prevents ultraviolet attack, but does cause the absorption of solar energy raising the temperature to a level that could cause vaporization of the plasticizer. A soil or other suitable cover material must be used to protect the PVC from heat, ultraviolet and weathering.

Plasticized PVC sheeting has excellent Tensile, Elongation, Puncture and Abrasion Resistance properties. It is readily seamed by solvent welding and dielectric welding methods.

Watersaver Company supplies PVC, which utilizes only first quality resin, primary plasticizers, stabilizers, biocides and other additives. Watersaver Company offers a wide variety of custom fabricated PVC panels.

USES OF PVC LINERS

PVC liners can be used in many different applications, including:

- solid waste landfills
- landfill caps
- water treatment ponds
- sewage lagoons
- sand filter beds
- evapotranspiration fields
- golf course ponds
- decorative lakes
- fish hatcheries
- mining heap leach pads
- tailings impoundments
- irrigation reservoirs
- reserve pit liners
- fly ash disposal cells
- irrigation canals
- moisture barriers
- leachate collection ponds
- fire water ponds
- stormwater detention ponds
- solar evaporation ponds
- industrial waste ponds & impoundments

The above information is furnished to aid in selecting PVC for use as a geomembrane. Watersaver Company, Inc., as a supplier of materials only, does not assume responsibility for errors in selection, design, engineering, quantities, dimensions or installation.

For additional information, contact Watersaver Company, Inc.

WATERSAVER CO., INC. • Plant/General Office • 5870 E. 56th Avenue • Commerce City, CO 80022
PO Box 16465 Denver, CO 80216 303-289-1818 • FAX 303-287-3136 • Interstate WATS 800-525-2424

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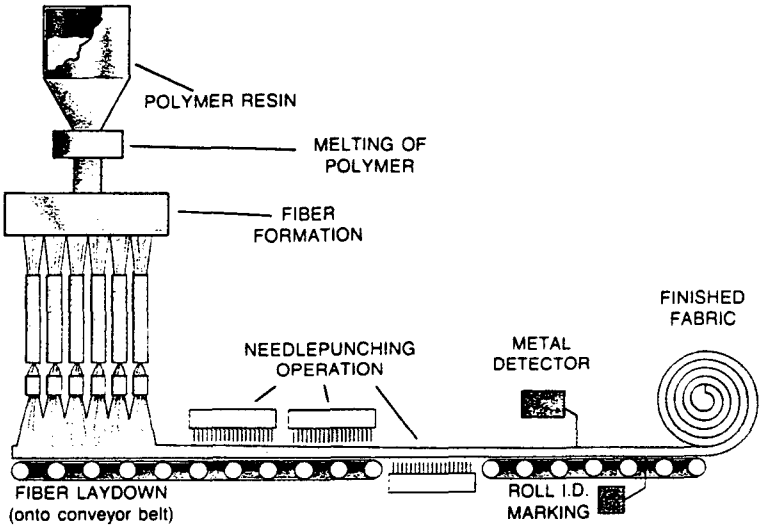
Polyfelt, a division of the Petrochemie Danubia Group, is a major worldwide producer of nonwoven geotextiles and the recognized leader in the research and development of application and manufacturing technology for geotextiles. Unlike other geotextile firms whose position within the geotextile market is secondary to their core business, Polyfelt has exclusively developed and committed its manufacturing technology and marketing efforts to the geotextile industry. This focus, combined with its worldwide experience and success, allows Polyfelt to uniquely meet the design and specification needs of the geotextile market.

Polyfelt's newest manufacturing facility, located in Evergreen, Alabama, represents the largest single investment within the geotextile industry in many years. This modern plant produces through a patented and fully computer controlled process nonwoven, continuous filament, needlepunched geotextiles of the highest quality. This quality is ensured through the use of statistical process control techniques and computerized monitoring, thereby providing Polyfelt the highest quality products available anywhere.

Our manufacturing excellence together with the world's highest ranked Application Engineering and extensive Marketing and Distribution network, makes Polyfelt unequalled in product, quality, cost, and service.

Nonwoven geotextiles have proven themselves superior to woven products for both installation survivability and performance in each of the major applications for geotextiles. Nonwoven products provide through their elongation an ability to conform to irregular subgrade features which often cause installation damage to woven products. This ability to survive installation without sacrificing hydraulic benefits makes nonwoven geotextiles the expert's choice.



Simplified view of Polyfelt's patented continuous filament manufacturing facility.

Polyfelt geotextiles are produced by the only nonwoven process specifically engineered to meet geotechnical design and installation requirements. Our application and manufacturing experience during the seventies led to the development and installation of a next generation manufacturing technology in 1982 which produces products offering the following unique features:

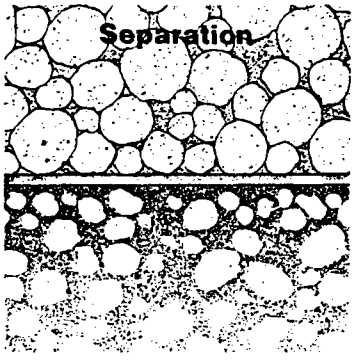
- **Randomly laid, continuous filament fiber extrusion provides excellent strength and fabric uniformity.**
- **Extensive needlepunching entangles fibers thereby forming excellent mechanical properties and thickness for hydraulic drainage.**
- **A controlled fabric forming process develops biaxial and isotropic mechanical properties and product elongation. These features form the basis for installation survivability.**
- **Fully traceable, high quality virgin polypropylene resin provides a nonbiodegradable fabric resistant to acid and alkaline soil conditions and chemical attack.**
- **An ultraviolet inhibitor within the resin provides the highest resistance to U.V. degradation of any geotextile.**
- **Available certified needle-free products for installation with geomembranes.**
- **Roll, lot, and product identification indelibly printed on every roll allows traceability to certified test results.**

The characteristics of nonwoven fabric forming, combined with Polyfelt's advanced manufacturing process, places Polyfelt's products steps ahead in geotechnical performance.

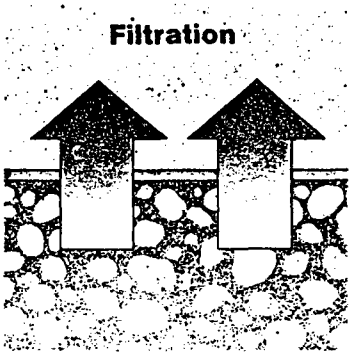
Design by Function

Geotextiles perform primary and supplementary functions in geotechnical design. These functions become design criteria in specific construction applications and are important to identify and rank to achieve the highest performing, most economical design.

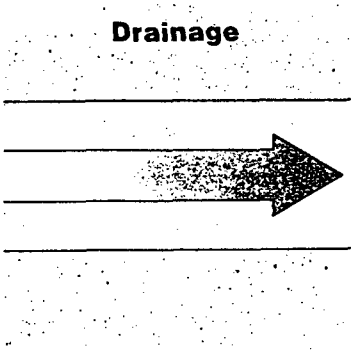
Geotextile Functions



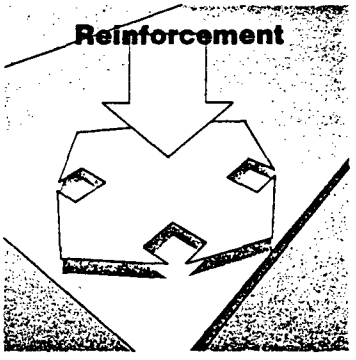
Polyfelt placed between two dissimilar layers of soil acts as a permeable separating barrier preventing the mixing of dissimilar soils.



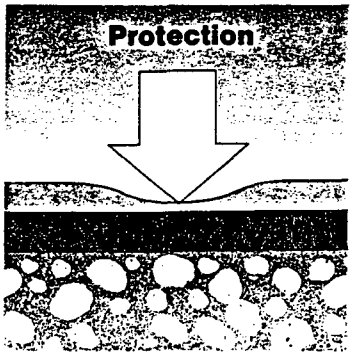
Polyfelt placed between a fine and a coarse grained soil allows water to flow from the fine grained soil through the geotextile and into the coarser soil while preventing the migration of fines into the granular soil.



Polyfelt acts as a drain by allowing water or gas to move along the plane of the geotextile.



By introducing a tensile membrane into the structure Polyfelt can help support a load applied to the subgrade.



Polyfelt placed beneath or on top of a geomembrane acts as a cushion protecting the geomembrane from damage during and after installation.

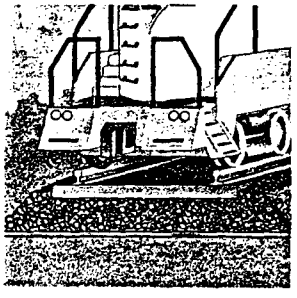
When impregnated with a bitumen or polymeric sealing material, Polyfelt can form an impermeable barrier.

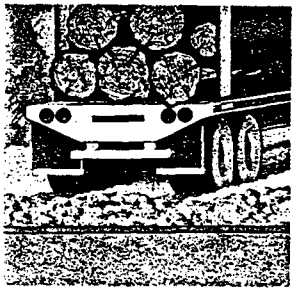
Construction Applications	Geotextile Functions	Product Requirements
Subgrade Stabilization	Separation, Filtration, Drainage	Mechanical and Hydraulic Properties
Drainage	Filtration, Drainage	Hydraulic Properties
Repaving	Waterproofing	Mechanical and Physical Properties
Erosion/Sediment Control	Filtration, Drainage	Mechanical, Hydraulic and Physical Properties, sp. U.V. Resistance
Geomembrane Protection Tunnels	Separation, Cushion	Mechanical and Physical Properties, sp. U.V. Resistance
Railroad Track Bed Stabilization/Dams	Separation, Drainage Filtration	Mechanical and Hydraulic Properties

StabilizaTion

The use of geotextiles in construction applications over weak soils reduces rutting and improves the bearing capacity of the structure by distributing loads over a wide surface area. When placed between the subgrade and aggregate or wearing surface, nonwoven geotextiles filter subgrade soil fines from entering the aggregate.

To preserve the key geotextile functional requirements of filtration, drainage, and separation, installation survivability of the geotextile during construction is important. Polyfelt nonwoven geotextiles provide superior installation survivability over woven products because of their ability to elongate and conform to irregular sharp surfaces without puncture or burst while maintaining critical hydraulic benefits. Polyfelt also acts as a planar drainage medium which extends the performance and life of the structure.





Paved and Unpaved Roads

Polyfelt geotextiles have been proven successful in the construction of unpaved forest, access, and haul roads as well as paved primary and secondary roads.

Benefits:

- **Maintains separation of subgrade and select fill or aggregate during construction.**
- **Lowers cost by speeding construction and reducing aggregate and select fill loss.**
- **Extends the performance and life of the structure.**

Railroad Track Beds

Polyfelt geotextiles used in railroad track bed stabilization perform the key functions of filtration, drainage, and separation under the severest installation and performance stresses. Nonwoven geotextiles have exhibited their superior performance over woven products in this application by exhaustive testing and overwhelming specifications.

Benefits:

- **Filters subgrade soil fines from entering ballast extending track bed performance and life.**
- **Thick nonwovens promote lateral drainage and prevent pumping.**
- **Heavyweight nonwovens elongate during installation and with in-service stresses, thereby resisting fabric damage.**

Storage and Work Yards

Geotextiles used when constructing work and storage yards act as a filter and separate subgrade soils from the aggregate or wearing surface.

Benefits:

- **Lowers costs by speeding construction over wet, weak soils and by reducing aggregate or select fill requirements.**
- **Extends wearing surface life and performance while preventing pumping.**

APPLICATION	SEPARATION	FILTRATION	DRAINAGE	REINFORCEMENT	PROTECTION	WATERPROOFING
STORAGE AND WORK YARDS	●	○	○	○		
PAVED ROADS	●	○	○			
UNPAVED ROADS	●	○	○	○		
REPAVING				○		●
RAILROAD TRACK BEDS	●	●				

FUNCTION

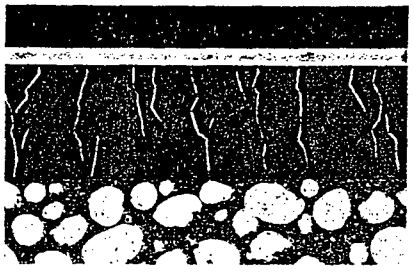
RECOMMENDED POLYFELT GRA

TS 420 | TS 500 | TS 550 | TS 600 | TS 650 | TS 700 | TS 750 | TS 80

● PRIMARY FUNCTION ○ SECONDARY FUNCTION

Repaving

Polyfelt nonwoven geotextiles used in asphalt overlay repaving applications form a waterproofing membrane between the new and old paving layers. The waterproofing membrane protects the subgrade from water intrusion and strength loss. Geotextiles used in pavement overlays also retard reflective cracking from occurring in the new pavement surface by providing a flexible stress relieving membrane between the new and old pavement layers.



To effectively form a waterproofing membrane the geotextile must have the ability to absorb and retain asphalt tack coat. Nonwoven geotextiles have this ability and are exclusively specified in this application.

Because excess water in a road base is the primary cause of road failure, the use of an asphalt system that includes an asphalt overlay geotextile reduces maintenance costs by extending road life.

Installation Guidelines

Proper installation of asphalt overlay geotextiles is critical to achieving the full benefit of their use. The following guidelines generally apply to most overlay installations. For further information refer to Polyfelt Geotextiles Repaving Brochure available from your local distributor or Polyfelt.

1. Clean road surface of all dirt, dust and vegetation.

2. Fill cracks and potholes with crackfiller, cold or hot asphalt mix or other suitable material. An alternative for severely cracked and faulted pavements is the application of a levelling course.

3. Uniform spray application of bituminous tack coat. When using an emulsion the application rate should be increased to ensure a residual *bitumen* quantity as shown below. Temperature of emulsions should not exceed 160°F.

Spraying temperature of straight tack coat should not exceed 320°F.

PGM 13 — 0.20-0.25 gal./yd.²
PGM 15 — 0.25-0.30 gal./yd.²
PGM 20 — 0.30-0.35 gal./yd.²

4. Polyfelt PGM may be laid mechanically or by hand. The paving fabric should be laid free of wrinkles; occurring wrinkles are to be cut and smoothed. Overlaps should be 4"-6" and adhered by additional binder. It is recommended not to open the road to traffic prior to paving. If necessary, however, a layer of sand should be spread on the fabric surface to absorb excess tack.

5. The application of the asphalt overlay can proceed immediately after the installation of Polyfelt PGM. Application of additional tack coat is not necessary. The temperature of the overlay should not exceed 320°F.

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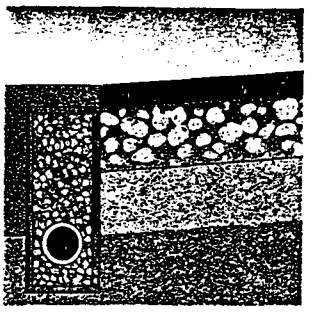
DESIGN PROPERTIES FOR POLYFELT

DES	Mechanical Properties					Hydraulic Properties			Physical Properties					
	Puncture	Mullen Burst	Grab Tensile	A.O.S.	Planar Permeability	Normal Permeability	Elongation	Thickness	Asphalt Retention					
TS 900				X		X	X	X	X	X				
TS 1000				X		X	X	X	X	X				
PGM 13				X		X	X	X	X	X				
PGM 15					X				X		X			
PGM 20				X		X	X	X	X	X				

This chart is to assist in proper geotextile selection. Test values for various Polyfelt grades are listed on the back cover. For additional information refer to Polyfelt's "Design and Practice Manual."

Filtration

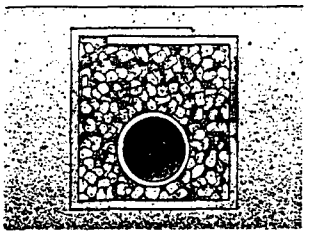


Subsurface Drainage

Geotextiles used in the construction of subsurface drainage structures filter soil fines from entering the drainage channel while allowing water to freely pass. Because of their small pore size and high permeability, nonwoven geotextiles are selected for this application.

Benefits:

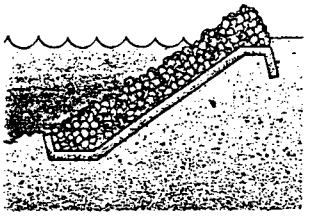
- Lowers construction costs by speeding construction.
- Improves long-term performance and life of the structure.



Erosion/Sediment Control

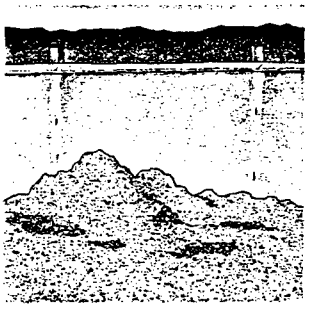
Geotextiles provide a filtration separation medium in erosion and sediment control applications. As in subsurface drainage, nonwoven geotextiles provide excellent filtration of soils on embankments and around construction sites while allowing water to freely pass.

In addition to filtration and permeability requirements geotextiles used in these applications must also exhibit high resistance to sunlight degradation or U.V. due to their prolonged exposure.



Erosion Control

Polyfelt's thick nonwoven geotextiles resist damage during the placement of rip rap and provide superior frictional resistance to the embankment subgrade and armament. These features, combined with the highest U.V. resistance of any geotextile, make Polyfelt products the right choice.



Sediment Control

Because of their small pore size, high U.V. resistance, and high permeability, Polyfelt geotextiles make excellent sediment control silt fences. When properly selected, nonwoven geotextiles offer far greater filtering effectiveness and water flow than conventionally used woven products.

DESIGN PROPERTIES FOR POLYFELT

FUNCTION / APPLICATION	SEPARATION	FILTRATION	DRAINAGE	REINFORCEMENT	PROTECTION	WATERPROOFING
SUBSURFACE DRAINAGE	○	●	○			
EROSION CONTROL	○	●				
MEMBRANE PROTECTION			●		●	
SEDIMENT CONTROL	○	●		○		

RECOMMENDED POLYFELT GRA	TS 420	TS 500	TS 550	TS 600	TS 650	TS 700	TS 750	TS 80
SUBSURFACE DRAINAGE	■	■	■	■	■	■	■	
EROSION CONTROL						■	■	
MEMBRANE PROTECTION					■	■	■	
SEDIMENT CONTROL	■	■	■	■	■	■		

● PRIMARY FUNCTION ○ SECONDARY FUNCTION

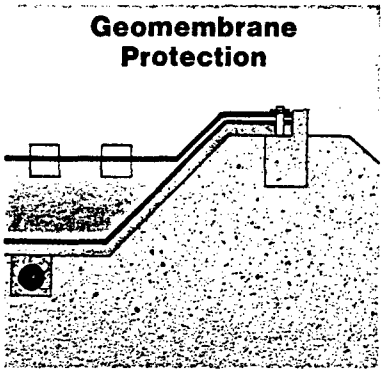
This chart is to assist in proper geotextile selection. Test values for various Polyfelt grades are listed on the back cover. For additional information refer to Polyfelt's "Design and Practice Manual."

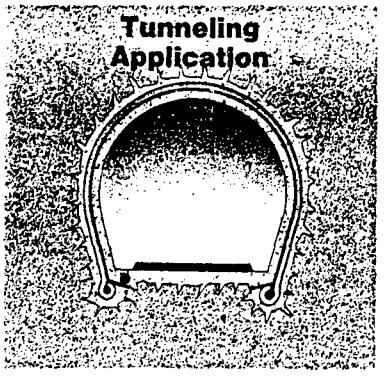
Membrane Protection

02275/ROL
BuyLine 2548

Geotextiles used in combination with geomembranes or impermeable liners primarily function as a separation layer to protect and cushion the membrane during construction and loading. Lateral drainage is also often required of the geotextile to vent gas or moisture, therefore requiring geotextile thickness.

Polyfelt geotextiles have been used extensively in the construction of waste and water storage and evaporation ponds and sites as well as in heap leachate pads, tailing impoundments, dam facings and tunnel construction.





Polyfelt products uniquely meet the requirements of these applications by providing the following features:

- **Certified needle-free products that assure confidence in avoiding membrane damage.**
- **Roll, lot, and product identification indelibly printed on each roll guaranteeing traceability and control.**
- **Statistical process quality control and computerized product test results.**
- **The highest U.V. resistance of any geotextile provides maintenance of product properties during prolonged exposure.**
- **Continuous filament fiber formation and thorough needlepunching provide excellent mechanical properties and thickness for drainage.**
- **Polypropylene composition is widely resistant to alkaline and chemical attack.**

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ES	Mechanical Properties					Hydraulic Properties			Physical Properties				
TS 900	TS 1000	PGM 13	PGM 15	PGM 20	Puncture	Mullen Burst	Grab Tensile	A.O.S.	Planar Permeability	Normal Permeability	Elongation	Thickness	Asphalt Retention
							X	X		X	X	X	X	X	
							X			X		X	X	X	
							X	X			X		X	X	
							X		X	X	X	X	X	X	

Product Specifications

TYPICAL ROLL PROPERTIES

PROPERTY	TEST PROCEDURE	UNIT	POLYFELT										PGM		
MECHANICAL			TS 420	TS 500	TS 550	TS 600	TS 650	TS 700	TS 750	TS 800	TS 900	TS 1000	13	15	20
Grab Tensile	ASTM D4632	lbs.	100	125	150	165	190	225	285	325	380/320	420/340	100	120	160
Grab Elongation	ASTM D4632	%	>50	>50	>50	>50	>50	>50	>50	>60	85/90	90/95	>50	>50	>50
Puncture	ASTM D4833	lbs.	55	65	70	90	100	120	130	150	155	160	55	65	90
Trapezoidal Tear	ASTM D4533	lbs.	50	60	70	75	85	100	120	135	150/140	160/150	50	60	75
Mullen Burst	ASTM D3786	psi	155	200	230	255	295	345	425	450	460	475			
HYDRAULIC															
Water Flow Rate	ASTM D4491	gpm/ft²	250	220	190	170	140	130	100	90	80	65			
Permittivity	ASTM D4491	sec^{-1}	2.9	2.7	2.3	2.0	1.8	1.6	1.3	1.2	0.9	0.8			
Permeability, k	ASTM D4491	cm/sec	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.35	0.35			
A O S	ASTM D4751	sieve size	70-35	80-40	80-45	100-60	100-70	120-80	140-100	140-100	>140	>140			
		mm	0 2-0 5	0 18-0 42	0 18-0 35	0 15-0 25	0 15-0 21	0 12-0 18	0 10-0 15	0 10-0 15	<0 10	<0 10			
PHYSICAL															
Fabric Weight	ASTM D3776	oz./yd.²	3.8	4.5	5.5	6.0	7.0	8.3	10.3	12.0	14 0	16.2	3.8	4.5	6.0
Thickness	ASTM D1777	mils	55	60	70	80	90	105	120	130	150	170	55	60	80
U.V Resistance (500 hours)	ASTM D4355	% strength retained	>80	>80	>80	>80	>80	>80	>90	>90	>90	>90	>80	>80	>80
pH Resistance			2-13	2-13	2-13	2-13	2-13	2-13	2-13	2-13	2-13	2-13	2-13	2-13	2-13
Asphalt Retention	T.F 25	gal./yd.²											0.20	0 25	0.30

MINIMUM AVERAGE ROLL PROPERTIES

PROPERTY															
Grab Tensile	ASTM D4632	lbs.	90	110	130	145	170	205	260	300	310	320	90	110	145
Puncture	ASTM D4833	lbs.	45	50	60	75	85	100	115	130	135	140	45	50	75
Trapezoidal Tear	ASTM D4533	lbs	45	50	60	70	80	95	110	120	130	140	45	50	70
Mullen Burst	ASTM D3786	psi	135	160	200	220	260	300	380	400	420	450			

PACKAGING

ROLL													
Width, ft.	15	15	15	15	15	15	14	13	10	10	12.5	12.5	12.5
Length, ft.	360	360	360	360	360	360	300	300	300	300	360	360	360
Area, yd.²	600	600	600	600	600	600	467	433	333	333	500	500	500
Weight, lbs	150	180	215	235	275	320	310	335	300	345	130	150	200

Nonstandard roll dimensions are available on request and subject to a minimum quantity.

Specified by Experts Worldwide

Polyfelt's worldwide manufacturing, distribution and application engineering services are available to assist you with your geotextile project. Please contact our regional office nearest you.

North America

Polyfelt, Incorporated
Manufacturing, Quality Control and Customer Service
200 Miller Sellers Drive
Post Office Box 727
Evergreen, Alabama 36401

Telephone: 205-578-4756
800-225-4547
Telefax: 205-578-4963

Polyfelt, Incorporated
Marketing and Executive Headquarters
1000 Abernathy Road
Building 400, Suite 1520
Atlanta, Georgia 30328

Telephone: 404-668-2119
Telefax: 404-668-2116

International Manufacturing and Application Engineering Offices

Polyfelt Ges.m.b.H.
St. Peter Strasse 25
Post Office Box 675
Linz, Austria A-4021

Telephone: 43-732-666381
Telefax: 43-732-667859

Polyfelt, Incorporated
200 Miller Sellers Drive
Post Office Box 727
Evergreen, Alabama 36401

Telephone: 205-578-4756
800-225-4547
Telefax: 205-578-4963

International Sales Offices

Polyfelt Australia
Brisbane
Unit 9
220 Boundary Street
Spring Hill 4000

Telephone: (07) 839-7666
Telefax: (07) 832-5151

Polyfelt Ges.m.b.H.
St. Peter Strasse 25
Post Office Box 675
Linz, Austria A-4021

Telephone: 43-732-666381
Telefax: 43-732-667859

Polyfelt France
F-93160 Noisy-le-Grand
Telephone: (1) 45-92-34-34
Telex: 232167 clf

Polyfelt Denmark
DK-1552 Copenhagen V.
Telephone: (01) 12-56-22
Telex: 16783 clag dk

Polyfelt Far East
Singapore 0923
Telephone: 73-728-83
Telex: 556412 clagfe rs

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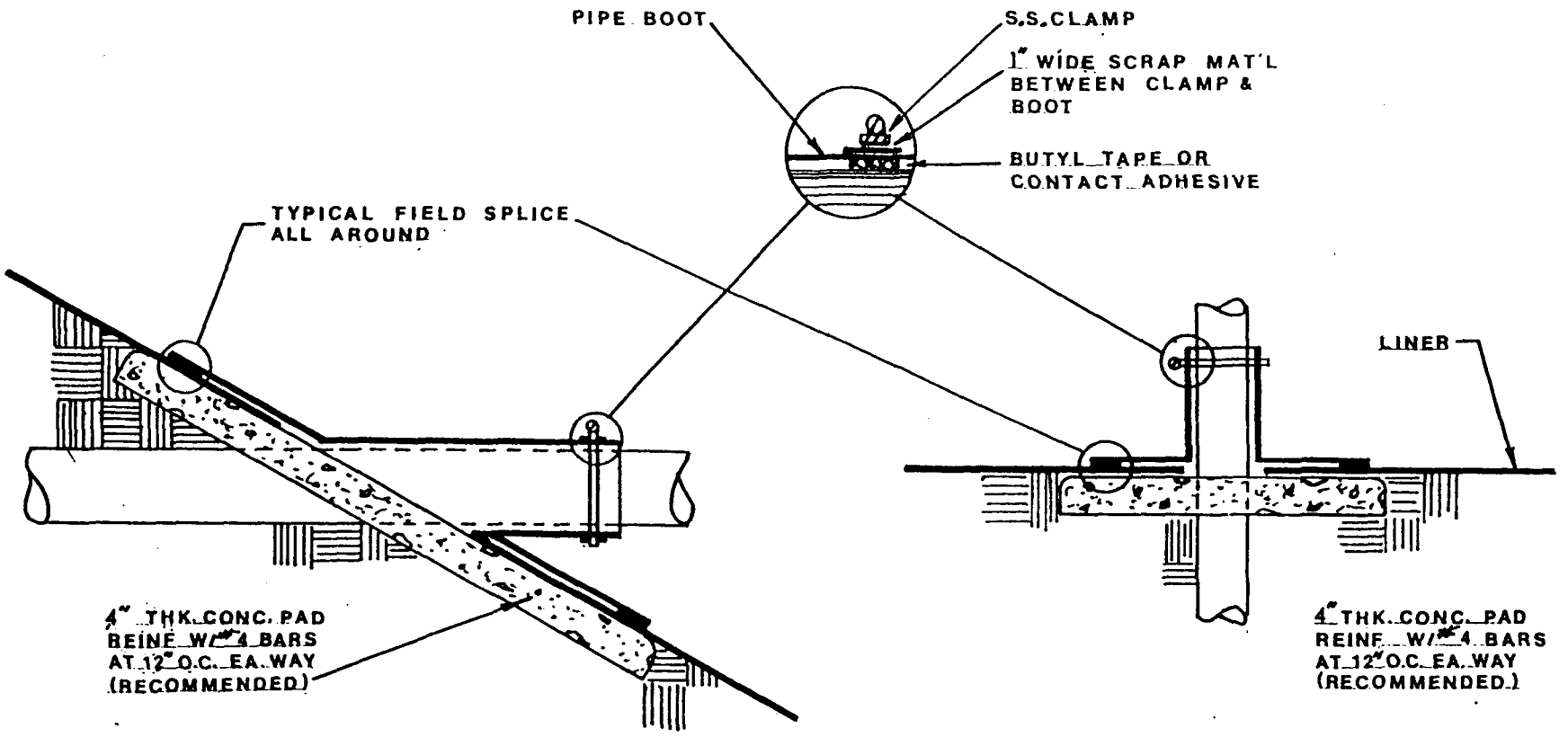


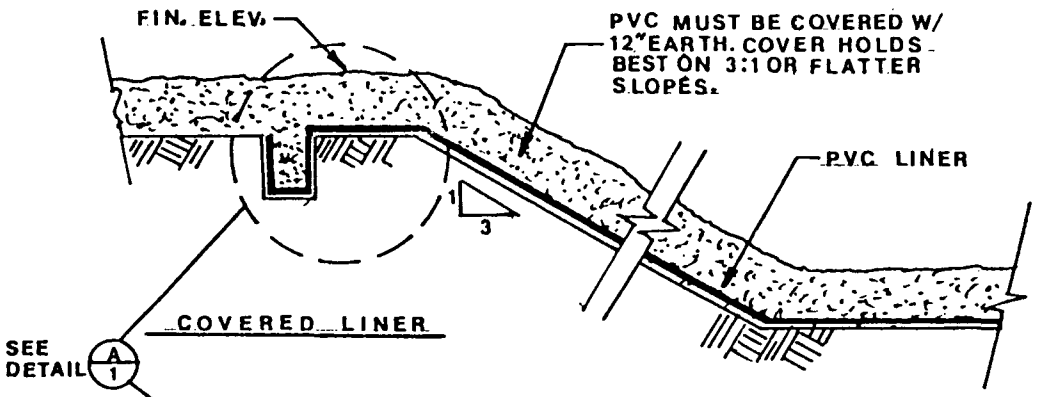
FACTORY FABRICATED PIPE BOOT (TYPICAL)

WATERSAVER CO., INC.

SCALE: nts	APPROVED BY	DRAWN BY
DATE:		

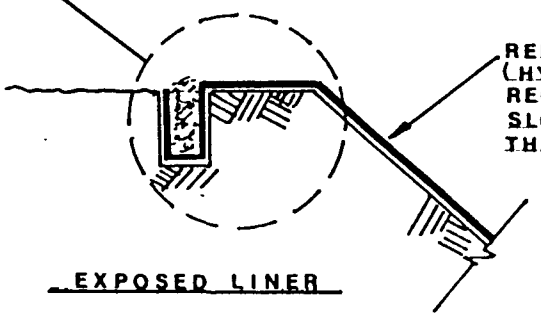
PIPE DETAILS

DRAWING NUMBER
WS DET 1

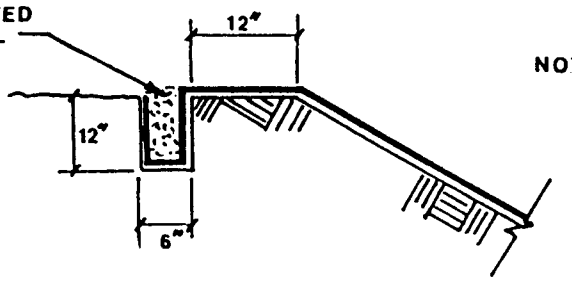


COVERED LINER

SEE DETAIL (A/1)



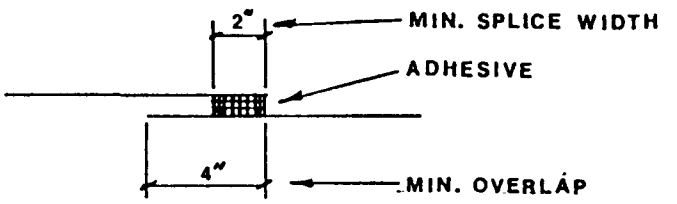
EXPOSED LINER



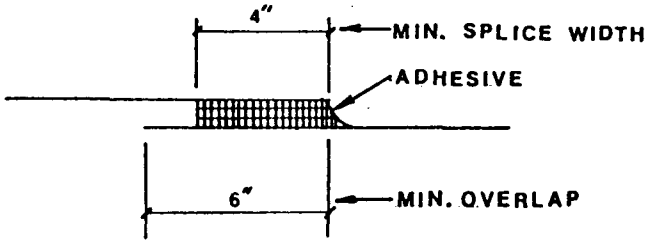
TYPICAL ANCHOR TRENCH DETAIL (A/1)

NOTE: ANGLE OF SLOPE MAY REQUIRE BURIAL TRENCH TO BE SET BACK FURTHER.

OPTIONAL "V" TRENCH DETAIL



PVC OR CPE FIELD SPLICE



HYPALON OR CPER FIELD SPLICE

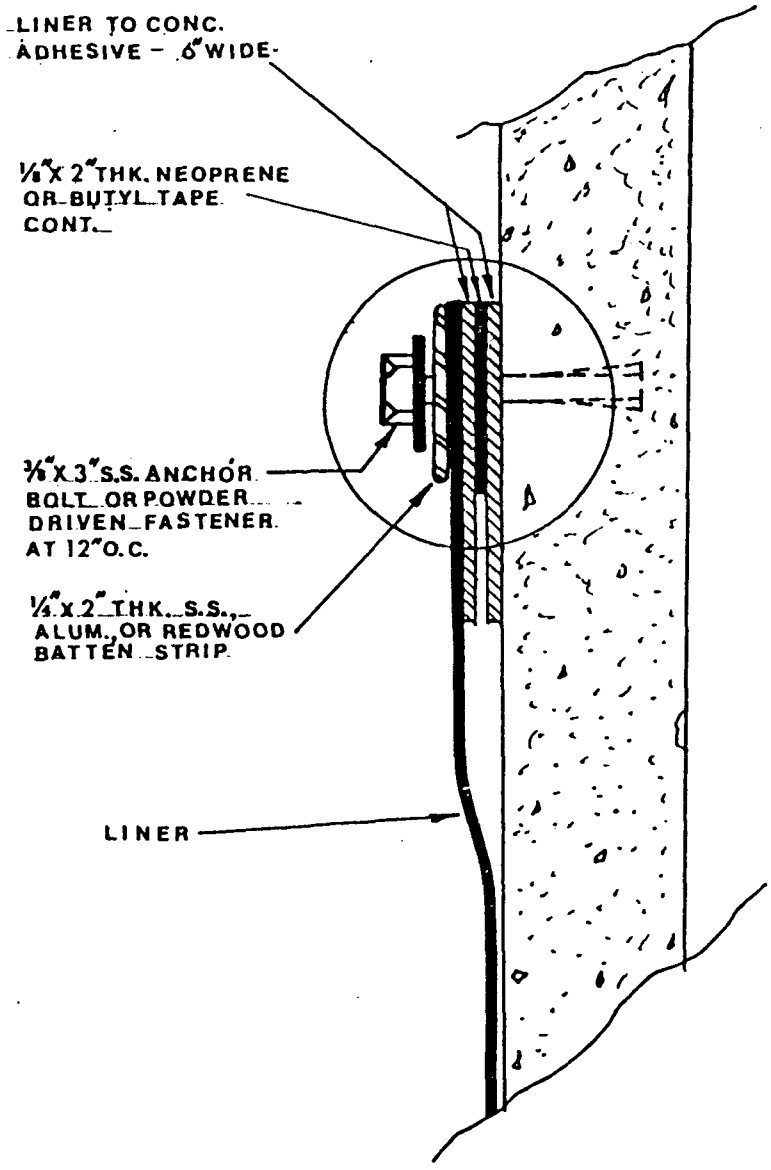
WATERSAVER CO., INC.

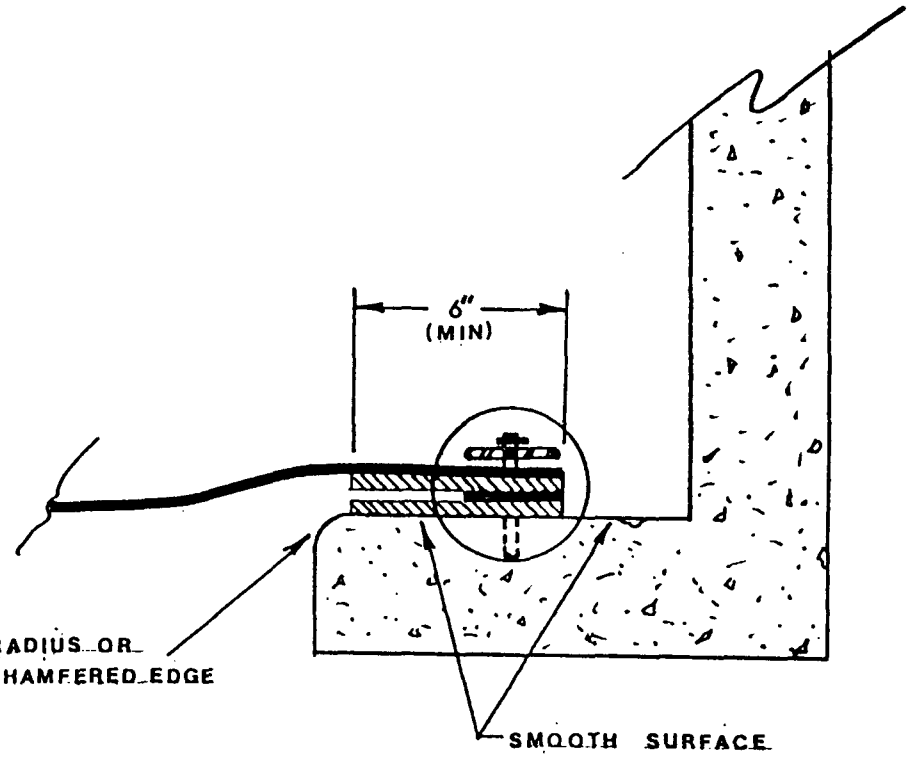
SCALE: nts	APPROVED BY	DRAWN BY
DATE:		

TYPICAL LINING DETAIL SHEET

DRAWING NUMBER
WS DET 2

TELEDYNE POST 18AB-01



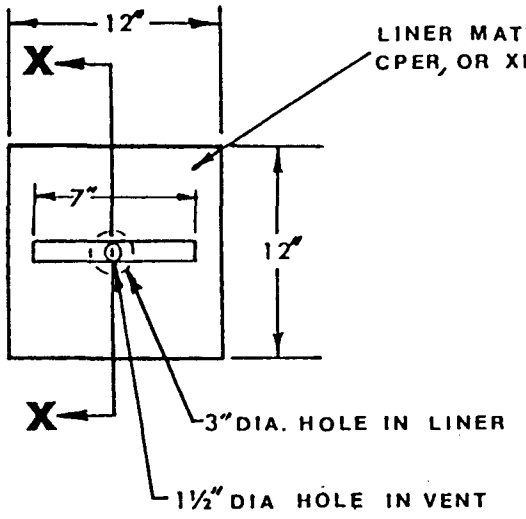


WATERSAVER CO., INC.

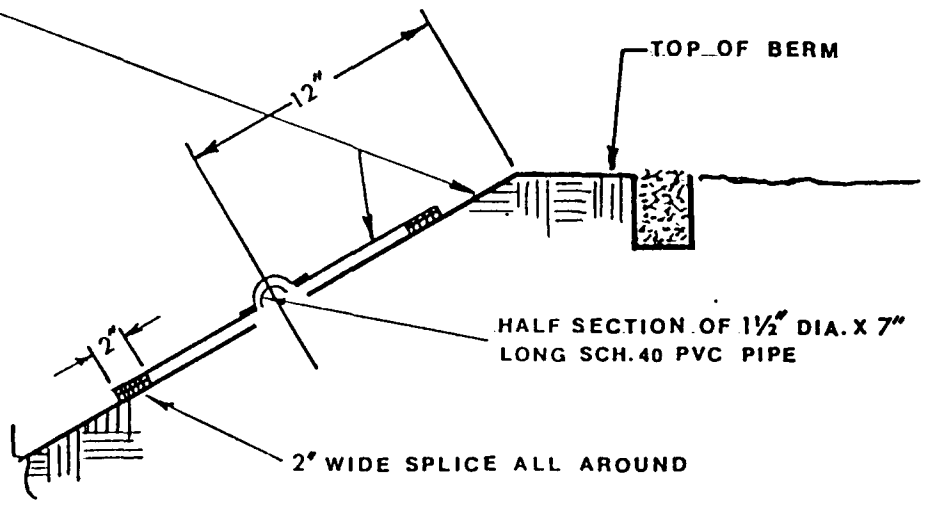
SCALE: nts	APPROVED BY	DRAWN BY
DATE:		

LINER TO CONCRETE DETAIL

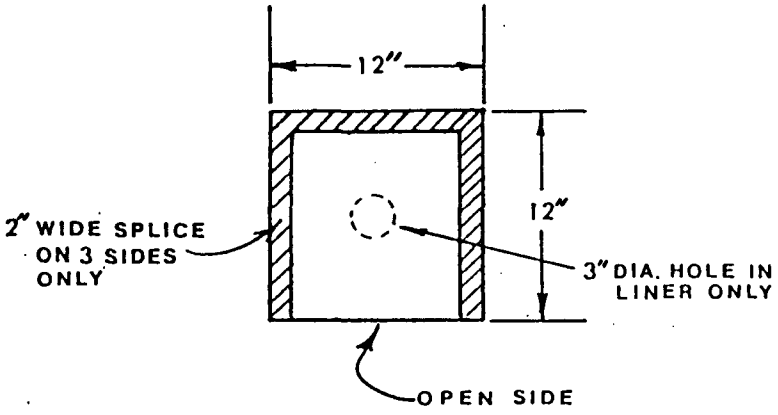
DRAWING NUMBER
WS DET 3



FACTORY VENT



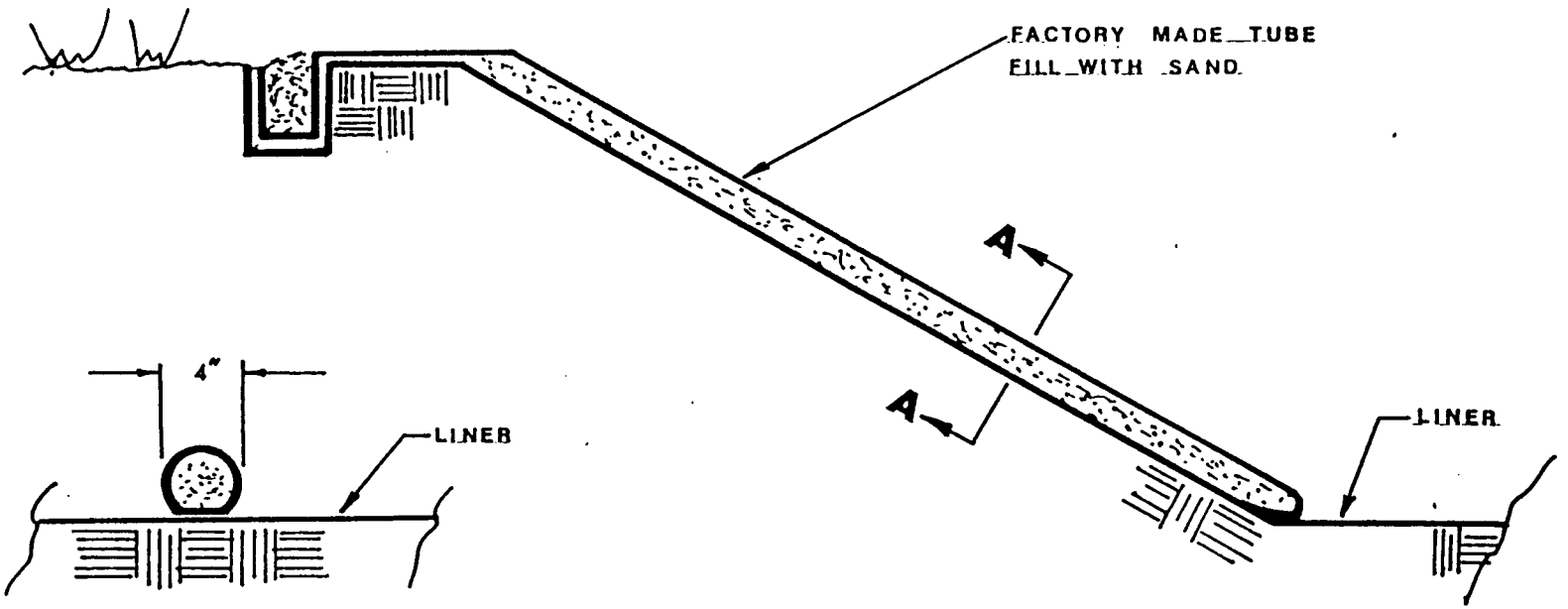
SECTION X-X



OPTIONAL METHOD

NOTE: RECOMMENDED SPACING IS ONE (1) VENT EVERY 50'

WATERSAVER CO., INC.		
SCALE: nts	APPROVED BY	DRAWN BY
DATE:		
AIR/GAS VENT DETAIL		
		DRAWING NUMBER **WS DET 6**



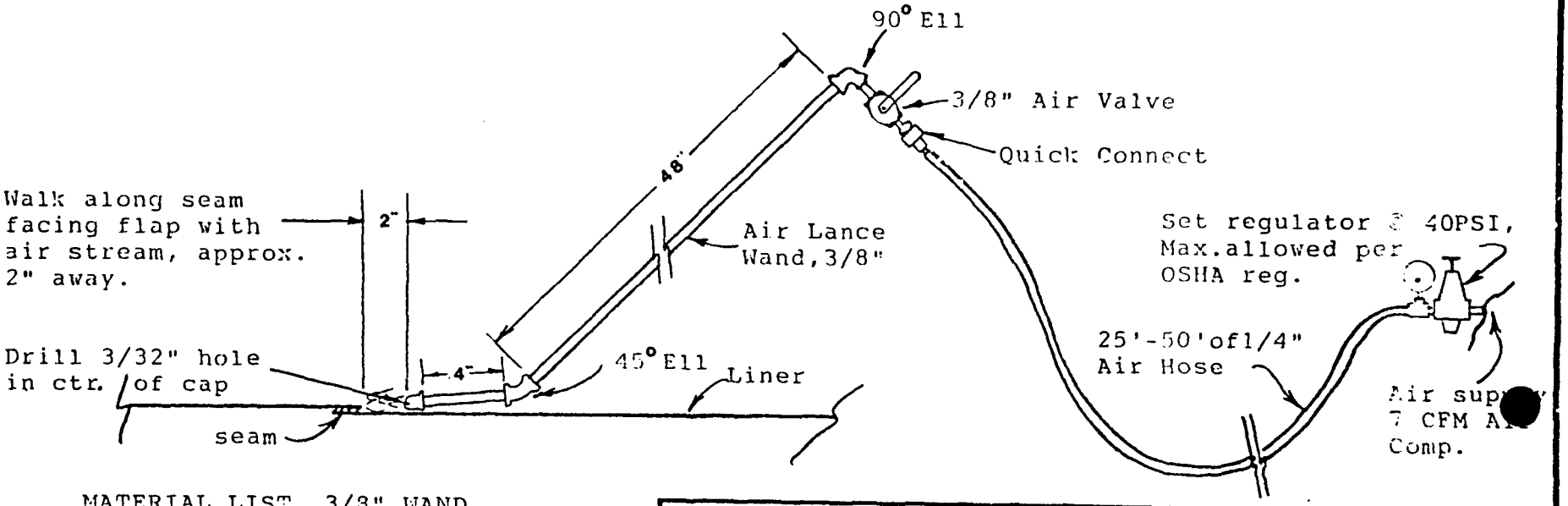
SEC. A-A

NOTE: RECOMMENDED SPACING IS ONE (1) TUBE EVERY 50'

WATERSAVER CO., INC.		
SCALE: nts	APPROVED BY	DRAWN BY
DATE:		
WIND PROTECTION TUBE		
		DRAWING NUMBER WS DET 7

TELEDYNE POST 18AB-01

FIELD SEAM TESTING-AIR LANCE METHOD: In addition to a visual inspection, the installation contractor shall furnish all the necessary equipment and shall test in the presence of the engineer or inspector.
The test consists of using a 3/32" air nozzle held at a 45 degree angle to the field seam approximately 2" off the edge of the material using a minimum of 30 psi-maximum 40 psi. The air shall be directed towards the seam edge, upper edge and surface to detect loose edges. Riffles indicating unbonded areas within the seam or other undesireable seam conditions shall be patched using care to extend the patch a minimum of 3" beyond all affected areas. The patch should then be tested using the same air lance test method.



MATERIAL LIST, 3/8" WAND

1-CAP
1-4" NIPPLE
1-45 DEGREE ELL
1-48" of 3/8" PIPE
1-90 DEGREE ELL
1-SHORT NIPPLE
1-AIR VALVE
1-QUICK CONNECT
1-25'of 1/4" AIR HOSE

WATERSAVER CO., INC.

SCALE:	APPROVED BY	DRAWN BY
DATE:		

AIR LANCE TEST

DRAWING NUMBER
WS DET 8

TELEDYNE POST 18AB-01

WATERSAVER COMPANY, INC.

P.O. BOX 16465 • DENVER, COLORADO 80216-0465 • (303) 289-1818

Plant and Office — 5870 E. 56th Avenue, Commerce City, Colorado 80022-3932

Established 1948

PANEL INCREMENT SHEET

MATERIAL TYPE & THICKNESS	PVC 10-20-30 &50	PVC 40	CPE-OR/CPER-OR 30-36-45	HYPALON 36-45-60	XR-5 30
ROLL WIDTH BEFORE FABRICATION	(76¼")	(72")	(72")	(76")	(58")
FACTORY INCREMENTS					
1	6.35'	6'	6'	6.33	4.83'
2	12.5	12	12	12.5	9.5
3	19	18	18	18.75	14.25
4	25.25	24	24	25	19
5	31.5	30	30	31.25	23.75
6	38	36	36	37.5	28.5
7	44.25	42	42	43.75	33.25
8	50.5	48	48	50	38
9	57	54	54	56.25	42.75
10	63.6	60	60	62.5	47.5
11	70	66	66	68.75	52.25
12	76	72	72	75	57
13	82.25				
14	88.5				
15	94.7				
16	101				

[NOTE: PANEL WIDTHS EXCEEDING THOSE SHOWN SUBJECT TO PLANT APPROVAL.]

STOCK PANEL SIZE

10 PVC- 70'x750'
20 PVC- 70'x400'
30 PVC- 70'x300'

MATERIAL WEIGHT PER SQ.FT.

10 PVC- .065
20 PVC- .125
30 PVC- .190
40 PVC- .250
50 PVC- .320

30 CPE-OR -.215
36 CPER-OR -.240

36 HYP-.250
45 HYP-.312
60 HYP-.420

XR-5: 30 OZ. PER SQ.YD.

9/88

Appendix B

P. O. BOX 1468
MONAHANS, TEXAS 79756
PH. 943-3234 OR 563-1040

Martin Water Laboratories, Inc.

709 W. INDIANA
MIDLAND, TEXAS 79701
PHONE 683-4521

RESULT OF WATER ANALYSES

LABORATORY NO. 989243

TO: Mr. David Demel
P.O. Box 728, Hobbs, NM

SAMPLE RECEIVED 9-25-89
RESULTS REPORTED 10-3-89

COMPANY Texaco, Inc. LEASE Vacuum Area
FIELD OR POOL Vacuum
SECTION ___ BLOCK ___ SURVEY ___ COUNTY Lea STATE NM
SOURCE OF SAMPLE AND DATE TAKEN:

NO. 1 Raw water - taken @ Texaco Buckeye Office. 9-25-89
NO. 2 Raw water - taken @ Buckeye store. 9-25-89
NO. 3 Raw water - taken from windmill (section 6). 9-25-89
NO. 4 Raw water - taken from windmill (section 12). 9-15-89

REMARKS: Samples taken by Tom Elrod, Martin Water Labs., Inc.

CHEMICAL AND PHYSICAL PROPERTIES	NO. 1	NO. 2	NO. 3	NO. 4
Specific Gravity at 60° F.	1.0018	1.0014	1.0013	1.0011
pH When Sampled				
pH When Received	7.50	7.40	7.60	7.60
Bicarbonate as HCO_3	278	281	210	205
Supersaturation as $CaCO_3$				
Undersaturation as $CaCO_3$				
Total Hardness as $CaCO_3$	424	344	238	216
Calcium as Ca	136	113	72	66
Magnesium as Mg	20	15	14	13
Sodium and/or Potassium	27	9	14	14
Sulfate as SO_4	77	75	47	25
Chloride as Cl	124	38	34	37
Iron as Fe	0.11	0.07	1.4	0.36
Barium as Ba				
Turbidity, Electric				
Color as Pt				
Total Solids, Calculated	662	531	392	359
Temperature °F.				
Carbon Dioxide, Calculated				
Dissolved Oxygen, Winkler				
Hydrogen Sulfide	0.0	0.0	0.0	0.0
Resistivity, ohms/m at 77° F.	11.84	16.60	22.50	24.20
Suspended Oil				
Filtrable Solids as mg/l				
Volume Filtered, ml				
Nitrate, as N	4.1	6.7	2.4	4.0

Results Reported As Milligrams Per Liter

Additional Determinations And Remarks

Form No. 3

By ___

P. O. BOX 1468
MONAHANS, TEXAS 79756
PH. 943-3234 OR 563-1040

Martin Water Laboratories, Inc.

709 W. INDIANA
MIDLAND, TEXAS 79701
PHONE 683-4521

RESULT OF WATER ANALYSES

LABORATORY NO. 989243 (Page 2)

TO: Mr. David Demel
P.O. Box 728, Hobbs, NM

SAMPLE RECEIVED 9-25-89

RESULTS REPORTED 10-3-89

COMPANY Texaco, Inc. LEASE Vacuum Area

FIELD OR POOL Vacuum

SECTION ___ BLOCK ___ SURVEY ___ COUNTY Lea STATE NM

SOURCE OF SAMPLE AND DATE TAKEN:

NO. 1 Raw water - taken from Vacuum Grayburg San Andres Unit water well #1. 9-25-89

NO. 2 Raw water - taken from Vacuum Grayburg San Andres Unit water well #4. 9-25-89

NO. 3 Raw water - taken from Central Vacuum Unit water well #2. 9-25-89

NO. 4 Raw water - taken from Central Vacuum Unit water well #3. 9-25-89

REMARKS:

CHEMICAL AND PHYSICAL PROPERTIES	NO. 1	NO. 2	NO. 3	NO. 4
Specific Gravity at 60° F.	1.0011	1.0010	1.0014	1.0038
pH When Sampled				
pH When Received	7.60	7.70	7.90	7.60
Bicarbonate as HCO_3	207	190	200	171
Supersaturation as $CaCO_3$				
Undersaturation as $CaCO_3$				
Total Hardness as $CaCO_3$	352	188	264	1,900
Calcium as Ca	109	58	83	544
Magnesium as Mg	19	11	14	131
Sodium and/or Potassium	69	17	31	272
Sulfate as SO_4	29	19	26	94
Chloride as Cl	213	35	99	1,598
Iron as Fe	0.14	0.14	0.04	0.04
Barium as Ba				
Turbidity, Electric				
Color as Pt				
Total Solids, Calculated	647	330	453	2,810
Temperature °F.				
Carbon Dioxide, Calculated				
Dissolved Oxygen, Winkler				
Hydrogen Sulfide	0.0	0.0	0.0	0.0
Resistivity, ohms/m at 77° F.	10.15	26.10	16.38	1.98
Suspended Oil				
Filtrable Solids as mg/l				
Volume Filtered, ml				
Nitrate, as N	4.6	3.9	3.1	1.8
Results Reported As Milligrams Per Liter				
Additional Determinations And Remarks				

Form No. 3

By ___

P. O. BOX 1468
MONAHANS, TEXAS 79756
PH. 943-3234 OR 563-1040

Martin Water Laboratories, Inc.

709 W. INDIANA
MIDLAND, TEXAS 79701
PHONE 683-4521

RESULT OF WATER ANALYSES

LABORATORY NO. 989243 (Page 3)

TO: Mr. David Demel
P.O. Box 728, Hobbs, NM

SAMPLE RECEIVED 9-25-89

RESULTS REPORTED 10-3-89

COMPANY Texaco, Inc. LEASE Vacuum Area

FIELD OR POOL Vacuum

SECTION ___ BLOCK ___ SURVEY ___ COUNTY Lea STATE NM

SOURCE OF SAMPLE AND DATE TAKEN:

NO. 1 Raw water - taken from Central Vacuum Unit water well @ Texaco Plant. 9-25-89

NO. 2 Raw water - taken @ New Mexico Potash #1. 9-25-89

NO. 3 Raw water - taken @ New Mexico Potash #5. 9-25-89

NO. 4 Raw water - taken @ New Mexico Potash #7. 9-25-89

REMARKS:

CHEMICAL AND PHYSICAL PROPERTIES	NO. 1	NO. 2	NO. 3	NO. 4
Specific Gravity at 60° F.	1.0014	1.0018	1.0012	1.0011
pH When Sampled				
pH When Received	7.30	7.30	7.50	7.90
Bicarbonate as HCO_3	200	200	190	210
Supersaturation as $CaCO_3$				
Undersaturation as $CaCO_3$				
Total Hardness as $CaCO_3$	260	228	208	184
Calcium as Ca	88	75	69	62
Magnesium as Mg	10	10	9	7
Sodium and/or Potassium	36	51	36	42
Sulfate as SO_4	29	31	19	25
Chloride as Cl	102	101	78	55
Iron as Fe	0.14	0.04	0.04	0.07
Barium as Ba				
Turbidity, Electric				
Color as Pt				
Total Solids, Calculated	465	467	401	402
Temperature °F.				
Carbon Dioxide, Calculated				
Dissolved Oxygen, Winkler				
Hydrogen Sulfide	0.0	0.0	0.0	0.0
Resistivity, ohms/m at 77° F.	16.10	16.02	19.60	21.00
Suspended Oil				
Filtrable Solids as mg/l				
Volume Filtered, ml				
Nitrate, as N	3.5	3.0	4.0	4.0

Results Reported As Milligrams Per Liter

Additional Determinations And Remarks

Form No. 3

By ___

P. O. BOX 1468
MONAHANS, TEXAS 79756
PH. 943-3234 OR 563-1040

Martin Water Laboratories, Inc.

709 W. INDIANA
MIDLAND, TEXAS 79701
PHONE 683-4521

RESULT OF WATER ANALYSES

LABORATORY NO. 989243 (Page 4)

TO: Mr. David Demel
P.O. Box 728, Hobbs, NM

SAMPLE RECEIVED 9-25-89

RESULTS REPORTED 10-3-89

COMPANY Texaco, Inc. LEASE Vacuum Area

FIELD OR POOL Vacuum

SECTION ___ BLOCK ___ SURVEY ___ COUNTY Lea STATE NM

SOURCE OF SAMPLE AND DATE TAKEN:

NO. 1 Raw water - taken @ New Mexico Potash #8. 9-25-89

NO. 2 Raw water - taken from Amex water supply well. 9-25-89

NO. 3 Raw water - taken from Western Ag. mineral 15-18 water well #1. 9-25-89

NO. 4 Raw water - taken from Western Ag. mineral 15-18 water well #4. 9-25-89

REMARKS:

CHEMICAL AND PHYSICAL PROPERTIES	NO. 1	NO. 2	NO. 3	NO. 4
Specific Gravity at 60° F.	1.0021	1.0013	1.0013	1.0013
pH When Sampled				
pH When Received	7.10	7.30	7.35	7.40
Bicarbonate as HCO_3	200	205	205	215
Supersaturation as $CaCO_3$				
Undersaturation as $CaCO_3$				
Total Hardness as $CaCO_3$	440	260	212	176
Calcium as Ca	140	77	70	59
Magnesium as Mg	22	17	9	7
Sodium and/or Potassium	66	19	33	36
Sulfate as SO_4	27	31	27	25
Chloride as Cl	277	72	62	37
Iron as Fe	0.07	0.29	0.11	0.07
Barium as Ba				
Turbidity, Electric				
Color as Pt				
Total Solids, Calculated	732	421	406	379
Temperature °F.				
Carbon Dioxide, Calculated				
Dissolved Oxygen, Winkler				
Hydrogen Sulfide	0.0	0.0	0.0	0.0
Resistivity, ohms/m at 77° F.	8.53	18.10	20.20	23.70
Suspended Oil				
Filtrable Solids as mg/l				
Volume Filtered, ml				
Nitrate, as N	3.1	4.5	3.9	6.8

Results Reported As Milligrams Per Liter

Additional Determinations And Remarks

Form No. 3

By ___

Appendix C

LARRY'S DRILLING & PUMP CO.
2116 W. BENDER HOBBS, N.M.

DRILLING LOGES ON TEST WELLS FOR TEXACO AT BUCKEYE, N.M.

WELL #10-TD 234 FT.

0	- 2	TOP SOIL LOOSE ROCK
2	- 20	CALICHE
20	- 27	HARD CALICHE RED ROCK
27	- 30	CALICHE
30	- 34	SAND GRAVEL
34	- 37	HARD RED ROCK
37	- 56	SAND
56	- 84	FINE SAND
84	- 208	SAND REAL SOFT
208	- 214	CORSE SAND GRAVEL
214	- 232	GRAVEL
232	- 234	RED BED

WELL #11-TD 240 FT.

0	- 6	TOP SOIL LOOSE ROCK
6	- 35	CALICHE
35	- 50	RED & WHITE ROCK SAND
50	- 53	VOID LOST CIRCULATION
53	- 142	SAND WHITE ROCK CLAY
142	- 180	SAND SOME GRAVEL
180	- 219	SAND WHITE ROCK
219	- 238	GRAVEL
238	- 240	RED BED

WELL #12 TD 230 FT.

0	- 2	TOP SOIL
2	- 31	CALICHE
31	- 33	HARD RED ROCK
33	- 50	CALICHE SAND
50	- 60	SAND
60	- 90	FINE SAND WHITE ROCK
90	- 100	ROCK SAND CLAY
100	- 190	SAND WHITE ROCK
190	- 218	SAND SOME CLAY & GRAVEL
218	- 228	GRAVEL
228	- 230	RED BED

WELL #13

0	- 1	TOP SOIL
1	- 10	CALICHE
10	- 16	HARD RED ROCK
16	- 23	CALICHE THIN LAYERS RED ROCK
23	- 26	HARD WHITE & RED ROCK
26	- 34	CALICHE
34	- 39	HARD RED ROCK
39	- 58	SAND CLAY
58	- 68	FINE SAND
68	- 118	SAND CLAY WHITE ROCK
118	- 140	CORSE SAND WHITE ROCK CLAY
140	- 190	SAND THIN WHITE ROCK CLAY
190	- 218	SAND WHITE ROCK LITTLE GRAVEL
218	- 228	GRAVEL
228	- 230	RED BED

WELL #14 230 FT.

0	- 2	TOP SOIL
2	- 22	CALICHE
22	- 36	BARD RED ROCK
36	- 50	SAND
50	- 54	CALICHE
54	- 90	SAND
90	- 116	THIN LAYERS WHITE ROCK SAND & CLAY
116	- 134	SAND CLAY
134	- 178	SAND SOME GRAVEL
178	- 203	SAND
203	- 218	SAND GRAVEL SOME CLAY
218	- 228	GRAVEL
228	- 230	RED BED

WELL # 15 TD 230 FT.

0	4	BLACK DIRT
4	12	HARD ROCK
12	20	SOFT CALICHE
20	25	SAND CLAY
25	30	HARD CALICHE
30	50	SAND CLAY CALICHE
50	80	SAND
80	100	SAND WHITE ROCK
100	138	SAND SOME GRAVEL & CLAY
138	205	SAND GRAVEL
205	220	HARDER SAND GRAVEL WHITE ROCK
220	228	GRAVEL
228	230	RED BED

WELL # 16 TD 233 FT.

0	33	CALICHE
33	38	HARD RED ROCK
38	63	SAND CLAY WHITE ROCK
63	120	SAND WHITE ROCK
120	130	SOFT SAND
130	180	SAND CLAY
180	216	SAND SOME WHITE ROCK
216	231	GRAVEL
231	233	RED BED

WELL # 17 TD 225 FT.

0	5	TOP SOIL CLAY
5	33	CALICHE
33	42	SAND
42	50	RED &WHITE ROCK
50	88	SAND & CLAY
88	110	SAND WHITE ROCK CLAY
110	144	SAND & CLAY
144	180	SAND GRAVEL
180	212	SAND CLAY GRAVEL
212	223	GRAVEL
223	225	RED BED

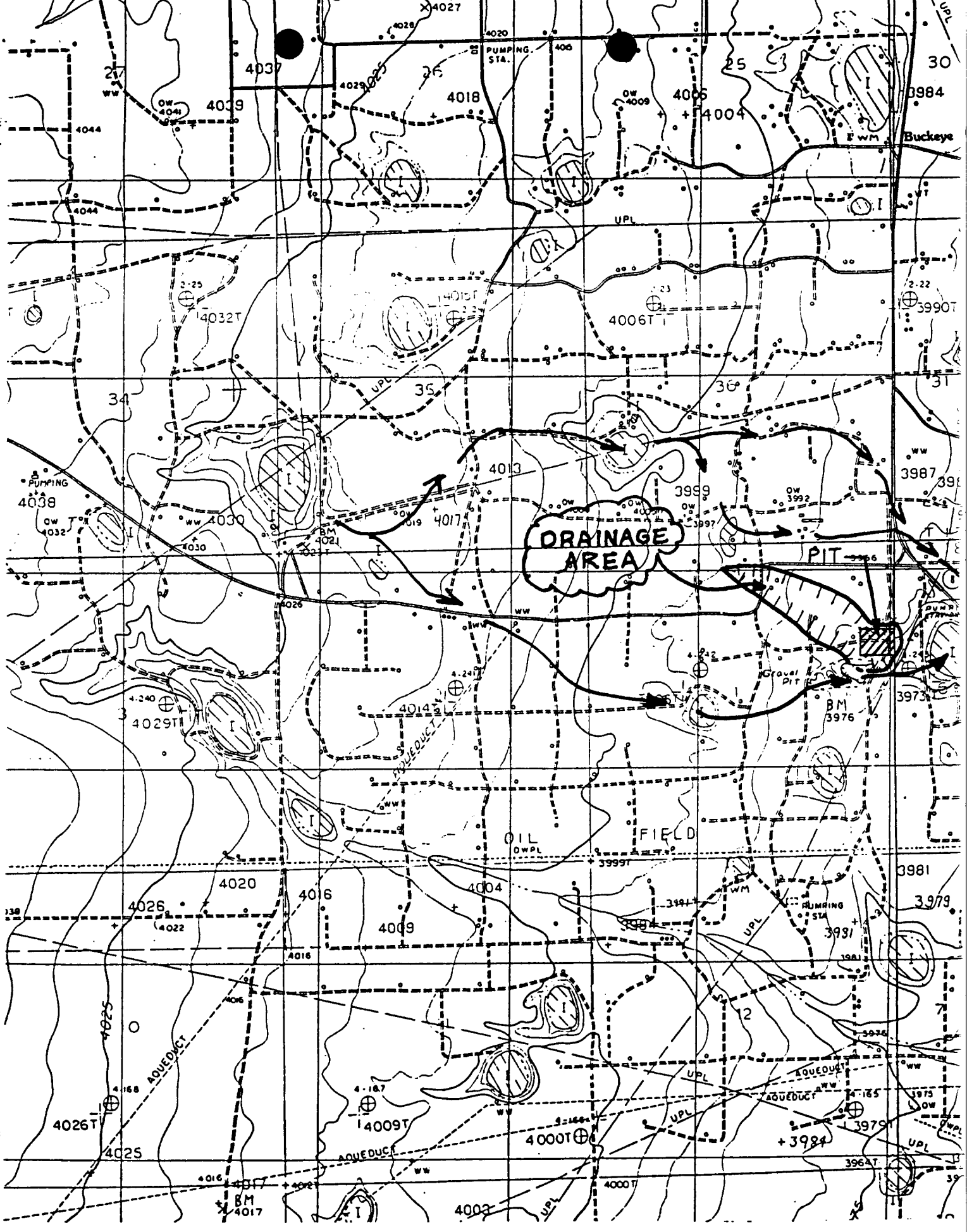
WELL # 18 TD 237 FT.

0	10	CALICHE
10	20	CALICHE HARD RED ROCK
20	26	HARD RED ROCK
26	34	SAND
34	38	HARD RED &WHITE ROCK
38	52	SAND THIN LAYERS ROCK
52	58	CALICHE
58	62	SAND WHITE ROCK
62	116	SAND REAL FINE
116	120	SAND WHITE ROCK
120	140	RED & WHITE ROCK
140	152	FINE BROWN SAND
152	190	CORSE SAND & GRAVEL
190	205	SAND
205	220	SAND WHITE ROCK
220	235	GRAVEL
235	237	RED BED

WELL # 19 226 FT.

0	8	BLACK DIRT
8	14	CLAY
14	22	CALICHE
22	31	SAND
31	32	WHITE ROCK
32	48	SAND WHITE ROCK
48	65	FINE SAND
65	110	SAND WHITE ROCK
110	139	HARD BROWN CLAY SAND WHITE ROCK
139	163	SAND SOME GRAVEL SOFT
163	207	SAND
207	215	SAND CLAY SOME GRAVEL
215	225	GRAVEL
225	226	RED BED

Appendix D



DRAINAGE MAP

Appendix E

JOHN WEST ENGINEERING
HOBBS, NEW MEXICO

CHKD. BY ____ DATE ____ PROJECT TEXACO PRODUCING, INC SHEET NO. 1 OF 1

SUBJECT BUCKEYE AREA SALTWATER RETENTION JOB. NO. ____

WAVE ANALYSIS; FREEBOARD CALCULATIONS BY KLD DATE 4/26/90

REFERENCE: "STANDARD HANDBOOK FOR CIVIL ENGINEERS"
EDITOR: FREDERICK S. MERRITT

FROM MOLITOR FORMULA pg 23-5

$H = 0.17\sqrt{UF} + 2.5\sqrt[4]{F}$

$H_M = 2.41'$

USE $H_M = 2.5'$

$F = 0.09$ miles
$U = 80$ mph
H_S = SIGNIFICANT WAVE HEIGHT
H_M = MAXIMUM WAVE HEIGHT

$H_M = 1.87 H_S$

$\frac{H_M}{H_S} = H_F$ = HEIGHT FACTOR

VERIFY WITH CORPS OF ENGINEERS FORMULA, pg 23-6 (EQ. 23-11)

$H_M = 0.0555\, U F^{0.5} (H_F)$

$H_M = 0.0555(80)(0.09)^{1/2}(1.87)$

$H_M = 2.49'$ ✓ CHECKS

~~$T = 5U^{0.5} F^{0.25}$~~

USE
$H_M = 2.5'$

Appendix F

CONTECH
C112 DRAINAGE COMPOSITE

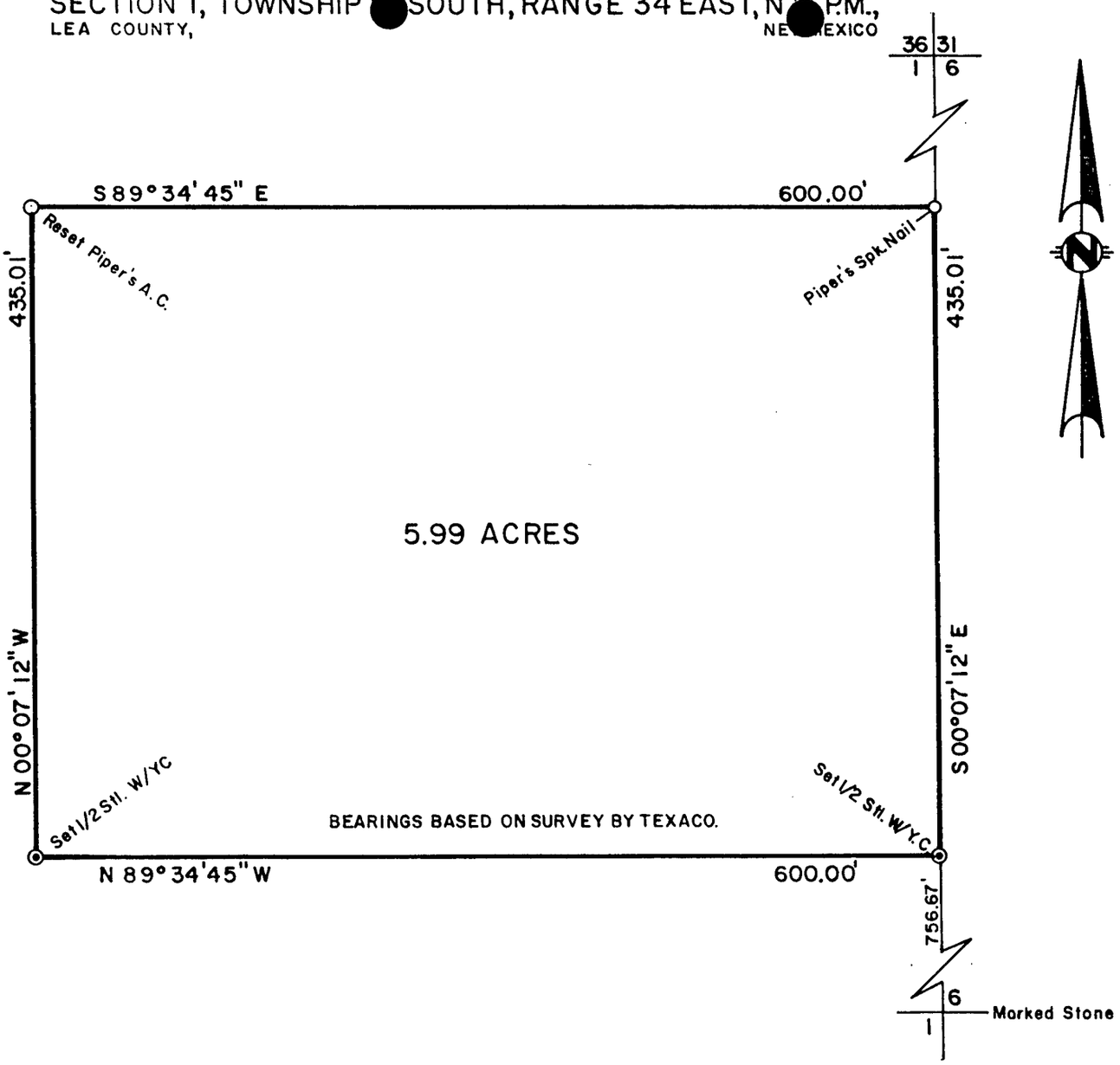
Contech Drainage Composite C112 consists of a nonwoven geotextile bonded to one side of a drainage net . A three inch overlap of geotextile will be present on two edges of the bonded net. Drainage geocomposites with higher-strength interior drainage cores are especially suitable for ground water collection and seepage pressure relief on retaining walls, building foundations and like underground structures subject to high dead and/or live loadings or where high resistance to creep deformation is needed.

PROPERTY	VALUE	TEST METHOD
Drainage Net:		
Peak Tensile Strength MD CMD	 260 lbs./foot 130 lbs./foot	 ASTM D638
Thickness	.22 inches	N/A
Polymer Specific Gravity	.922 grams/cm.^{3}	ASTM D1505
Polymer Carbon Black Stabilization	2.5 %	ASTM D4218
Geotextile (Min. Average Roll Values)		
Grab Tensile Strength	80 lbs.	ASTM D4632
Grab Elongation	50 %	ASTM D4632
Puncture Resistance	40 lbs.	ASTM D3787
Trapezoidal Tear Resistance	30 lbs.	ASTM D4533
Mullen Burst Strength	170 psi	ASTM D3786
A.O.S.	70-100	ASTM D4751
Permeability	.26 cm./sec.	ASTM D4491
Finished Product Dimensions:		
Roll Length	25 or 100 feet	
Roll Weight	5.2 feet	
Roll Weight	25 lbs. and 99 lbs.	
Wrapped in Polybag		

CONTECH
CONSTRUCTION PRODUCTS INC.

134689

SECTION 1, TOWNSHIP [redacted] SOUTH, RANGE 34 EAST, N.M.P.M.,
LEA COUNTY, NE[redacted]EXICO



LEGAL DESCRIPTION

A tract of land located in Section 1, Township 18 South, Range 34 East, N.M.P.M., Lea County, New Mexico and being more particularly described as follows:

Beginning at a point on the East Section Line, which lies N00°07'12"W, a distance of 756.67 feet from the East Quarter corner of said Section 1;

Thence N89°34'45"W, a distance of 600.00 feet; thence N00°07'12"W a distance of 435.01 feet; thence S89°34'45"E a distance of 600.00 feet to a point on the East Section line; thence S00°07'12"E a distance of 435.01 feet to the Point of Beginning and containing 5.99 acres, more or less, all being within the SE/4 NE/4 of said Section 1.

EXHIBIT "A"

I HEREBY CERTIFY THAT THIS PLAT WAS MADE FROM NOTES TAKEN IN THE FIELD IN A BONA FIDE SURVEY MADE UNDER MY SUPERVISION, AND THAT THE SAME IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

JOHN W. WEST, N.M. P.E. & L.S. No. 676
TEXAS R.P.S. No. 1138
RONALD J. EIDSON, N.M. L.S. No. 3239
TEXAS R.P.S. No. 1883

TEXACO, INC.

A tract of land located in Section 1, Township 18 South, Range 34 East, N.M.P.M., Lea County, New Mexico.

JOHN W. WEST ENGINEERING COMPANY
CONSULTING ENGINEERS HOBBS, NEW MEXICO

Scale: 1" = 100'		Drawn By: Presley
Date: 2/9/90	Ck. GJ	Sheet 1 of 1 Sheets

PROJECT SITE

Buckeye

OIL FIELD

Gravel Pit

PUMPING STA.

BM 4027

BM 4021

BM 3976

BM 4017

BM 3950

UPL

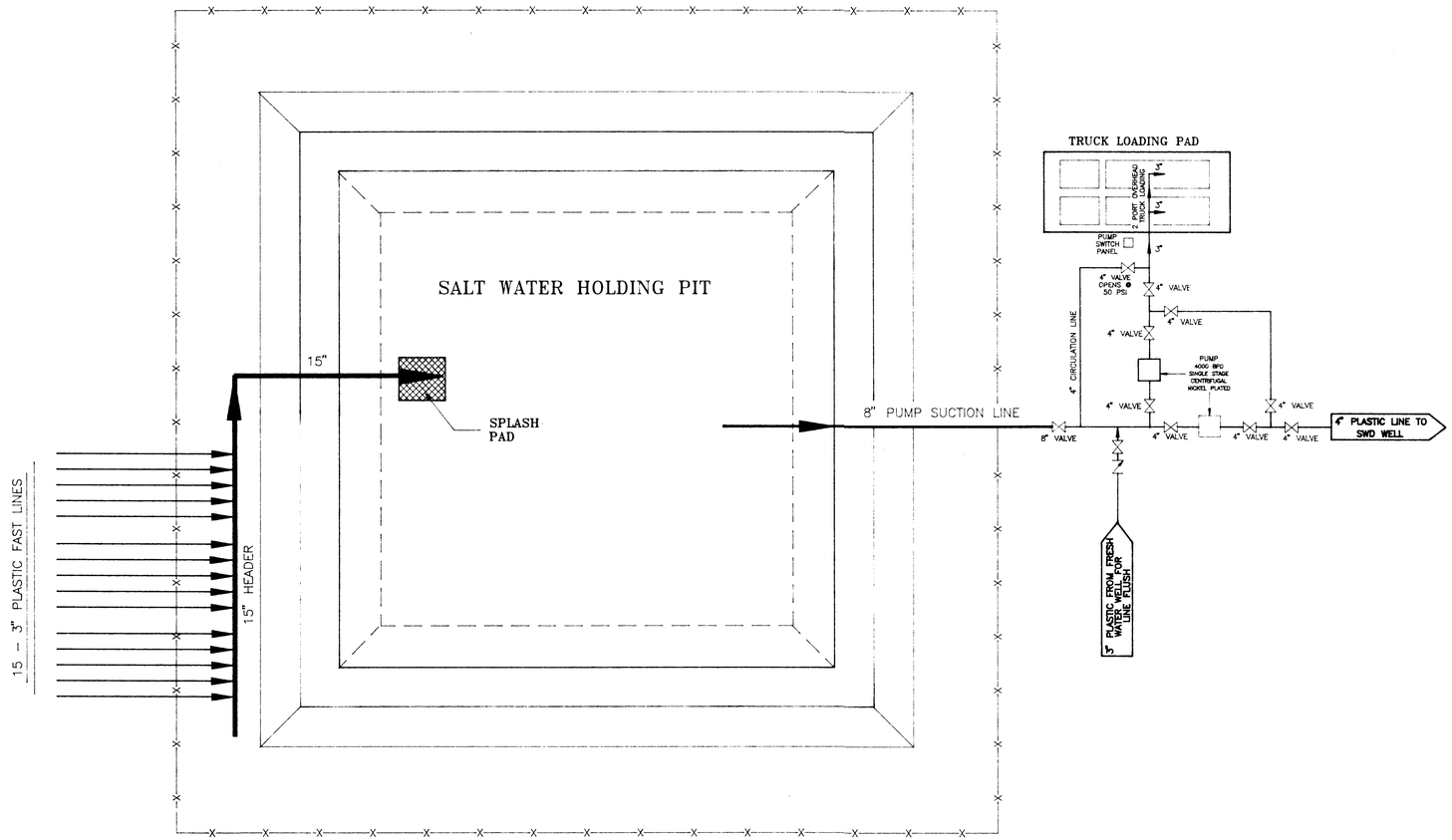
DWPL

AQUEDUCT

FRQUEDUCT

EXHIBIT "B"

TOPO MAP



SALTWATER RETENTION BASIN – PIPING SCHEMATIC

NOT TO SCALE

EXHIBIT "C"

TEXACO PRODUCING, INC.

BUCKEYE AREA
SALTWATER RETENTION BASIN

JOHN WEST ENGINEERING CO.
CONSULTANTS
HOBBS NEW MEXICO

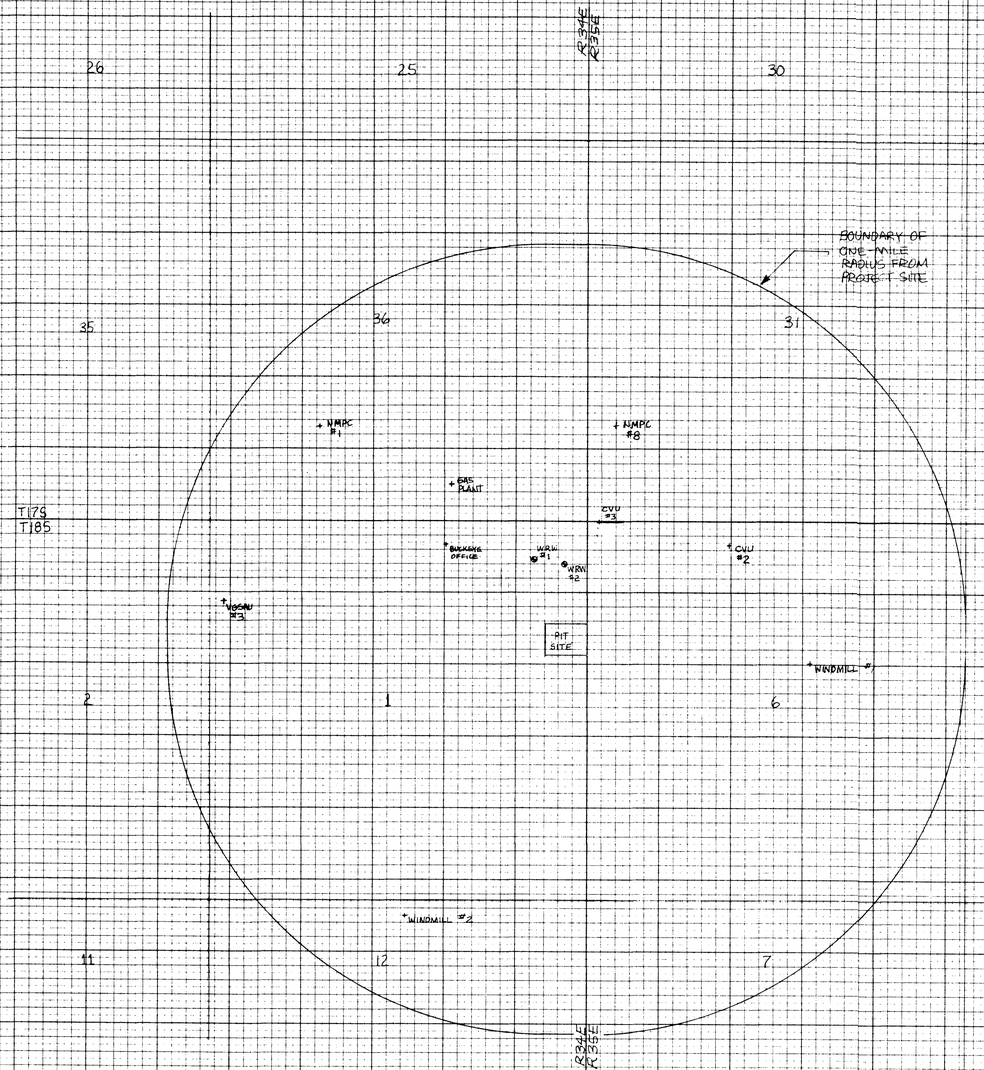
Surveyed By	Drawn By S. STANFIELD	Last Rev. Date 4-26	Drawing Number
Date Begin	Date 4-22-90	Disk KLD-1	
Date End	Checked By KLD	Sheet 1 of 1	
Project Number:	File Name: TXSWDSCH.DWG (KLD-1)		

FINAL SURVEY — SURVEYED, PLOTTED, TEMPLATE, AREAS, AREAS CHECKED, NOTE BOOK, NO., BY, DATE

ORIGINAL SURVEY — SURVEYED, PLOTTED, TEMPLATE, AREAS, AREAS CHECKED, NOTE BOOK, NO., BY, DATE

FRESH WATER SUPPLY WELL
WATER USAGE

WELL	USE
VGSAU #1	OILFIELD WATERFLOOD INJECTION
NMPC #1	POTASH MINING
NMPC #8	POTASH MINING
CVU #3	OILFIELD WATERFLOOD INJECTION
~~CVUUWSW#3~~	" " " "
CVU #2	" " " "
GAS PLANT	PRIVATE SUPPLY
BUCKEYE OFC	" "
WINDMILL #1	STOCK
WINDMILL #2	STOCK



LEGEND

- + WATER SUPPLY WELL
- ✦ WATER RECOVERY WELL (SEE NOTE)

NOTE: QUARTERLY TESTING OF WATER QUALITY IN AREA FRESH WATER WELLS REVEALED CHLORIDE CONTAMINATION IN CVU #3. TEXACO AND THE STATE OF NEW MEXICO OIL CONSERVATION DIVISION ISOLATED THE CAUSE TO A CASING LEAK IN AN OILFIELD PRODUCTION WELL. WRW #1 AND #2 WERE DRILLED TO CLEAN UP THE CONTAMINATION. FOR A COMPLETE REPORT ON THIS UNRELATED INCIDENT SEE APPENDIX "A" TO THIS APPLICATION.

EXHIBIT "D"

TEXACO PRODUCING, INC.
BUCKEYE AREA
SALTWATER RETENTION BASIN
AREA WATER SUPPLY WELLS
JOHN WEST ENGINEERING CO.
DRAWN BY: RJD — DRAWING NO.:
DATE: 4/25/90

HIGHWAY FEDERAL AID SHEET
PLATE 3-FULL CROSS SECTION-FULL LINE
TELEDYNE
PRINTED IN U.S.A.