NM2 - 11

GENERAL CORRESPONDENCE YEAR(S):

2004 - 1993

NEW MEXICO ENERGY, MINERALS and NATURAL RESOURCES DEPARTMENT

BILL RICHARDSON
Governor
Joanna Prukop
Cabinet Secretary

September 20, 2004

Mark E. Fesmire, P.E.
Director
Oil Conservation Division

Mr. Buddy Shaw
BP America Production Co.
200 Amoco Court
Farmington, NM 87401

Dear Mr. Shaw:

Since the New Mexico Oil Conservation Division (NMOCD) promulgated Rule 50 covering pits and below-grade tanks, there has arisen a need, in certain circumstances, for operators to transport their drill cuttings off-site and dispose of them.

NMOCD Rule 711, as it pertains to landfarms, does not specifically address the issue of exempt oilfield wastes that may be contaminated with salts. Your landfarm application and permit were written with only hydrocarbon-contaminated soils in mind. Salt-contaminated wastes cause the following problems:

1. Lessening the effectiveness of the biodegradation capacity of your landfarm
2. Rapid leachability causing adverse effects on groundwater

If you want to accept salt-contaminated cuttings or any other salt-contaminated wastes, your 711 permit must be modified to ensure that your acceptance of those wastes will not adversely affect public health or the environment.

Please check one of the following:

☐ I have accepted or intend to accept salt-contaminated wastes in my landfarm. An OCD form C-137, applying for a modification to my 711 permit is attached. Included, as an attachment, is a demonstration that the accepted salt-contaminated soils will not adversely affect groundwater in the foreseeable future. (Closure requirements will also require modification to ensure the protection of groundwater. Should your acceptance of salt-contaminated wastes prove detrimental to groundwater, future liability for such damage rests with the landfarm operator).

☐ I do not intend to accept salt-contaminated wastes in my landfarm. Should this condition change, I will submit an OCD Form C-137 for a modification to my 711 permit at that time.

New Mexico Oil Conservation Division
Attn: Ed Martin
1220 S. St. Francis
Santa Fe, NM 87505

This letter must be returned to the above address no later than October 31, 2004. An extension of time may be granted if you contact this office no later than that date.

If you have any questions, contact Ed Martin (505) 476-3492 or emartin@state.nm.us

Signed _____ Date _____

Kieling, Martyne

From: Hoffman, Wilmer [hoffmawj@bp.com]
Sent: Thursday, November 06, 2003 9:27 AM
To: mkieling@state.nm.us
Subject: Amoco Evaporation Pond Engineering Drawings

Dear Martyne Kieling,

My name is Wilmer Hoffman and I am a production engineer with BP America Production Company based out of Farmington, NM. I just started my role here in August and was wanting to see if you had some information that Amoco had filed with you in 1997-1998 time frame. I know it is a long shot since it was a long time ago, but I understand from our documents that some engineering design blueprints were turned into you for one of our evaporation ponds. The information I have that could help you locate them if you keep those records are as follows:

AMOCO Manzaneres Mesa Surface Waste Management Facility
E/2 NW/14 of Section 4, Township 29 North, Range 8 West, NMPM, San Juan County, New Mexico

We have a letter dated November 8,1997 from Mr. John E. Boysen with B.C. Technologies, Ltd. addressed to you personally stating that enclosed were two copies of engineering design blueprints of the pond and containment systems, engineering and design specs of the moisture sensor grid, and current usage of moisture sensor technology per your request to Mr. Buddy Shaw of AMOCO dated 10/29/97. Apparantly there were 9 blueprints provided.

We have this letter in our records but for some reason do NOT have the blueprints. I am currently working on engineering a new installation for an evaporation pond in our field but would like to have some previous engineering drawings of ponds we had installed. I was wondering if your office or yourself kept records/files of these on hand that I could have you send to me. I know it is a long shot since it was so long ago, but I thought I would try. If you could let me know either way whether or not you have them, I would appreciate it.

Thank you for any help you can provide,

Wilmer J. Hoffman
Production Engineer
BP America
San Juan Operations Center
Office: 505.326.9221
Fax: 505.326.9262
Cell : 832.651.6057
BOOMER SOONER!

200 Energy Court . . .

Kieling, Martyne

From: Kieling, Martyne
Sent: Wednesday, August 27, 2003 8:34 AM
To: 'Benko, Brittany D'; Anderson, Roger
Cc: Foust, Denny; Kieling, Martyne
Subject: RE: Manzanares Mesa Waste Management Facility

PERM0698.WPD

Brittany,

This E-mail is a follow up to the phone conversation held on August 27, 2003. The permit for Manzanares is still valid. As you mentioned BP America would propose to modify the permit. The modifications would most likely entail replacing the unlined pond and sensor grid in the original permit with a traditional double synthetic lined, leachate collection pond similar to that at Cahn or Schneider facility. To modify the Rule 711 facility BP America would need to submit a form C-137 with all information regarding the planed design changes. Please also note any modifications to the original landfarm/compost portion of the plan for the facility. Upon receipt of the request for modification the OCD will then determine if this is a minor or major modification to the original permit and if any additional public notice is required.

Attached please find an electronic copy of the permit issued June 26, 1998.

Sincerely

Martyne Kieling
Environmental Geologist

-----Original Message-----
From: Benko, Brittany D [mailto:BenkoBD@bp.com]
Sent: Tuesday, August 26, 2003 3:38 PM
To: 'rcanderson@state.nm.us'
Cc: Denny Foust (E-mail); 'mkieling@state.nm.us'
Subject: Manzanares Mesa Waste Management Facility

Roger,

We permitted an evaporation pond in the Manzanares area of our field (E/2 NW/4 Sec. 4, T29N, R8W) in 1997/1998. The facility was never built. However, we are now once again exploring this option. Our permit was #NM 020011. Is it possible for us to reinstate the permit? If it is possible, would you like us to re-issue public notification with a 30 day comment period? Please let me know if you have further questions.

Thank you,
Brittany D Benko
BP America Production Company
Environmental Coordinator
Farmington, NM
Office (505) 326-9235
Mobile (505) 486-4424
benkobd@bp.com

STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION DIVISION
2040 S. PACHECO
SANTA FE, NEW MEXICO 87505
(505) 827-7131

June 26, 1998

CERTIFIED MAIL
RETURN RECEIPT NO. P-326-936-446

Mr. Buddy Shaw
Amoco Production Company
200 Amoco Court
Farmington, New Mexico 87401

RE: OCD Rule 711 Permit Approval NM-02-0011
Amoco Production Company
Manzanares Mesa Centralized Surface Waste Management Facility
E/2 NW/4 of Section 4, Township 29 North, Range 8 West, NMPM,
San Juan County, New Mexico.

Dear Mr. Shaw:

The **permit application for the Amoco Production Company (Amoco) centralized surface waste management facility** located in the E/2 NW/4 of Section 4, Township 29 North, Range 8 West, NMPM, San Juan County, New Mexico **is hereby approved** in accordance with New Mexico Oil Conservation Division (OCD) Rule 711 under the conditions contained in the enclosed attachment. **This permit approval is conditional upon the receipt and approval by the Director of financial assurance in the amount of $25,000 for this facility or a $50,000 blanket bond for all of Amoco's centralized surface waste management facilities.** According to the enclosed attachment financial assurance is required within thirty (30) days of the date of this permit approval letter. The application consists of the permit application Form C-137 dated July 8, 1997, the public notice dated September 3, 1997, and supplemental materials dated November 14, 1997, and February 25, 1998.

The construction, operation, monitoring and reporting shall be as specified in the enclosed attachment. All modifications and alternatives to the approved landfarming methods must receive prior OCD approval. Amoco is required to notify the Director of any facility expansion or process modification and to file the appropriate materials with the Division.

Please be advised approval of this facility permit does not relieve Amoco Production Company of liability should your operation result in actual pollution of surface water, ground water, or the environment. In addition, OCD approval does not relieve Amoco Production Company of

responsibility for compliance with other federal, state or local laws and/or regulations.

Please be advised that all tanks exceeding 16 feet in diameter and exposed pits, ponds or lagoons must be screened, netted or otherwise rendered nonhazardous to migratory birds. In addition, OCD Rule 310 prohibits oil from being stored or retained in earthen reservoirs, or open receptacles.

The Amoco Manzanares Mesa Centralized Surface Waste Management Facility Permit NM-02-0011 will expire two (2) years from the approval date or June 26, 2000. Amoco may apply to renew the permit for subsequent two (2) year periods. The facility is subject to periodic inspections by the OCD. The conditions of this permit and the facility will be reviewed by the OCD no later than two (2) years from the date of this approval.

Enclosed are two copies of the conditions of approval. **Please sign and return one copy to the OCD Santa Fe Office within five working days of receipt of this letter.**

If you have any questions please do not hesitate to contact Martyne J. Kieling at (505) 827-7153.

Sincerely,

Lori Wrotenbery

Lori Wrotenbery
Director

LW/mjk

xc with attachments:
Aztec OCD Office

ATTACHMENT TO OCD 711 PERMIT APPROVAL
PERMIT NM-02-0011
AMOCO PRODUCTION COMPANY
E/2 NW/4 of Section 4, Township 29 North, Range 8 West, NMPM,
San Juan County, New Mexico
(June 26, 1998)

EVAPORATION POND DESIGN AND CONSTRUCTION

1. The evaporation pond and moisture sensor grid shall be constructed in accordance with the engineering designs submitted as part of the application. The permit application consists of Form C-137 dated July 8, 1997, the public notice dated September 3, 1997, and supplemental materials dated November 14, 1997, and February 25, 1998.

2 This approval is for the specific site and location identified, E/2 NW/4 of Section 4, Township 29 North, Range 8 West, NMPM, San Juan County, New Mexico. The location of the pond shall not be changed from the submitted site plan without specific authorization from the OCD Santa Fe office.

3. The pond shall have a minimum freeboard of two feet (2'). A device shall be installed in the pond to accurately measure freeboard.

4. If the drainage and sump system is to be used, a network of slotted or perforated drainage pipes shall be constructed in accordance with the engineering designs submitted as part of the application with the following modifications. The network shall be of sufficient density so that no point in the pond bed is more than twenty feet (20') from such drainage pipe or lateral thereof. The material placed between the pipes and laterals shall be sufficiently permeable to allow transport of the fluids to the drainage pipe. The slope for all drainage lines and laterals shall be at least six inches (6") per fifty feet (50'). The slope of the pond bed shall also conform to these values to assure fluid flow towards the leak detection system. The drainage pipe shall convey any fluids to a corrosion-proof sump located outside the perimeter of the pond.

5. The Aztec district office shall be notified at least 24 hours in advance of the scheduled installation of the moisture sensor grid and the seepage collection system to afford the opportunity for a Division representative to inspect the leak detection system.

6. A continuously operating aeration system will be installed in the evaporation pond to minimize the possibility of H_2S development. Such a system shall be able to provide sufficient oxygen in the pond to maintain a residual oxygen concentration of 0.5 ppm at one foot off the bottom of the pit. The system shall be designed to permit expansion if

actual oxygen demand exceeds the oxygen demand used in design calculations.

7. Upon completion of construction "as built" completion diagrams of the pond and all pond systems including the aeration system shall be submitted and approved by the Director prior to commencement of operations.

EVAPORATION POND OPERATION

1. A skimmer tank with impermeable secondary containment shall be used to separate any oil from the water prior to allowing the water to discharge into the evaporation pond. The skimmer tank shall be designed to allow for oil/water separation. Oil shall be removed in a timely manner and stored in tanks as per Division General Rule 310. Oil shall not be stored or retained in earthen reservoirs or in open receptacles.

    a. The material of construction shall provide for corrosion resistance.

    b. Siphons or other suitable means shall be employed to draw water from below the oil/water interface for transfer to the evaporation pond. The siphon shall be located as far as possible from the inlet to the skimmer tank.

    c. The skimmer tank shall at all times be kept free of appreciable oil buildup to prevent oil flow into the evaporation pond.

2. To protect migratory birds, all tanks exceeding 16 feet in diameter and exposed pits, ponds or lagoons must be screened, netted, covered or otherwise rendered nonhazardous to migratory birds.

3. Liquid reduction technologies that may be used to eliminate pond waters include evaporation, enhanced evaporation, and freeze thaw.

4. Use of water from the pond on the landfarm or compost areas or for any other beneficial purpose shall be subject to approval on a case-by-case basis. Requests shall be submitted to the Santa Fe OCD office for review. The water to be used is subject to analytical testing. The type of analysis will be dependant upon the request.

5. Weekly testing of all components of the moisture sensor grid and leak detection system will be performed. Results will be recorded and maintained for OCD review.

6. Tests of ambient H_2S levels shall be conducted on a weekly basis. Test results will be

recorded and retained. The tests will be conducted at four (4) locations around the pond at the top of the berm. The wind speed and direction shall be recorded in conjunction with each test.

a. If an H_2S reading of 1.0 ppm or greater is obtained:

   i. a second reading shall be taken on the downwind berm within one hour;

   ii. the dissolved oxygen and dissolved sulfide levels of the pond shall be tested immediately and the need for immediate treatment determined; and

   iii. tests for H_2S levels shall be made at the fence line down wind from the problem pond.

b. If two (2) consecutive H_2S readings of 1.0 ppm or greater are obtained:

   i. the operator shall notify the Aztec office of the OCD immediately;

   ii. the operator shall commence hourly monitoring on a 24-hour basis; and

   iii. the operator will obtain daily analysis of dissolved sulfides in the pond.

c. If an H_2S reading of 10.0 ppm or greater at the facility fence line is obtained:

   i. the operator will immediately notify the Aztec office of the OCD and the following public safety agencies:

      New Mexico State Police
      San Juan County Sheriff
      San Juan County Fire Marshall; and

   ii. the operator will initiate notification of all persons residing with in one-half (½) mile of the fence line and assist public safety officials with evacuation as requested.

7. In order to prevent development of harmful concentrations of H_2S, the following procedures shall be followed:

   a. Water hauler drivers will be instructed to not transport water with possible H_2S content to the facility, and such water is to be transported to an alternate licensed facility with the capacity to accept and treat H_2S contaminated water.

   b. A continuously operating aeration system will be installed in the evaporation pond to minimize the possibility of H_2S development.

   c. Weekly tests shall be conducted and records made and maintained of the pH levels in each pond, and if the pH falls below 7.0 remedial steps shall be taken immediately to raise the pH.

   d. Weekly tests shall be conducted and records made and retained at the facility of the dissolved sulfide concentrations in the pond.

   e. Weekly tests shall be conducted and records made and retained at the facility of the dissolved oxygen levels in the pond. The sample for each test shall be taken one (1) foot from the bottom of the pond. The location of each test shall vary around the pond. If any test shows a dissolved residual oxygen level of less than 0.5 ppm, immediate steps shall be taken to raise the oxygen level to at least 0.5 ppm. The steps may include adding chemicals or increasing aeration.

LANDFARM AND COMPOST CONSTRUCTION

1. The facility will be fenced and have a sign at the entrance. The sign will be legible from at least fifty (50) feet and contain the following information: a) name of the facility, b) location by section, township and range, and c) emergency phone number.

2. Contaminated soils will not be placed within one hundred (100) feet of the boundary of the facility.

3. Contaminated soils will not be placed within twenty (20) feet of any pipelines crossing the landfarm/compost facility. In addition, no equipment will be operated within ten (10) feet of a pipeline. All pipelines crossing the facility will have surface markers identifying the location of the pipelines.

4. The portion of the facility containing contaminated soils will be bermed to prevent runoff and runon. A berm no less than three (3) feet above grade will be constructed and maintained such that it is capable of containing precipitation from a one-hundred year flood for that specific region.

5. All above ground tanks located at the facility and containing materials other than fresh water will be placed on an impermeable pad or surface and be bermed to contain one and one-third the volume of the largest tank or all interconnected tanks.

LANDFARM AND COMPOST OPERATION

1. Disposal will only occur when an attendant is on duty. The facility will be secured when no attendant is present.

2. All contaminated soils received at the facility for land farming will be spread and disked within 72 hours of receipt.

3. Soils to be landfarmed will be spread on the surface in six inch lifts or less.

4. Soils to be landfarmed will be disked a minimum of one time every two weeks (biweekly) to enhance biodegradation of contaminants.

5. All contaminated soils received at the facility for composting will be placed into compost piles or cells within 72 hours of receipt. Weekly temperature measurements will be kept on each compost cell, recorded, and maintained for OCD review. Compost piles will be turned as necessary to enhance biodegradation.

6. Exempt contaminated soils will be placed in the landfarm and compost facility so that they are physically separate (ie. bermed) from non-exempt contaminated soils. There will be no mixing of exempt and non-exempt soils.

7. Successive lifts of contaminated soils will not be spread on the landfarm or compost facility until a laboratory measurement of total petroleum hydrocarbons (TPH) in the previous lift is less than 100 ppm and the sum of all aromatic hydrocarbons (BTEX) is less than 50 ppm, and the benzene is less than 10 ppm. Comprehensive records of the laboratory analyses and the sampling locations will be maintained at the facility for OCD review.

8. Prior to removal of remediated soils from the facility the soils will be tested for TPH, BTEX and benzene content. The remediated soils may only be moved to a location when the level of TPH in the remediated soil is less than 100 ppm, BTEX is less than 50 ppm, and the benzene is less than 10 ppm. Comprehensive records of the laboratory analyses, destination and volume of remediated soils removed from the facility will be maintained at the facility for OCD review. Amoco may request alternate remediation levels for soils to be used or deposited at a location where remediation standards are consistent with those described in the OCD surface impoundment closure guidelines. Alternate remediation levels shall be subject to approval on a case-by-case basis.

Requests shall be submitted to the Santa Fe OCD office for review.

9. Moisture will be added as necessary to enhance bioremediation and to control blowing dust. There will be no ponding, pooling or run-off of water allowed. Any ponding of precipitation will be removed within twenty-four (24) hours of discovery.

10. Enhanced bio-remediation through the application of microbes (bugs) and/or fertilizers (manure) will only be permitted after prior approval from the OCD. Request for application of microbes will include the location of the area designated for the bio-remediation program, the composition of additives, and the method, amount and frequency of application.

TREATMENT ZONE MONITORING OF LANDFARM AND COMPOSTING AREA

1. One (1) background soil sample will be taken from the center portion of the landfarm and compost area two (2) feet below the native ground surface prior to operation. The sample will be analyzed for total petroleum hydrocarbons (TPH), major cations/anions, volatile aromatic organics (BTEX), and heavy metals using approved EPA methods.

2. A treatment zone not to exceed three (3) feet beneath the landfarm native ground surface will be monitored. A minimum of one random soil sample will be taken from each individual cell, with no cell being larger than five (5) acres, six (6) months after the first contaminated soils are received in the cell and then quarterly thereafter. The sample will be taken at two (2) to three (3) feet below the native ground surface.

3. A treatment zone not to exceed three (3) feet beneath the composting area native ground surface will be monitored. A minimum of one random soil sample will be taken from each individual compost cell six (6) months after the first contaminated soils are received in the cell and then quarterly thereafter. The sample will be taken at two (2) to three (3) feet below the native ground surface.

4. The soil samples will be analyzed using approved EPA methods for TPH and BTEX quarterly, and for major cations/anions and heavy metals annually.

5. After obtaining the soil samples the boreholes will be filled with an impermeable material such as cement or bentonite.

WASTE ACCEPTANCE CRITERIA

1. The facility is authorized to accept only exempt and "non-hazardous" non-exempt oilfield wastes that are generated in the State of New Mexico by Amoco Production

Company.

2. The facility is authorized to accept only:

   a. Oilfield waste that are exempt from RCRA Subtitle C regulations and that do not contain Naturally Occurring Radioactive Material (NORM) regulated pursuant to 20 NMAC 3.1 Subpart 1403.

   b. "Non-hazardous" non-exempt oilfield waste on a case-by-case basis after conducting a hazardous waste characterization including corrosivity, reactivity, ignitability, and toxic constituents and receiving OCD approval. The test for hazardous characteristics for a particular waste may be effective for an extended period of time from the date of analysis if approved by the OCD. In addition, the generator must certify that this waste does not contain Naturally Occurring Radioactive Material (NORM) regulated pursuant to 20 NMAC 3.1 Subpart 1403.

3. At no time will any OCD-permitted surface waste management facility accept wastes that are determined to be RCRA Subtitle C hazardous wastes by either listing or characteristic testing.

4. The transporter of any wastes to the facility will supply a certification that wastes delivered are those wastes received from the generator and that no additional materials have been added.

5. No free liquids or soils with free liquids will be accepted at the landfarm and compost portion of the facility.

6. No produced water shall be received at the facility from motor vehicles unless the transporter has a valid Form C-133, "Authorization to Move Produced Water" on file with the Division.

7. Comprehensive records of all material disposed of at the surface waste management facility will be maintained by the Permit holder.

REPORTING AND RECORD KEEPING

1. Analytical results from the treatment zone monitoring will be submitted to the OCD Santa Fe office for annual review **by June 26, of each year**.

2. Weekly testing of all components of the moisture sensor grid and leak detection system will be performed. Results will be recorded and will be submitted to the OCD Santa Fe

office for annual review **by June 26 of each year**.

3. Weekly testing on the evaporation pond for H_2S, pH, dissolved sulfides, and dissolved oxygen will be performed. Results will be submitted to the OCD Santa Fe Office for annual review **by June 26 of each year.**

4. The applicant will notify the **OCD Aztec District office within 24 hours** of any break, spill, blow out, or fire or any other circumstance that could constitute a hazard or contamination in accordance with OCD Rule 116.

5. Authorization from the OCD Santa Fe office will be obtained prior to removal of the remediated soils to sensitive areas.

6. All records of testing and monitoring will be retained for a period of two (2) years.

7. The OCD will be notified prior to the installation of any pipelines or wells or other structures within the boundaries of the facility.

8. The OCD Santa Fe and Aztec District offices will be notified when operation of the facility is discontinued for a period in excess of six (6) months or when the facility is to be dismantled. A closure plan for the facility will be provided.

FINANCIAL ASSURANCE

1. Pursuant to OCD Rule 711.B.3.a., financial assurance in a form approved by the Director is required from Amoco Production Company in the amount of **$25,000** for this facility or in the amount of **$50,000** to cover all of Amoco Production Company's surface waste management facilities.

2. Financial assurance must be submitted within thirty (30) days of this permit approval or on July 31, 1998.

3. The facility is subject to periodic inspections by the OCD. The conditions of this permit and the facility will be reviewed by the OCD no later than two (2) years from the date of this approval.

CLOSURE

1. The OCD Santa Fe and Aztec District offices will be notified when operation of the facility is discontinued for a period in excess of six (6) months or when the facility is to be dismantled. Upon cessation of operations for six (6) consecutive months, the

operator shall complete cleanup of constructed facilities and restoration of the facility site within the following six (6) months, unless an extension of time is granted by the Director.

2. A closure plan for the facility will be provided including the following OCD closure procedures:

   a. When the facility is to be closed no new material will be accepted.

   b. Existing landfarm and compost soils will be remediated until they meet the OCD standards in effect at the time of closure.

   c. The soils beneath the evaporation pond and liquids receiving area will be characterized as to any potential migration of contamination.

   d. Contaminated soils will be removed for remediation.

   e. The area will be contoured, reseeded with natural grasses and allowed to return to its natural state.

   f. Closure will be pursuant to all OCD requirements in effect at the time of closure, and any other applicable local, state and/or federal regulations.

CERTIFICATION

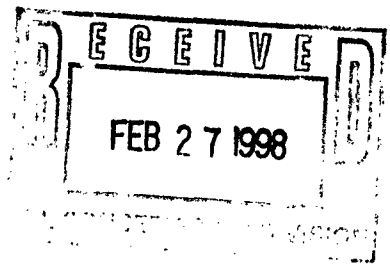
Amoco Production Company, by the officer whose signature appears below, accepts this permit and agrees to comply with all terms and conditions contained herein. Amoco Production Company further acknowledges that these conditions and requirements of this permit may be changed administratively by the Division for good cause shown as necessary to protect ground water, surface water, human health and the environment.

Accepted:

AMOCO PRODUCTION COMPANY

by_____title_____

BLAGG ENGINEERING, INC.
P.O. Box 87, Bloomfield, New Mexico 87413
Phone: (505)632-1199 Fax: (505)632-3903



February 25, 1998

Ms. Martyne J. Kieling
New Mexico Oil Conservation Division
2040 South Pacheco Street
Santa Fe, New Mexico 87505

Re: Amoco Production Company
Application for Manzanares Mesa Waste Management Facility
E/2 NW/4 Sec. 4 - T29N - R8W, NMPM

Dear Ms. Kieling:

On behalf of Amoco Production Company, Blagg Engineering, Inc. (BEI) is responding to your letter dated January 17, 1997 concerning the referenced proposed waste management facility. The additional information requested in your correspondence is addressed below.

Form C-137, Section 6

A. Buffer Zone: The proposed waste management facility is to be located on private property in a rural location of San Juan County. There are no private residences within 2 miles of the site and the primary surface use is range land and oil & gas development. The permitted waste facility is proposed to encompass a fenced area of 4.9 acres within the 80 acre tract included in the E/2 NW/4 Sec. 4 - T29N - R8W, NMPM. The private property owner of the proposed facility also holds the property to the north and west of the facility and does not object to a 100 foot minimum buffer zone. The Bureau of Land Management (BLM) holds the surface rights to the east and south of the facility and no development of this property is anticipated. The BLM has previously authorized numerous landfarms for contaminated soils on their properties for remediation of oilfield wastes. A minimum buffer zone of 100 feet will be maintained between the fenced facility and these BLM lands.

B. Facility Berming: The entire 4.9 acre facility is to contain a single berm with a minimum height of 3 feet above grade. The berm height at the down gradient 1/3 of the facility will be constructed to a height of 4 feet above grade. The National Weather Service was consulted with respect to precipitation during a 100 year storm for this area and the maximum rainfall expected is approximately 2.7-inches during a 24 hour period. The proposed facility is to be located in an area with a 4% grade towards the south east. During construction this grade is expected to be reduced to approximately 2% and approximately 1 acre of the facility is to be dedicated to a lined pond. However, as a worst case scenario assuming a 4% grade, a 100 year 24 hour storm event and a full 4.9 acre area of water accumulation, the downgradient extent of the facility would develop a standing water level of 2.9 feet. The proposed berm will be sufficient to contain this volume of precipitation.

Form C-137, Section 7

A. Wave Calculations: Wind setup (increase in water level at downwind side of pond) from maximum predicted sustained winds is calculated for the 200' x 200' x 7.2' deep pond to be (from Water Resources Engineering, McGraw-Hill, 1972):

$$Z_s = V_w^2 F/1400d$$

where Z_s = rise in feet above still water level
V_w^2 = maximum sustained windspeed in miles per hour = 38 mph per Farmington FAA
F = fetch in miles = 282/5280 = 0.0534 miles
d = maximum pond depth in feet = 7.2 feet

Therefore $Z_s = (38^2)(0.0534)/(1400)(7.2) = 0.0076$ feet

Wave-height is calculated to be (from Water Resources Engineering, McGraw-Hill, 1972):

$$z_w = 0.034 V_w^{1.06} F^{0.47}$$

where z_w = average maximum height of waves (significant wave height) in feet
V_w = maximum wind velocity in mph
F = fetch in miles

Therefore $z_w = (0.034)(38^{1.06})(0.0534^{0.47}) = 0.41$ feet.

Given these conditions and calculations, the maximum downwind increase in water level is approximately 0.42 feet. Average annual rainfall for the region is 0.72 feet (per U.S. Weather Service, Albuquerque District Office). Therefore, a total required freeboard for the pond is calculated to be approximately 1.14 feet. For safety considerations, a minimum freeboard of 2.0 feet is proposed.

B. Freeboard Measurement: A marking device shall be installed in the pond to accurately measure freeboard.

Form C-137, Section 9

A. 1) Routine Inspection and Maintenance: Inspection and maintenance will be conducted on a weekly basis or immediately following consequential rainstorms or windstorms. This inspection will include determination of facility integrity and security.

2) Landfarm and Compost Treatment Zone Monitoring: There will be one (1) landfarm of approximate area of one (1) acre and one (1) compost facility of approximate area of one (1) acre. Each of these small facilities will not be further divided into smaller cells. Prior to operation of these facilities, one background soil sample will be collected from each of the landfarm and compost sites.

These samples will be collected from a depth of 2 feet below the native ground surface prior to operation. The samples will be submitted to a qualified laboratory and tested for total petroleum hydrocarbons (TPH), major cations/anions, volatile aromatic organics (BTEX) and heavy metals using approved EPA methods.

Approximately 6 months after initial operation of the compost and/or landfarm facilities, random soil samples will be collected at facility from a depth of approximately 2-3 feet below native ground surface. Random soil samples will be collected quarterly thereafter. The samples will be analyzed for TPH and BTEX quarterly, and for major cations/anions and heavy metals annually. Test boreholes will be filled with cement following collection of soil samples. An annual report that includes analytical test results will be submitted to the NMOCD Santa Fe and Aztec offices.

Form C-137, Section 10

A. Landfarm and Compost Facility Closure Sampling: Prior to final closure of the landfarm or compost areas at the facility, a 5-point composite sample will be collected from the waste material in the treatment area. These samples will be submitted to a qualified laboratory and tested for TPH and BTEX using EPA approved methods. BLM and NMOCD closure standards for this area are 5,000 ppm TPH, total BTEX of 50 ppm and benzene 10 ppm. These standards will be applied to closure of the facilities.

Sensitive Areas

Prior to removal of remediated soils from the facility the soils will be tested for TPH and BTEX content. The remediated soils will only be moved to a location with a closure standard consistent with the level of TPH and BTEX tested in the soils (ie, 100 ppm, 1,000 ppm or 5,000 ppm TPH).

Form C-137, Section 13

A. H_2S Contingency Plan: A single produced water evaporative pond is scheduled to be constructed at the facility. Tests of ambient H_2S gas at the pond will be conducted on a weekly basis and test results will be recorded and retained. The tests will be conducted at four (4) locations around the pond. Wind speed and direction will be recorded with each test.

If an H_2S reading of 0.1 ppm or greater is detected, a second reading will be taken on the downwind berm within one hour of the first test. Dissolved oxygen and dissolved sulfide levels of the pond will also be measured and appropriate treatments, if any, will be initiated. Additionally, the H_2S level at the down wind fence line of the facility will then be measured.

If two (2) consecutive H_2S readings of 0.1 ppm or greater are obtained, the NMOCD Aztec district office will be immediately notified. Hourly monitoring of H_2S levels will then be initiated and maintained on a 24-hour basis. Dissolved sulfides in the pond will then be measured daily.

If an H_2S measurement of 10.0 ppm or greater at the facility fence line is obtained, the NMOCD Aztec district office will be notified immediately. Additionally, the New Mexico State Police, San Juan County Sheriff and San Juan County Fire Marshall will also be immediately notified. All persons residing within ½ mile of the fence line will be notified and public safety officials will be assisted with any evacuations that may be required.

Harmful levels of H_2S will be prevented from developing by initiation of the following procedures:

a) Water hauler truck drivers are familiar with H_2S identification by odor. Drivers will be instructed to not transport water with possible H_2S content to the facility, and such water is to be transported to an alternate licensed facility with the capacity to accept and treat such water.

b) A continuously operating aeration system will be installed in the evaporation pond to minimize the possibility of H_2S development.

c) Weekly tests of pond pH will be conducted and recorded. If pH falls below 7.0, remedial steps will be taken to raise the pH to above 7.0.

d) Monthly tests of pond dissolved sulfide will be conducted and recorded.

e) Monthly tests of pond dissolved oxygen will be conducted and recorded. This sampling will be conducted at a depth of 1 foot from the bottom of the pond. The test location will vary between tests. If testing indicates dissolved oxygen levels of less than 0.5 ppm, steps will be taken to raise the dissolved oxygen level to greater than 0.5 ppm.

Form C-137, Section 14

Amoco understands the permit will have an expiration date of two (2) years from the date approved by the NMOCD. Amoco may apply to renew the permit for subsequent two (2) year periods.

A progress report will be submitted on the performance of the evaporation pond 6 months after initial water placement into the pond, and every 6 months thereafter. A final report will be submitted following completion of the pond test.

Questions or comments with respect to this transmittal may be directed to Jeff Blagg of Blagg Engineering at (505)632-1199, or the Buddy Shaw of Amoco at (505)326-9219.

Respectfully,
Blagg Engineering, Inc.

Jeffrey C. Blagg, P.E.
President

cc: B.D. Shaw - Amoco

MEMORANDUM OF CONVERSATION

✓ TELEPHONE __ PERSONAL TIME____ DATE 2-16-98 Afternoon
2-17-98

ORIGINATTING PARTY Jeff Blagg For Amoco
505-632-1199

OTHER PARTIES Marlene Kieling
Discussed with Denny Foutz on 2-17-98 prior to callback

DISCUSSION Questions on Buffer Zone, Burming, H_2S Monitoring, Sulfide & O_2 Monitoring

1) Buffer Zone 100' unless written Approval From landowners or Center The Facility with in the 1/4 1/4 Section to be Permitted
2) Burming To Supply Height of Berm to Hold 100 yr Rain Event.
3) H_2S Monitoring Shifted to Weekly. Sulfide & O_2 Monitoring & PH to Monthly Can all be done at Same Visit. Reducing H_2S From Daily to Weekly Because there are No Nearby Neighbors 2½ to 3 miles NW & 2 miles to the NE Are Nearest Neighbors.
Add and Automatic Safty Alarm that Reads 0.10 ppm 4 Directions ←
2) a change. First Load is Received From each Job (Location Specific) ⚡
~~10 ppm~~ 10 ppm with calibrated weekly. Have the Instrument on Site And Record Level in Sign in Sheet. ←

CONCLUSIONS In addition Change PH measurements to Bottom of Pond? Possibly.

~~CHRIS EUSTICE~~

Amoco Manzanaras Mesa

6/11/97

Prior to Construction

NEW MEXICO ENERGY, MINERALS
& NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION
2040 South Pacheco Street
Santa Fe, New Mexico 87505
(505) 827-7131

January 27, 1997

CERTIFIED MAIL
RETURN RECEIPT NO. P-326-936-384 7 mjk

Mr. Buddy Shaw
AMOCO Production Company
200 Amoco Court
Farmington, New Mexico 87401

RE: AMOCO Manzanares Mesa Surface Waste Management Facility
E/2 NW/4 of Section 4, Township 29 North, Range 8 West, NMPM,
San Juan County, New Mexico.

Dear Mr. Shaw:

The Oil Conservation Division (OCD) has received and is in the process of reviewing the above referenced application for an oil field related centralized solids landfarm, composting and evaporation pond facility located in the E/2 NW/4 of Section 4, Township 29 North, Range 8 West, NMPM, San Juan County, New Mexico. The following comments and requests for additional information are based on review of the application, dated July, 8 1997 and additional information provided.

In order for the review process to continue the OCD requires Amoco Production Company (Amoco) to submit the additional information requested in Attachment 1. Submission of the above requested information will allow the review process to continue.

If you have any questions please do not hesitate to contact me at (505) 827-7153.

Sincerely,

Martyne J. Kieling
Environmental Geologist

xc with attachments:
xc: Aztec OCD Office

ATTACHMENT 1
REQUEST FOR ADDITIONAL INFORMATION
JANUARY 26, 1998
AMOCO PRODUCTION COMPANY
E/2, NW/4 of Section 4, Township 29 North, Range 8 West, NMPM,
San Juan County, New Mexico

1. Sections one, two, three, four, and five (1,2, 3, 4, & 5) Application Form C-137

   A. Amoco Production Company (Amoco) has completed sections one, two, three, four, and five (1,2, 3, 4, & 5).

2. Section six (6) Application Form C-137;

   A. Buffer Zone: No contaminated soils should be placed within one hundred (100) feet of the boundary of the facility unless it can be demonstrated that a smaller buffer zone will not adversely impact the adjacent properties.

      Amoco shall provide additional information regarding the size of the buffer zone to be installed at the facility.

   B. Facility Berming: The portion of the facility containing contaminated soils shall be bermed to prevent runoff and runon. A berm should be constructed and maintained such that is capable of containing precipitation from a one-hundred year flood for that specific region.

      Amoco shall provide additional detail concerning height of the berm and volume that will be contained.

3. Section seven (7) Application Form C-137;

   A. Amoco shall provide wave calculations for the pond design dimensions to determine freeboard. In addition, average annual rainfall for the region shall also be taken into consideration.

      Pond dimensions provided by Amoco;
      Pond dimensions at the top of the berm 200 x 200 feet
      Pond dimensions inside berm 152 x 152 feet
      Maximum depth from the top of the berm to bottom of pond 9.5 feet
      Minimum depth from the top of the berm to the bottom of pond 7.2 feet.

   B. Amoco shall propose a liner marking or device to be installed to accurately measure freeboard.

4. Section eight (8) Application Form C-137;

A. Amoco has completed section eight (8).

5. Section nine (9) Application Form C-137;

A. Amoco shall submit a routine inspection and maintenance plan with additional detailed information on the following:

1) Routine inspection and maintenance will be conducted on a weekly basis or immediately following consequential rainstorms or windstorms.

2) Treatment Zone Monitoring: Because a landfarm/composting facility is designed to remediate contaminated soils and not transfer contaminants into the underlying native soil and/or groundwater, the applicant shall submit a plan to detect leaching of contaminants. If the native ground surface has a minimum of three feet of uncemented material (ie. soil) then a treatment zone monitoring program may be incorporated into the facility design to ensure contaminants are not leaching into the native soil/groundwater. The following procedures shall be used to monitor a treatment zone not to exceed three (3) feet beneath the landfarm/composting facility:

a. One (1) background soil sample should be taken from the center portion of the landfarm/composting facility two (2) feet below the native ground surface prior to operation. The sample should be analyzed for total petroleum hydrocarbons (TPH), major cations/anions, volatile aromatic organics (BTEX), and heavy metals using approved EPA methods.

b. A treatment zone not to exceed three (3) feet beneath the land farm/composting facility should be monitored. A minimum of one random soil sample should be taken from each individual landfarm cell and each composting cell, with no landfarm cell being larger than five (5) acres, six (6) months after the first contaminated soils are received in the cell and then quarterly thereafter. The sample should be taken at two to three (2-3) feet below the native ground surface.

c. The soil samples should be analyzed using approved EPA methods for TPH and BTEX quarterly, and for major cations/anions and heavy metals annually.

d. After obtaining the soil samples the boreholes should be filled with an impermeable material such as cement.

e. Analytical results from the treatment zone monitoring should be submitted to the OCD Santa Fe office for review on a regular schedule to be proposed by the applicant.

6. Section ten (10) Application Form C-137;

A. Amoco shall continue to perform quarterly treatment zone monitoring until a laboratory measurement of total petroleum hydrocarbons (TPH) in the last landfarm and compost cells are less than 100 parts per million (ppm), and the sum of all aromatic hydrocarbons (BTEX) is less than 50 ppm, and the benzene is less than 10 ppm.

7. Section eleven (11) Application Form C-137;

A. Amoco has completed section eleven (11).

8. Section twelve (12) Application Form C-137

A. Amoco has provided proof that all notice requirements have been met.

9. Section Thirteen (13) Application Form C-137

A. A contingency plan in the event of a release of H_2S shall be submitted for approval along with the details for pit construction. The contingency plan will outline a procedure for monitoring for H_2S, notifying the OCD, aeration or treatment of pit fluids for H_2S generation, and notification of a appropriate authorities. Amoco shall prepare an outline that contains the following.

1) In order to prevent any harm by hydrogen sulfide gas, tests of ambient H_2S levels shall be conducted daily, and records made and retained. Such tests shall be made at varying locations around the berm of the pond and shall be conducted daily. The wind speed and direction shall be recorded in conjunction with each test.

a. If an H_2S reading of 0.1 ppm or greater is obtained:

i. A second reading shall be taken on the downwind berm within one hour;

ii. The dissolved oxygen and dissolved sulfide levels

of the pond shall be tested immediately and the need for immediate treatment determined;

iii. Tests for H_2S levels shall be made at the fence line down wind from the problem pond.

b. If two consecutive H_2S readings of 0.1 ppm or greater are obtained:

i. The operator shall notify the Aztec office of the OCD immediately;

ii. The operator shall commence hourly monitoring on a 24-hour basis;

iii. The operator will obtain daily analysis of dissolved sulfides in the pond.

c. If an H_2S reading of 10.0 ppm or greater at the facility fence line is obtained;

i. The operator will immediately notify the OCD and the following public safety agencies:
State Police
County Sheriff
County Fire Marshall;

ii. The operator will initiate notification of all persons residing with in one-half (½) mile of the fence line and assist public safety officials with evacuation as requested.

2) In order to prevent development of harmful concentrations of H_2S, the following procedures shall be followed:

a. The first load of water from each job (location specific) shall be tested for H_2S. If H_2S is detected then all loads from that job shall be treated for H_2S.

b. Weekly tests shall be conducted and records made and maintained of the pH in each pond, and if the pH falls below 7.0 remedial steps shall be taken immediately to raise the pH.

c. Weekly tests shall be conducted and records made and retained at the facility of the dissolved sulfide concentrations in the pond.

d. Weekly tests shall be conducted, and records made and retained at the facility of such tests, to determine the dissolved oxygen levels in each pond. The sample of each test shall be taken one (1) foot from the bottom of the pond. The location of each test shall vary around the pond. If any test shows a dissolved residual oxygen level of less than 0.5 ppm, immediate steps shall be undertaken to raise the oxygen level to at least 0.5 ppm, which measures may include adding bleach or increased aeration.

10. Section Fourteen (14) Application Form C-137.

A. The permit when approved by the OCD, will have an expiration date of two (2) years. Amoco may submit an application to renew the permit for additional two (2) year periods.

B. Amoco shall submit a progress report on the performance of the unlined evaporation holding test design every 6 months beginning after the first load of water is accepted at the facility. Upon completion of the test Amoco shall submit a final report on the pond performance.

B.C. TECHNOLOGIES, Ltd.

507 IVINSON ST.
LARAMIE, WYOMING 82070
Phone: (307) 742-5651/FAX: (307) 745-3428

(307) 742-5651

November 8, 1997

New Mexico Energy, Minerals & Natural Resources Department
Oil Conservation Division
attn: Martyne J. Kieling
2040 S. Pacheco St.
Sante Fe, NM 87505

RE: AMOCO Manzanares Mesa Surface Waste Management Facility
E/2 NW/14 of Section 4, Township 29 North, Range 8 West, NMPM,
San Juan County, New Mexico

Dear Martyne Kieling

Enclosed are two copies each of the engineering design blueprints of the pond and containment systems, the engineering and design specifications of the moisture sensor grid, and current usage of the moisture sensor technology per your request to Mr. Shaw of AMOCO dated 10/29/97. I am forwarding this information to you at the request of Mr. Shaw.

The engineering designs of the pond and containment systems are described in the nine blueprints provided. Please note that we have opted to install a conventional leak detection system for both backup and confirmation of the operation of the moisture sensors. The locations of the moisture sensors with respect to the pond are provided in drawing NO.s 1 and 3 of the engineering design blueprints of the pond and containment systems. In addition, the design of the leak detection system is described in drawing No.s 3, 4, and 5 of the engineering design blueprints for the pond and containment systems. Three additional drawings are enclosed to described the engineering and installation of the moisture sensors along with a letter, from Mr. Ames Grisanti of the University of North Dakota EERC, explaining the selection and history of the sensors. Also provided are copies of the manufactures specifications and instructions related to the purchase, installation, and operation of the moisture sensors.

I hope that this information will be of sufficient detail to satisfy your requirements for items 1 - 3 of your letter.

Sincerely,

John E. Boysen,
B.C. Technologies, Ltd.

cc: Buddy Shaw, AMOCO
John Harju, GRI
Ames Grisanti, UND EERC

Energy & Environmental Research Center

15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World Wide Web Server Address: www.eerc.und.nodak.edu

UNIVERSITY OF NORTH DAKOTA

November 5, 1997

Mr. John Boysen
B.C. Technologies
507 Ivinson Street
Laramie, WY 82070

Dear John:

Subject: Subsurface Moisture Sensor Grid

The sensor we have selected for use in the moisture sensor grid for installation beneath the holding pond is the Model CS615 Water Content Reflectometer manufactured by Campbell Scientific. These units provide a measure of volumetric water content in the soil by sensing changes in the dielectric properties of the soil. Therefore, changes in moisture content of the soil will be detected by the sensors since dielectric properties of the soil are strongly dependent on moisture content. For your information, technical data on the CS615 are enclosed with this letter.

While these sensors have not been applied in the specific application we will use them for, they have been employed extensively in other applications to sense moisture in porous media such as gravel, concrete, fly ash, coal, flour, grains (corn, wheat), and tilled soils. Campbell Scientific has sold more than 3000 of these sensors in the last year for applications in irrigation monitoring and other agriculture-related soil moisture-monitoring applications. Of the 3000 sensors sold, only six have been returned to the factory because of failure. The six units that were returned to the factory failed because of being struck by lightning. This, in my opinion, represents an excellent reliability history. Additionally, since we will install the sensors in a way that allows removal, it will be possible to verify sensor indications or replace sensors at any time during the lifetime of the holding pond.

Sincerely,

Ames A. Grisanti
Project Manager

AAG/rlo

Enclosure

CS615 WATER CONTENT REFLECTOMETER

1. INTRODUCTION

NOTE: There is more than one version of the CS615. This manual is written for version 8221-07. The version number is listed on a cable label near the end of the probe cable. All CS615s are similar in measurement method but the calibration varies with version.

The CS615 Water Content Reflectometer provides a measure of the volumetric water content of porous media. The water content information is derived from the effect of changing dielectric constant on electromagnetic waves propagating along a wave guide.

The reflectometer output is a square wave and can be connected to Campbell Scientific dataloggers CR10X, CR10, CR500, 21X, or CR7. The measured period can be converted to volumetric water content using calibration values.

2. DESCRIPTION

The Water Content Reflectometer consists of two stainless steel rods connected to a printed circuit board. A shielded four-conductor cable is connected to the circuit board to supply power, enable the probe, and monitor the pulse output. The circuit board is encapsulated in epoxy.

High speed electronic components on the circuit board are configured as a bistable multivibrator. The output of the multivibrator is connected to the probe rods which act as a wave guide. The oscillation frequency of the multivibrator is dependent on the dielectric constant of the media being measured. The dielectric constant is predominantly dependent on the water content. Digital circuitry scales the multivibrator output to an appropriate frequency for measurement with a datalogger. The CS615 output is essentially a square wave with an amplitude swing of ±2.5VDC. The period of the square wave output ranges from 0.7 to 1.6 milliseconds and is used for the calibration to water content.

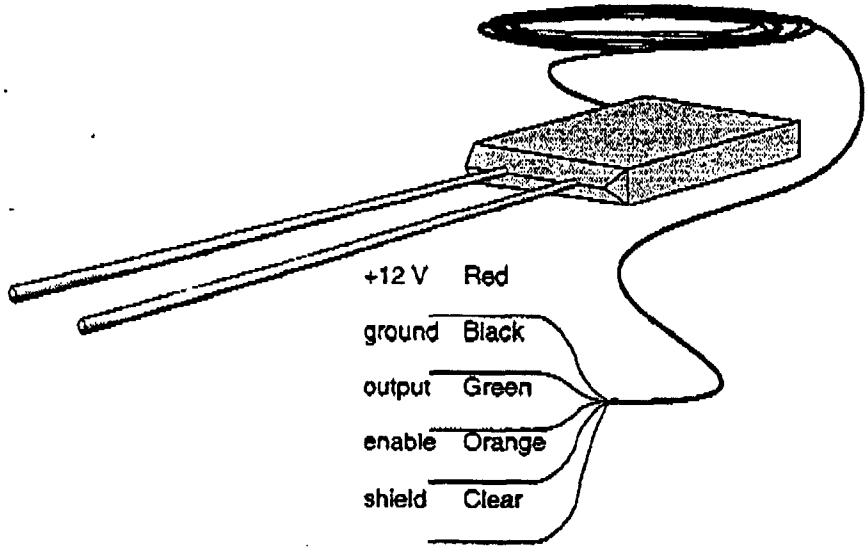


FIGURE 1. CS615 Water Content Reflectometer

3. SPECIFICATIONS

3.1 DIMENSIONS

Rods: 30.0 cm long
3.2 mm diameter
3.2 cm spacing
Head: 11.0 cm x 6.3 cm x 2.0 cm

3.2 WEIGHT

Probe: 280 g
Cable: 35 g m^{-1}

3.3 ELECTRICAL

Power

70 milliamps @ 12VDC when enabled
less than 10 microamps quiescent

Power Supply Voltage

9VDC minimum, 18VDC maximum

Enable Voltage

minimum voltage to enable probe is 1.3VDC

4. PERFORMANCE SPECIFICATIONS

4.1 ACCURACY

See the Calibration section for a discussion of accuracy. The accuracy is ±2% when using calibration for specific soil. The accuracy when using the general calibrations depends on soil texture and mineral composition.

4.2 RESOLUTION

The resolution of the volumetric water content measurement depends on which datalogger instruction is used. When the CR10X, CR10 or CR500 Instruction 27, Period Measurement, is used, the resolution is on the order of 10^{-6} m^3 m^{-3}. Period Measurement is not available on the CR7 or 21X.

When Instruction 3, Pulse Count, is used, the resolution with an execution interval of 1.0 second is 10^{-4} m^3 m^{-3} when pulse period is 1.3 milliseconds. The resolution improves as the water content decreases and as the execution interval increases. A shorter execution interval of 0.1 seconds yields a resolution of 10^{-2} m^3 m^{-3} at the same water content.

4.3 OPERATING RANGE

4.3.1 Soil Electrical Conductivity

The quality of soil moisture measurements which apply electromagnetic fields to wave guides is affected by soil electrical conductivity. The propagation of electromagnetic fields in the configuration of the CS615 is predominantly affected by changing dielectric constant due to changing water content, but it is also affected by electrical conductivity. Free ions in soil solution provide electrical conduction paths which result in attenuation of the signal applied to the waveguides. This attenuation both reduces the amplitude of the high-frequency signal on the probe rods and affects the shape of the oscillating signal. The attenuation reduces oscillation frequency at a given water content because it takes a longer time to reach the oscillator trip threshold.

Soil electrical conductivity can be described by (Rhoades et al., 1976)

$$\sigma_{bulk} = \sigma_{solution}\theta_v T + \sigma_{solid}$$

with σ the electrical conductivities of the bulk soil, the soil solution, and the solid constituents, θ_v the volumetric water content and T a soil-specific transmission coefficient intended to account for the tortuosity of the flow path as water content changes. See Rhoades et al., 1989 for a form of this equation which accounts for mobile and immobile water. The above equation is presented here the show the relationship between soil solution electrical conductivity and soil bulk electrical conductivity.

Soil solution electrical conductivity, $\sigma_{solution}$ can be determined in the laboratory using extraction methods. Soil bulk electrical conductivity can be measured using time domain reflectometry (TDR) methods. Most expressions of soil electrical conductivity are given in terms of solution conductivity. Discussion of the effects of soil electrical conductivity on CS615 performance will be on a soil solution basis unless stated otherwise.

When soil solution electrical conductivity values exceed 1 dS m^{-1}, the slope of the calibration begins to change. The slope decreases with increasing electrical conductivity. The probe will still respond to water content changes with good stability, but the calibration will have to be modified. (See the Calibration section.) At

electrical conductivity values greater than 5 dS m^{-1} the probe output can become unstable.

4.3.2 Soil Organic Matter and Clay Content

The amount of organic matter and clay in a soil can alter the response of dielectric-dependent methods to changes in water content. This is apparent when mechanistic models are used to describe this measurement methodology.

The electromagnetic energy introduced by the probe acts to re-orientate or polarize the water molecules which are polar. If other forces are acting on the polar water molecules, the force exerted by the applied signal will be less likely to polarize it. This has the net effect of 'hiding' some of the water from the probe.

Organic matter and most clays are highly polar. Additionally, some clays sorb water interstitially and thus inhibit polarization by the applied field. It would be convenient if the calibration of water content to CS615 output period could be adjusted according to some parameter of the soil which reflects the affect of the intrinsic forces. However, identification of such a parameter has not been done, and it is likely that measurement of the correlation parameter would be more difficult than calibrating the CS615 for a given soil.

4.3.3 Cable Length

Probe cable length is not a limitation under typical applications. Laboratory measurements show no degradation in measurement quality with cable lengths up to 100 meters. Cable lengths greater than 50 m may increase the potential for damage from electrostatic discharge (lightning). The performance may be degraded if a cable type other than that provided with the probe is used.

4.3.4 Temperature Dependence

The CS615 output is sensitive to temperature, and compensation can be applied to enhance accuracy. The magnitude of the temperature coefficient varies with water content. Laboratory measurements were performed at various water contents and over the temperature range from 10°C to 30°C. The calibration information presented in Section 9 is for a temperature of 20°C. The following equation can be used to interpolate the temperature coefficient for a range of volumetric water content (θ_v) values.

$$Coef_{temperature} = -3.46 * 10^{-4} + 0.0190\theta_v - 0.0450\theta_v^2$$

To apply this correction, the following equation can be used.

$$\theta_{vcorrected} = \theta_{vuncorrected} - (T - 20) * Coef_{temperature}$$

Application of this correction yields a maximum difference between corrected and uncorrected water content of approximately 1.6%. Considering the accuracy of the measurement and the potential spatial variability of soil temperature along the length of the probe rods, the correction is not necessary in most cases.

An example for using the temperature correction is a measurement taken on a soil at a water content of about 0.23 and a temperature of 25°C. The temperature coefficient value is 0.00164 $m^3\ m^{-3}\ °C^{-1}$ which means that the measured water content is 5°C *(0.00164 $m^3\ m^{-3}\ °C^{-1}$) or 0.8% high.

5. INSTALLATION

5.1 ORIENTATION

The probe rods can be inserted vertically into the soil surface or buried at any orientation to the surface. A probe inserted vertically into a soil surface will give an indication of the water content in the upper 30 cm of soil. The probe can be installed horizontal to the surface to detect the passing of wetting fronts or other vertical water fluxes. A probe installed at an angle of 30 degrees with the surface will give an indication of the water content of the upper 15 cm of soil.

5.2 POTENTIAL PROBLEMS WITH IMPROPER INSERTION

The method used for probe installation can affect the accuracy of the measurement. The probe rods should be kept as close to parallel as possible when installed to maintain the design wave guide geometry. The sensitivity of this measurement is greater in the regions closest to the rod surface than at distances away from the surface. Probes inserted in a manner which generates air voids around the rods will reduce the measurement accuracy. In

some applications, installation can be improved by using insertion guides or a pilot tool. Campbell Scientific offers the CS615G and CS615P insertion tools. The CS615G is a probe insertion guide which holds the rods parallel during rod insertion. The CS615P pilot tool is essentially the CS615 rods which are inserted into the soil then removed. This makes proper installation of the CS615 easier in soils which are difficult to insert probes into.

6. WIRING

color	function	CR10(X)	21X/CR7
red	+12 V	+12 V	+12 V
green	output	SE analog channel	pulse channel
orange	enable	control port	control port
black	ground	G	⏚
clear	shield (ground)	G	⏚

NOTE: CS615s manufactured before 12/95 have the green and black leads reversed. Consult the wiring label near the end of the cable.

The enable line is set high to put the probe in the measuring mode.

7. DATALOGGER INSTRUCTIONS

7.1 INTRODUCTION

The output of the CS615 is essentially a square wave with amplitude ±2.5 volts and a frequency which is dependent on the dielectric constant of the material surrounding the probe rods. The frequency range is approximately 600 to 1500 Hz. The period (0.7 to 1.6 milliseconds) is used in the calibration for water content.

The Pulse Count instruction of a CR10, CR500, 21X or CR7 dataloggers can be used with the CS615 output connected to a pulse count channel. The Period Measurement instruction of the CR10 or CR500 can be used with the CS615 output connected to a single-ended analog channel.

7.2 PULSE COUNT

It is important to understand the event sequence during the Instruction 3 Pulse Count Measurement when using it with the CS615. See the Instructions section of the datalogger manual for a detailed explanation of the Pulse Count instruction.

A brief explanation of pulse count use in a CS615 application is presented here. The LOW LEVEL AC option for the configuration code is used, and the output is selected for frequency (Hz). Period (msec) is easily obtained with the Inverse instruction (42).

TABLE 1. Instruction 3 Pulse Count Measurement Sample Program

```
;{21X}
;Simple program to demonstrate use of
;pulse count instruction with CS615
;
*Table 1 Program
  01:      2.0          Execution Interval (seconds)

1: If time is (P92)
  1:     0000           Minutes into a
  2:       15           Minute Interval
  3:       30           Then Do

2: Do (P86) ;set CS615 enable high
  1:       41           Set Port 1 High

3: Beginning of Loop (P87)
  1:        1           Delay
  2:        2           Loop Count

4: End (P95)

5: Pulse (P3)
  1:        1           Reps
  2:        1           Pulse Input Channel
  3:       21           Low Level AC, Output Hz
  4:        1           Loc [ kHz     ]
  5:     .001           Mult ;convert Hz to kHz
  6:      0.0           Offset

6: Do (P86) ;set CS615 enable low
  1:       51           Set Port 1 Low

7: End (P95)

End Program
```

The Pulse Count instruction uses accumulators to monitor pulses on the datalogger Pulse Count Channels. At the beginning of each execution interval for the table containing the Pulse Count instruction, the accumulator count is dumped to a section in datalogger RAM, the accumulator is then reset to zero and begins accumulating counts again. When the Pulse Count instruction is reached, the value in RAM is modified by the multiplier and offset in the Pulse Count instruction and the result written to input storage. The RAM is then reset to zero.

Consider the simple 21X program in Table 1. Additional instructions which might be needed for multiplexer control or other functions have been omitted for simplicity. This program is written to obtain a CS615 reading every 15 minutes. When the program is compiled by the datalogger, the accumulators begin monitoring the Pulse Count Channels. Immediately following compilation by the datalogger, there is no signal on the input channels because the CS615 is not enabled until the 15 minute interval specified in the Instruction 92 is reached. When the 15 minute interval is reached, Instruction 86 is executed which sets the enable of the CS615 high and the probe outputs a signal which is detected by the pulse counters.

The Loop Instruction in this application uses a Delay of 1 and a Loop Count of 2. Program execution pauses during the first loop count until the execution interval of 2 seconds is complete. This delay is necessary because the probe has not been enabled for the entire execution interval which means a complete count is not obtained. More complex programs will contain additional instructions prior to the instruction to enable the CS615, and these instructions can take a significant amount of time to execute. During the second time through the Loop Instruction the pulse counters see the CS615 output for the full execution interval. At the end of this interval the accumulators transfer to RAM and are reset. When the program execution then moves to the Pulse Count Instruction (P3) the value in RAM is converted to kHz and written to input storage.

7.3 PERIOD MEASUREMENT

Instruction 27, Period Measurement is available only on the CR10, CR10X, or CR500. For convenience, the following tables from the datalogger manual are presented here. See the datalogger manual for detailed description of the instruction and the example programs for typical values.

8. MAINTENANCE

The CS615 does not require periodic maintenance.

9. CALIBRATION

9.1 GENERAL

The information in this calibration section applies only to CS615 version 8221-07. The version number is listed on a cable label near the end of the probe cable.

The CS615 provides an indirect measurement of soil water content by using the effect of changing dielectric constant on applied electromagnetic waves. The probe rods act as a wave guide and the material surrounding the rods (soil) varies in dielectric constant with the amount of water in the material.

The dielectric constant of the soil is a weighted summation of the dielectric constants of the soil constituents. The dielectric constant for water is significantly higher than that of other constituents. Changes in the dielectric constant of the soil system can be attributed to changes in water content. This is the basis for the measurement technique.

There are two soil properties which affect the response of the CS615 to changes in water content. High clay contents (greater than 30%) or high electrical conductivity (greater than 1 dS m^{-1}) may require that the calibration be adjusted or generated for the specific soil.

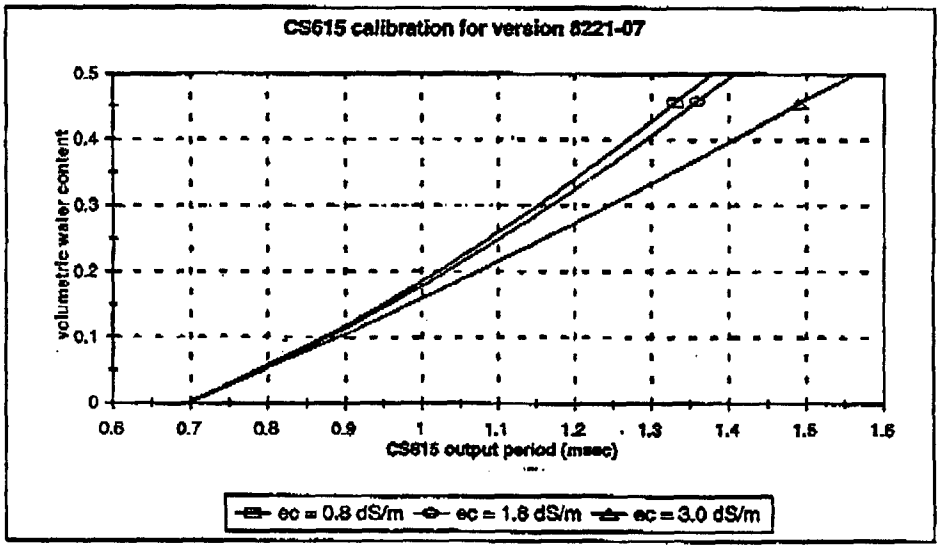


FIGURE 2. CS615 Calibration Curves

Figure 2 demonstrates the effect of electrical conductivity on the calibration. At electrical conductivity values of 1 dS m^{-1} and below, the calibration shown for 0.8 dS m^{-1} works well for a wide range of soil textures. The calibration curves for the higher electrical conductivities show that the slope decreases with increasing conductivity. The response of the CS615 to changes in water content at higher electrical conductivity values is well-behaved up to approximately 5 dS m^{-1}. The calibration can be approximated from figure 2 if the soil solution electrical conductivity is known or if soil measurements are made with the CS615 and the actual water content is independently determined. High clay content has a similar affect on the calibration but the magnitude is dependent on the clay type.

electrical conductivity (dS m^{-1})	calibration
≤1.0	$\theta_v(\tau) = -0.187 + 0.037 * \tau + 0.335 * \tau^2$
1.8	$\theta_v(\tau) = -0.207 + 0.097 * \tau + 0.288 * \tau^2$
3.0	$\theta_v(\tau) = -0.298 + 0.361 * \tau + 0.096 * \tau^2$

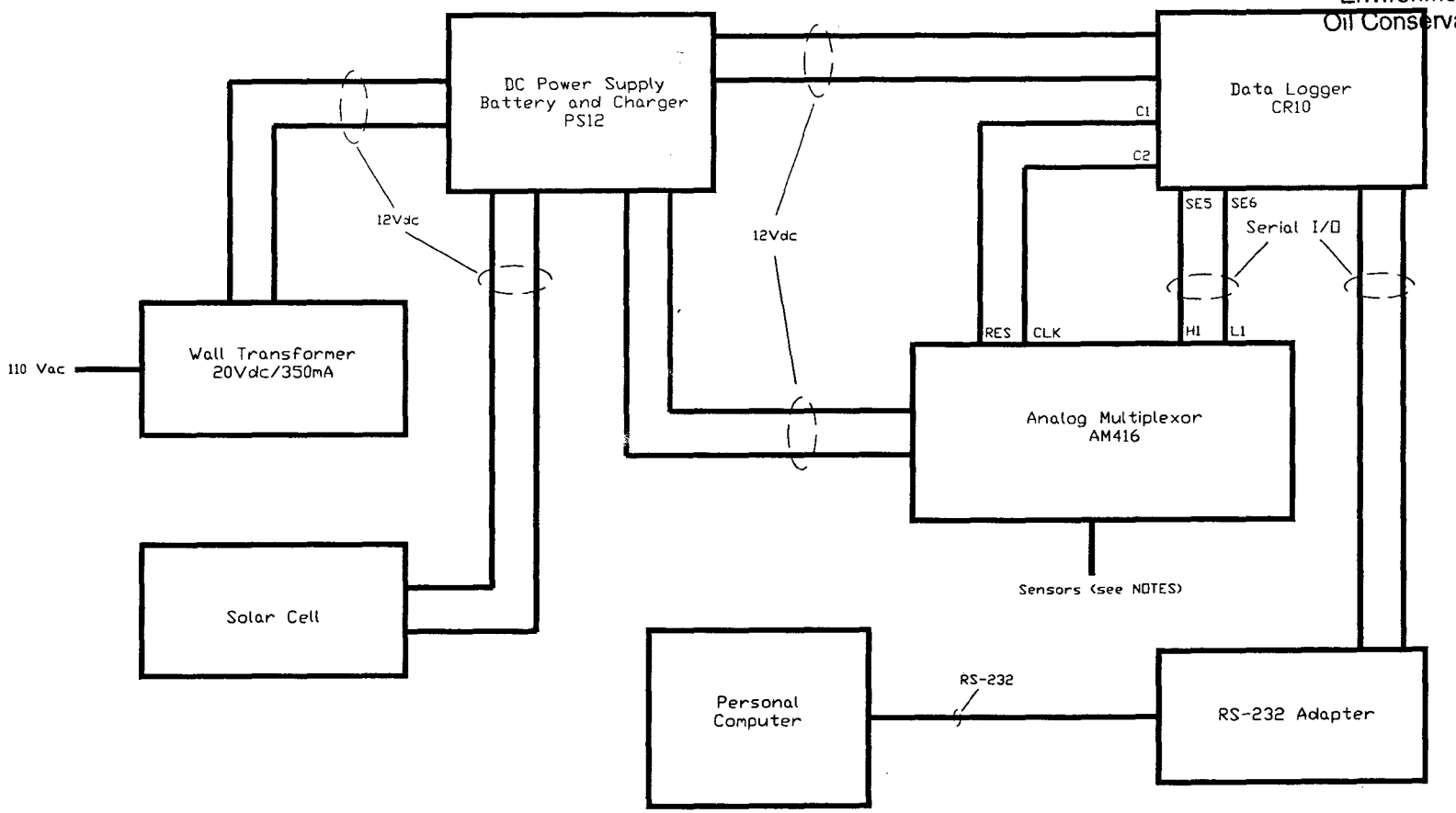
θ_v is the volumetric water content on a fraction basis i.e. 0.20 is 20% volumetric water content. τ is the CS615 output period in milliseconds.

9.2 CALIBRATION FOR A SPECIFIC SOIL

The calibration relationship between volumetric water content and CS615 output period for a specific soil may need to be established if increased accuracy is needed or if the composition of the soil deviates from what might be considered typical. High electrical conductivity, high clay content, high quartz content and high organic matter content are conditions which will affect probe response.

10. SAMPLE PROGRAMS

Sample Program number	Description
1	Monitor 1 CS615 with CR10 datalogger using Period Averaging Instruction (P27)
2	Monitor 1 CS615 with 21X datalogger using Pulse Count Instruction (P3)
3	Monitor 48 CS615s with 21X datalogger and AM416 multiplexer using Pulse Count Instruction (P3)
4	Monitor 48 CS615s with CR10 datalogger and AM416 multiplexer using Period Averaging Instruction (P27)



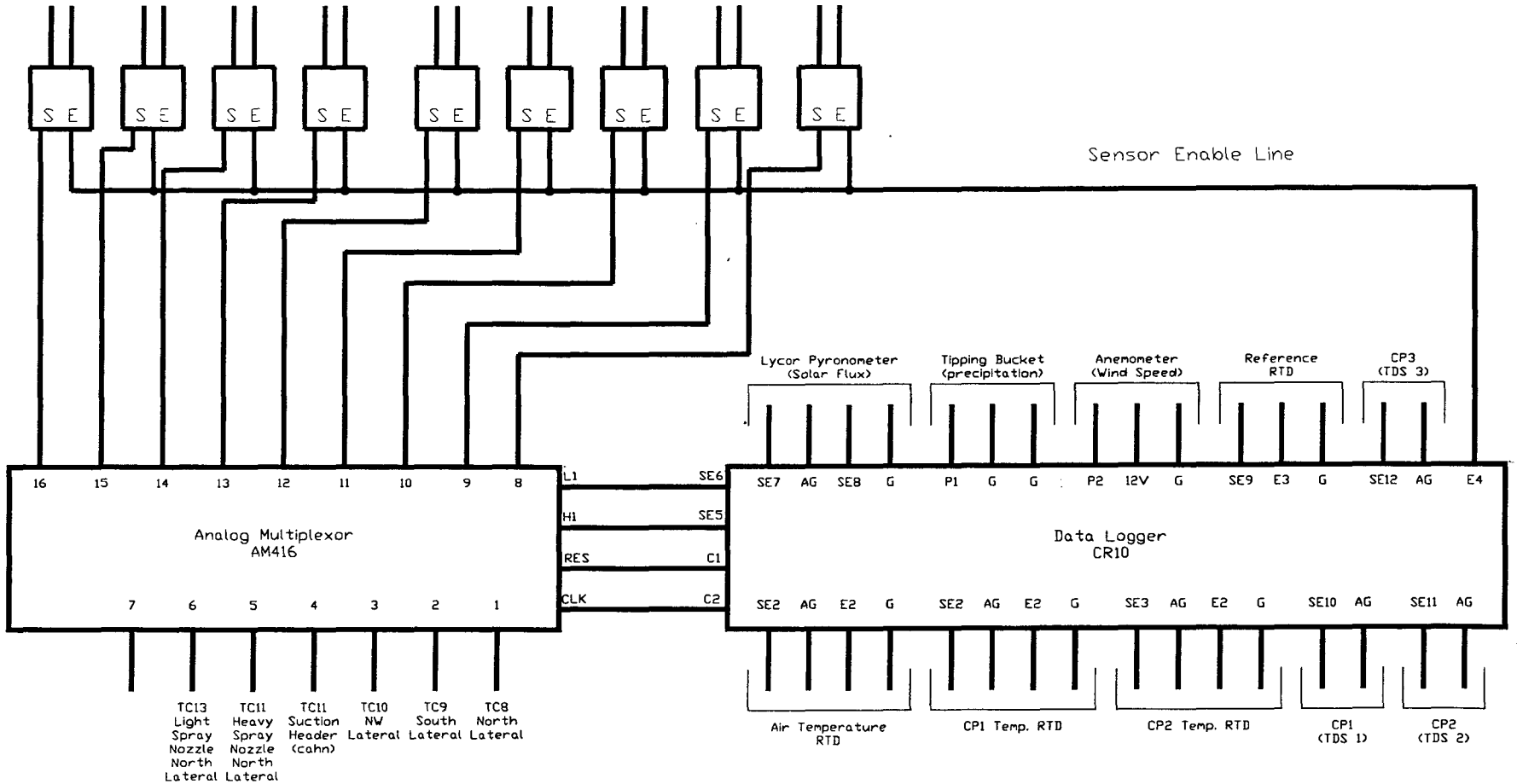
NOTES

Details of sensor connections are on a separate sheet

(see Arg No 2)

	CONTRACT NO.	DATE	COMPANY B.C. Technologies, Ltd. Energy & Environmental Research Center
	DRAWN BY A. Grisanti	2/1/97	
	CHECKED BY J. Burgess	11/8/97	TITLE Data Logger
	DESIGNED BY A. Grisanti		SIZE A / FSCM NO. / DWG NO. / FILE NAME
	DESIGN ACTIVITY		
	CUSTOMER AMOCO/GRI/DOE		SCALE NONE / DATE 4 Nov 97 / SHEET 1 of 3

Water Content Reflectometer Sensor Array CS615



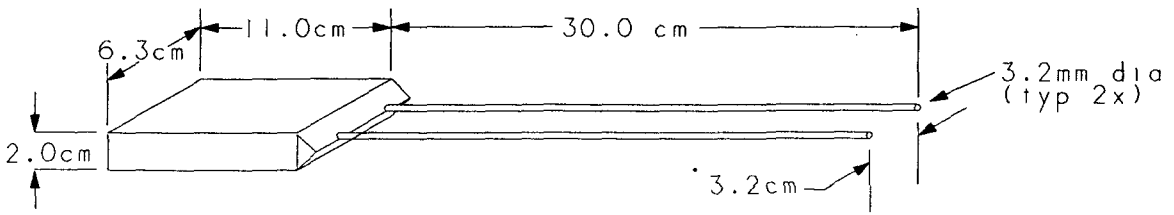
NOTES

All thermocouples (TC) are Type K

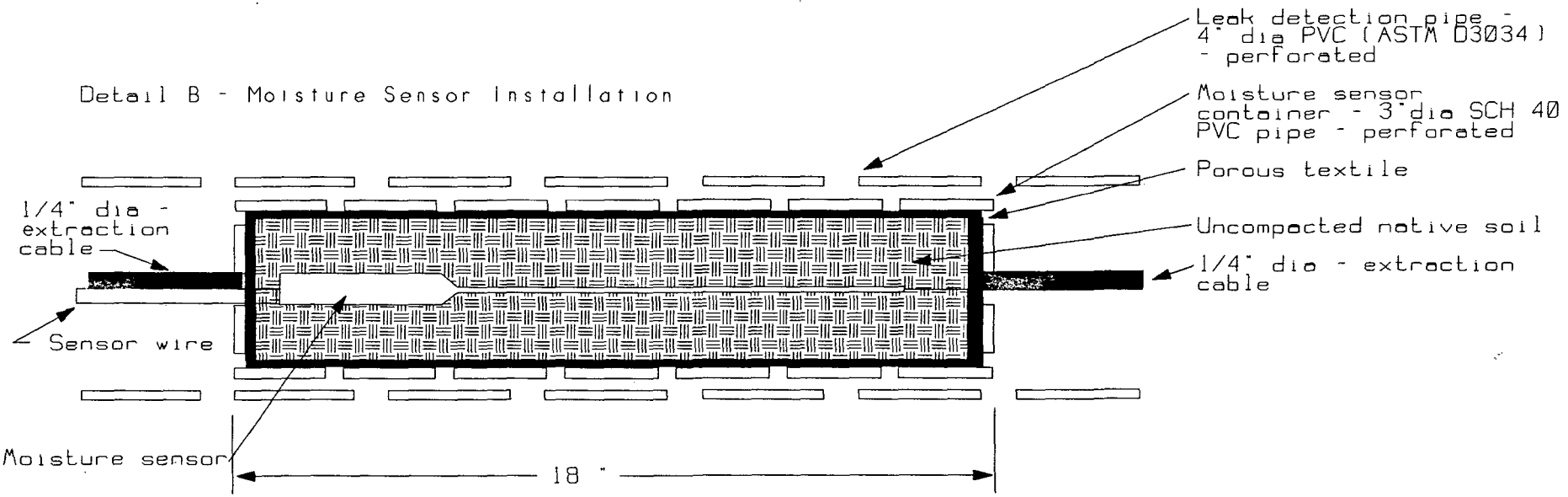
All CS615 connected to +12V and GND

CONTRACT NO.		DATE	COMPANY: B.C. Technologies, Ltd. Energy & Environmental Research Center
DRAWN BY	A. Grisanti	2/1/97	
CHECKED BY	J. Bryce	11/3/97	TITLE: Data Logger Sensor Connections
DESIGNED BY	A. Grisanti		
DESIGN ACTIVITY			SIZE: A; FSCM NO.; DWG NO. / FILE NAME
CUSTOMER	AMOCO/GRI/DOE		SCALE: NONE; DATE: 4 Nov 97; SHEET: 2 of 3

Detail A - Moisture Sensor



Detail B - Moisture Sensor Installation



NOTES:

1) Sensor installation is typical for all nine sensors.

2) Sensors are to be located in leak detection piping using attached cables.

3) If required, sensors can be extracted and re-installed using attached cables.

4) Sensors are continuously monitored using CR10 data logger.

B.C. Technologies, Ltd.			
Drawn by: J. E. Boysen	Manzanares Mesa Facility Moist.Sensor Installation		
Approved: John E. Boysen	Date: 11/08/97	Scale: No Scale	Drawing No. 3 of 3

Energy & Environmental Research Center
UNIVERSITY OF NORTH DAKOTA
15 North 23rd Street — PO Box 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
World Wide Web Server Address: www.eerc.und.nodak.edu

November 5, 1997

Mr. John Boysen
B.C. Technologies
507 Ivinson Street
Laramie, WY 82070

Dear John:

Subject: Subsurface Moisture Sensor Grid

The sensor we have selected for use in the moisture sensor grid for installation beneath the holding pond is the Model CS615 Water Content Reflectometer manufactured by Campbell Scientific. These units provide a measure of volumetric water content in the soil by sensing changes in the dielectric properties of the soil. Therefore, changes in moisture content of the soil will be detected by the sensors since dielectric properties of the soil are strongly dependent on moisture content. For your information, technical data on the CS615 are enclosed with this letter.

While these sensors have not been applied in the specific application we will use them for, they have been employed extensively in other applications to sense moisture in porous media such as gravel, concrete, fly ash, coal, flour, grains (corn, wheat), and tilled soils. Campbell Scientific has sold more than 3000 of these sensors in the last year for applications in irrigation monitoring and other agriculture-related soil moisture-monitoring applications. Of the 3000 sensors sold, only six have been returned to the factory because of failure. The six units that were returned to the factory failed because of being struck by lightning. This, in my opinion, represents an excellent reliability history. Additionally, since we will install the sensors in a way that allows removal, it will be possible to verify sensor indications or replace sensors at any time during the lifetime of the holding pond.

Sincerely,

Ames A. Grisanti
Project Manager

AAG/rlo

Enclosure

CS615 WATER CONTENT REFLECTOMETER

1. INTRODUCTION

NOTE: There is more than one version of the CS615. This manual is written for version 8221-07. The version number is listed on a cable label near the end of the probe cable. All CS615s are similar in measurement method but the calibration varies with version.

The CS615 Water Content Reflectometer provides a measure of the volumetric water content of porous media. The water content information is derived from the effect of changing dielectric constant on electromagnetic waves propagating along a wave guide.

The reflectometer output is a square wave and can be connected to Campbell Scientific dataloggers CR10X, CR10, CR500, 21X, or CR7. The measured period can be converted to volumetric water content using calibration values.

2. DESCRIPTION

The Water Content Reflectometer consists of two stainless steel rods connected to a printed circuit board. A shielded four-conductor cable is connected to the circuit board to supply power, enable the probe, and monitor the pulse output. The circuit board is encapsulated in epoxy.

High speed electronic components on the circuit board are configured as a bistable multivibrator. The output of the multivibrator is connected to the probe rods which act as a wave guide. The oscillation frequency of the multivibrator is dependent on the dielectric constant of the media being measured. The dielectric constant is predominantly dependent on the water content. Digital circuitry scales the multivibrator output to an appropriate frequency for measurement with a datalogger. The CS615 output is essentially a square wave with an amplitude swing of ±2.5VDC. The period of the square wave output ranges from 0.7 to 1.6 milliseconds and is used for the calibration to water content.

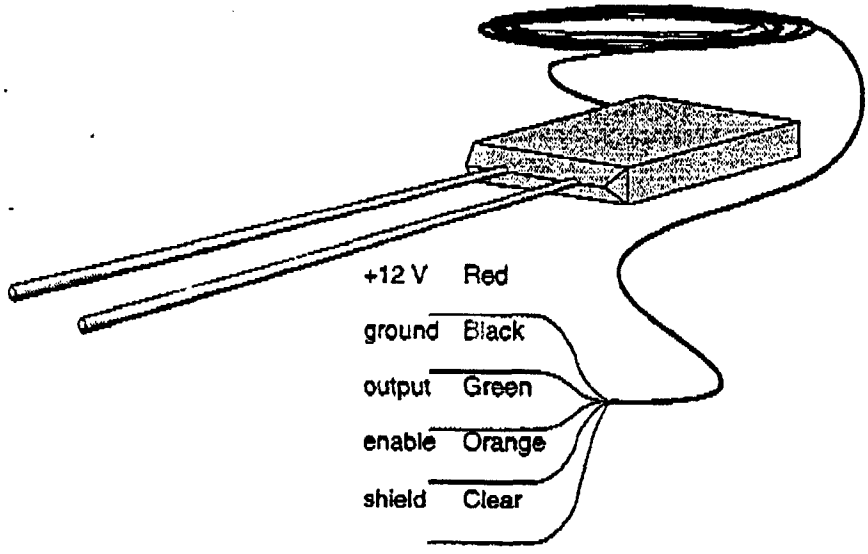


FIGURE 1. CS615 Water Content Reflectometer

3. SPECIFICATIONS

3.1 DIMENSIONS

Rods: 30.0 cm long
3.2 mm diameter
3.2 cm spacing
Head: 11.0 cm x 6.3 cm x 2.0 cm

3.2 WEIGHT

Probe: 280 g
Cable: 35 g m^{-1}

3.3 ELECTRICAL

Power

70 milliamps @ 12VDC when enabled
less than 10 microamps quiescent

Power Supply Voltage

9VDC minimum, 18VDC maximum

Enable Voltage

minimum voltage to enable probe is 1.3VDC

4. PERFORMANCE SPECIFICATIONS

4.1 ACCURACY

See the Calibration section for a discussion of accuracy. The accuracy is ±2% when using calibration for specific soil. The accuracy when using the general calibrations depends on soil texture and mineral composition.

4.2 RESOLUTION

The resolution of the volumetric water content measurement depends on which datalogger instruction is used. When the CR10X, CR10 or CR500 Instruction 27, Period Measurement, is used, the resolution is on the order of 10^{-6} m^3 m^{-3}. Period Measurement is not available on the CR7 or 21X.

When Instruction 3, Pulse Count, is used, the resolution with an execution interval of 1.0 second is 10^{-4} m^3 m^{-3} when pulse period is 1.3 milliseconds. The resolution improves as the water content decreases and as the execution interval increases. A shorter execution interval of 0.1 seconds yields a resolution of 10^{-2} m^3 m^{-3} at the same water content.

4.3 OPERATING RANGE

4.3.1 Soil Electrical Conductivity

The quality of soil moisture measurements which apply electromagnetic fields to wave guides is affected by soil electrical conductivity. The propagation of electromagnetic fields in the configuration of the CS615 is predominantly affected by changing dielectric constant due to changing water content, but it is also affected by electrical conductivity. Free ions in soil solution provide electrical conduction paths which result in attenuation of the signal applied to the waveguides. This attenuation both reduces the amplitude of the high-frequency signal on the probe rods and affects the shape of the oscillating signal. The attenuation reduces oscillation frequency at a given water content because it takes a longer time to reach the oscillator trip threshold.

Soil electrical conductivity can be described by (Rhoades et al., 1976)

$$\sigma_{bulk} = \sigma_{solution}\theta_v T + \sigma_{solid}$$

with σ the electrical conductivities of the bulk soil, the soil solution, and the solid constituents, θ_v the volumetric water content and T a soil-specific transmission coefficient intended to account for the tortuosity of the flow path as water content changes. See Rhoades et al., 1989 for a form of this equation which accounts for mobile and immobile water. The above equation is presented here the show the relationship between soil solution electrical conductivity and soil bulk electrical conductivity.

Soil solution electrical conductivity, $\sigma_{solution}$ can be determined in the laboratory using extraction methods. Soil bulk electrical conductivity can be measured using time domain reflectometry (TDR) methods. Most expressions of soil electrical conductivity are given in terms of solution conductivity. Discussion of the effects of soil electrical conductivity on CS615 performance will be on a soil solution basis unless stated otherwise.

When soil solution electrical conductivity values exceed 1 dS m^{-1}, the slope of the calibration begins to change. The slope decreases with increasing electrical conductivity. The probe will still respond to water content changes with good stability, but the calibration will have to be modified. (See the Calibration section.) At

electrical conductivity values greater than 5 dS m^{-1} the probe output can become unstable.

4.3.2 Soil Organic Matter and Clay Content

The amount of organic matter and clay in a soil can alter the response of dielectric-dependent methods to changes in water content. This is apparent when mechanistic models are used to describe this measurement methodology.

The electromagnetic energy introduced by the probe acts to re-orientate or polarize the water molecules which are polar. If other forces are acting on the polar water molecules, the force exerted by the applied signal will be less likely to polarize it. This has the net effect of 'hiding' some of the water from the probe.

Organic matter and most clays are highly polar. Additionally, some clays sorb water interstitially and thus inhibit polarization by the applied field. It would be convenient if the calibration of water content to CS615 output period could be adjusted according to some parameter of the soil which reflects the affect of the intrinsic forces. However, identification of such a parameter has not been done, and it is likely that measurement of the correlation parameter would be more difficult than calibrating the CS615 for a given soil.

4.3.3 Cable Length

Probe cable length is not a limitation under typical applications. Laboratory measurements show no degradation in measurement quality with cable lengths up to 100 meters. Cable lengths greater than 50 m may increase the potential for damage from electrostatic discharge (lightning). The performance may be degraded if a cable type other than that provided with the probe is used.

4.3.4 Temperature Dependence

The CS615 output is sensitive to temperature, and compensation can be applied to enhance accuracy. The magnitude of the temperature coefficient varies with water content. Laboratory measurements were performed at various water contents and over the temperature range from 10°C to 30°C. The calibration information presented in Section 9 is for a temperature of 20°C. The following equation can be used to interpolate the temperature coefficient for a range of volumetric water content (θ_v) values.

$$Coef_{temperature} = -3.46 * 10^{-4} + 0.0198\theta_v - 0.0458\theta_v^2$$

To apply this correction, the following equation can be used.

$$\theta_{vcorrected} = \theta_{vuncorrected} - (T - 20) * Coef_{temperature}$$

Application of this correction yields a maximum difference between corrected and uncorrected water content of approximately 1.6%. Considering the accuracy of the measurement and the potential spatial variability of soil temperature along the length of the probe rods, the correction is not necessary in most cases.

An example for using the temperature correction is a measurement taken on a soil at a water content of about 0.23 and a temperature of 25°C. The temperature coefficient value is 0.00164 $m^3\ m^{-3}\ °C^{-1}$ which means that the measured water content is 5°C *(0.00164 $m^3\ m^{-3}\ °C^{-1}$) or 0.8% high.

5. INSTALLATION

5.1 ORIENTATION

The probe rods can be inserted vertically into the soil surface or buried at any orientation to the surface. A probe inserted vertically into a soil surface will give an indication of the water content in the upper 30 cm of soil. The probe can be installed horizontal to the surface to detect the passing of wetting fronts or other vertical water fluxes. A probe installed at an angle of 30 degrees with the surface will give an indication of the water content of the upper 15 cm of soil.

5.2 POTENTIAL PROBLEMS WITH IMPROPER INSERTION

The method used for probe installation can affect the accuracy of the measurement. The probe rods should be kept as close to parallel as possible when installed to maintain the design wave guide geometry. The sensitivity of this measurement is greater in the regions closest to the rod surface than at distances away from the surface. Probes inserted in a manner which generates air voids around the rods will reduce the measurement accuracy. In

some applications, installation can be improved by using insertion guides or a pilot tool. Campbell Scientific offers the CS615G and CS615P insertion tools. The CS615G is a probe insertion guide which holds the rods parallel during rod insertion. The CS615P pilot tool is essentially the CS615 rods which are inserted into the soil then removed. This makes proper installation of the CS615 easier in soils which are difficult to insert probes into.

6. WIRING

color	function	CR10(X)	21X/CR7
red	+12 V	+12 V	+12 V
green	output	SE analog channel	pulse channel
orange	enable	control port	control port
black	ground	G	⏚
clear	shield (ground)	G	⏚

NOTE: CS615s manufactured before 12/95 have the green and black leads reversed. Consult the wiring label near the end of the cable.

The enable line is set high to put the probe in the measuring mode.

7. DATALOGGER INSTRUCTIONS

7.1 INTRODUCTION

The output of the CS615 is essentially a square wave with amplitude ±2.5 volts and a frequency which is dependent on the dielectric constant of the material surrounding the probe rods. The frequency range is approximately 600 to 1500 Hz. The period (0.7 to 1.6 milliseconds) is used in the calibration for water content.

The Pulse Count instruction of a CR10, CR500, 21X or CR7 dataloggers can be used with the CS615 output connected to a pulse count channel. The Period Measurement instruction of the CR10 or CR500 can be used with the CS615 output connected to a single-ended analog channel.

7.2 PULSE COUNT

It is important to understand the event sequence during the Instruction 3 Pulse Count Measurement when using it with the CS615. See the Instructions section of the datalogger manual for a detailed explanation of the Pulse Count instruction.

A brief explanation of pulse count use in a CS615 application is presented here. The LOW LEVEL AC option for the configuration code is used, and the output is selected for frequency (Hz). Period (msec) is easily obtained with the Inverse instruction (42).

TABLE 1. Instruction 3 Pulse Count Measurement Sample Program

```
;{21X}
;Simple program to demonstrate use of
;pulse count instruction with CS615
;
*Table 1 Program
  01:      2.0          Execution Interval (seconds)

1: If time is (P92)
  1:    0000            Minutes into a
  2:      15            Minute Interval
  3:      30            Then Do

2: Do (P86) ;set CS615 enable high
  1:      41            Set Port 1 High

3: Beginning of Loop (P87)
  1:       1            Delay
  2:       2            Loop Count

4: End (P95)

5: Pulse (P3)
  1:       1            Reps
  2:       1            Pulse Input Channel
  3:      21            Low Level AC, Output Hz
  4:       1            Loc [ kHz     ]
  5:    .001            Mult ;convert Hz to kHz
  6:     0.0            Offset

6: Do (P86) ;set CS615 enable low
  1:      51            Set Port 1 Low

7: End (P95)

End Program
```

The Pulse Count instruction uses accumulators to monitor pulses on the datalogger Pulse Count Channels. At the beginning of each execution interval for the table containing the Pulse Count instruction, the accumulator count is dumped to a section in datalogger RAM, the accumulator is then reset to zero and begins accumulating counts again. When the Pulse Count instruction is reached, the value in RAM is modified by the multiplier and offset in the Pulse Count instruction and the result written to input storage. The RAM is then reset to zero.

Consider the simple 21X program in Table 1. Additional instructions which might be needed for multiplexer control or other functions have been omitted for simplicity. This program is written to obtain a CS615 reading every 15 minutes. When the program is compiled by the datalogger, the accumulators begin monitoring the Pulse Count Channels. Immediately following compilation by the datalogger, there is no signal on the input channels because the CS615 is not enabled until the 15 minute interval specified in the Instruction 92 is reached. When the 15 minute interval is reached, Instruction 86 is executed which sets the enable of the CS615 high and the probe outputs a signal which is detected by the pulse counters.

The Loop Instruction in this application uses a Delay of 1 and a Loop Count of 2. Program execution pauses during the first loop count until the execution interval of 2 seconds is complete. This delay is necessary because the probe has not been enabled for the entire execution interval which means a complete count is not obtained. More complex programs will contain additional instructions prior to the instruction to enable the CS615, and these instructions can take a significant amount of time to execute. During the second time through the Loop Instruction the pulse counters see the CS615 output for the full execution interval. At the end of this interval the accumulators transfer to RAM and are reset. When the program execution then moves to the Pulse Count Instruction (P3) the value in RAM is converted to kHz and written to input storage.

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Instruction 27, Period Measurement is available only on the CR10, CR10X, or CR500. For convenience, the following tables from the datalogger manual are presented here. See the datalogger manual for detailed description of the instruction and the example programs for typical values.

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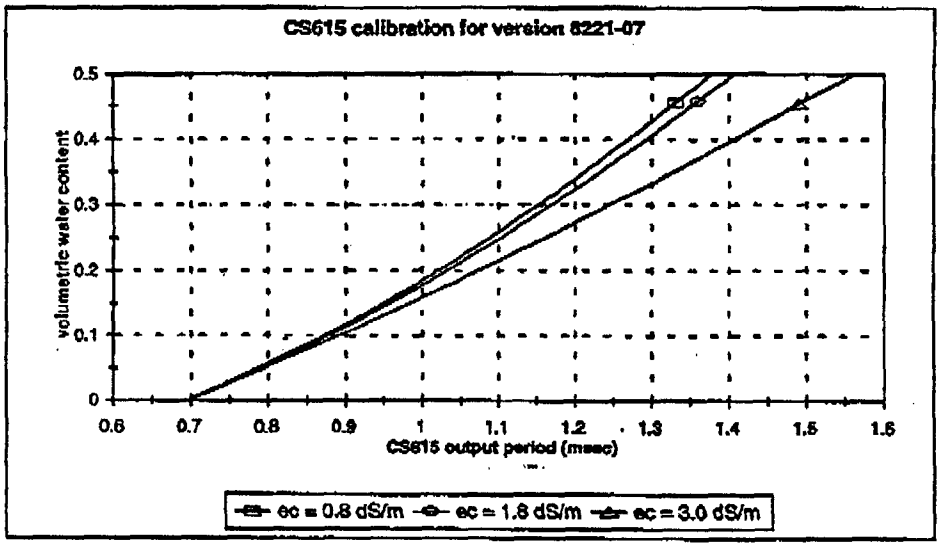

FIGURE 2. CS615 Calibration Curves

Figure 2 demonstrates the effect of electrical conductivity on the calibration. At electrical conductivity values of 1 dS m^{-1} and below, the calibration shown for 0.8 dS m^{-1} works well for a wide range of soil textures. The calibration curves for the higher electrical conductivities show that the slope decreases with increasing conductivity. The response of the CS615 to changes in water content at higher electrical conductivity values is well-behaved up to approximately 5 dS m^{-1}. The calibration can be approximated from figure 2 if the soil solution electrical conductivity is known or if soil measurements are made with the CS615 and the actual water content is independently determined. High clay content has a similar affect on the calibration but the magnitude is dependent on the clay type.

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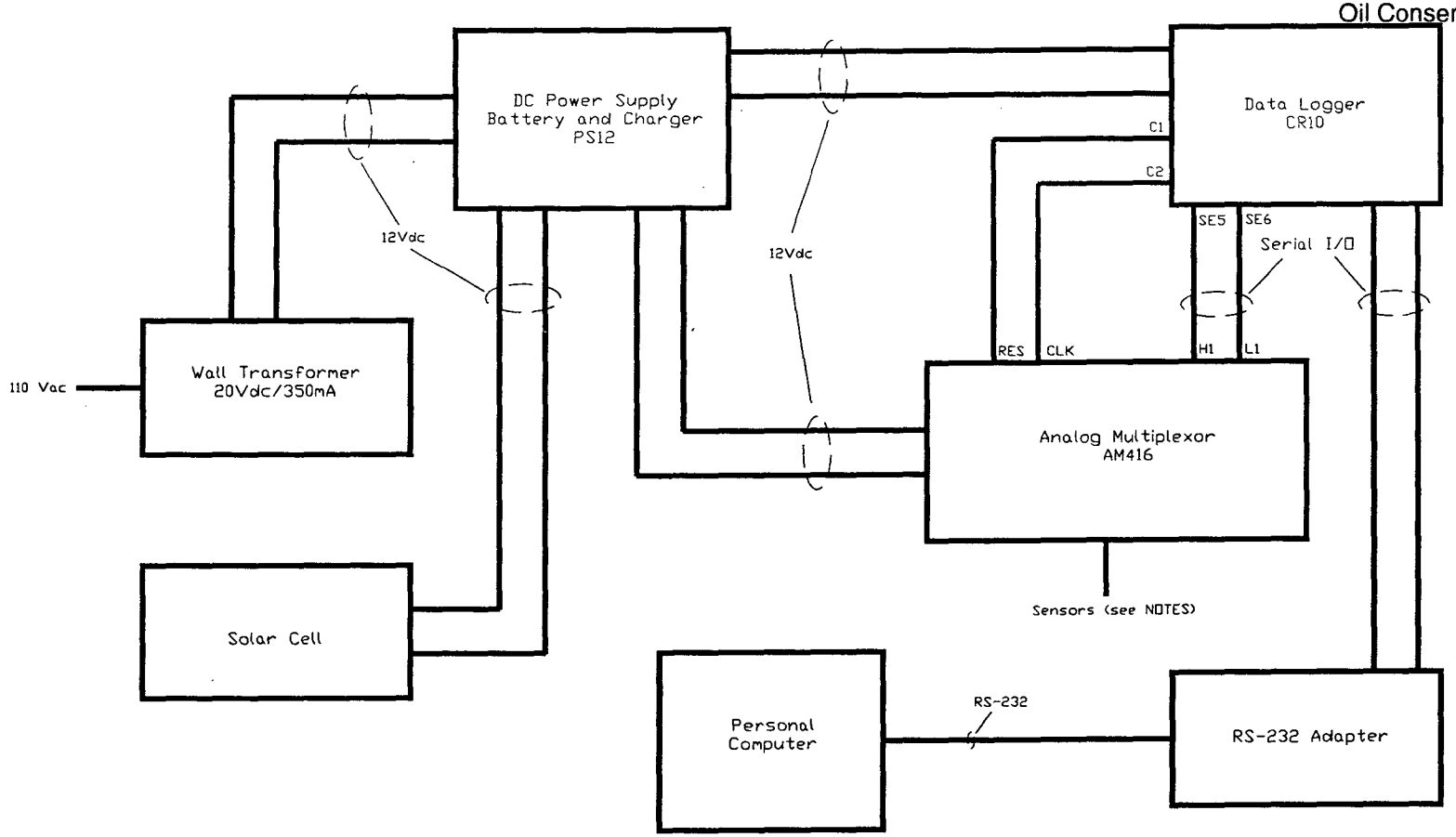
3	Monitor 48 CS615s with 21X datalogger and AM416 multiplexer using Pulse Count Instruction (P3)
4	Monitor 48 CS615s with CR10 datalogger and AM416 multiplexer using Period Averaging Instruction (P27)



NOTES

Details of sensor connections are on a separate sheet

(see drg No. 2)

CONTRACT NO.		DATE
DRAWN BY	A. Grisanti	2/1/97
CHECKED BY	J. Bergen	11/5/97
DESIGNED BY	A. Grisanti	
DESIGN ACTIVITY		
CUSTOMER	AMOCO/GRI/DOE	

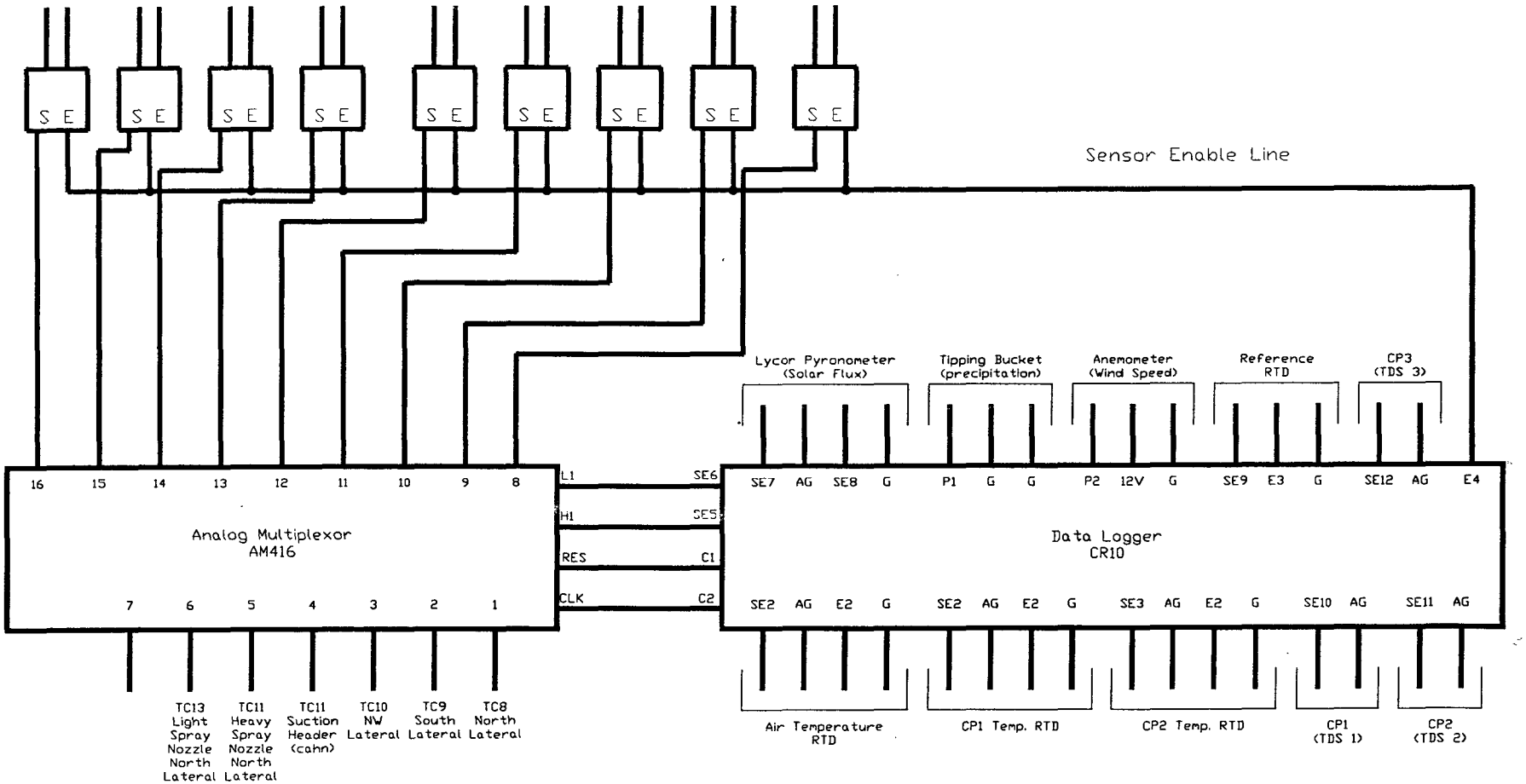
COMPANY: B.C. Technologies, Ltd.
Energy & Environmental Research Center

TITLE: Data Logger

SIZE	FSCM NO.	DWG NO. / FILE NAME
A		

SCALE	DATE	SHEET
NONE	4 Nov 97	1 of 3

Water Content Reflectometer Sensor Array CS615



NOTES

All thermocouples (TC) are Type K

All CS615 connected to +12V and GND

CONTRACT NO.		DATE	
DRAWN BY	A. Grisanti	2/1/97	
CHECKED BY	J. Bryce	11/3/97	
DESIGNED BY	A. Grisanti		
DESIGN ACTIVITY			
CUSTOMER	AMOCO/GRI/DOE		

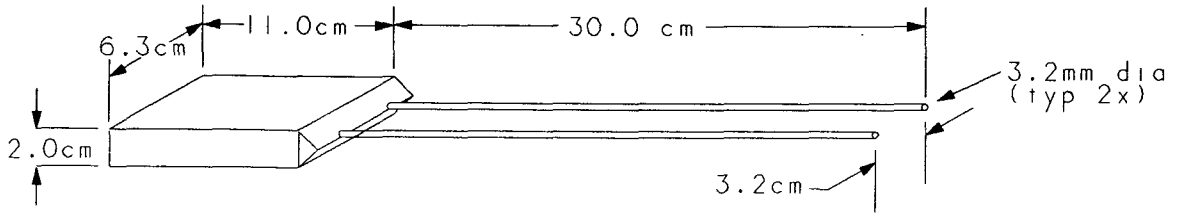
COMPANY: B.C. Technologies, Ltd.
Energy & Environmental Research Center

TITLE: Data Logger Sensor Connections

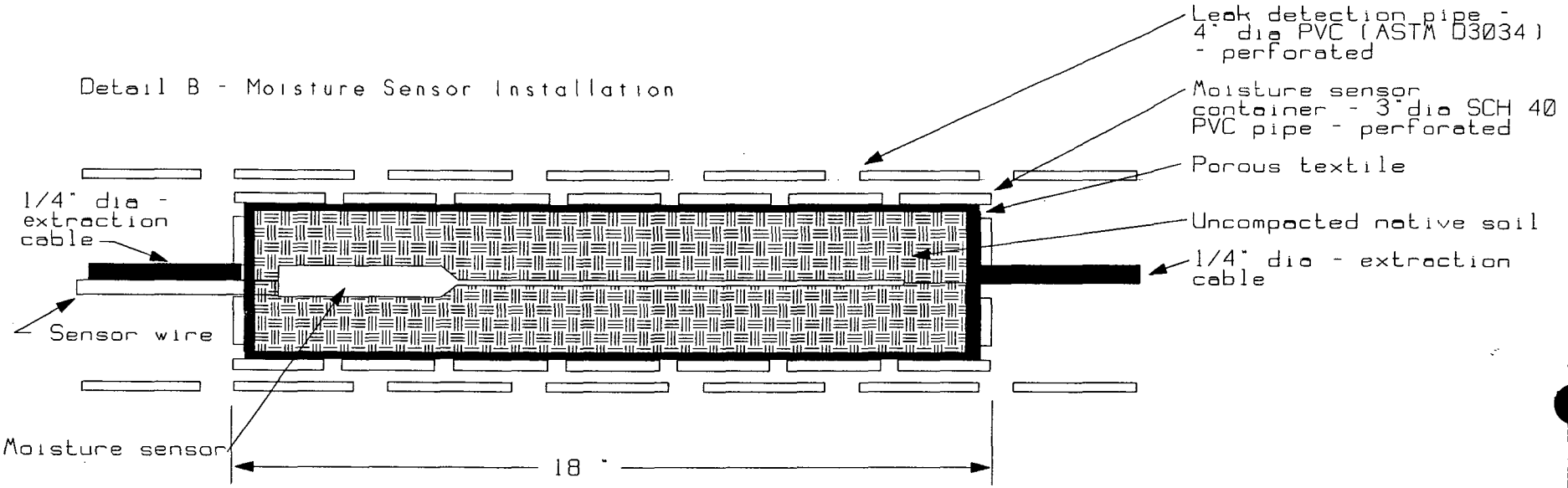
SIZE	FSCM NO.	DWG NO. / FILE NAME
A		

SCALE	DATE	SHEET
NONE	4 Nov 97	2 of 3

Detail A - Moisture Sensor



Detail B - Moisture Sensor Installation



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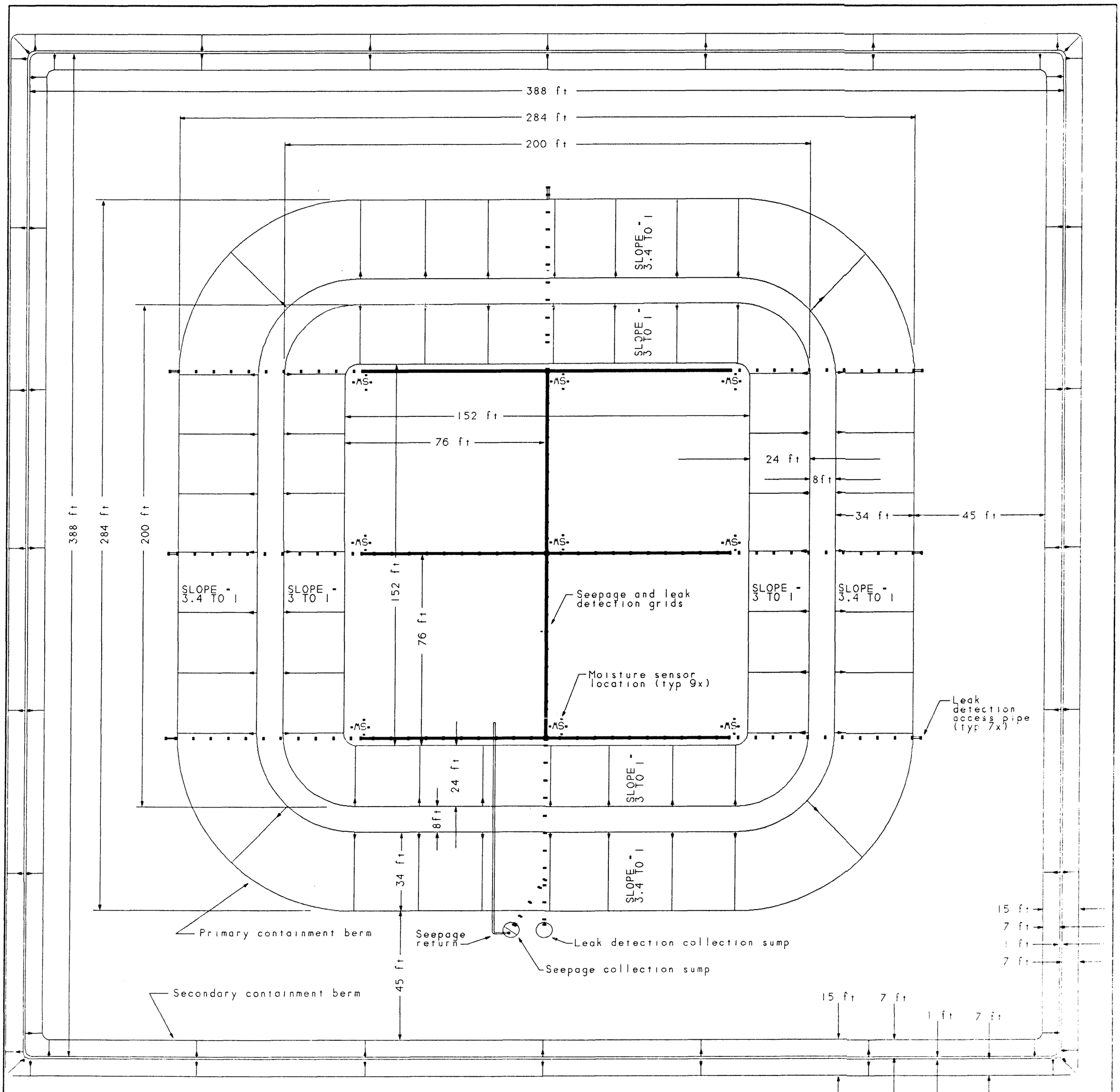
B.C. Technologies, Ltd.			
Drawn by: J. E. Boysen	Manzanares Mesa Facility Moist.Sensor Installation		
Approved: John E. Boysen	Date: 11/08/97	Scale: No Scale	Drawing No. 3 of 3



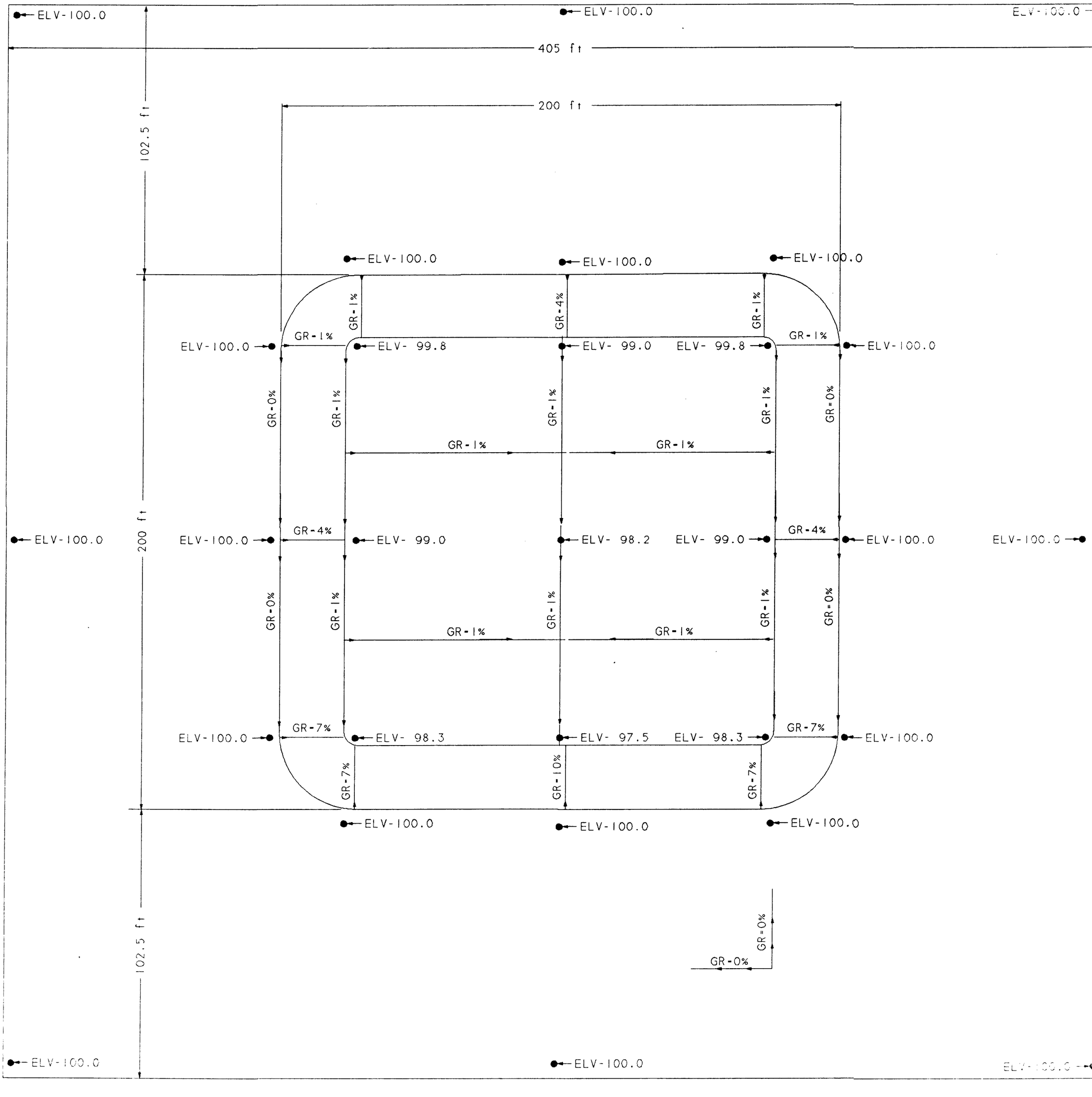
Top View of Evaporation Pond

NOTES:

List of drawings-

1 - Evaporation Pond Layout - Top View of Evaporation Pond
2 - Surface Grade Preparation - Top View of Graded Surface
3 - Leak Detection System - Top View and Elevation of Leak Detection Grid
4 - Leak Detection System - Detail A - Collection Sump, Detail D - Trench Detail
5 - Leak Detection System - Cross section B-B, Cross section C-C
6 - Evaporation Pond Const. - Top View and Elevations of Evaporation Pond
7 - Evaporation Pond Const. - Cross section E-E, Cross section F-F, Cross section G-G, Cross section H-H, Detail I - Construction of Pond Bottom
8 - Seepage Collection System - Top View and Elevation of Seepage Collection Grid
9 - General Construction - Detail J - Seepage Collection Sump, Detail K - Construction of Secondary Containment Berm

B.C. Technologies, Ltd.			
Drawn by: J. E. Boysen	Manzanares Mesa Facility Evaporation Pond Layout		
Approved: John E. Boysen	Date: 11/05/97	Scale: No Scale	Drawing No. 1 of 9



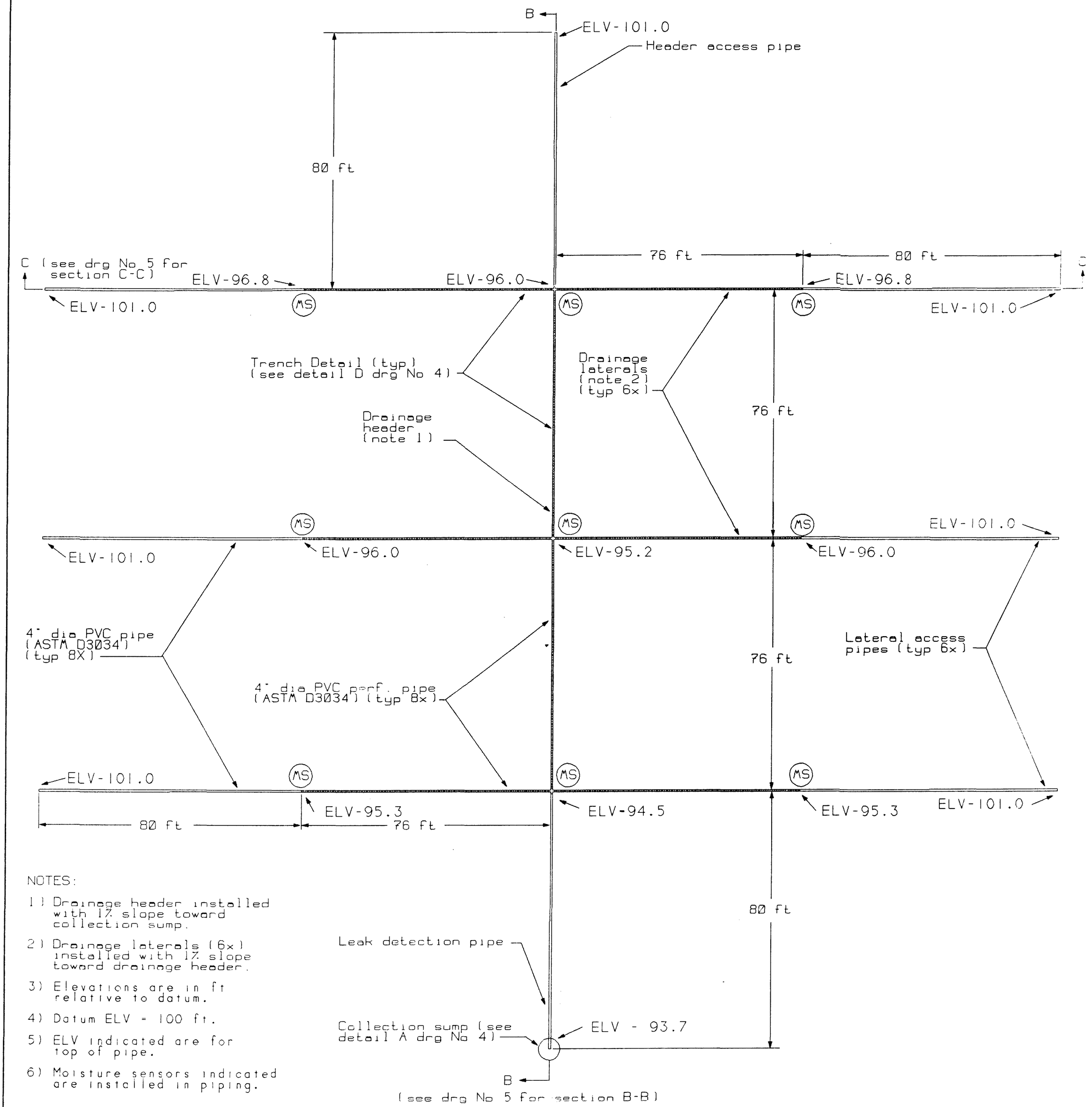
Top View of Graded Surface

NOTES:

1) Elevations (ELV) are in ft relative to datum.

2) Datum ELV = 100 ft.

B.C. Technologies, Ltd.			
Drawn by: J. E. Boysen	Manzanares Mesa Facility Surface Grade Preparation		
Approved: John E. Boysen	Date: 11/05/97	Scale: No Scale	Drawing No. 2 of 9



NOTES:

1) Drainage header installed with 1% slope toward collection sump.
2) Drainage laterals (6x) installed with 1% slope toward drainage header.
3) Elevations are in ft relative to datum.
4) Datum ELV = 100 ft.
5) ELV indicated are for top of pipe.
6) Moisture sensors indicated are installed in piping.

Top View and Elevation of Leak Detection Grid

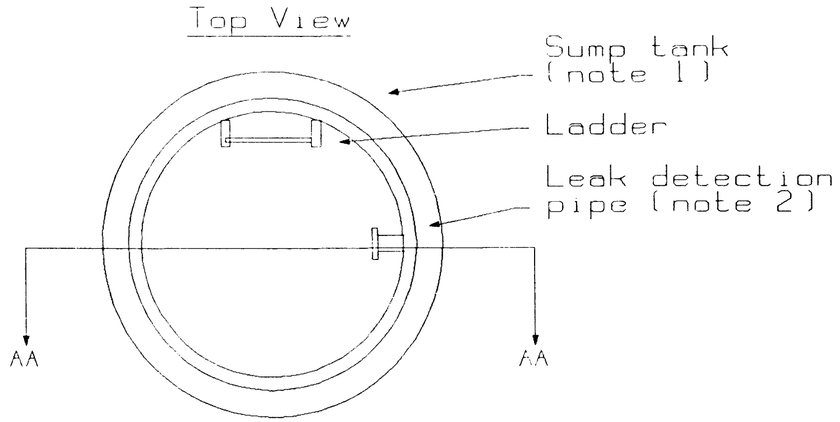
Legend	
Moisture sensor —	MS
Perforated pipe —	
Standard pipe —	

B.C. Technologies, Ltd.

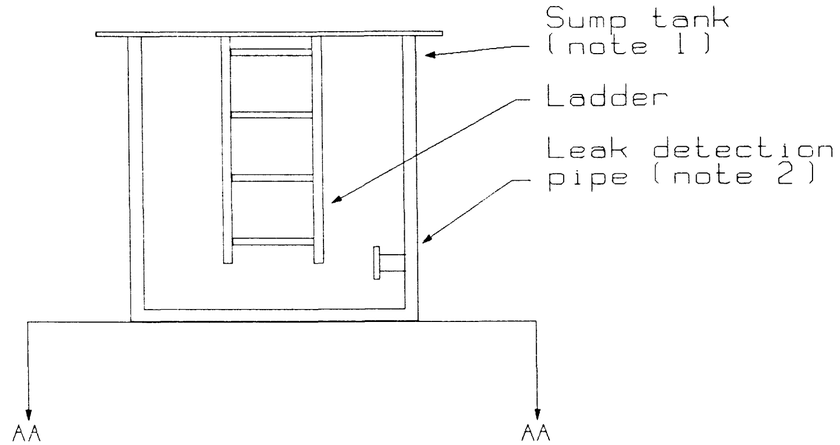
Drawn by:	Manzanares Mesa Facility Leak Detection System		
J. E. Boysen			
Approved:	Date:	Scale:	Drawing No.
John E. Boysen	11/03/97	No Scale	3 of 9

Detail A - Collection Sump

Top View



Section AA-AA Front Cutaway



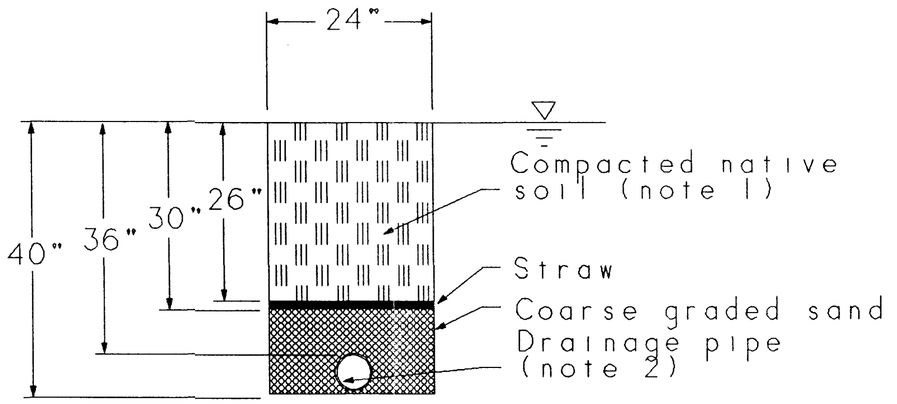
NOTES: (Detail A)

1) Sump tank is standard well sump tank with ladder installed. Approximate tank dim. are 3 ft dia and 7 ft high.

2) Leak detection pipe is 4" dia PVC (ASTM 3034) with cap installed.

Detail D - Trench Detail

Top View



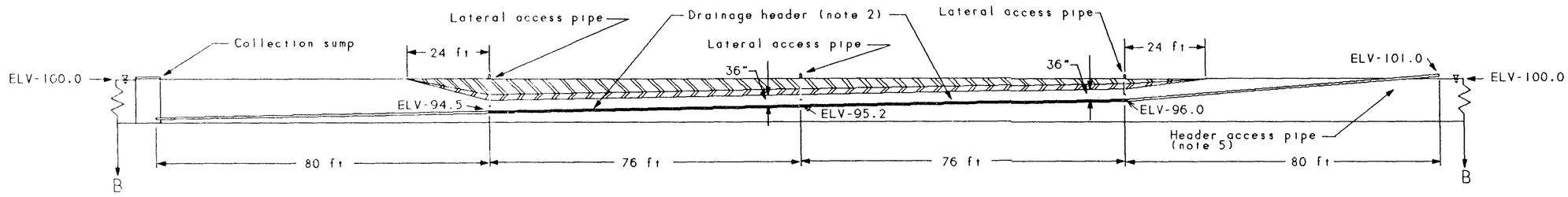
NOTES: (Detail D)

1) Native soil compacted to 92% (standard proctor ASTM D698).

2) Drainage pipe - 4" dia PVC (D3034) perforated - perforations covered with porous textile.

B.C. Technologies, Ltd.			
Drawn by: J. E. Reysen	Manzanares Mesa Facility Leak Detection System		
Approved: John E. Reysen	Date: 11/04/97	Scale: N. Scale	Drawing No. 4 of 9

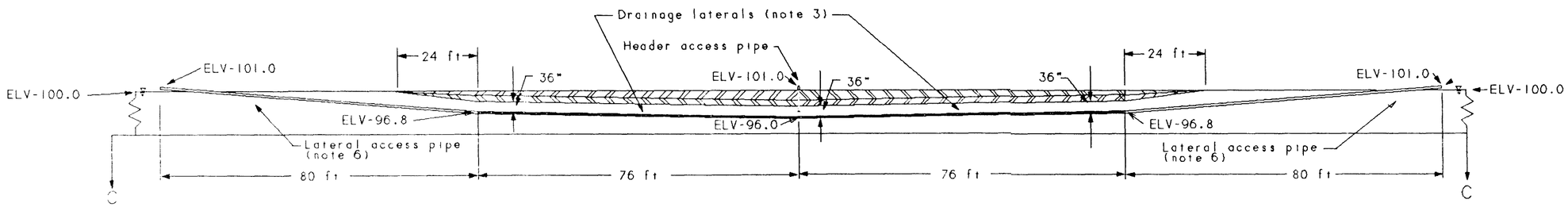
Cross section B-B



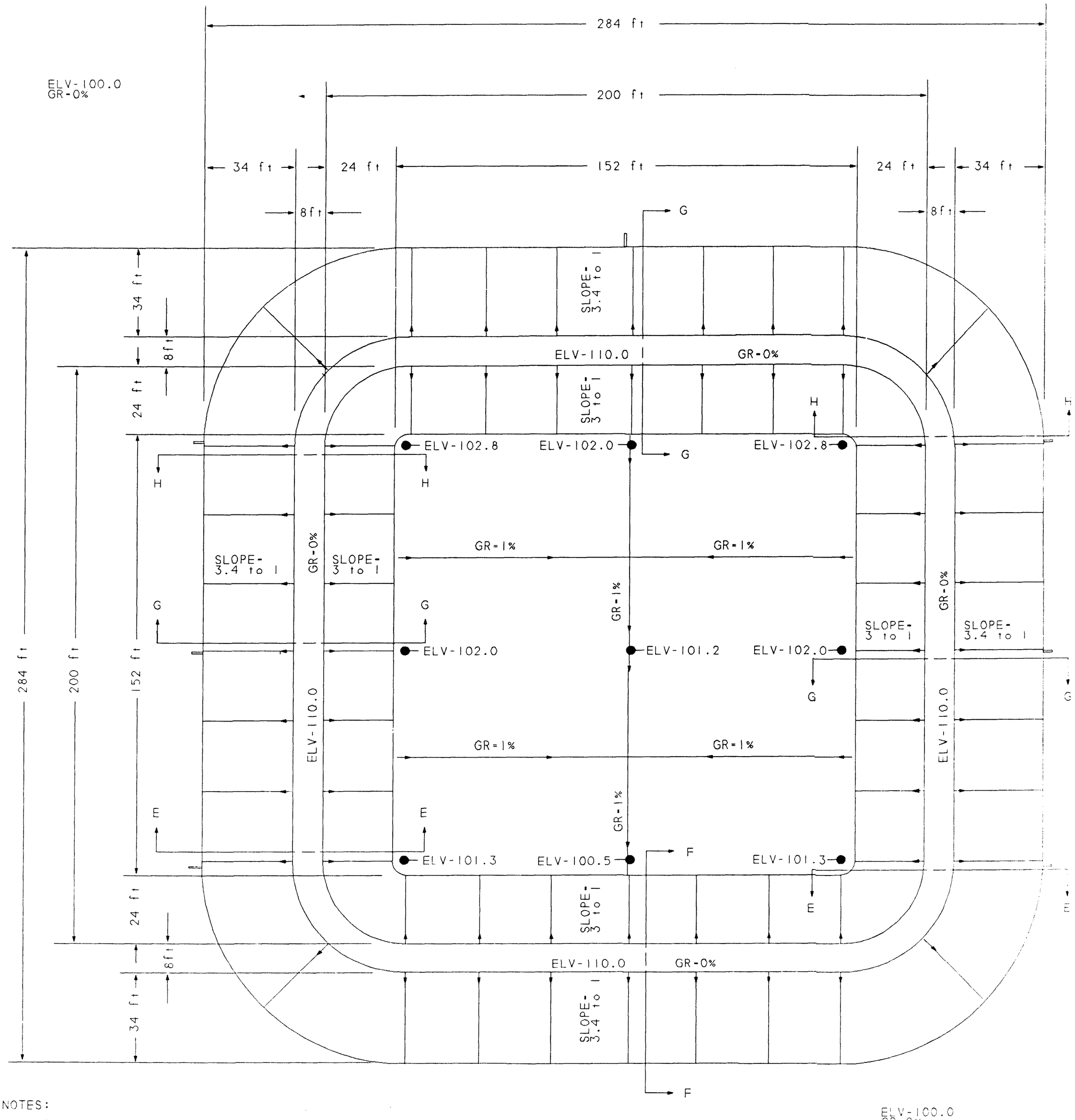
NOTES:

1) Graded surface is prepared with a 1% slope from lateral access pipes towards drainage header and with a 1% slope from header access pipe towards collection sump.
2) Drainage header is installed with a 1% slope toward collection sump.
3) Drainage laterals are installed with a 1% slope towards drainage header.
4) Moisture sensors not shown. Sensors are installed in drainage piping at locations indicated in drawing No. 2.
5) Header access pipe installed with a 3.8% slope.
6) Lateral access pipes installed with a 3.8% slope.
7) Elevations (ELV) are in ft relative to datum.
8) Datum ELV = 100 ft.
9) Elevations indicated are for top of pipe.

Cross section C-C



B.C. Technologies, Ltd.			
Drawn by: J. E. Boysen	Manzanares Mesa Facility Leak Detection System		
Approved: John E. Boysen	Date: 11/03/97	Scale: As Shown	Drawing No. 5 of 9



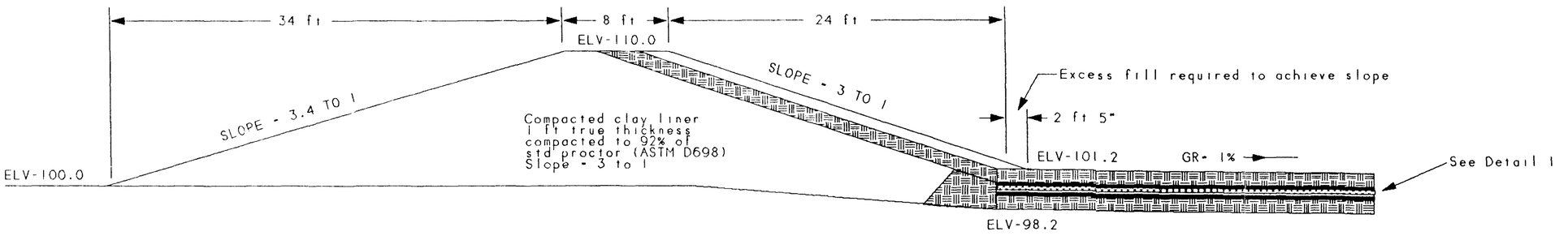
NOTES:

1) Elevations are in ft relative to datum.
2) Datum ELV-100 ft.
3) Elevations provided are for berm height and top of primary clay liner.
4) Pond piping not indicated on drawing.
5) Not shown is fill dirt placed on top of primary clay liner to achieve 3 to 1 slope where ELV is less than 102.0.
6) Cross sections E-E, F-F, G-G, and H-H are provided in drg No 7.
7) Details regarding construction of pond bottom are provided in Detail 1 of drg No 7.

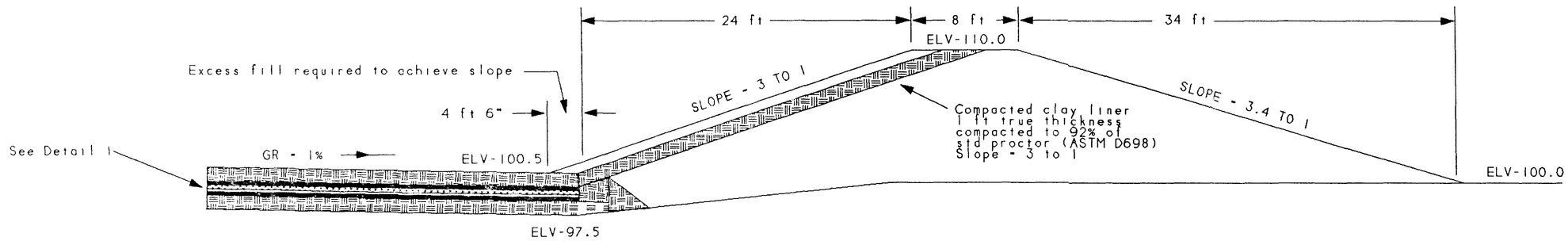
Top View and Elevations of Evaporation Pond

B.C. Technologies, Ltd.			
Drawn by: J. E. Boysen	Manzanares Mesa Facility Evaporation Pond Const.		
Approved: John E. Boysen	Date: 11/06/97	Scale: No Scale	Drawing No.: 5 of 9

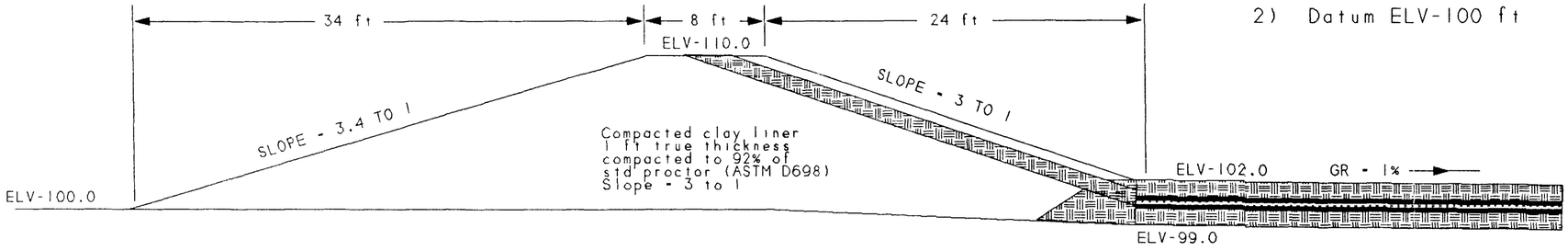
Cross section E-E



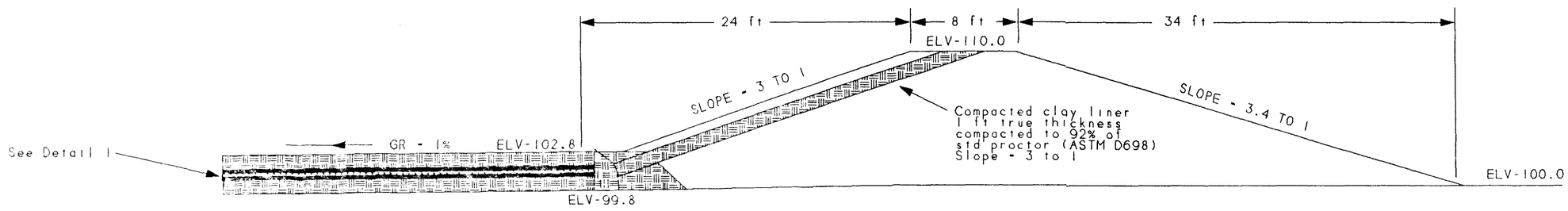
Cross section F-F



Cross section G-G



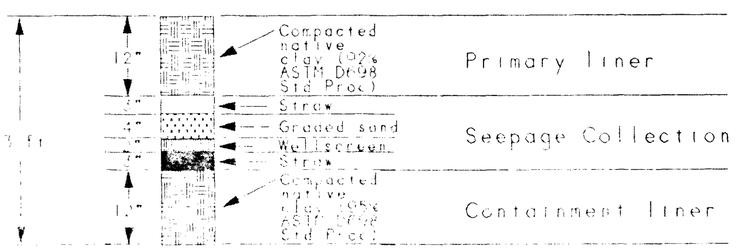
Cross section H-H



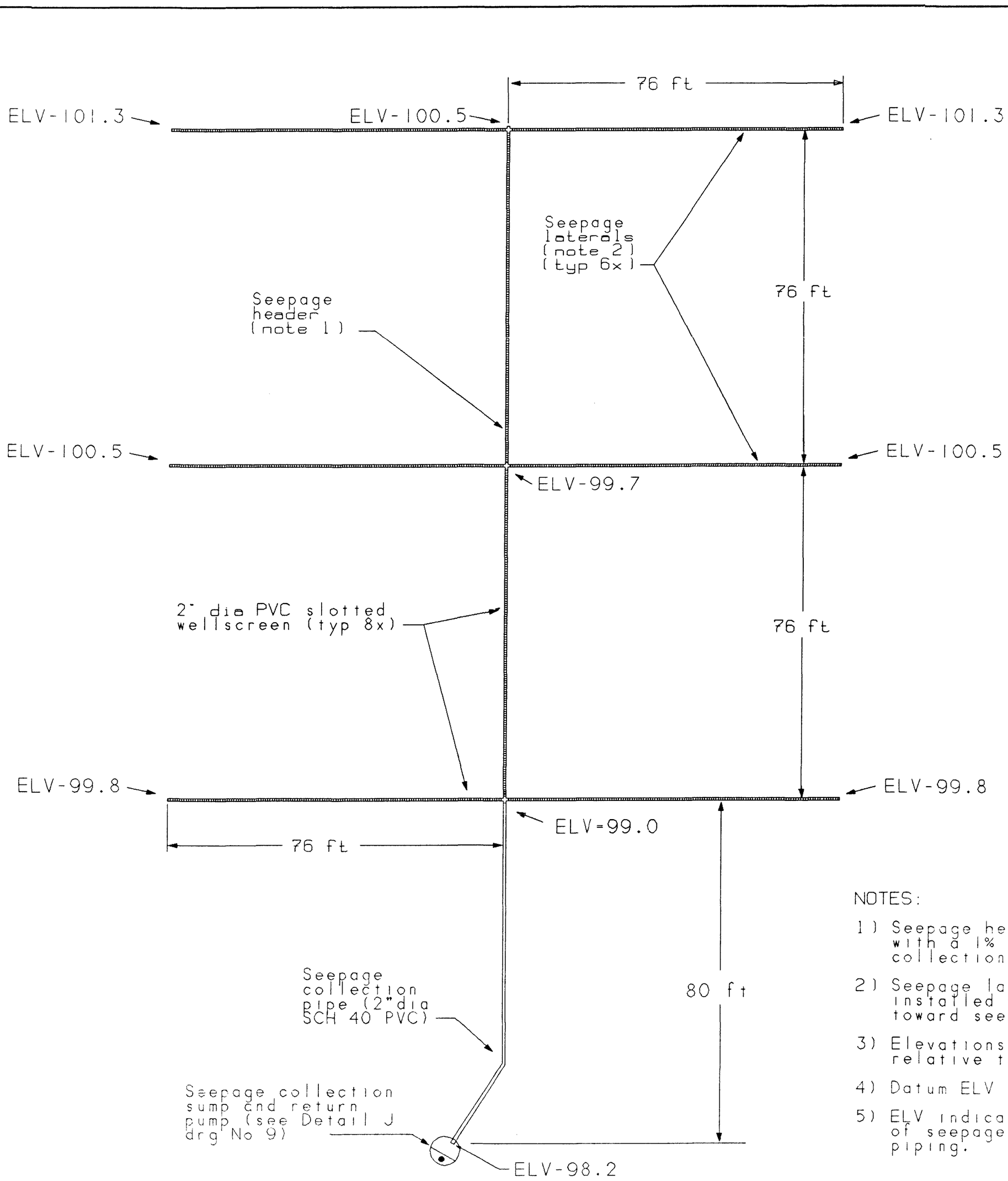
NOTES:

1) Elevations are in ft relative to datum.
2) Datum ELV-100 ft

Detail 1 - Construction of Pond Bottom



B.C. Technologies, Ltd.			
Drawn by: J. E. Boysen	Manzanares Mesa Facility Evaporation Pond Const.		
Approved: John E. Boysen	Date: 11/07/97	Scale: No Scale	Drawing No. 7 of 9



NOTES:

1) Seepage header installed with a 1% slope toward collection sump.
2) Seepage laterals (6x) installed with a 1% slope toward seepage header.
3) Elevations are in ft relative to datum.
4) Datum ELV = 100 ft.
5) ELV indicated are for top of seepage collection piping.

Top View and Elevation of Seepage Collection Grid

Legend

Slotted wellscreen ——

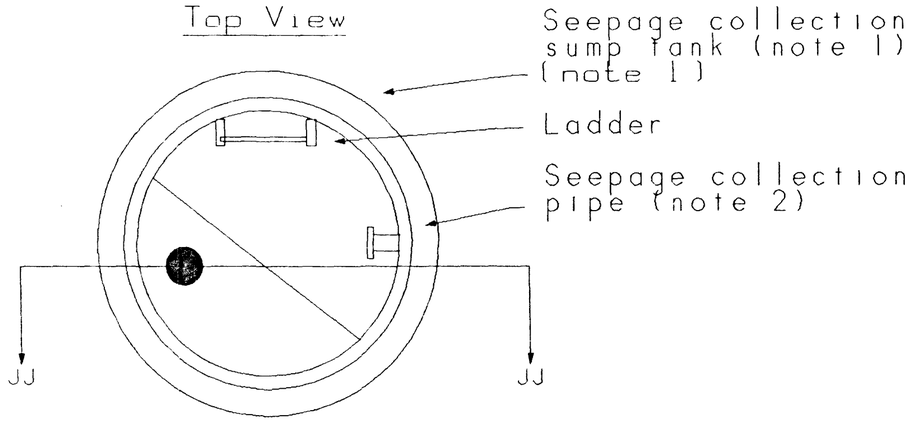
Standard pipe ——

B.C. Technologies, Ltd.

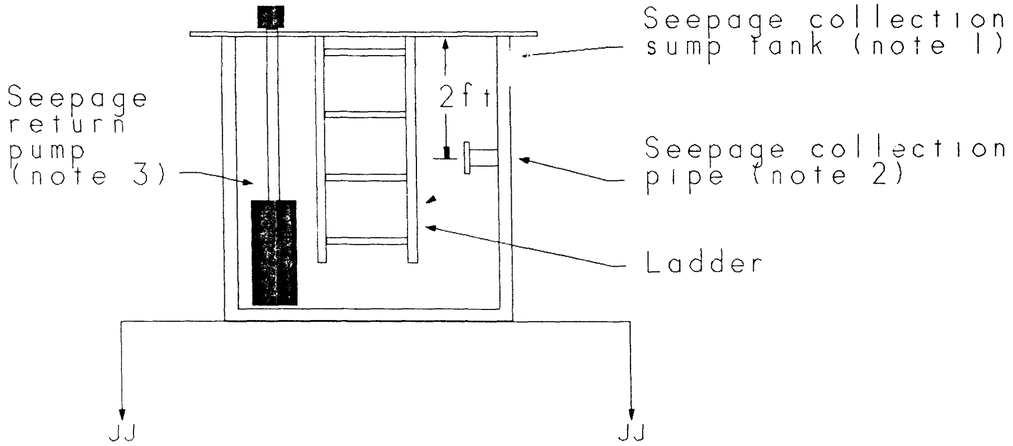
Drawn by:	Manzanares Mesa Facility Seepage Collection System		
J. E. Boysen			
Approved:	Date:	Scale:	Drawing No.:
John E. Boysen	11/06/97	No Scale	8 of 9

Detail J - Seepage Collection Sump

Top View



Section JJ-JJ Front Cutaway



NOTES: (Detail J)

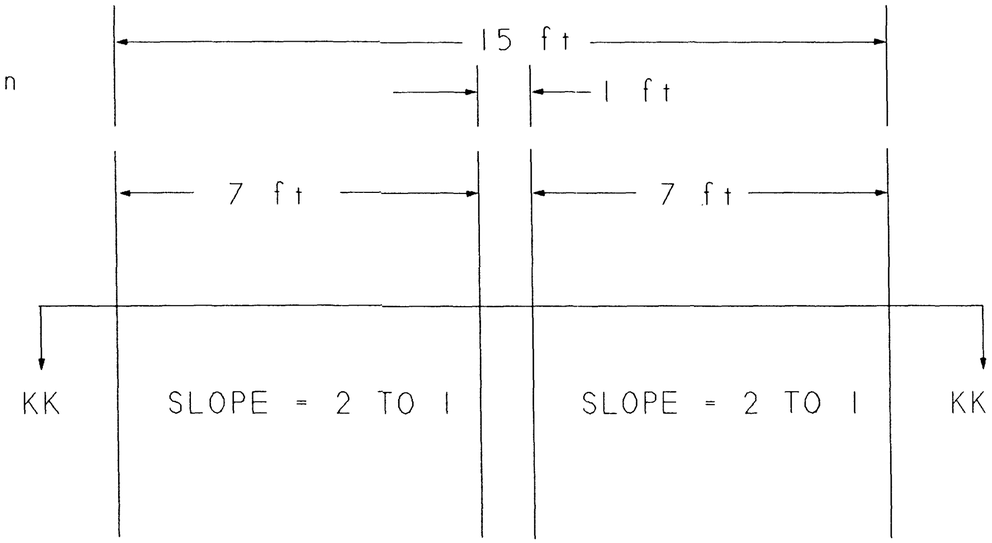
1) Sump tank is standard well sump tank with ladder installed. Approximate tank dimensions are 5 ft diameter x 5 ft high.

2) Seepage collection pipe is 2" dia SCH 40 PVC.

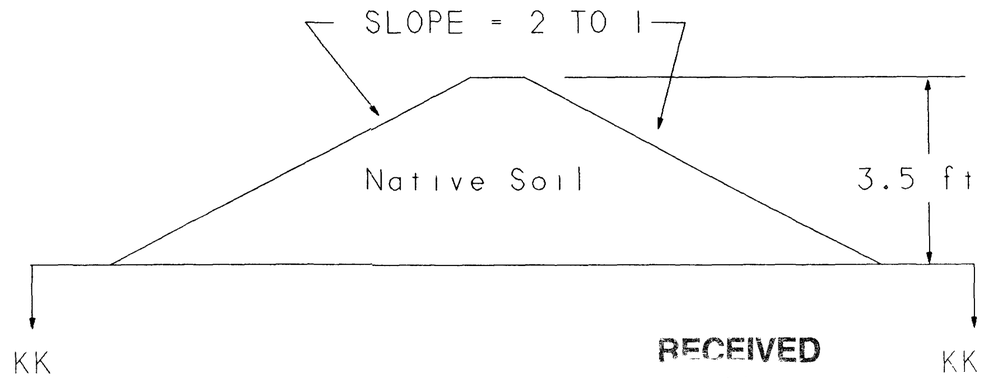
3) Seepage return pump - submersible, 40 gph at 40 ft head. Equipped with level sensor on/off automatic control.

Detail K - Construction of Secondary Containment Berm.

Top View



Section KK-KK Berm Cutaway



B.C. Technologies, Ltd.			
Drawn by: J. E. Boysen	Manzanares Mesa Facility Leak Detection System		
Approved: John E. Boysen	Date: 11/07/97	Scale: No Scale	Drawing No. 9 of 9

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

MEMORANDUM OF MEETING OR CONVERSATION

☒ Telephone ☐ Personal	Time @ 9:00	Date 11-3-97

Originating Party	Other Parties
Martyne Kieling	Buddy Shaw

Subject: Manzanares

2:15 - John Boyson BCD
307-742-5651
Laramie Wy

Discussion

Verbal Approval to begin Dirt Work
Will Probably Have Someone else call OCD About the Drawing and Pond design.

John Boyson
Will besending Some Blue prints of the Pond Design with Conventional leak Detection and a well screen 75 Ft Grid Spacing with Leakdetection in tubeing

Conclusions or Agreements

Distribution

Signed Martyne J Kieling

NEW MEXICO ENERGY, MINERALS
& NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION
2040 South Pacheco Street
Santa Fe, New Mexico 87505
(505) 827-7131

October 29, 1997

CERTIFIED MAIL
RETURN RECEIPT NO. P-326-936-357

Mr. Buddy Shaw
AMOCO Production Company
200 Amoco Court
Farmington, New Mexico 87401

RE: AMOCO Manzanares Mesa Surface Waste Management Facility
E/2 NW/4 of Section 4, Township 29 North, Range 8 West, NMPM,
San Juan County, New Mexico.

Dear Mr. Shaw:

The New Mexico Oil Conservation Division (OCD), has received the Amoco Production Company (Amoco) application for a surface waste management facility at Manzanares Mesa and the affidavit of publication from the Farmington Daily Times and the Santa Fe New Mexican. The thirty (30) day public comment period ended on October 22, 1997 without any interested parties submitting comments. The application proposes the construction of a test model earthen evaporation pond, composting and landfarm surface waste management facilities. The OCD is requesting the following additional information as to the design and construction of the earthen evaporation pond:

1. Engineering design blueprints of the pond and all containment systems to be constructed;

2. Engineering and design specifications on the Moisture Sensor Grid to be installed;

3. Previous studies or current usage of this particular Moisture Sensor Grid technology;

4. Engineering and design specification on the automated system that will provide 24 hour monitoring.

Amoco shall send two copies of the above information to the Santa Fe OCD office and one copy to the appropriate District office.

If you have any questions please do not hesitate to contact me at (505) 827-7153.

Sincerely,

Martyne J. Kieling
Environmental Geologists

Attachments
xc: Aztec OCD Office

NEW MEXICO ENERGY, MINERALS
& NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION
2040 South Pacheco Street
Santa Fe, New Mexico 87505
(505) 827-7131

October 7, 1997

CERTIFIED MAIL
RETURN RECEIPT NO. P-326-936-343

Ms. Ginger Lusk
Legals Dept.
Daily Times
P.O. Box 450
Farmington, NM 87499

Dear Ms. Lusk

Enclosed please find the invoice and one copy of the affidavit of publication (No. 38510). As we discussed over the phone on October 7, 1997, please bill Amoco Production Company, Buddy Shaw, Environmental Coordinator, 200 Amoco Ct., Farmington, New Mexico, 87401. I will retain one copy of the affidavit of publication for the New Mexico Oil Conservation Division records.

If you have any questions please do not hesitate to contact me at (505)827-7153.

Sincerely,

Martyne J. Kieling
Environmental Geologist

Attachments

AFFIDAVIT OF PUBLICATION

No. 38510

STATE OF NEW MEXICO
County of San Juan:

DENISE H. HENSON being duly sworn says: That she is the Classified Manager of THE DAILY TIMES, a daily newspaper of general circulation published in English at Farmington, said county and state, and that the hereto attached Legal Notice was published in a regular and entire issue of the said DAILY TIMES, a daily newspaper duly qualified for the purpose within the meaning of Chapter 167 of the 1937 Session Laws of the State of New Mexico for publication on the following day(s):

Friday, September 19, 1997;

and the cost of publication is: $68.65.

Denise H. Henson

On 9-25-97 DENISE H. HENSON appeared before me, whom I know personally to be the person who signed the above document.

Reese Nelson

My Commission Expires November 1, 2000

COPY OF PUBLICATION

Legals

NOTICE OF PUBLICATION
STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION DIVISION

Notice is hereby given that pursuant to the New Mexico Oil Conservation Division Regulations, the following application has been submitted to the Director of the Oil Conservation Division, 2040 S. Pacheo, Santa Fe, New Mexico 87505, Telephone (505) 827-7131:

Amoco Production Company, Buddy Shaw, Environmental Coordinator, 200 Amoco Ct., Farmington, New Mexico, 87401, has submitted for approval an application to construct and operate a Rule 711 centralized evaporation pond, and a centralized soils remediation facility located in the E/2 NW/4 of Section 4, Township 29 North, Range 8 West, NMPM, San Juan County, New Mexico. Produced water associated with oil and gas production will be disposed of in a test model evaporation pond. The pond will be constructed with compacted soil and soil binder, a soil moisture sensor grid and a seepage collection system. Hydrocarbon contaminated soils associated with oil and gas production will be remediated by composting or by spreading them on the ground surface in 6 inch lifts or less and periodically disking them to enhance biodegradation of contaminants. Ground water most likely to be affected by any accidental discharges at the surface is at a depth of 140 feet to 520 feet with a total dissolved solids concentration of approximately 2,140 parts per million. The facility is underlain by the San Jose Formation, a massive sandstone ranging in thickness from 1,100 feet to 2,500 feet. The permit application addresses the construction, operations, spill/leak prevention and monitoring procedures to be incorporated at the proposed site.

Any interested person may obtain further information from the Oil Conservation Division and may submit written comments to the Director of the Oil Conservation Division at the address given above. The application may be viewed at the above address between 8:00 a.m. and 4:00 p.m., Monday thru Friday. Prior to ruling on any proposed application, the Director of the Oil Conservation Division shall allow at least thirty (30) days after the date of publication of this notice during which comments may be submitted to him and public hearing may be requested by any interested person. Request for public hearing shall set forth the reasons why a hearing shall be held. A hearing will be held if the director determines that there is significant public interest.

If no hearing is held, the Director will approve or disapprove the application based on the information available. If a public hearing is held, the Director will approve the application based on the information in the application and information presented at the hearing.

GIVEN under the Seal of New Mexico Oil Conservation Commission at Santa Fe, New Mexico, on this 3rd day of September, 1997.

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

SEAL

/s/ William J. LeMay
WILLIAM J. LEMAY, Director

Legal No. 38510 published in The Daily Times, Farmington, New Mexico, on Friday, September 19, 1997.

The Santa Fe New Mexican

Since 1849. We Read You.

NM OCD
ATTN: WILLIAM LEMAY
2040 S. PACHECO ST.
SANTA FE, NM 87505

RECEIVED
SEP 26 1997
CONSERVATION DIVISION

AD NUMBER: 696922 ACCOUNT: 999901

LEGAL NO: 62383 P.O. #:

196 LINES ONCE at $ 125.44

Affidavits: 5.25

Tax: 8.17

Total: $ 138.86

NOTICE OF PUBLICATION

STATE OF NEW MEXICO

ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION

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GIVEN under the Seal of New Mexico Oil Conservation Commission at Santa Fe, New Mexico, on this 3rd day of September 1997.

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION
WILLIAM J. LEMAY,
Director
Legal #62383
Pub. September 22, 1997

AFFIDAVIT OF PUBLICATION

STATE OF NEW MEXICO
COUNTY OF SANTA FE

I, BETSY PERNER being first duly sworn declare and say that I am Legal Advertising Representative of THE SANTA FE NEW MEXICAN, a daily news paper published in the English language, and having a general circulation in the Counties of Santa Fe and Los Alamos, State of New Mexico and being a Newspaper duly qualified to publish legal notices and advertisements under the provisions of Chapter 167 on Session Laws of 1937; that the publication # 62383 a copy of which is hereto attached was published in said newspaper once each WEEK for ONE consecutive week(s) and that the notice was published in the newspaper proper and not in any supplement; the first publication being on the 22 day of SEPTEMBER 1997 and that the undersigned has personal knowledge of the matter and things set forth in this affidavit.

/S/ Betsy Perner
LEGAL ADVERTISEMENT REPRESENTATIVE

Subscribed and sworn to before me on this 22 day of SEPTEMBER A.D., 1997

Notary B Mathie
Commission Expires 3-14-2001

OFFICIAL SEAL
B. MATHIE
NOTARY PUBLIC
STATE OF NEW MEXICO
My Commission Expires 3-14-2001

NOTICE OF PUBLICATION
STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION DIVISION

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GIVEN under the Seal of New Mexico Oil Conservation Commission at Santa Fe, New Mexico, on this 3rd day of September, 1997.

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

SEAL

WILLIAM J. LEMAY, Director

NEW MEXICO ENERGY, MINERALS
& NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION
2040 South Pacheco Street
Santa Fe, New Mexico 87505
(505) 827-7131

September 3, 1997

CERTIFIED MAIL
RETURN RECEIPT NO. P-326-936-331

Mr. Buddy Shaw
Amoco Production Company
200 Amoco Ct.
Farmington, NM 87401

RE: Public Notice for Amoco Manzaneres 711 Facility
E/2 NW/4 of Section 4, Township 29 North, Range 8 West, NMPM,
San Juan County, New Mexico.

Dear Mr. Shaw:

The New Mexico Oil Conservation Division (OCD), has received the Amoco Production Company (Amoco) application for a 711 waste management facility at Manzaneres dated July 8, 1997. The application proposes the construction of a test model earthen evaporation pond, composting and landfarm 711 facility. The facility is to be located in E/2 NW/4 of Section 4, Township 29 North, Range 8 West, NMPM, San Juan County, New Mexico.

Based on the information provided with the application Form C-137 and additional information on file, the OCD has prepared a public notice statement that Amoco must published in the Farmington Daily Times and in the Santa Fe New Mexican newspapers. Amoco must send the original certified affidavit of publication from both the Farmington Times and the Santa Fe New Mexican to the OCD Santa Fe office and a copy to the appropriate District office.

If you have any questions please do not hesitate to contact me at (505) 827-7153.

Sincerely,

Martyne J. Kieling
Environmental Geologists

Attachments
xc: Aztec OCD Office

NOTICE OF PUBLICATION
STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION DIVISION

Notice is hereby given that pursuant to the New Mexico Oil Conservation Division Regulations, the following application has been submitted to the Director of the Oil Conservation Division, 2040 S. Pacheco, Santa Fe, New Mexico 87505, Telephone (505) 827-7131:

Amoco Production Company, Buddy Shaw, Environmental Coordinator, 200 Amoco Ct., Farmington, New Mexico, 87401, has submitted for approval an application to construct and operate a Rule 711 centralized evaporation pond, and a centralized soils remediation facility located in the E/2 NW/4 of Section 4, Township 29 North, Range 8 West, NMPM, San Juan County, New Mexico. Produced water associated with oil and gas production will be disposed of in a test model evaporation pond. The pond will be constructed with compacted soil and soil binder, a soil moisture sensor grid and a seepage collection system. Hydrocarbon contaminated soils associated with oil and gas production will be remediated by composting or by spreading them on the ground surface in 6 inch lifts or less and periodically disking them to enhance biodegradation of contaminants. Ground water most likely to be affected by any accidental discharges at the surface is at a depth of 140 feet to 520 feet with a total dissolved solids concentration of approximately 2,140 parts per million. The facility is underlain by the San Jose Formation, a massive sandstone ranging in thickness from 1,100 feet to 2,500 feet. The permit application addresses the construction, operations, spill/leak prevention and monitoring procedures to be incorporated at the proposed site.

Any interested person may obtain further information from the Oil Conservation Division and may submit written comments to the Director of the Oil Conservation Division at the address given above. The application may be viewed at the above address between 8:00 a.m. and 4:00 p.m., Monday thru Friday. Prior to ruling on any proposed application, the Director of the Oil Conservation Division shall allow at least thirty (30) days after the date of publication of this notice during which comments may be submitted to him and public hearing may be requested by any interested person. Request for public hearing shall set forth the reasons why a hearing shall be held. A hearing will be held if the director determines that there is significant public interest.

If no hearing is held, the Director will approve or disapprove the application based on the information available. If a public hearing is held, the Director will approve the application based on the information in the application and information presented at the hearing.

GIVEN under the Seal of New Mexico Oil Conservation Commission at Santa Fe, New Mexico, on this 3rd day of September, 1997.

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

SEAL

WILLIAM J. LEMAY, Director

District I - (505) 393-6161
P. O. Box 1980
Hobbs, NM 88241-1980
District II - (505) 748-1283
811 S. First
Artesia, NM 88210
District III - (505) 334-6178
1000 Rio Brazos Road
Aztec, NM 87410
District IV - (505) 827-7131

New Mexico
Energy Minerals and Natural Resources Department
Oil Conservation Division
2040 South Pacheco Street
Santa Fe, New Mexico 87505
(505) 827-7131

JUL 15 1997

Form C-137
Originated 8/8/95

Submit Original
Plus 1 Copy
to Santa Fe
1 Copy to appropriate
District Office

APPLICATION FOR WASTE MANAGEMENT FACILITY

(Refer to the OCD Guidelines for assistance in completing the application)

☐ Commercial ☒ Centralized

1. Type: ☒ Evaporation ☐ Injection ☒ Other (Drilling muds, tank bottoms)
   ☒ Solids/Landfarm ☐ Treating Plant

2. Operator: Amoco Production Company
   Address: 200 Amoco Ct., Farmington, NM 87401
   Contact Person: Buddy Shaw Phone: (505)326-9200

3. Location: E/2 /4 NW /4 Section 4 Township 29N Range 8W
   Submit large scale topographic map showing exact location

4. Is this a modification of an existing facility? ☐ Yes ☒ No

5. Attach the name and address of the landowner of the facility site and landowners of record within one mile of the site.

6. Attach description of the facility with a diagram indicating location of fences, pits, dikes, and tanks on the facility.

7. Attach designs prepared in accordance with Division guidelines for the construction/installation of the following: pits or ponds, leak-detection systems, aerations systems, enhanced evaporation (spray) systems, waste treating systems, security systems, and landfarm facilities.

8. Attach a contingency plan for reporting and clean-up for spills or releases.

9. Attach a routine inspection and maintenance plan to ensure permit compliance.

10. Attach a closure plan.

11. Attach geological/hydrological evidence demonstrating that disposal of oil field wastes will not adversely impact groundwater. Depth to and quality of ground water must be included.

12. Attach proof that the notice requirements of OCD Rule 711 have been met.

13. Attach a contingency plan in the event of a release of H_2S.

14. Attach such other information as necessary to demonstrate compliance with any other OCD rules, regulations and orders.

15. CERTIFICATION

I hereby certify that the information submitted with this application is true and correct to the best of my knowledge and belief.

Name: Buddy D. Shaw Title: Environmental Coordinator

Signature: Buddy D. Shaw Date: July 8, 1997

AMOCO PRODUCTION COMPANY
APPLICATION FOR WASTE MANAGEMENT FACILITY

Name and address of facility site landowner:

Paul & Son Construction, Inc.
210 W. Main
Bloomfield, NM 87413

Name and address of landowners of record within one mile of site:

U.S. Bureau of Land Management
1235 La Plata Highway
Farmington, NM 87401

N.M. State Land Office
4601 College Blvd.
Farmington, NM 87401

Facility description:

The proposed facility is a 4.9 acre non-commercial centralized waste management site. Non RCRA oilfield generated wastes resulting from oil and gas production operations will be transported to the site for treatment. Wastes will include impacted soils, tank bottoms, drilling media, produced water and produced oil. Soils and other solids will be treated in compost piles or landfarmed; bad oil will be placed into steel holding tanks and held for final disposition off site; produced water (free of floating hydrocarbons) will be placed into a hydraulically engineered earthen pit for evaporation. A site schematic of the overall facility is attached.

The proposed evaporation pond is a test model earthen pit of approximate dimensions 200' x 200' x 5' deep. The pond is a proprietary design that will incorporate compacted soil with soil binder, moisture sensor grid and seepage collection trenches. This is a test design that will receive funding and technical evaluation by the U.S. Department of Energy, the Gas Research Institute and Amoco Production Company. The test pond was originally proposed for another Amoco treatment facility in July 1996, but that site became unavailable for the project. A plan and description of the proposed pond prepared by Energy & Environmental Research Center, University of North Dakota, is attached.

Various liquid reduction technologies will be used to eliminate pond waters, including freeze thaw, landfarm-compost treatments and private beneficial use.

General site operations, security systems and automation:

Only Amoco Production Company generated wastes will be transported to the facility. A locked gate will be placed at the site entrance and access will be restricted to those personnel approved by Amoco.

Sign-in logs will be maintained indicating those personnel entering the site, quantity and type of waste deposited, and origination location of the waste. These logs will be filed at Amoco's Farmington office, located at 200 Amoco Ct, Farmington, NM.

An automation system will be installed at the site to provide 24-hour monitoring of fluid levels and hazard alarms. High fluid levels in bad oil holding tanks and in the evaporation pond will trigger an alarm that is received by the Amoco Farmington office.

Contingency plan for reporting and clean-up of spills & releases:

All spills and releases will be treated on site. The entire facility is to be bermed and no off site releases will be anticipated. If an off site release does occur, the impacted soils will be excavated and transported back to the facility for treatment. Soils impacted by an on site release of hydrocarbons will be excavated and transported to the site compost facility or landfarm for treatment and remediation.

Pursuant to Rule 116, major spills of 25 barrels or more of liquid will be reported to the NMOCD district office and to the Environmental Bureau Chief by telephone or personal communication within 24 hours of the release. A subsequent written notification of the spill on Form C-141 will be submitted in duplicate to the district office and to the Environmental Bureau Chief within 15 days of the spill or incident.

Minor spills of between 5 and 25 barrels of liquid will be reported to the district office and the Environmental Bureau Chief with a subsequent written notification on Form C-141 within 15 days of the spill or incident.

Inspection and maintenance plan:

The facility will be inspected weekly to insure permit compliance. The condition of all dikes, fences and fluid levels will be documented. Sumps and seepage collection trenches will be inspected. Repairs to the facility will be made as soon as possible. If a defect is discovered that will jeopardize the integrity of a treatment unit, additional wastes will not be placed into the treatment unit until repairs have been completed.

Closure plan:

At closure, all storage tanks will be removed from the facility. Composite sampling of landfarm and compost pile soils will be performed to determine residual hydrocarbon impacts. Soils found with greater than 5,000 parts per million hydrocarbon content will either be treated on site or transported off site to a permitted facility for treatment.

The on site evaporation pond will be filled and recontoured to fit existing grades. Alternatively, if the landowner desires to keep the evaporation pond for livestock watering, the pond will be left in tact and given to the land owner.

Site fences will be removed and berms will be recontoured to fit existing grades. Alternatively, if the landowner desires to keep the fences and berms in place, no alterations to these structures will be made.

The estimated cost to complete site closure and abandonment, including surface soil sampling and testing, is $15,000.

Groundwater depth, quality and resistance to impacts:

Groundwater at the site is believed to be in excess of 140 feet below ground surface. The site is located on the Manzanares Mesa at an elevation of 6,420 feet. There are no windmills or water wells within one mile of the site. Approximately 3 miles northwest of the proposed facility the San Juan River is at an elevation of 5,600 feet, and approximately 2.5 miles northeast a private domestic water well (the Jones well) is at elevation of 5,900 feet. Approximately 2,000 feet northwest of the site a natural spring is found at an elevation of 6,280 feet.

The surface geology at the site is comprised of the San Jose Formation. This is a massive sandstone ranging in thickness from 1,100 to 2,500 feet. The San Jose sandstone is anticipated to form a sufficient barrier to prevent seepage of surface waters from the proposed unlined evaporation pond.

Below the San Jose is the Nacimiento Formation, a shale/mudstone/sandstone, that is a main water bearing strata for the region. The groundwater from the Nacimiento is not of high quality. A water sample collected from the Jones Well, which is believed to be completed in the Nacimiento, was tested for general water chemistry in August, 1996. High total dissolved solids (2,140 mg/L) and sulfate (1,260 mg/L) was reported by the testing laboratory. The complete laboratory report is attached.

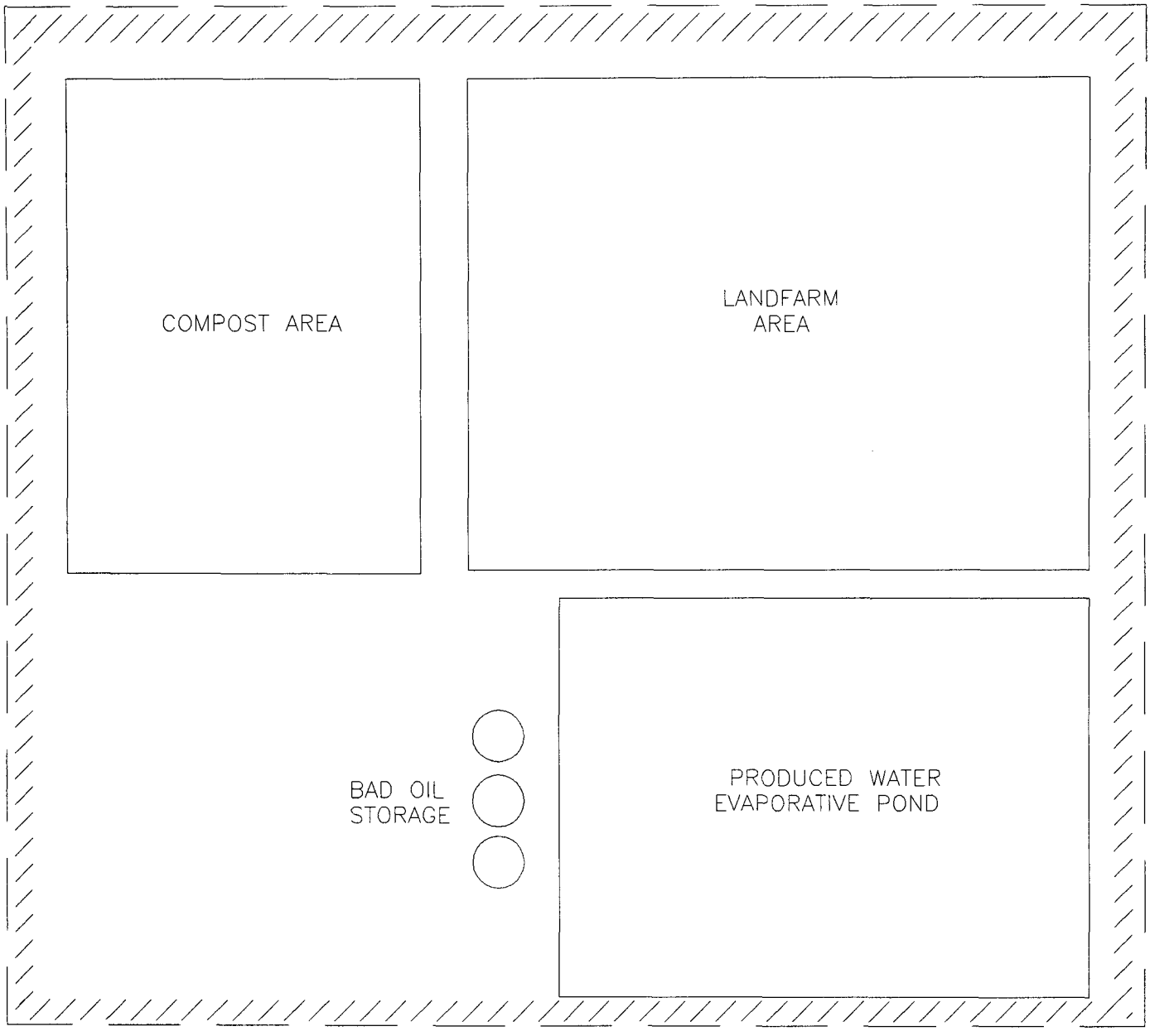
Test drilling with an auger drill rig is scheduled prior to facility construction. This drilling will be to characterize soil lithology in the first 50 feet below ground surface. If groundwater or perched water is encountered, this water will be sampled and tested.

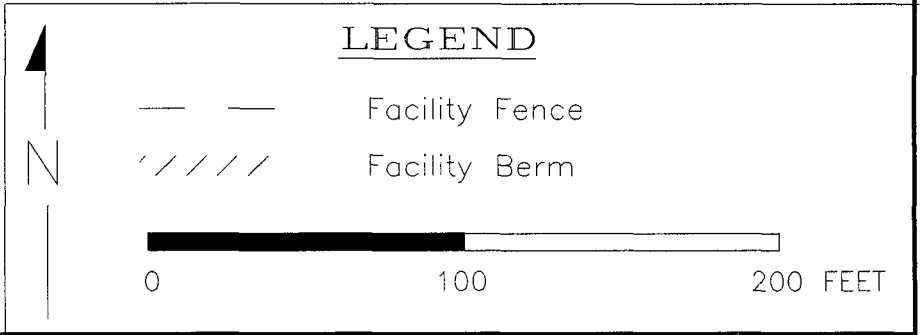
Notice requirements of OCD Rule 711:

Land owners within 1 mile of the proposed facility have been notified of this permit application. Attached is a copy of the notification letter and certified receipt from the U.S.P.S.

Contingence plan in the event of H_2S release:

No known H_2S laden waters, soils, oils or condensates are anticipated to be transported to the facility for treatment. In the event that H_2S is detected at the site, the facility will be closed until trained personnel with appropriate personal protection can conduct monitoring to determine health and environment hazards. H_2S generating media will be chemically treated until discharges are within acceptable health and safety standards.





AMOCO PRODUCTION CO.
PROPOSED WASTE MANAGEMENT FACILITY
E/2 NW/4 4-T29N-R8W
SAN JUAN COUNTY, NM

BLAGG ENGINEERING, INC.
CONSULTING ENGINEERING SERVICES
P.O. BOX 87
BLOOMFIELD, NEW MEXICO 87413
PHONE: (505) 632-1199

SITE SCHEMATIC

FIGURE 1	JULY 1997
manz1	PROJ MGR: JCB

Energy & Environmental Research Center

CONFIDENTIAL

CONSTRUCTION, DEMONSTRATION, AND EVALUATION OF AN ECONOMIC AND ENVIRONMENTALLY SAFE EVAPORATION AND HOLDING POND DESIGN

EERC Proposal No.97-6601

Submitted to:

Dr. Madhav R. Ghate

U.S. Department of Energy
Morgantown Energy Technology Center
PO Box 880
Morgantown, WV 26507-0880

Submitted by:

John A. Harju

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, ND 58202-9018

John A. Harju, Project Manager

Director
Office of Research & Program Development

July 1996

CONSTRUCTION, DEMONSTRATION, AND EVALUATION OF AN ECONOMIC AND ENVIRONMENTALLY SAFE EVAPORATION AND HOLDING POND DESIGN

This proposal discusses the construction, demonstration, and evaluation of a uniquely designed evaporation and holding pond that has the potential to significantly reduce the cost of conventional pond evaporation for the disposal and management of various wastewaters resulting from energy production, including by-products of coal combustion and oil and gas produced water. The proposed project would be conducted at Amoco's Schneider/Cahn Evaporation Facility in northern New Mexico and jointly conducted by personnel from Amoco, the University of North Dakota Energy & Environmental Research Center (EERC), and B.C. Technologies. The project duration would be 18 months.

BACKGROUND

Conventional evaporation and holding pond designs typically use two synthetic liners with a sand and gravel pack between the two liners. A pipe is inserted within the sand and gravel pack to alert operators of a leak in the upper liner. However, this design has several inherent disadvantages, which include the following:

- The ponds are very expensive to build.
- There is often no means to detect a leak in the lower liner.
- Leaks can and often do develop in the liners over time.

Therefore, the need for a new pond design has become of primary economic and environmental interest.

The economic and environmentally safe pond design to be demonstrated calls for the construction of the pond above ground surface on a gravel/sand pack that incorporates a well screen seepage recovery header for leachate collection. This seepage collection layer overlies compacted native materials. The net effect created by these two layers is a horizontal-to-vertical permeability ratio of greater than 1000, reducing the potential for subsurface seepage to effectively zero. A containment trench, seepage return pump, and piping are automatically controlled by trench fluid level to return seepage to the pond. A moisture sensor grid is installed underneath the well screen header to confirm no leakage to the subsurface. In addition, a berm for temporary fluid containment is in place in case of a catastrophic event. (A detailed schematic of the pond design is found in Attachment A.)

The advantages of this unique pond design over the conventional design are as follows:

- This pond can be constructed for 20% to 40% of the cost of a conventional pond with double synthetic liners.

- The surface-level gravel/sand pack with well screen header and seepage collection trench overlying compacted native materials virtually ensures no subsurface leakage.

- Subsurface leakage can be detected by the moisture sensor grid included in the design. This sensor grid can be used to confirm that subsurface leakage is zero.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

ARCHULETA QUADRANGLE
NEW MEXICO-SAN JUAN CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

AMOCO PRODUCTION COMPANY
APPROXIMATE LOCATION OF PROPOSED
WASTE MANAGEMENT FACILITY

PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY
CONTROL BY . . . . . USGS, NOS/NOAA
COMPILED FROM AERIAL PHOTOGRAPHS TAKEN. 1981
FIELD CHECKED . . . . . 1981 MAP EDITED 1985
PROJECTION . . . . . TRANSVERSE MERCATOR
GRID: 1000-METER UNIVERSAL TRANSVERSE MERCATOR . . . . . ZONE 13
10,000-FOOT STATE GRID TICKS . . . . . NEW MEXICO, WEST ZONE
UTM GRID DECLINATION . . . . . 1°37' WEST
1985 MAGNETIC NORTH DECLINATION . . . . . 12° EAST
VERTICAL DATUM . . . . . NATIONAL GEODETIC VERTICAL DATUM OF 1929
HORIZONTAL DATUM . . . . . 1927 NORTH AMERICAN DATUM

To place on the predicted North American Datum of 1983, move the projection lines as shown by dashed corner ticks (2 meters north and 55 meters east)

There may be private inholdings within the boundaries of any Federal and State Reservations shown on this map

All marginal data and lettering generated and positioned by automated type placement procedures

PROVISIONAL MAP
Produced from original manuscript drawings. Information shown as of date of field check. 2

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225
OR RESTON, VIRGINIA 22092

NEW MEXICO
QUADRANGLE LOCATION

ADJOINING 7.5' QUADRANGLE NAMES
1 Mount Nebo
2 Anastacio Spring
3 Burnt Mesa
4 Turley
5 Pine River
6 Blanco
7 Cutter Canyon
8 Delgadito Mesa

ROAD LEGEND
Improved Road
Unimproved Road
Trail
Interstate Route U.S. Route State Route

ARCHULETA, NEW MEXICO
PROVISIONAL EDITION 1985

36107-G6-TF-024

OBJECTIVES AND SCOPE OF WORK

Task 1 - Acquisition of the required regulatory approval for the construction and demonstration of the pond. This task will be conducted primarily by Amoco personnel, with assistance from EERC and B.C. Technologies personnel.

Task 2 - Construction of the pond and installation of piping, pumps, and instrumentation required to perform the demonstration. This task will be conducted by Amoco and B.C. Technologies personnel with assistance from EERC personnel.

Task 3 - Operation of the pond with the objective of collecting sufficient data to evaluate the efficiency of the design. This task will be conducted by B.C. Technologies and EERC personnel with assistance from Amoco personnel.

Task 4 - Evaluation of the pond. The objectives of this task are as follows:

1. Confirm the technical and economic feasibility of the pond.
2. Gain regulatory approval for further uses of the pond design.

Objective 1 will be conducted by EERC and B.C. Technologies personnel, and Objective 2 will be conducted by Amoco, with assistance from EERC and B.C. Technologies personnel.

PROJECT MANAGEMENT

The EERC will take the lead in overall project management. The EERC proposes that a technical management team be assembled with representatives from Electric Power Research Institute (EPRI), the EERC, B.C. Technologies, and Amoco. The technical management team members anticipated at this time include:

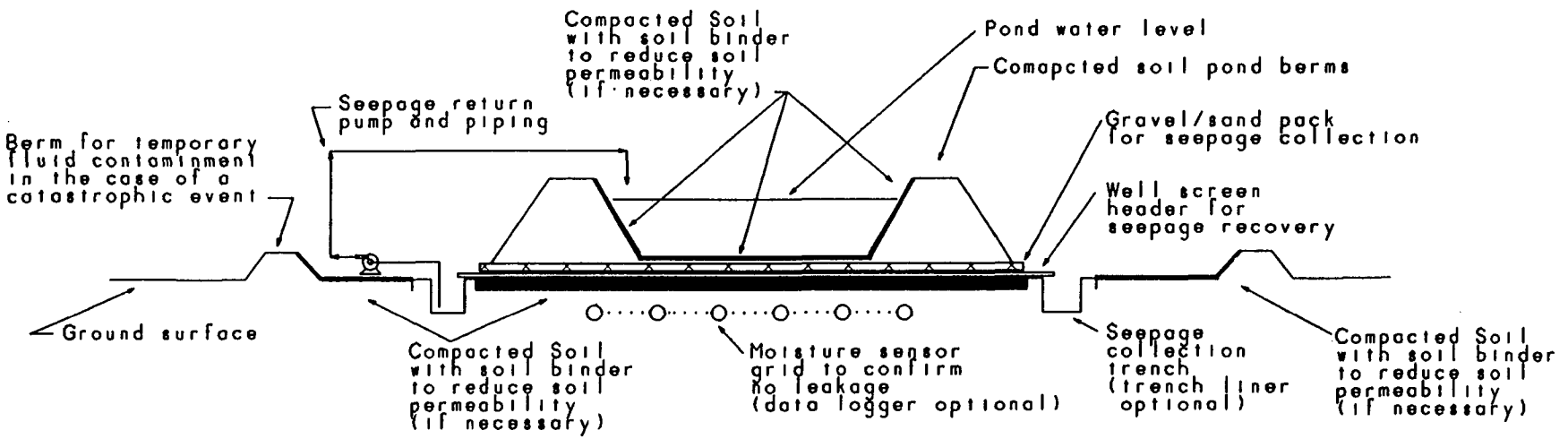
- EERC - John Harju.
- B.C. Technologies - John Boysen.
- EPRI - Dean Golden.
- Amoco - Buddy Shaw.

ESTIMATED PROJECT COSTS

The total project cost is estimated to be between $230,000 and $250,000, with the variability primarily in the construction costs of the facility. Both monetary and in-kind funding for the economic and environmentally safe evaporation and holding pond are requested. Amoco will provide all of the requested in-kind support, while EPRI and the U.S. Department of Energy (DOE) will provide the monetary support. The total estimated demonstration in-kind cost requirements at this time are between $60,000 and $80,000. The in-kind funding to be provided by Amoco is primarily for installed costs of the pond and related equipment (pit construction, well screen header, pumps, piping, etc.).

All requirements for data collection during Task 3 that are not part of the normal operation of the facility would be conducted by EERC and B.C. Technologies personnel. The cost for the EERC and B.C. Technologies to provide the environmental, analytical, engineering, and operations support required in Tasks 1 through 4 is $170,000. These funds will be provided as $100,000 from EPRI and $70,000 from the DOE Jointly Sponsored Research Program Cooperative Agreement with the EERC.

Hydraulically Engineered, Economic, and Environmentally Safe Evaporation Pond Design



Notes:

1) Pond construction above ground surface to minimize downward leakage.
2) Gravel/sand pack and seepage recovery header constructed of well screen to create a horizontal to vertical permeability ratio > 1000. Thereby reducing the potential for sub-surface seepage to effectively zero.
3) Containment trench and seepage return pump and piping automatically controlled by trench fluid level to return seepage to pond.
4) Outside containment berm to temporarily contain fluid in case of a catastrophic event.
5) Moisture sensors to confirm no downward seepage.

B.C. Technologies, Ltd.			
Drawn by: GB	Hydraulically Engineered, Economic, and Envir. Safe Evaporation Pond Design		
Approved: GB	Date: 2/15/96	Scale: NTS	Drawing No. 1 of 1

CDS Laboratories
75 Suttle Street
PO Box 2605
Durango, CO 81302

Phone:(970)-247-4220
Fax :(970)-247-4227

Report Date: 09/13/96

ANALYSIS REPORT

Attn:

BLAGG ENGINEERING, INC.
P.O. BOX 87
BLOOMFIELD NM 87413

Our Lab #: A96-130814
Sample ID: JONES WELL
Date Login: 08/21/96
Date Rec'd: 08/21/96

COLLECTION INFORMATION

Date/Time/By: 08/21/96 1220 J.C.B.
Location: JONES WELL

Lab#	Testname	Result	Units
A96-130814	Total Alkalinity as CaCO3	220	mg/L
	Bicarbonate as CaCO3	220	mg/L
	BENZENE	< 1	µg/L
	Carbonate as CaCO3	0	mg/L
	Calcium, dissolved	410	mg/L
	Chloride	16	mg/L
	Conductivity	2240	µS/cm
	ETHYL BENZENE	< 1	µg/L
	Iron, dissolved	0.5	mg/L
	Potassium, dissolved	2.0	mg/L
	Methane	0.13	mg/L
	Ethane = < .02 mg/L, Propane = ND < .02		mg/L
	Magnesium, dissolved	46.2	mg/L
	Manganese, dissolved	2.5	mg/L
	Sodium, dissolved	91.3	mg/L
	pH	7.16	Units
	Sulfate	1260	mg/L
	Total Dissolved Solids	2140	mg/L
	TOLUENE	< 1	µg/L
	XYLENE (TOTAL)	< 2	µg/L

Approved By: Cynthia Barr Checked By: DZ

BLAGG ENGINEERING, INC.
P.O. Box 87, Bloomfield, New Mexico 87413
Phone: (505)632-1199 Fax: (505)632-3903

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

July 8, 1997

U.S. Bureau of Land Management
1235 La Plata Highway
Farmington, New Mexico 87401

Re: Amoco Production Company
Notification of Application for Waste Management Facility

Dear Sirs:

On behalf of Amoco Production Company, Blagg Engineering, Inc. (BEI) is submitting an application for an oilfield waste management facility in E/2 NW/4 Sec. 4 - T29N - R8W, San Juan County, New Mexico. This facility is located on private land. Public records indicate that the U.S. Bureau of Land Management is a land owner within one mile of the proposed facility. New Mexico Oil Conservation Division (NMOCD) regulations, Rule 711, require notification of land owners within one mile of proposed waste management facilities.

The application for the facility will be filed with the NMOCD within several weeks of this notification to you. The application may be reviewed at NMOCD's District III office, 1000 Rio Brazos Road, Aztec, New Mexico, or in their state office, 2040 South Pacheco Street, Santa Fe, New Mexico.

Questions or comments concerning this notification may be directed to Jeff Blagg of Blagg Engineering at (505)632-1199, or to Buddy Shaw with Amoco at (505)326-9200.

Respectfully:
Blagg Engineering, Inc.

Jeffrey C. Blagg, P.E.
President

cc: Mr. B.D. Shaw, Amoco Production Company

BLAGG ENGINEERING, INC.
P.O. Box 87, Bloomfield, New Mexico 87413
Phone: (505)632-1199 Fax: (505)632-3903

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

July 8, 1997

N.M. State Land Office
4601 College Blvd.
Farmington, New Mexico 87401

Re: Amoco Production Company
Notification of Application for Waste Management Facility

Dear Sirs:

On behalf of Amoco Production Company, Blagg Engineering, Inc. (BEI) is submitting an application for an oilfield waste management facility in E/2 NW/4 Sec. 4 - T29N - R8W, San Juan County, New Mexico. This facility is located on private land. Public records indicate that the N.M. State Land Office is a land owner within one mile of the proposed facility. New Mexico Oil Conservation Division (NMOCD) regulations, Rule 711, require notification of land owners within one mile of proposed waste management facilities.

The application for the facility will be filed with the NMOCD within several weeks of this notification to you. The application may be reviewed at NMOCD's District III office, 1000 Rio Brazos Road, Aztec, New Mexico, or in their state office, 2040 South Pacheco Street, Santa Fe, New Mexico.

Questions or comments concerning this notification may be directed to Jeff Blagg of Blagg Engineering at (505)632-1199, or to Buddy Shaw with Amoco at (505)326-9200.

Respectfully:
Blagg Engineering, Inc.

Jeffrey C. Blagg, P.E.
President

cc: Mr. B.D. Shaw, Amoco Production Company

SENDER:
- Complete items 1 and/or 2 for additional services.
- Complete items 3, 4a, and 4b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write *"Return Receipt Requested"* on the mailpiece below the article number.
- The Return Receipt will show to whom the article was delivered and the date delivered.

I also wish to receive the following services (for an extra fee):
1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:
N. M. STATE LAND OFFICE
4601 College Blvd.
FARMINGTON, NM 87401

4a. Article Number
P 216 316 234

4b. Service Type
☐ Registered ☑ Certified
☐ Express Mail ☐ Insured
☐ Return Receipt for Merchandise ☐ COD

7. Date of Delivery
7-9-97

5. Received By: *(Print Name)*

8. Addressee's Address *(Only if requested and fee is paid)*

6. Signature: *(Addressee or Agent)*
X Allan Bruce

PS Form **3811,** December 1994 Domestic Return Receipt

Thank you for using Return Receipt Service.

Is your RETURN ADDRESS completed on the reverse side?

SENDER:
- Complete items 1 and/or 2 for additional services.
- Complete items 3, 4a, and 4b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write *"Return Receipt Requested"* on the mailpiece below the article number.
- The Return Receipt will show to whom the article was delivered and the date delivered.

I also wish to receive the following services (for an extra fee):
1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:
U.S. Bureau of Land Mgmt.
1235 La Plata Highway
Farmington, NM 87401

4a. Article Number
P 216 316 233

4b. Service Type
☐ Registered ☑ Certified
☐ Express Mail ☐ Insured
☐ Return Receipt for Merchandise ☐ COD

7. Date of Delivery
7-09-97

5. Received By: *(Print Name)*
Nola R. Teswood

8. Addressee's Address *(Only if requested and fee is paid)*

6. Signature: *(Addressee or Agent)*
X Nola R. Teswood

PS Form **3811,** December 1994 Domestic Return Receipt

Thank you for using Return Receipt Service.

P 216 316 234

US Postal Service
Receipt for Certified Mail
No Insurance Coverage Provided.
Do not use for International Mail *(See reverse)*

Sent to N. M. STATE LAND OFFICE	
Street & Number 4601 College Blvd.	
Post Office, State, & ZIP Code FARMINGTON NM 87401	
Postage	$ 32
Certified Fee	135
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to Whom & Date Delivered	110
Return Receipt Showing to Whom, Date, & Addressee's Address	
TOTAL Postage & Fees	$ 277
Postmark or Date	

PS Form **3800,** April 1995

P 216 316 233

US Postal Service
Receipt for Certified Mail
No Insurance Coverage Provided.
Do not use for International Mail *(See reverse)*

Sent to U.S. BUREAU OF LAND MGMT	
Street & Number 1235 La Plata Highway	
Post Office, State, & ZIP Code FARMINGTON, NM 87401	
Postage	$ 32
Certified Fee	135
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to Whom & Date Delivered	110
Return Receipt Showing to Whom, Date, & Addressee's Address	
TOTAL Postage & Fees	$ 277
Postmark or Date	

PS Form **3800,** April 1995

District I - (505) 393-6161
P. O. Box 1980
Hobbs, NM 88241-1980
District II - (505) 748-1283
811 S. First
Artesia, NM 88210
District III - (505) 334-6178
1000 Rio Brazos Road
Aztec, NM 87410
District IV - (505) 827-7131

New Mexico
Energy Minerals and Natural Resources Department
Oil Conservation Division
2040 South Pacheco Street
Santa Fe, New Mexico 87505
(505) 827-7131

JUL 15 1997

Form C-137
Originated 8/8/95

Submit Original
Plus 1 Copy
to Santa Fe
1 Copy to appropriate
District Office

APPLICATION FOR WASTE MANAGEMENT FACILITY

(Refer to the OCD Guidelines for assistance in completing the application)

☐ Commercial ☒ Centralized

1. Type: ☒ Evaporation ☐ Injection ☒ Other (Drilling muds, tank bottoms)
   ☒ Solids/Landfarm ☐ Treating Plant

2. Operator: Amoco Production Company
   Address: 200 Amoco Ct., Farmington, NM 87401
   Contact Person: Buddy Shaw Phone: (505)326-9200

3. Location: E/2 /4 NW /4 Section 4 Township 29N Range 8W
   Submit large scale topographic map showing exact location

4. Is this a modification of an existing facility? ☐ Yes ☒ No

5. Attach the name and address of the landowner of the facility site and landowners of record within one mile of the site.

6. Attach description of the facility with a diagram indicating location of fences, pits, dikes, and tanks on the facility.

7. Attach designs prepared in accordance with Division guidelines for the construction/installation of the following: pits or ponds, leak-detection systems, aerations systems, enhanced evaporation (spray) systems, waste treating systems, security systems, and landfarm facilities.

8. Attach a contingency plan for reporting and clean-up for spills or releases.

9. Attach a routine inspection and maintenance plan to ensure permit compliance.

10. Attach a closure plan.

11. Attach geological/hydrological evidence demonstrating that disposal of oil field wastes will not adversely impact groundwater. Depth to and quality of ground water must be included.

12. Attach proof that the notice requirements of OCD Rule 711 have been met.

13. Attach a contingency plan in the event of a release of H_2S.

14. Attach such other information as necessary to demonstrate compliance with any other OCD rules, regulations and orders.

15. CERTIFICATION

I hereby certify that the information submitted with this application is true and correct to the best of my knowledge and belief.

Name: Buddy D. Shaw Title: Environmental Coordinator

Signature: Buddy D. Shaw Date: July 8, 1997

AMOCO PRODUCTION COMPANY
APPLICATION FOR WASTE MANAGEMENT FACILITY

Name and address of facility site landowner:

Paul & Son Construction, Inc.
210 W. Main
Bloomfield, NM 87413

Name and address of landowners of record within one mile of site:

U.S. Bureau of Land Management
1235 La Plata Highway
Farmington, NM 87401

N.M. State Land Office
4601 College Blvd.
Farmington, NM 87401

Facility description:

The proposed facility is a 4.9 acre non-commercial centralized waste management site. Non RCRA oilfield generated wastes resulting from oil and gas production operations will be transported to the site for treatment. Wastes will include impacted soils, tank bottoms, drilling media, produced water and produced oil. Soils and other solids will be treated in compost piles or landfarmed; bad oil will be placed into steel holding tanks and held for final disposition off site; produced water (free of floating hydrocarbons) will be placed into a hydraulically engineered earthen pit for evaporation. A site schematic of the overall facility is attached.

The proposed evaporation pond is a test model earthen pit of approximate dimensions 200' x 200' x 5' deep. The pond is a proprietary design that will incorporate compacted soil with soil binder, moisture sensor grid and seepage collection trenches. This is a test design that will receive funding and technical evaluation by the U.S. Department of Energy, the Gas Research Institute and Amoco Production Company. The test pond was originally proposed for another Amoco treatment facility in July 1996, but that site became unavailable for the project. A plan and description of the proposed pond prepared by Energy & Environmental Research Center, University of North Dakota, is attached.

Various liquid reduction technologies will be used to eliminate pond waters, including freeze thaw, landfarm-compost treatments and private beneficial use.

Buddy S. 1/27/94

General site operations, security systems and automation: Plant will not be on Duty 5 Automation system.

Only Amoco Production Company generated wastes will be transported to the facility. A locked gate will be placed at the site entrance and access will be restricted to those personnel approved by Amoco.

Sign-in logs will be maintained indicating those personnel entering the site, quantity and type of waste deposited, and origination location of the waste. These logs will be filed at Amoco's Farmington office, located at 200 Amoco Ct, Farmington, NM.

An automation system will be installed at the site to provide 24-hour monitoring of fluid levels and hazard alarms. High fluid levels in bad oil holding tanks and in the evaporation pond will trigger an alarm that is received by the Amoco Farmington office.

Contingency plan for reporting and clean-up of spills & releases:

All spills and releases will be treated on site. The entire facility is to be bermed and no off site releases will be anticipated. If an off site release does occur, the impacted soils will be excavated and transported back to the facility for treatment. Soils impacted by an on site release of hydrocarbons will be excavated and transported to the site compost facility or landfarm for treatment and remediation.

Pursuant to Rule 116, major spills of 25 barrels or more of liquid will be reported to the NMOCD district office and to the Environmental Bureau Chief by telephone or personal communication within 24 hours of the release. A subsequent written notification of the spill on Form C-141 will be submitted in duplicate to the district office and to the Environmental Bureau Chief within 15 days of the spill or incident.

Minor spills of between 5 and 25 barrels of liquid will be reported to the district office and the Environmental Bureau Chief with a subsequent written notification on Form C-141 within 15 days of the spill or incident.

Inspection and maintenance plan:

The facility will be inspected weekly to insure permit compliance. The condition of all dikes, fences and fluid levels will be documented. Sumps and seepage collection trenches will be inspected. Repairs to the facility will be made as soon as possible. If a defect is discovered that will jeopardize the integrity of a treatment unit, additional wastes will not be placed into the treatment unit until repairs have been completed.

Closure plan:

At closure, all storage tanks will be removed from the facility. Composite sampling of landfarm and compost pile soils will be performed to determine residual hydrocarbon impacts. Soils found with greater than 5,000 parts per million hydrocarbon content will either be treated on site or transported off site to a permitted facility for treatment.

The on site evaporation pond will be filled and recontoured to fit existing grades. Alternatively, if the landowner desires to keep the evaporation pond for livestock watering, the pond will be left in tact and given to the land owner.

Site fences will be removed and berms will be recontoured to fit existing grades. Alternatively, if the landowner desires to keep the fences and berms in place, no alterations to these structures will be made.

The estimated cost to complete site closure and abandonment, including surface soil sampling and testing, is $15,000.

Groundwater depth, quality and resistance to impacts:

Groundwater at the site is believed to be in excess of 140 feet below ground surface. The site is located on the Manzanares Mesa at an elevation of 6,420 feet. There are no windmills or water wells within one mile of the site. Approximately 3 miles northwest of the proposed facility the San Juan River is at an elevation of 5,600 feet, and approximately 2.5 miles northeast a private domestic water well (the Jones well) is at elevation of 5,900 feet. Approximately 2,000 feet northwest of the site a natural spring is found at an elevation of 6,280 feet.

The surface geology at the site is comprised of the San Jose Formation. This is a massive sandstone ranging in thickness from 1,100 to 2,500 feet. The San Jose sandstone is anticipated to form a sufficient barrier to prevent seepage of surface waters from the proposed unlined evaporation pond.

Below the San Jose is the Nacimiento Formation, a shale/mudstone/sandstone, that is a main water bearing strata for the region. The groundwater from the Nacimiento is not of high quality. A water sample collected from the Jones Well, which is believed to be completed in the Nacimiento, was tested for general water chemistry in August, 1996. High total dissolved solids (2,140 mg/L) and sulfate (1,260 mg/L) was reported by the testing laboratory. The complete laboratory report is attached.

Test drilling with an auger drill rig is scheduled prior to facility construction. This drilling will be to characterize soil lithology in the first 50 feet below ground surface. If groundwater or perched water is encountered, this water will be sampled and tested.

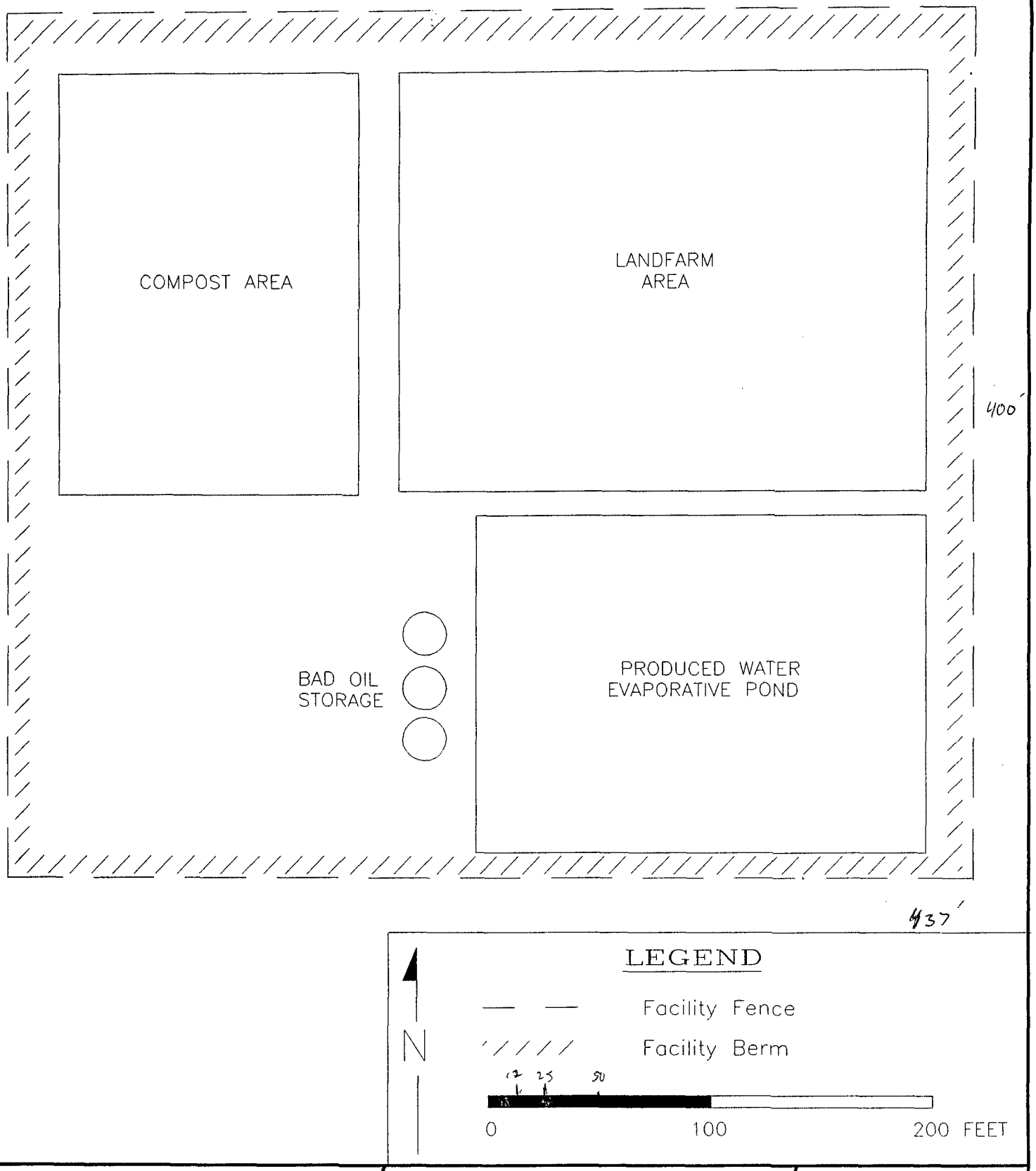
Notice requirements of OCD Rule 711:

Land owners within 1 mile of the proposed facility have been notified of this permit application. Attached is a copy of the notification letter and certified receipt from the U.S.P.S.

Contingence plan in the event of H_2S release:

No known H_2S laden waters, soils, oils or condensates are anticipated to be transported to the facility for treatment. In the event that H_2S is detected at the site, the facility will be closed until trained personnel with appropriate personal protection can conduct monitoring to determine health and environment hazards. H_2S generating media will be chemically treated until discharges are within acceptable health and safety standards.

H_2S monitoring is needed - Wind Direction et ..



AMOCO PRODUCTION CO.
PROPOSED WASTE MANAGEMENT FACILITY
E/2 NW/4 4-T29N-R8W
SAN JUAN COUNTY, NM

BLAGG ENGINEERING, INC.
CONSULTING ENGINEERING SERVICES
P.O. BOX 87
BLOOMFIELD, NEW MEXICO 87413
PHONE: (505) 632-1199

SITE SCHEMATIC

FIGURE 1	JULY 1997
manz1	PROJ MGR: JCB

Energy & Environmental Research Center

CONSTRUCTION, DEMONSTRATION, AND EVALUATION OF AN ECONOMIC AND ENVIRONMENTALLY SAFE EVAPORATION AND HOLDING POND DESIGN

EERC Proposal No.97-6601

Submitted to:

Dr. Madhav R. Ghate

U.S. Department of Energy
Morgantown Energy Technology Center
PO Box 880
Morgantown, WV 26507-0880

Submitted by:

John A. Harju

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, ND 58202-9018

John A. Harju, Project Manager

Director
Office of Research & Program Development

July 1996

CONSTRUCTION, DEMONSTRATION, AND EVALUATION OF AN ECONOMIC AND ENVIRONMENTALLY SAFE EVAPORATION AND HOLDING POND DESIGN

This proposal discusses the construction, demonstration, and evaluation of a uniquely designed evaporation and holding pond that has the potential to significantly reduce the cost of conventional pond evaporation for the disposal and management of various wastewaters resulting from energy production, including by-products of coal combustion and oil and gas produced water. The proposed project would be conducted at Amoco's Schneider/Cahn Evaporation Facility in northern New Mexico and jointly conducted by personnel from Amoco, the University of North Dakota Energy & Environmental Research Center (EERC), and B.C. Technologies. The project duration would be 18 months.

BACKGROUND

Conventional evaporation and holding pond designs typically use two synthetic liners with a sand and gravel pack between the two liners. A pipe is inserted within the sand and gravel pack to alert operators of a leak in the upper liner. However, this design has several inherent disadvantages, which include the following:

- The ponds are very expensive to build.
- There is often no means to detect a leak in the lower liner.
- Leaks can and often do develop in the liners over time.

Therefore, the need for a new pond design has become of primary economic and environmental interest.

The economic and environmentally safe pond design to be demonstrated calls for the construction of the pond above ground surface on a gravel/sand pack that incorporates a well screen seepage recovery header for leachate collection. This seepage collection layer overlies compacted native materials. The net effect created by these two layers is a horizontal-to-vertical permeability ratio of greater than 1000, reducing the potential for subsurface seepage to effectively zero. A containment trench, seepage return pump, and piping are automatically controlled by trench fluid level to return seepage to the pond. A moisture sensor grid is installed underneath the well screen header to confirm no leakage to the subsurface. In addition, a berm for temporary fluid containment is in place in case of a catastrophic event. (A detailed schematic of the pond design is found in Attachment A.)

The advantages of this unique pond design over the conventional design are as follows:

- This pond can be constructed for 20% to 40% of the cost of a conventional pond with double synthetic liners.

- The surface-level gravel/sand pack with well screen header and seepage collection trench overlying compacted native materials virtually ensures no subsurface leakage.

- Subsurface leakage can be detected by the moisture sensor grid included in the design. This sensor grid can be used to confirm that subsurface leakage is zero.

OBJECTIVES AND SCOPE OF WORK

Task 1 - Acquisition of the required regulatory approval for the construction and demonstration of the pond. This task will be conducted primarily by Amoco personnel, with assistance from EERC and B.C. Technologies personnel.

Task 2 - Construction of the pond and installation of piping, pumps, and instrumentation required to perform the demonstration. This task will be conducted by Amoco and B.C. Technologies personnel with assistance from EERC personnel.

Task 3 - Operation of the pond with the objective of collecting sufficient data to evaluate the efficiency of the design. This task will be conducted by B.C. Technologies and EERC personnel with assistance from Amoco personnel.

Task 4 - Evaluation of the pond. The objectives of this task are as follows:

1. Confirm the technical and economic feasibility of the pond.
2. Gain regulatory approval for further uses of the pond design.

Objective 1 will be conducted by EERC and B.C. Technologies personnel, and Objective 2 will be conducted by Amoco, with assistance from EERC and B.C. Technologies personnel.

PROJECT MANAGEMENT

The EERC will take the lead in overall project management. The EERC proposes that a technical management team be assembled with representatives from Electric Power Research Institute (EPRI), the EERC, B.C. Technologies, and Amoco. The technical management team members anticipated at this time include:

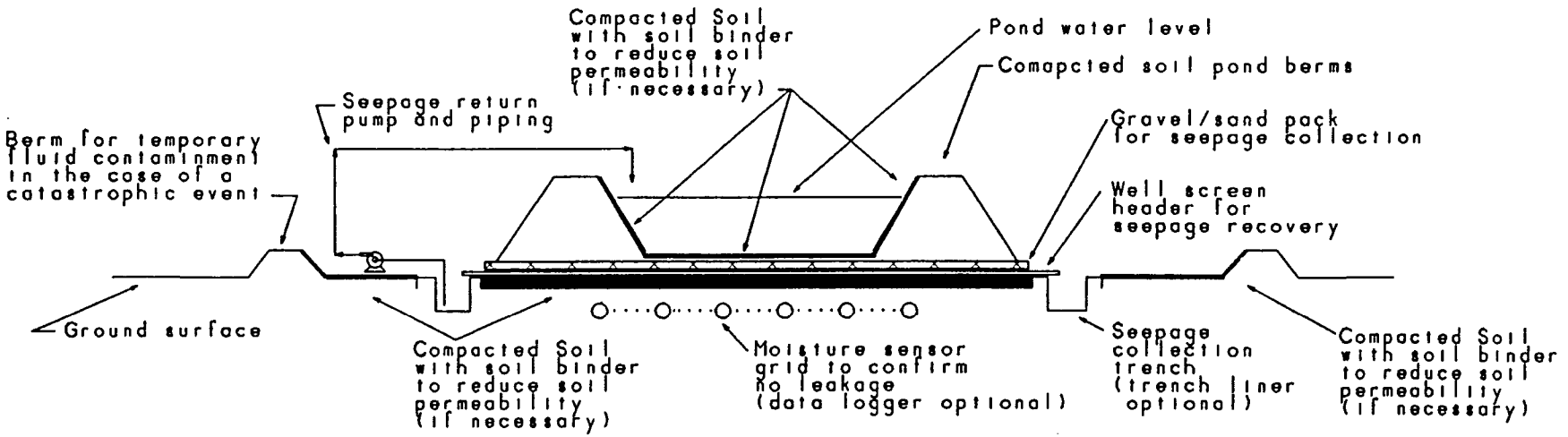
- EERC - John Harju.
- B.C. Technologies - John Boysen.
- EPRI - Dean Golden.
- Amoco - Buddy Shaw.

ESTIMATED PROJECT COSTS

The total project cost is estimated to be between $230,000 and $250,000, with the variability primarily in the construction costs of the facility. Both monetary and in-kind funding for the economic and environmentally safe evaporation and holding pond are requested. Amoco will provide all of the requested in-kind support, while EPRI and the U.S. Department of Energy (DOE) will provide the monetary support. The total estimated demonstration in-kind cost requirements at this time are between $60,000 and $80,000. The in-kind funding to be provided by Amoco is primarily for installed costs of the pond and related equipment (pit construction, well screen header, pumps, piping, etc.).

All requirements for data collection during Task 3 that are not part of the normal operation of the facility would be conducted by EERC and B.C. Technologies personnel. The cost for the EERC and B.C. Technologies to provide the environmental, analytical, engineering, and operations support required in Tasks 1 through 4 is $170,000. These funds will be provided as $100,000 from EPRI and $70,000 from the DOE Jointly Sponsored Research Program Cooperative Agreement with the EERC.

Hydraulically Engineered, Economic, and Environmentally Safe Evaporation Pond Design



Notes:

1) Pond construction above ground surface to minimize downward leakage.
2) Gravel/sand pack and seepage recovery header constructed of well screen to create a horizontal to vertical permeability ratio > 1000. Thereby reducing the potential for sub-surface seepage to effectively zero.
3) Containment trench and seepage return pump and piping automatically controlled by trench fluid level to return seepage to pond.
4) Outside containment berm to temporarily contain fluid in case of a catastrophic event.
5) Moisture sensors to confirm no downward seepage.

B.C. Technologies, Ltd.			
Drawn by: GB	Hydraulically Engineered, Economic, and Envir. Safe Evaporation Pond Design		
Approved: GB	Date: 2/15/96	Scale: NTS	Drawing No. 1 of 1

CDS Laboratories
75 Suttle Street
PO Box 2605
Durango, CO 81302

Phone:(970)-247-4220
Fax :(970)-247-4227

Report Date: 09/13/96

ANALYSIS REPORT

Attn:

BLAGG ENGINEERING, INC.
P.O. BOX 87
BLOOMFIELD NM 87413

Our Lab #: A96-130814
Sample ID: JONES WELL
Date Login: 08/21/96
Date Rec'd: 08/21/96

COLLECTION INFORMATION

Date/Time/By: 08/21/96 1220 J.C.B.
Location: JONES WELL

Lab#	Testname	Result	Units
A96-130814	Total Alkalinity as CaCO3	220	mg/L
	Bicarbonate as CaCO3	220	mg/L
	BENZENE	< 1	µg/L
	Carbonate as CaCO3	0	mg/L
	Calcium, dissolved	410	mg/L
	Chloride	16	mg/L
	Conductivity	2240	µS/cm
	ETHYL BENZENE	< 1	µg/L
	Iron, dissolved	0.5	mg/L
	Potassium, dissolved	2.0	mg/L
	Methane	0.13	mg/L
	Ethane = < .02 mg/L, Propane = ND < .02		mg/L
	Magnesium, dissolved	46.2	mg/L
	Manganese, dissolved	2.5	mg/L
	Sodium, dissolved	91.3	mg/L
	pH	7.16	Units
	Sulfate	1260	mg/L
	Total Dissolved Solids	2140	mg/L — Brackish
	TOLUENE	< 1	µg/L
	XYLENE (TOTAL)	< 2	µg/L

Approved By: Cynthia Burr Checked By: DJ

BLAGG ENGINEERING, INC.
P.O. Box 87, Bloomfield, New Mexico 87413
Phone: (505)632-1199 Fax: (505)632-3903

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

July 8, 1997

U.S. Bureau of Land Management
1235 La Plata Highway
Farmington, New Mexico 87401

Re: Amoco Production Company
Notification of Application for Waste Management Facility

Dear Sirs:

On behalf of Amoco Production Company, Blagg Engineering, Inc. (BEI) is submitting an application for an oilfield waste management facility in E/2 NW/4 Sec. 4 - T29N - R8W, San Juan County, New Mexico. This facility is located on private land. Public records indicate that the U.S. Bureau of Land Management is a land owner within one mile of the proposed facility. New Mexico Oil Conservation Division (NMOCD) regulations, Rule 711, require notification of land owners within one mile of proposed waste management facilities.

The application for the facility will be filed with the NMOCD within several weeks of this notification to you. The application may be reviewed at NMOCD's District III office, 1000 Rio Brazos Road, Aztec, New Mexico, or in their state office, 2040 South Pacheco Street, Santa Fe, New Mexico.

Questions or comments concerning this notification may be directed to Jeff Blagg of Blagg Engineering at (505)632-1199, or to Buddy Shaw with Amoco at (505)326-9200.

Respectfully:
Blagg Engineering, Inc.

Jeffrey C. Blagg, P.E.
President

cc: Mr. B.D. Shaw, Amoco Production Company

BLAGG ENGINEERING, INC.
P.O. Box 87, Bloomfield, New Mexico 87413
Phone: (505)632-1199 Fax: (505)632-3903

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

July 8, 1997

N.M. State Land Office
4601 College Blvd.
Farmington, New Mexico 87401

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Respectfully:
Blagg Engineering, Inc.

Jeffrey C. Blagg, P.E.
President

cc: Mr. B.D. Shaw, Amoco Production Company

SENDER:
- Complete items 1 and/or 2 for additional services.
- Complete items 3, 4a, and 4b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write *"Return Receipt Requested"* on the mailpiece below the article number.
- The Return Receipt will show to whom the article was delivered and the date delivered.

I also wish to receive the following services (for an extra fee):
1. ☐ Addressee's Address
2. ☐ Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:
N. M. STATE LAND OFFICE
4601 College Blvd.
FARMINGTON, NM 87401

4a. Article Number
P 216 316 234

4b. Service Type
☐ Registered ☑ Certified
☐ Express Mail ☐ Insured
☐ Return Receipt for Merchandise ☐ COD

7. Date of Delivery
7-9-97

5. Received By: *(Print Name)*

8. Addressee's Address *(Only if requested and fee is paid)*

6. Signature: *(Addressee or Agent)*
X Allan Brice

PS Form **3811**, December 1994 Domestic Return Receipt

Thank you for using Return Receipt Service.

Is your RETURN ADDRESS completed on the reverse side?

SENDER:
- Complete items 1 and/or 2 for additional services.
- Complete items 3, 4a, and 4b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
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Consult postmaster for fee.

3. Article Addressed to:
U.S. Bureau of Land Mgmt.
1235 La Plata Highway
Farmington, NM 87401

4a. Article Number
P 216 316 233

4b. Service Type
☐ Registered ☑ Certified
☐ Express Mail ☐ Insured
☐ Return Receipt for Merchandise ☐ COD

7. Date of Delivery
7-09-97

5. Received By: *(Print Name)*
Nola R. Teswood

8. Addressee's Address *(Only if requested and fee is paid)*

6. Signature: *(Addressee or Agent)*
X Nola R. Teswood

PS Form **3811**, December 1994 Domestic Return Receipt

Thank you for using Return Receipt Service.

P 216 316 234

US Postal Service
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Do not use for International Mail *(See reverse)*

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PS Form **3800**, April 1995

P 216 316 233

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Street & Number 1235 La Plata HIGHWAY	
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PS Form **3800**, April 1995

AMOCO MANZANARES 711 FACILITY INSPECTION (PHOTOS BY OCD)

PHOTO NO. 1 DATE: 06/11/97

AMOCO MANZANERES

New Submittal

July 8, 1997

Facility will consist of Evap Pond, Compost, LANDFARM

Roger

CONFIDENTIAL

Energy & Environmental Research Center

CONSTRUCTION, DEMONSTRATION, AND EVALUATION OF AN ECONOMIC AND ENVIRONMENTALLY SAFE EVAPORATION AND HOLDING POND DESIGN

EERC Proposal No.97-6601

Submitted to:

Dr. Madhav R. Ghate

U.S. Department of Energy
Morgantown Energy Technology Center
PO Box 880
Morgantown, WV 26507-0880

Submitted by:

John A. Harju

Energy & Environmental Research Center
University of North Dakota
PO Box 9018
Grand Forks, ND 58202-9018

John A. Harju, Project Manager

Director
Office of Research & Program Development

July 1996

CONSTRUCTION, DEMONSTRATION, AND EVALUATION OF AN ECONOMIC AND ENVIRONMENTALLY SAFE EVAPORATION AND HOLDING POND DESIGN

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1. Confirm the technical and economic feasibility of the pond.
2. Gain regulatory approval for further uses of the pond design.

Objective 1 will be conducted by EERC and B.C. Technologies personnel, and Objective 2 will be conducted by Amoco, with assistance from EERC and B.C. Technologies personnel.

PROJECT MANAGEMENT

The EERC will take the lead in overall project management. The EERC proposes that a technical management team be assembled with representatives from Electric Power Research Institute (EPRI), the EERC, B.C. Technologies, and Amoco. The technical management team members anticipated at this time include:

- EERC - John Harju.
- B.C. Technologies - John Boysen.
- EPRI - Dean Golden.
- Amoco - Buddy Shaw.

ESTIMATED PROJECT COSTS

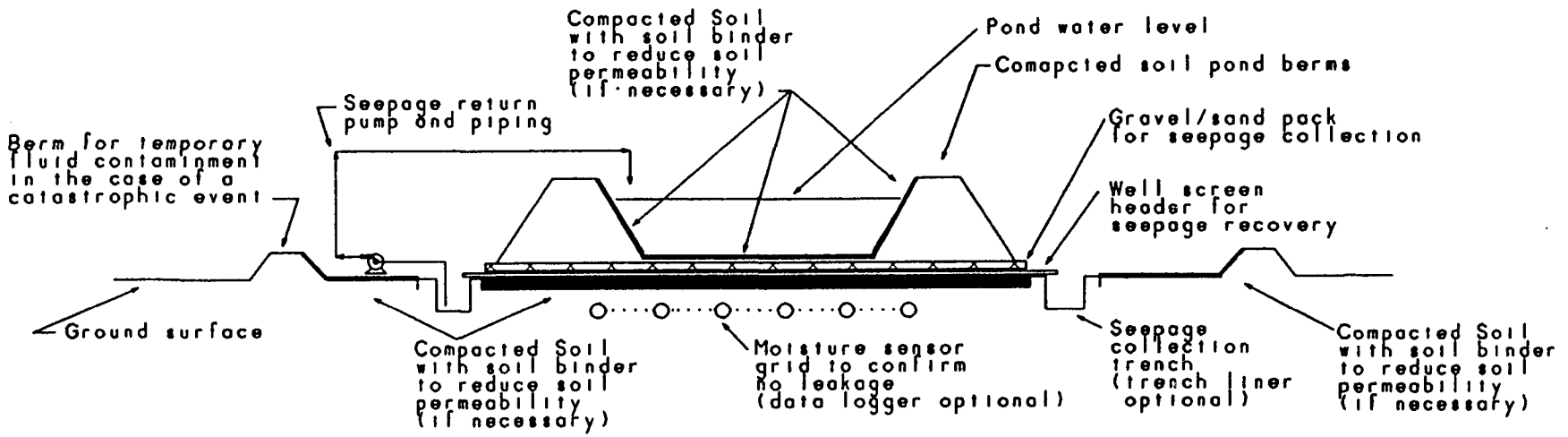
The total project cost is estimated to be between $230,000 and $250,000, with the variability primarily in the construction costs of the facility. Both monetary and in-kind funding for the economic and environmentally safe evaporation and holding pond are requested. Amoco will provide all of the requested in-kind support, while EPRI and the U.S. Department of Energy (DOE) will provide the monetary support. The total estimated demonstration in-kind cost requirements at this time are between $60,000 and $80,000. The in-kind funding to be provided by Amoco is primarily for installed costs of the pond and related equipment (pit construction, well screen header, pumps, piping, etc.).

All requirements for data collection during Task 3 that are not part of the normal operation of the facility would be conducted by EERC and B.C. Technologies personnel. The cost for the EERC and B.C. Technologies to provide the environmental, analytical, engineering, and operations support required in Tasks 1 through 4 is $170,000. These funds will be provided as $100,000 from EPRI and $70,000 from the DOE Jointly Sponsored Research Program Cooperative Agreement with the EERC.

EQUIPMENT LIST
EERC PROPOSAL #97-6601

MOISTURE SENSING GRID	$8,000

Hydraulically Engineered, Economic, and Environmentally Safe Evaporation Pond Design



Notes:

1) Pond construction above ground surface to minimize downward leakage.
2) Gravel/sand pack and seepage recovery header constructed of well screen to create a horizontal to vertical permeability ratio > 1000. Thereby reducing the potential for sub-surface seepage to effectively zero.
3) Containment trench and seepage return pump and piping automatically controlled by trench fluid level to return seepage to pond.
4) Outside containment berm to temporarily contain fluid in case of a catastrophic event.
5) Moisture sensors to confirm no downward seepage.

B.C. Technologies, Ltd.			
Drawn by: GB	Hydraulically Engineered, Economic, and Envir. Safe Evaporation Pond Design		
Approved: GB	Date: 2/15/96	Scale: NTS	Drawing No. 1 of 1

STATE OF NEW MEXICO

ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION

BRUCE KING
GOVERNOR

ANITA LOCKWOOD
CABINET SECRETARY

March 8, 1993

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

CERTIFIED MAIL
RETURN RECEIPT NO. P-667-241-941

Mr. B.D. Shaw, Environmental Coordinator
Amoco Production Company
200 Amoco Court
Farmington, New Mexico 87401

RE: **Manzanares Centralized Soils Remediation Facility**
OCD Rule 711 Permit Approval
San Juan County, New Mexico

Dear Mr. Shaw:

The **permit application for the Amoco Production Company Manzaneres centralized soils remediation facility** located in the SE/4 NW/4, Section 4, Township 29 North, Range 8 West, San Juan County, New Mexico, **is hereby approved** in accordance with the Oil Conservation Division (OCD) Rule 711 under the conditions contained in the enclosed attachment. The permit consists of the application dated October 15, 1992.

The operation, monitoring and reporting shall be as specified in the enclosed attachment. All modifications and alternatives to the approved soils remediation methods must receive prior OCD approval. You are required to notify the Director of any facility expansion or process modification and to file the appropriate materials with the Division.

Please be advised that approval of this permit does not relieve you of liability should your operation result in actual pollution of surface or ground waters or the environment actionable under other laws and/or regulations. In addition, the OCD approval does not relieve you of liability for compliance with any other laws and/or regulations.

Please be advised that all tanks exceeding 16 feet in diameter and exposed pits, ponds, or lagoons must be screened, netted or otherwise rendered nonhazardous to migratory birds.

This permit approval is for a period of five (5) years. This approval will expire on March 8, 1998 and you should submit an application for renewal in ample time before that date. The Division shall have the authority to administratively change this permit to protect fresh water, human health and the environment.

If you have any questions, please do not hesitate to contact Kathy Brown at (505) 827-5884.

Sincerely:

William J. LeMay
Director

WJL/kmb

Attachment

xc: Denny Foust- OCD Aztec Office

ATTACHMENT TO OCD 711 PERMIT APPROVAL
AMOCO PRODUCTION COMPANY
CENTRALIZED SOILS REMEDIATION FACILITY
(March 8, 1993)

COMPOSTING OPERATION

1. Disposal at the facility will only occur when an attendant is on duty. The facility will be secure when no attendant is present.

2. The facility will be fenced and have a sign at the entrance. The sign will be legible from at least fifty (50) feet and contain the following information: a) name of the facility, b) location by section, township and range, and c) emergency phone number.

3. An adequate berm will be constructed and maintained to prevent runoff and runon for that portion of the facility containing contaminated soils.

4. Only contaminated soils from Amoco operations will be accepted at the facility.

5. Only solids which are exempt from the RCRA Subtitle C regulations or are non-hazardous by characteristic testing will be accepted at the facility. Solids from operations not currently exempt under RCRA Subtitle C or mixed exempt/non-exempt solids will be tested for appropriate hazardous constituents. Test results must be submitted to the OCD along with a request to receive the non-exempt solids, and a written OCD approval (case specific) must be obtained prior to disposal. Comprehensive records of all laboratory analyses and sample locations will be maintained by the operator.

6. Moisture will be added as necessary to enhance bioremediation and to control blowing dust. There will be no ponding, pooling or run-off of water.

7. Enhanced bioremediation through the application of microbes (bugs) will only be permitted after prior approval from the OCD. Request for application of microbes must include the location of the area designated for the bio-remediation program, composition of additives, and the method, amount and frequency of application.

8. No free liquids or soils with free liquids will be accepted at the facility.

9. Comprehensive records of all material disposed of at the facility will be maintained at the facility. The records for each load will include: 1) the origin, 2) date received, 3) quantity, 4) exempt or non-exempt status and analysis for hazardous constituents if required, 5) transporter, and 6) exact cell location and any addition of microbes, moisture, fertilizer, etc.

TREATMENT ZONE MONITORING

1. One (1) background soil sample will be taken from the center portion of the landfarm two (2) feet below the native ground surface. The sample will be analyzed for total petroleum hydrocarbons (TPH), general chemistry, and heavy metals using approved EPA methods.

2. A treatment zone not to exceed three (3) feet beneath the original land surface will be monitored. A minimum of one random soil sample will be taken from each individual cell, with no cell being larger than five (5) acres, six (6) months after the first contaminated soils are received in the cell and then quarterly thereafter. The sample will be taken at two to three (2-3) feet below the native ground surface.

3. The soil samples will be analyzed using approved EPA methods for TPH and BTEX quarterly, and for general chemistry and heavy metals annually.

4. After obtaining the soil samples the boreholes will be filled with an impermeable material such as cement.

REPORTING

1. Analytical results from the treatment zone monitoring will be submitted to the OCD Santa Fe Office within thirty (30) days of receipt from the laboratory.

2. The OCD will be notified of any break, spill, blow out, or fire or any other circumstance that could constitute a hazard or contamination in accordance with OCD Rule 116.

CLOSURE

1. The operator will notify the Division of cessation of operations. Upon cessation of disposal operations for six (6) consecutive months, the operator will complete cleanup of constructed facilities and restoration of the facility site within the following six (6) months, unless an extension for time is granted by the Director. A closure plan for the facility will be approved by the OCD prior to any closure operations.

2. When the facility is to be closed no new material will be accepted. Existing soils will be remediated until they meet the OCD standards in effect at the time of closure. The area will then be reseeded with natural grasses and allowed to return to its natural state. Closure will be pursuant to all OCD requirements in effect at the time of closure.

STATE OF NEW MEXICO

OIL CONSERVATION DIVISION

MEMORANDUM OF MEETING OR CONVERSATION

☒ Telephone ☐ Personal | Time 8:45 | Date 11/25/92

Originating Party	Other Parties
Kathy Brown - OCD	Buddy Shaw - Amoco 326-9219

Subject: 2 Proposed Centralized Soil Composting Sites - Additional Information.

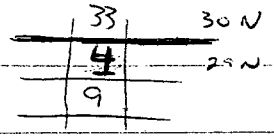
Discussion: Needed to know operational procedures. Basically, those sites will be identical to Crouch Mesa Compost Site, only smaller. No landfarming, only composting. Mix piles with oily soil, water, manure, hay, wood chips etc... and let sit and do there thing. Believe that the hydrocarbons are killed within 3-6 weeks, but it takes a little longer to get the TPH down to standards since other ingredients added. Want to start the new facilities in March. Would use the remediated soils for backfill into pits as remove the oily soils, so would not be backfilling the pits with soils removed from those pits. BLM has a problem with this - they actually have a problem with bringing any remediated soils back to their sites.

Conclusions or Agreements: They are using the 100 50 10 for clean backfill levels. At Crouch Mesa they are conducting the monitor zone treatment sampling as required.

Distribution:

Signed: Kathy

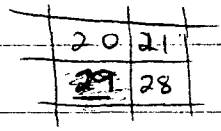
Amoco's Proposed Landfarms



① SE/4 NW/4, Sec. 4, T29N, R8W

Well 170'

Local	Depth	DTW	Prod Int	SC	x.7 TDS	Unit
29.08.09.3433	1624'	569'	206'-1624'	2160	1512	Tn
30.08.33.2121	Spring	-	-	1300	910	-



② N/2 NW/4, Sec. 29, T31N, R9W

No gw depths

Local	Depth	DTW	Prod Int	SC	x.7 TDS	Unit
31.09.28.1	100'	51'	-	1205	844	Qual, Tsj
31.09.20.3	510'	-	355'-505'	-	-	Tn
31.09.20.2	202'	-	140'-170'	-	-	Tsj, Tn

Revised 5/92

State of New Mexico
Energy, Minerals and Natural Resources Department
OIL CONSERVATION DIVISION
P.O. Box 2088
Santa Fe, NM 87501

OIL CONSERVATION DIVISION RECEIVED
'92 OCT 19 PM 9 18

APPLICATION FOR SURFACE WASTE DISPOSAL FACILITY

(Refer to OCD Guidelines for assistance in completing the application)

☐ Commercial ☒ Centralized

I. Type: ☐ Produced Water ☐ Drilling Muds ☐ Other _____
☒ Solids ☐ Treating Fluids

II. OPERATOR: Amoco Production Company
ADDRESS: 200 Amoco Court Farmington, NM 87401
CONTACT PERSON: Buddy Shaw PHONE: 326-9219

III. LOCATION: SE /4 NW /4 Section 4 Township 29N Range 8W
Submit large scale topographic map showing exact location.

IV. IS THIS AN EXPANSION OF AN EXISTING FACILITY? ☐ Yes ☒ No

V. Attach the name and address of the landowner of the disposal facility site and landowners of record within one-half mile o the site.

VI. Attach discription of the facility with a diagram indicating location of fences, pits, dikes, and tanks on the facility.

VII. Attach detailed engineering designs with diagrams prepared in accordance with Division guidelines for the construction/installation of the following: pits or ponds, leak-detection systems, acrations sytems, enhanced evaporation (spray) systems, waste treating systems, and security systems.

VIII. Attach a contingency plan for reporting and clean-up of spills or releases.

IX. Attach a routine inspection and maintenance plan to ensure permit compliance.

X. Attach a closure plan.

XI. Attach geological/hydrological evidence demonstrating that disposal of oil field wastes will not adversely impact fresh water. Depth to and quantity of ground water must be included.

XII. Attach proof that the notice requirements of OCD Rule 711 have been met (Commercial facilities only).

XIII. Attach a contingency plan in the event of a release of H_2S.

XIV. Attach such other information as necessary to demonstrate compliance with any other OCD rules, regulations and/or orders.

XV. CERTIFICATION

I hereby certify that the information submitted with this application is true and correct to the best of my knowledge and belief.

Name: Buddy Shaw Title: Environmental Coordinator

Signature: BJ Shaw Date: 10-15-92

DISTRIBUTION: Original and one copy to Santa Fe with one copy to appropriate Division District Office.

Plan for Disposal

Compost mixture consists of the following:

1. Oil soil from Amoco pits
2. Manure from NAPI and San Juan Downs
3. Paper products diverted from Regional Landfill

TPH and BTEX composite tests will be conducted on the final compost sites prior to use as backfill material for ongoing pit cleanups across the San Juan Basin. The site will be fenced for security purposes (6' chain-linked with barbed wire).

Contingency Plan

The site will be bermed and fenced. Should a leak or spill occur it will be contained on site. Any such occurrence will be reported to the OCD office in Aztec immediately. Cleanup will consist of re-entry into the compost pile. Cleanup equipment will be onsite.

Inspection and Maintenance Plan

Site equipment and berm will be inspected daily. Any needed repairs will be made immediately.

Closure Plan

Additional testing will be conducted at the end of the project to make sure no contamination has occurred to the landowner's property. Test results will be furnished as they are received.

Landowner

Chris Velasquez
766 CR 4599
Blanco, NM 87412

This site has no other landowners within one-half mile.

One water well in this area is 170' deep.

Revised 5/92

State of New Mexico
Energy, Minerals and Natural Resources Department
OIL CONSERVATION DIVISION
P.O. Box 2088
Santa Fe, NM 87501

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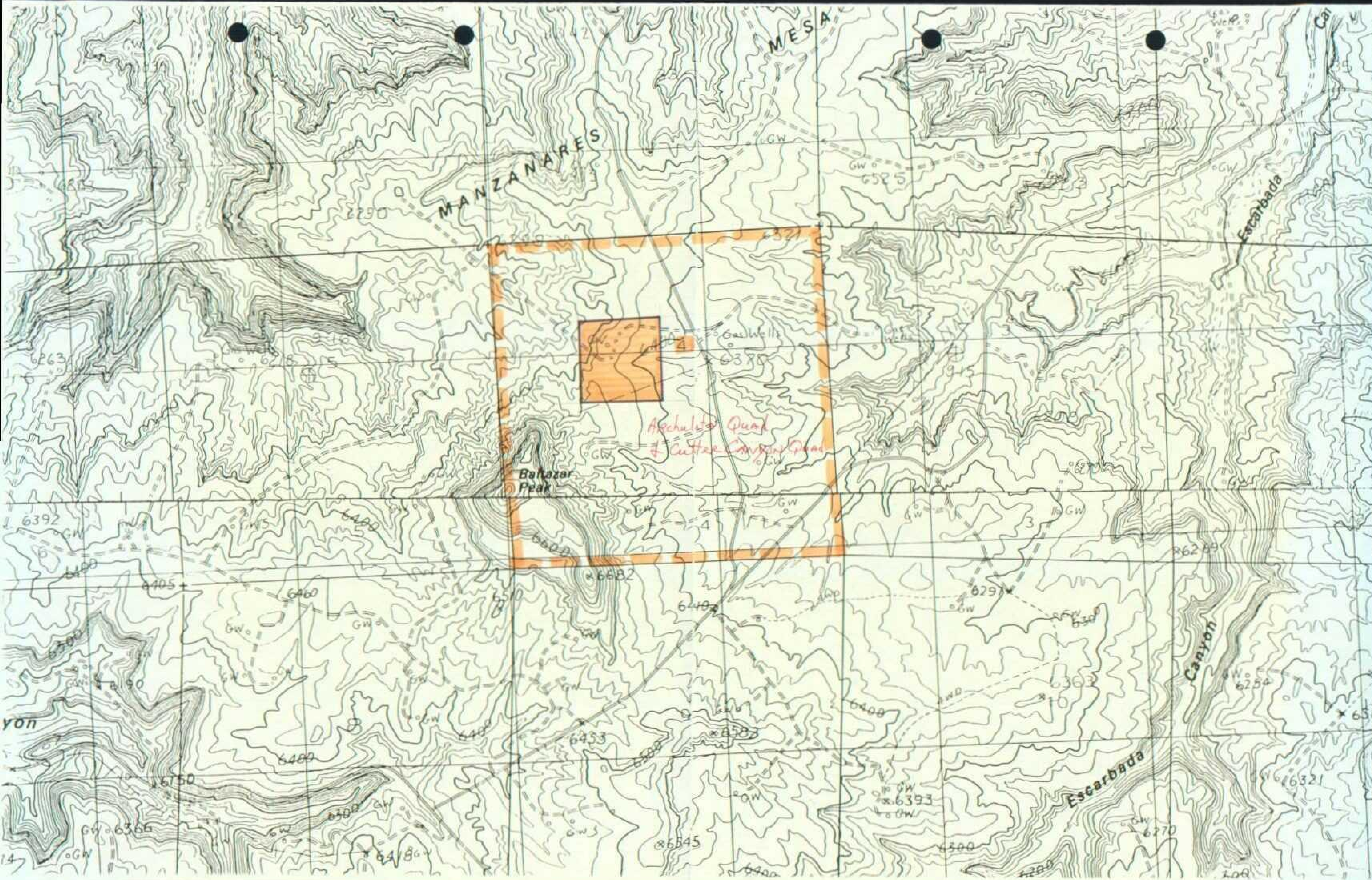
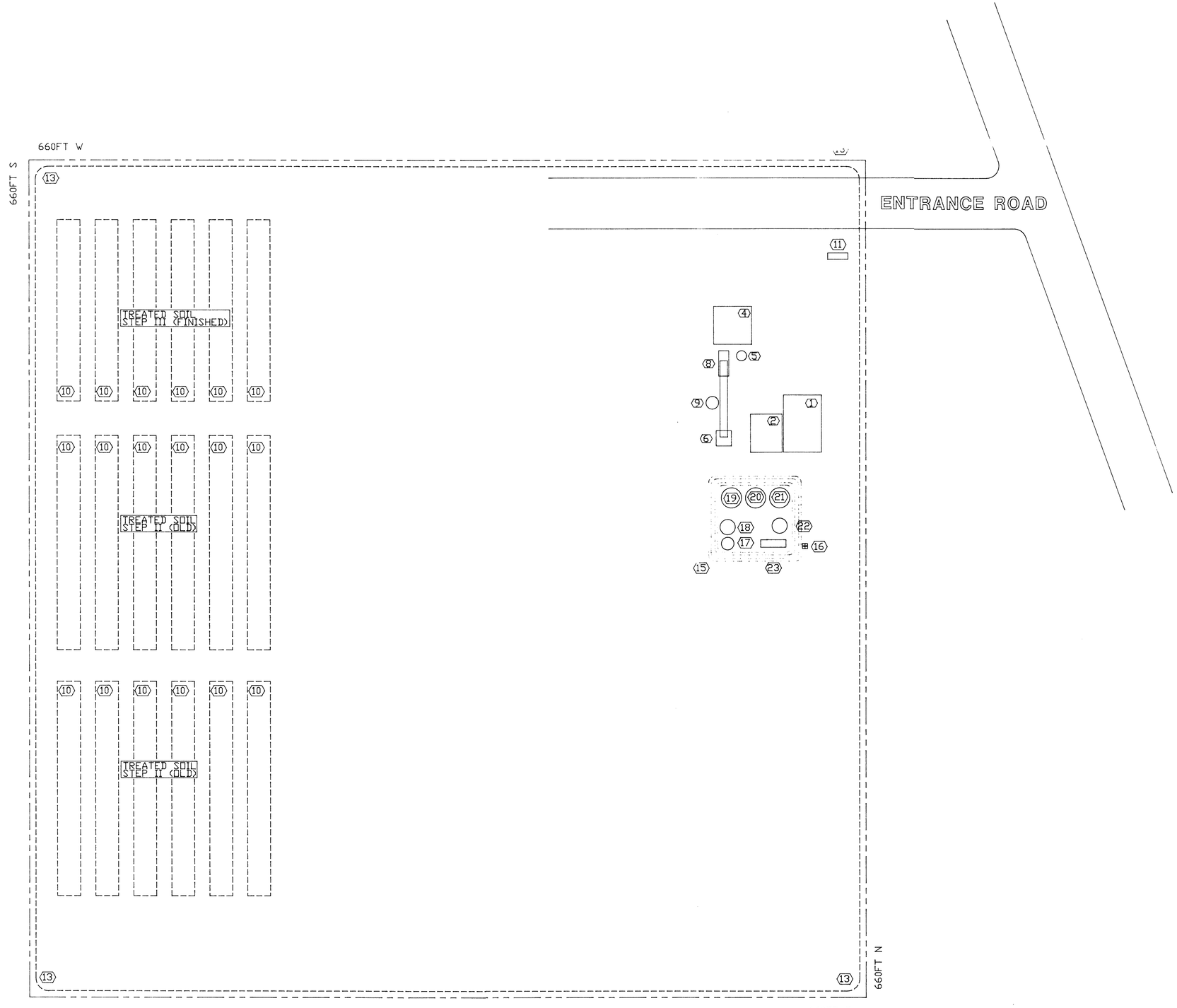


MANZANARES MESA
Baltazar Peak
Escarbada
Escarbada Canyon
Gas Wells
Archuleta Quad
& Cutter Canyon Quad
6682
6263
6392
6405
6433
6545
6393
6297
6254
6321
6270
6366



KEYED NOTES

1. OILY DIRT STORAGE
2. MANURE STORAGE
3. NUTRIENT STORAGE BLDG
4. PAPER STORAGE BLDG
5. TUB GRINDER
6. ~~STIRRED SLUDGE TANK~~
7. ~~STIRRED REACTOR TANK~~
8. PUG MILL
9. PUG MILL CONVEYOR
10. TREATED SOIL STORAGE
11. SITE OFFICE
13. 6FT CHAIN LINK FENCE w/BARBED WIRE
14. INTERIOR ACCESS ROAD
15. CONTAINMENT BERM
16. NEW FILL/PUMP CONNECTION
17. WATER STORAGE TANK
18. FINISHED PRODUCT TANK
19. WET OIL STORAGE TANK #1
20. WET OIL STORAGE TANK #2
21. PIT OIL STORAGE TANK
22. SEDIMENT FILTER TANK
23. COALESER

PROJECT INFO

1. ACTIVE STORAGE OF TREATED SOIL 6,850cy
2. PROJECT SITE: SE/4, NW/4 SEC 4, T29N, R8W, NMPM 10 ACRE ±

SITE PLAN

SCALE 1" = 40FT

NORTH

BY	REVISION	DATE

PECOS BILL SPECIALITIES
P.O.Box 1264
Farmington, NM 87499-1264
(505) 327-6400
fax (505) 325-7765

SITE PLAN & PROJECT INFO
AMOCO COMPOSTING PROJECT
SITE #3 - BALTZAR PEAK
AMOCO PRODUCTION COMPANY
200 AMOCO COURT, FARMINGTON, NM 87401

DATE: SEPT'92
DRAWN BY: GEB
PROJ. 92603
SCALE: NA
SHEET C1
OF 1