Maine Drilling & Blasting

January 16, 2002

Jay Reynolds
Development Review Coordinator
City of Portland
389 Congress Street
Portland, Maine 04101

RE: Ocean Ridge Blasting Plan

Jay:

According to the letter of January 15, 2003 from Sarah Hopkins we need to clear up three issues:

First, the status of Brian Skehan as an independent consultant has been unclear in our submittal and addendum. We have hired Bernstein, Shur, Sawyer, & Nelson, P.A. to draft an affidavit that is signed by our Wayne Flagg on this issue. This will be delivered to Penny in Room 211 this afternoon.

Second, the notification letters will be modified as requested.

Third, the blast reports will be forwarded to the City within 7 days.

We apologize for the confusion. Hopefully, the blast will be able to commence on Friday January 17, 2003.

Sincerely yours

Stephen Blaisdell

Stephen Blaisdell
Construction Manger

Maine Drilling and Blasting, Inc.
P.O. Box 1140
Brunswick Road
Gardiner, ME 04345
207 582-2338
FAX 207 582-8794

Divisional Offices:
Maine 207 582-2338
Massachusetts 508 689-2983
New Hampshire 603 647-0299
Vermont/New York 802 479-3341

An Equal Opportunity Employer

Department of Planning & Development
Lee D. Urban, Director

CITY OF PORTLAND

Division Directors
Mark B. Adelson
Housing & Neighborhood Services

Alexander Q. Jaegerman, AICP
Planning

John N. Lufkin
Ecomonic Development

January 15, 2003

Wayne Flagg
Eastern Division Manager
Maine Drilling & Blasting, Inc.
P.O. Box 1140
Brunswick Road
Gardiner, ME 04345

RE: Ocean Ridge Blasting Plan
Ocean Ridge Condominium Development, 852 Ocean Avenue
Job #2001-0002, CBL#416A-A-001

Dear Mr. Flagg:

We are in receipt of the recently submitted letter/amendment dated January 13, 2003 for the Ocean Ridge Condominiums at 852 Ocean Avenue. In reviewing the submittal, the City has the following concerns:

- Blast monitoring shall be conducted by an independent qualified professional engineer or seismologist (page 12, Sebago Technics Earthwork). Based on your submittal, it does not appear that Mr. Skehan is an independent representative.
  Although Mr. Blaisdell of your company has stated Mr. Skehan is not an employee of Maine Drilling and Blasting, the City needs to be satisfied that Mr. Skehan provides truly independent analysis to individuals receiving a pre-blast survey. Please provide to the City an affidavit detailing the relationship of Mr. Skehan to Maine Drilling and Blasting and any documents to support your position.

- Since the notification letters have already been distributed to properties, it appears that the requested language was not added. When additional letters are sent to property owners, please amend the language to include the required language.

- Your letter does not state that copies of the blast reports will be forwarded to the City within 7 days.

Please do not hesitate to call if you have any questions.

Sincerely,

Sarah Hopkins
Development Review Services Manager

389 Congress Street • Portland, Maine 04101 • (207) 874-8721 • FAX 756-8258 • TTY 874-8936

389 Congress Street, 4th Floor
Portland, ME 04101
(207)874-8721 or (207)874-8719
Fax: (207)756-8258

City of Portland
Planning and Development Department
Planning Division

To: Craig Babbidge
Steve Blaisdell
Wayne Flagg

Company: Marietta
Maine Drilling + Blasting

Fax: 883-7019 / 582-8794

Date: 1-16-03

From: Jay Reynolds

Comments: Items that Remain, In order to Issue Blasting Permit for Ocean Ridge.

Jay

Maine Drilling & Blasting

January 13, 2002

Jay Reynolds
Development Review Coordinator
City of Portland
389 Congress Street
Portland, Maine 04101

RE: Ocean Ridge Blasting Plan

Jay:

According to our meeting today at the Portland Fire Department, we are incorporating your requests in order to start the blasting for this project. These requests include:

Blast monitoring will be conducted by Brian Skehan. He is a qualified independent seismologist. He conducted the preblast surveys that were submitted today. His resume is attached.

Three seismographs will be utilized.

All blast reports and seismograph tapes will be attached for each blast. They will be available daily at the site. They will be copied and submitted to Maietta Construction on Mondays for distribution to Lt. McDougal.

If you have any further questions feel free to contact me at 207-582-2338.

Sincerely yours

Stephen Blaisdell

Stephen Blaisdell P.E.
Construction Manager

Cc Craig Babbidge
Wayne Flagg
Brian Skehan
Enc.

Maine Drilling and Blasting, Inc.
P.O. Box 1140
Brunswick Road
Gardiner, ME 04345
207 582-2338
FAX 207 582-8794

Divisional Offices:
Maine 207 582-2338
Massachusetts 508 689-2983
New Hampshire 603 647-0299
Vermont/New York 802 479-3341

Brian J Skehan

Resume for Preblast Surveyor and Blast Monitor at Ocean Ridge in Portland Maine

INDEPENDENT PREBLAST SURVEYOR & SEISMOLOGIST

Job Description

ADJACENT PROPERTY RISK MANAGEMENT

Review tax maps to have names and contact information for all structures within 1000 feet of blasting
Meet each resident and inspect structure in full compliance with Maine Drilling and Blasting standards as well as the specifications.
Communicate to each resident the impact of blasting, the schedule, and the alarm signals.
Leave a telephone contact for each resident to facilitate answers to questions as the blasting continues.
Log in private wells locations
Review preblast surveys with Blasting Consultant for submittal to the City of Portland.

BLAST MONITORING

Work with Maine Drilling and Blasting blaster in charge to monitor compliance with the submittal for each blast design
Establish seismograph locations and calibration compliance.
Assemble seismograph data and blast design for each shot for submittal to City of Portland.
Record all incidents of non compliance from specifications or Maine Drilling and Blasting standards.

REPORTING PROCESS
Prepare and submit notification list and procedures.
Prepare and submit through blasting consultant all preblast surveys.
Prepare and submit all seismograph and blast reports for each shot.
Prepare a non compliance report (NCR) for any deviations.

Past experience relating to blasting, preblast surveys, and building management

1969 Began working at Maine Drilling and Blasting as a drill operator.
1970 Began purchasing rental property real estate and assumed role as general contractor in renovation and rehabilitation of properties.
1973 Blaster and project foreman for Maine Drilling and Blasting in Maine , New Hampshire, and Massachusetts. Specialized in close areas such as: Eastern Maine Medical Center Expansion in Bangor, Maine Yankee Nuclear Power Plant in Wiscasset, One City Center in Portland.

1974 Continued in pursuit of personal real estate rental and renovation business. Approximately 40 units as well as on going rental of properties.

1980 Began seismograph monitoring of some projects.

1986 to 2002 Worked as a Federal Employee.

2002 Preblast surveying as an independent contractor working exclusively for Maine Drilling and Blasting. Working throughout New England States. This work includes a significant amount of public relations work with home and business owners. Each owner needs an explanation of blasting operations and its impact on their structure.

CURRENT SUCCES RATE:

I have performed approximately 250 preblast surveys. Of these surveys I have had 6 recalls to assess possible damages. To my knowledge there are no dis-satisfied parties from this effort.

Department of Planning & Development
Lee D. Urban, Director

CITY OF PORTLAND

Division Directors
Mark B. Adelson
Housing & Neighborhood Services

Alexander Q. Jaegerman, AICP
Planning

John N. Lufkin
Economic Development

December 23, 2002

Wayne Flagg
Eastern Division Manager
Maine Drilling & Blasting, Inc.
P.O. Box 1140
Brunswick Road
Gardiner, ME 04345

RE: Ocean Ridge Blasting Plan
Ocean Ridge Condominium Development, 852 Ocean Avenue
Job #2001-0002, CBL#416A-A-001

Dear Mr. Flagg:

We are in receipt of the recently submitted Maine Drilling and Blasting Inc. Blasting Plan for the Ocean Ridge Condominiums at 852 Ocean Avenue. In reviewing the blasting plan, we identified a number of areas in which the plan does not conform with the Ocean Ridge Blasting Contract executed on November 7, 2002. Examples of the inconsistencies include:

- Blast monitoring shall be conducted by an independent qualified professional engineer or seismologist (page 12, Sebago Technics Earthwork).
- Three seismographs must be used (page 12, Sebago Technics Earthwork).
- Documentation of air blast and peak particle velocity shall be documented for each blast and reported to the Owner's representative within 24 hours and a copy forwarded to the City within 7 days (page 13, Sebago Technics Earthwork).
  Those reports should be forwarded to Jay Reynolds in the Planning Office and Lt. McDougal at Fire Prevention.

Since City Hall is often the first place people call with concerns during blasting events, we request that the following language be added to your notification letter to neighbors within 1000ft: "Both the City of Portland Fire Department and Planning and Development Department will be monitoring construction of the Ocean Ridge Condominiums. Should any questions or issues arise, please call Lt. McDougal of Fire Prevention at 874-8405 or Jay Reynolds of the Planning Office at 874-8632."

Lastly, we request that prior to commencement of blasting, Maine Drilling and Blasting provide to the City documentation listing the owners within 1000ft of blasting limits, indicating the receipt of preblast survey work or the offer to conduct the preblast survey, and for each property, whether the offer was denied or accepted. (This list has proven to be very useful to locate neighbors if concerns or complaints arise.)

389 Congress Street • Portland, Maine 04101 • (207) 874-8721 • FAX 756-8258 • TTY 874-8936

Maine Drilling & Blasting

Index of Submittal for Ocean Ridge Blasting Approval

BLASTING PLAN FOR OCEAN RIDGE
DATED 12/17/2002 BY WAYNE FLAGG

ADDITIONAL SUBMITTAL NOTES

RESUME OF BRIAN SKEHAN

RESUME OF STEPHEN BLAISDELL

PREBLAST NOTIFICATION PACKAGE

WARNING NOTIFICATION

BLASTING LOCATION PLAN OF OCEAN RIDGE
Seismograph location
Blast locations for different blast designs in Blasting Plan
Preblast survey property within 1000 feet of blast

Maine Drilling and Blasting, Inc.
P.O. Box 1140
Brunswick Road
Gardiner, ME 04345
207 582-2338
FAX 207 582-8794

Divisional Offices:
Maine 207 582-2338
Massachusetts 508 689-2983
New Hampshire 603 647-0299
Vermont/New York 802 479-3341

Maine Drilling & Blasting

Blasting Plan

for

Ocean Ridge

Ocean Ave., Portland, Maine

Date: December 17, 2002

Prepared By: Maine Drilling & Blasting, Inc.
Eastern
P.O. Box 1140
Brunswick Road
Gardiner, ME 04345
Telephone: 207-582-2338
Fax: 207-582-8794

Wayne C. Flagg — Name

EASTERN DIV. MGR. — Title

Maine Drilling and Blasting, Inc.
P.O. Box 1140
Brunswick Road
Gardiner, ME 04345
207 582-2338
FAX 207 582-8794

Job Number: 1113609

Table Of Contents

Blasting Personnel

All blasting operations shall be conducted by experienced, trained and competent persons who understand the hazards involved. Persons working with explosive materials shall:

1. Have demonstrated a knowledge of, and a willingness to comply with, safety and security requirements.

2. Be capable of using mature judgment in all situations.

3. Be of good physical condition and not addicted to intoxicants, narcotics, or other similar type of drugs.

4. The person(s) responsible for the explosives shall possess current knowledge of the local, State and Federal laws and regulations applicable to his work.

5. The person(s) responsible for the explosives shall have obtained a Certificate of Competency or a license as required by State law.

Licenses and Permits

Maine Drilling & Blasting, Inc. is fully licensed and insured for the transportation, use, and handling of explosives. Evidence of insurance is available. Blasting permits will be applied for as required from the local authorities by the Maine Drilling & Blasting, Inc. Blaster/Foreman when blasting is about to begin.

Blast Vibration

Blast vibration will be monitored at the blast site, typically at the structure(s) closet to the blast site. Vibration limits will closely follow limits described in the project specifications and the State Regulations. Blast designs will be modified as required to stay within the guidelines and meet project schedules as well. Blasting operations will be modified accordingly when approaching buildings and utilities. Enclosed are preliminary vibration calculations based on known distances to the structures of concern and anticipated initial blast designs.

Blast Reports

Enclosed is a sample of a Maine Drilling & Blasting, Inc. Blast Report. This report will be filled out for each blast and copies supplied as needed.

Typical Blast Design

Enclosed are what would be considered typical blast designs for this project. Hole sizes, depths, spacing and loading information is provided. These designs are to be considered a good starting point. Modifications are usually made, if necessary, following the first blasts to meet control and seismic considerations.

General

Maine Drilling & Blasting, Inc. considers safety as the priority during all phases of blasting operations. We are knowledgeable of and will follow all local, state and federal regulations related to transportation and use of explosives. The project specifications and conditions have been reviewed. Details of procedures for pre-blast surveys, explosives use, blast security, monitoring and documentation are enclosed.

Pre-Blast Surveys / Notifications

Pre-blast surveys will be offered to all property owners within 1000 foot radius of the blast site. Appropriate notices will be given and appointments arranged for those owners who desire a survey. Pre-blast surveys will be conducted by a Company Representative. Results of those surveys will be documented through video or still photograghs and appropriate narration or written reports.

Blast Monitoring

All blasts will be monitored by a representative of Maine Drilling & Blasting, Inc. who has been properly trained in the setup and use of seismic monitoring equipment. At least one seismograph will be in use at all times. Placement of monitoring equipment will be at the nearest structure to the blast site. Maine Drilling & Blasting, Inc. monitoring equipment will consist of Instantel type seismographs. Details are enclosed. Results of blast monitoring will typically be available before the next blast, usually immediately following a blast. Results can be reviewed and modifications can be made to the blast design for the next blast if necessary.

Sequence of Blasting

All blasting operations will be strictly coordinated with Maietta Construction , engineers, Portland Police and Fire Department. Emphasis will be on the safe and efficient removal of the rock existing on this project without impact to surrounding structures. Blasts will be developed so as to create adequate relief which will minimize ground vibrations and offer the greatest protection possible to the surrounding structures.

Blasting Procedures

1. Blasting operations shall commence after 9:00 AM and cease before 4:00 PM, Monday through Friday.

2. Blasting cannot be conducted at times different from those announced in the blasting schedule except in emergency situations, such as electrical storms or public safety required unscheduled detonation.

3. Warning and all-clear signals of different character that are audible within a range of one-half mile from the point of the blast shall be given. All persons within the permit area shall be notified of the meaning of the signals through appropriate instructions and signs posted.

4. Access to blasting area shall be regulated to protect the public from the effects of blasting. Access to the blasting area shall be controlled to prevent unauthorized entry before each blast and until the perimeter's authorized representative has determined that no unusual circumstances exist after the blast. Access to and travel in or through the area can then safely resume.

5. Areas in which charged holes are awaiting firing shall be guarded, barricaded and posted, or flagged against unauthorized entry.

6. All blasts shall be made in the direction of the stress relieved face previously marked out or previously blasted.

7. All stemming shall be minimum as specified using clean, dry 3/8" crushed stone.

8. Blasting mats shall be used as necessary to cover blasts.

. The Blasting Contractor shall insure that extra safety and judgment is exercised by his blaster to prevent the simultaneous blasting of numerous holes.

Blasting Mats

Blasting mats and backfill will be used to control excessive amounts of rock movement when blasting in close proximity to structures. Placement and number of mats are typically determined by the blaster. Mats will be placed so as to protect all people and structures on, or surrounding the blast site and property. Rubber tire type blasting mats will be utilized on this project and will be approximately 12' x 12' in size; Rubber mat @ 12' x 12' 38 lbs./s.f. = 5,472 lbs./ea.

Blast Security and Warning Whistles

Each blast will be preceded by a security check of the affected area and then a series of warning whistles. Communications will be made with job site supervisors and local officials as required to ensure the safest possible operation. All personnel in the vicinity closest to the blast area will be warned. The warning whistles will follow the following sequence:

3 Whistles - 5 Minutes to Blast

2 Whistles - 1 Minute to Blast

1 Whistle - All Clear

The blast site will be examined by the blaster prior to the all clear signal to determine that it is safe to resume work. No blast will be fired until the area has been secured and determined safe.

Explosives

All explosives will be delivered to the job site on a daily basis. There will be no overnight storage. Only the amount of explosives required to perform the day's work will be brought to the site. All explosives will be stored in approved magazines when not in use.

Enclosed are Technical Data and MSDS sheets for the explosive products proposed for use on this project. Any one of, or a combination of these products may be in use at any one time on the site.

Blaster Qualifications

All Maine Drilling & Blasting, Inc. blasters on this job will be licensed in the State of Maine and have received various amounts of training in the safe use and handling of explosives. Additionally, Maine Drilling & Blasting, Inc. blasters are familiar with all OSHA Regulations, State Regulations, and Federal Regulations regarding construction site safety, including transportation, use, and handling of explosive materials. Weekly safety meetings are to be held on site by the Maine Drilling & Blasting, Inc. job foreman, with a record of that meeting returned to the Maine Drilling & Blasting, Inc. office.

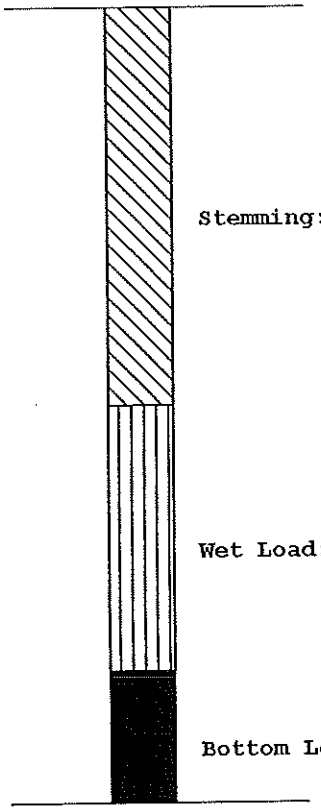
MAINE DRILLING AND BLASTING, INC.

Blast Design Plan
OCEAN RIDGE
Description: TRENCH
Utility Trench Work.

APENDIX A.

Blast Design Plan

Est. # of Holes	15
Depth	8'
Hole Diameter	3.0"
Burden	5'
Spacing	3'
Holes per Delay	1
Pounds per Delay	10.67 lbs
Pounds per Hole	10.67 lbs
Total Est. Pounds	160.00 lbs
Powder Factor	4.80 lbs/CY
Decks	0



Stemming:	4.0'	Stemming Stone
Wet Load:	2.7'	EMGEL 250 2.5"
Bottom Load:	1.3'	POWER PRIMER

Blast Plan Notes
Seismographs To Be Placed At The Nearest Structur

Vibration Predication (formula based on Dupont Handbook)

Site Factor (k)	160	Ground Constant based on Site/Rock Conditions
Distance ft (d)	80	Distance to Structure
lbs per Delay (w)	10.67	lbs explosives per 8 milisecond Delay
Scaled Distance (sd)	24.49	(sd = d / square root of w)
Esimated PPV	0.96	(ppv = k * sd ^ - 1.6)

Typical for production work consistent holes 8' deep at 80' from a structure utilizing 3.0" diameter at a 5' by 3' pattern.

Plan View/Timing Design (please see attached timing diagrams)

○ ○ ○ ○ ○ ○ ○ ○

TIMING BASED ON FIELD CONDITIONS

MAINE DRILLING AND BLASTING, INC.

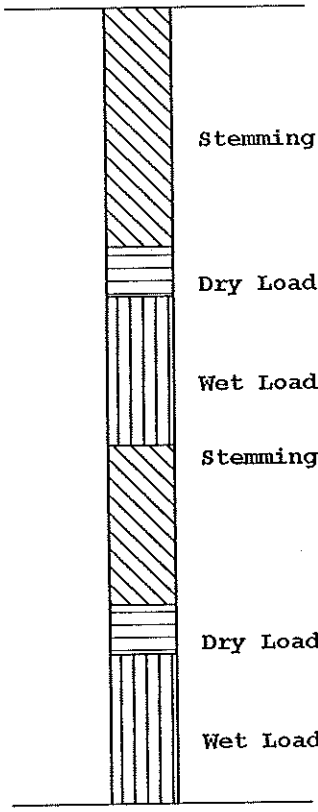
Blast Design Plan
OCEAN RIDGE
Description: OPEN ROCK
Roadway & Site Rock.

APENDIX A.

BLASTING TO NEAREST STRUCTURE

Blast Design Plan

Est. # of Holes	10
Depth	10'
Hole Diameter	3.0"
Burden	5'
Spacing	6'
Holes per Delay	1
Pounds per Delay	6.30 lbs
Pounds per Hole	12.59 lbs
Total Est. Pounds	125.93 lbs
Powder Factor	1.13 lbs/CY
Decks	1



Stemming:	3.0'	Stemming Stone
Dry Load:	.6'	PELLITE (ANFO)
Wet Load:	1.9'	EMGEL 250 2.5"
Stemming:	2.0'	Stemming Stone
Dry Load:	.6'	PELLITE (ANFO)
Wet Load:	1.9'	EMGEL 250 2.5"

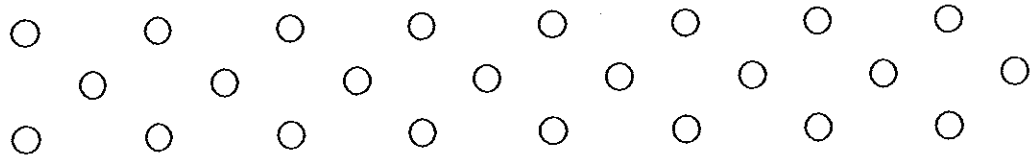
Blast Plan Notes
Seismographs To Be Placed At The Nearest Structure

Vibration Predication (formula based on Dupont Handbook)

Site Factor (k)	160	Ground Constant based on Site/Rock Conditions
Distance ft (d)	50	Distance to Structure
lbs per Delay (w)	6.30	lbs explosives per 8 milisecond Delay
Scaled Distance (sd)	19.93	(sd = d / square root of w)
Esimated PPV	1.33	(ppv = k * sd ^ - 1.6)

Typical for production work consistent holes 10' deep at 50' from a structure utilizing 3.0" diameter at a 5' by 6' pattern.

Plan View/Timing Design (please see attached timing diagrams)



TIMING BASED ON FIELD CONDITIONS

M A I N E D R I L L I N G A N D B L A S T I N G, I N C.

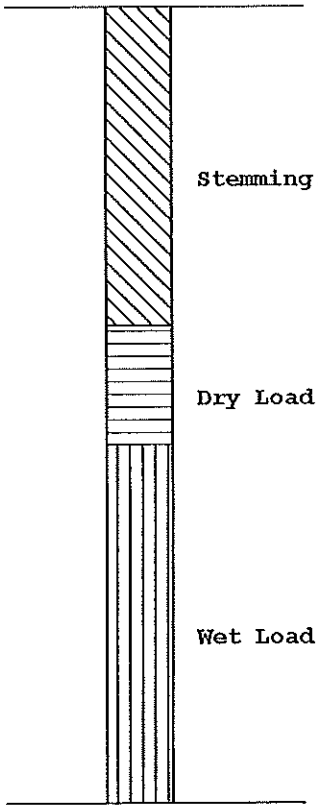
Blast Design Plan
OCEAN RIDGE
Description: OPEN ROCK
Roadway & Site Rock.

APENDIX A.

BLASTING FURTHER THAN 80' FROM STRUCTURES

Blast Design Plan

Est. # of Holes	20
Depth	10'
Hole Diameter	3.0"
Burden	5'
Spacing	6'
Holes per Delay	1
Pounds per Delay	15.11 lbs
Pounds per Hole	15.11 lbs
Total Est. Pounds	302.22 lbs
Powder Factor	1.36 lbs/CY
Decks	0



Stemming:	4.0'	Stemming Stone
Dry Load:	1.5'	PELLITE (ANFO)
Wet Load:	4.5'	EMGEL 250 2.5"

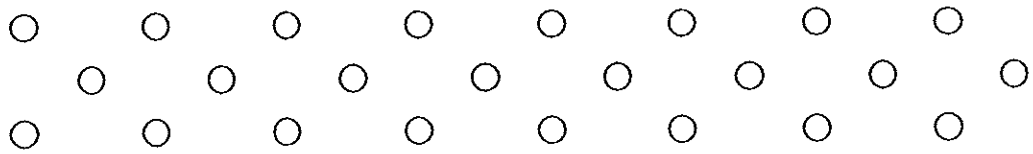
Blast Plan Notes
Seismographs To Be Placed At The Nearest Structure

Vibration Predication (formula based on Dupont Handbook)

Site Factor (k)	160	Ground Constant based on Site/Rock Conditions
Distance ft (d)	80	Distance to Structure
lbs per Delay (W)	15.11	lbs explosives per 8 milisecond Delay
Scaled Distance (sd)	20.58	(sd = d / square root of w)
Esimated PPV	1.27	(ppv = k * sd ^ - 1.6)

Typical for production work consistent holes 10' deep at 80' from a structure utilizing 3.0" diameter at a 5' by 6' pattern.

Plan View/Timing Design (please see attached timing diagrams)



TIMING BASED ON FIELD CONDITIONS

Calibration Certificate

Part Number: 712A0102

Description: DS477 BMII MIC 2-250HZ

Date: November 18,2002

Unit S/N: 1403

TEST REFERENCES	Model	Serial No.
Stanford Spectrum Analyzer*	SR760	41036
Good Will Inst. Frequency Counter*	GUC-2010G	5110825
Fluke Multimeter*	87III	71990510
VOD Cable Simulation Test Jig	717J0201	n/a
Bruel & Kjaer Accelerometer*	4370	1425906
Bruel & Kjaer Charge Amplifier*	2635	1423229
Bruel & Kjaer Mic Power Supply*	2804	1904864
Bruel & Kjaer Microphone Preamplifier*	2669	1834210
Bruel & Kjaer Microphone Element*	4193	1863904

INSTANTEL INC. hereby certifies that this unit has been calibrated and that the results are consistent with the specifications published regarding this instrument. The SENSORCHECK™ feature of the unit is sufficiently reliable to indicate proper operation, although it is recommended that this unit be sent to INSTANTEL or an authorized service centre for regular calibration.

AUTHORIZED BY: K. Marleau

*References are traceable to NRC, NIST or equivalent

Calibration Certificate

Part Number: 712A0101

Description: DS477 BMII MIC 2-250HZ

Date: November 4, 2002

Unit S/N: 2239

TEST REFERENCES	Model	Serial No.
Stanford Spectrum Analyzer*	SR760	41036
Good Will Inst. Frequency Counter*	GUC-2010G	5110825
Fluke Multimeter*	87III	71990510
VOD Cable Simulation Test Jig	717J0201	n/a
Bruel & Kjaer Accelerometer*	4370	1425906
Bruel & Kjaer Charge Amplifier*	2635	1423229
Bruel & Kjaer Mic Power Supply*	2804	1904864
Bruel & Kjaer Microphone Preamplifier*	2669	1834210
Bruel & Kjaer Microphone Element*	4193	1863904

INSTANTEL INC. hereby certifies that this unit has been calibrated and that the results are consistent with the specifications published regarding this instrument. The SENSORCHECK™ feature of the unit is sufficiently reliable to indicate proper operation, although it is recommended that this unit be sent to INSTANTEL or an authorized service centre for regular calibration.

AUTHORIZED BY: Martin Payne

*References are traceable to NRC, NIST or equivalent

Calibration Certificate

Part Number: 714A0801

Description: BLASTMATE III

Date: November 1, 2002

Unit S/N: BA6414

TEST REFERENCES	Model	Serial No.
Stanford Spectrum Analyzer*	SR760	41036
Good Will Inst. Frequency Counter*	GUC-2010G	5110825
Fluke Multimeter*	87III	71990510
VOD Cable Simulation Test Jig	717J0201	n/a
Bruel & Kjaer Accelerometer*	4370	1425906
Bruel & Kjaer Charge Amplifier*	2635	1423229
Bruel & Kjaer Mic Power Supply*	2804	1904864
Bruel & Kjaer Microphone Preamplifier*	2669	1834210
Bruel & Kjaer Microphone Element*	4193	1863904

INSTANTEL INC. hereby certifies that this unit has been calibrated and that the results are consistent with the specifications published regarding this instrument. The SENSORCHECK™ feature of the unit is sufficiently reliable to indicate proper operation, although it is recommended that this unit be sent to INSTANTEL or an authorized service centre for regular calibration.

AUTHORIZED BY: _____

*References are traceable to NRC, NIST or equivalent

APPENDIX B.-ALTERNATIVE BLASTING LEVEL CRITERIA

Safe blasting vibration criteria were developed for residential structures, having two frequency ranges and a sharp discontinuity at 40 Hz (table 13). There are blasts that represent an intermediate frequency case, being higher that the structure resonance (4 to 12 Hz) and lower that 40 Hz. The criteria of table 13 apply equally to a 35-Hz and a 10-Hz ground vibration, although the responses and damage potentials are very much different.

Using both the measured structure amplifications (fig. 39) and damage summaries (figs. 52 and 54), a smoother set of criteria was developed. These criteria have more severe measuring requirements, involving both displacement and velocity (fig. B-1).

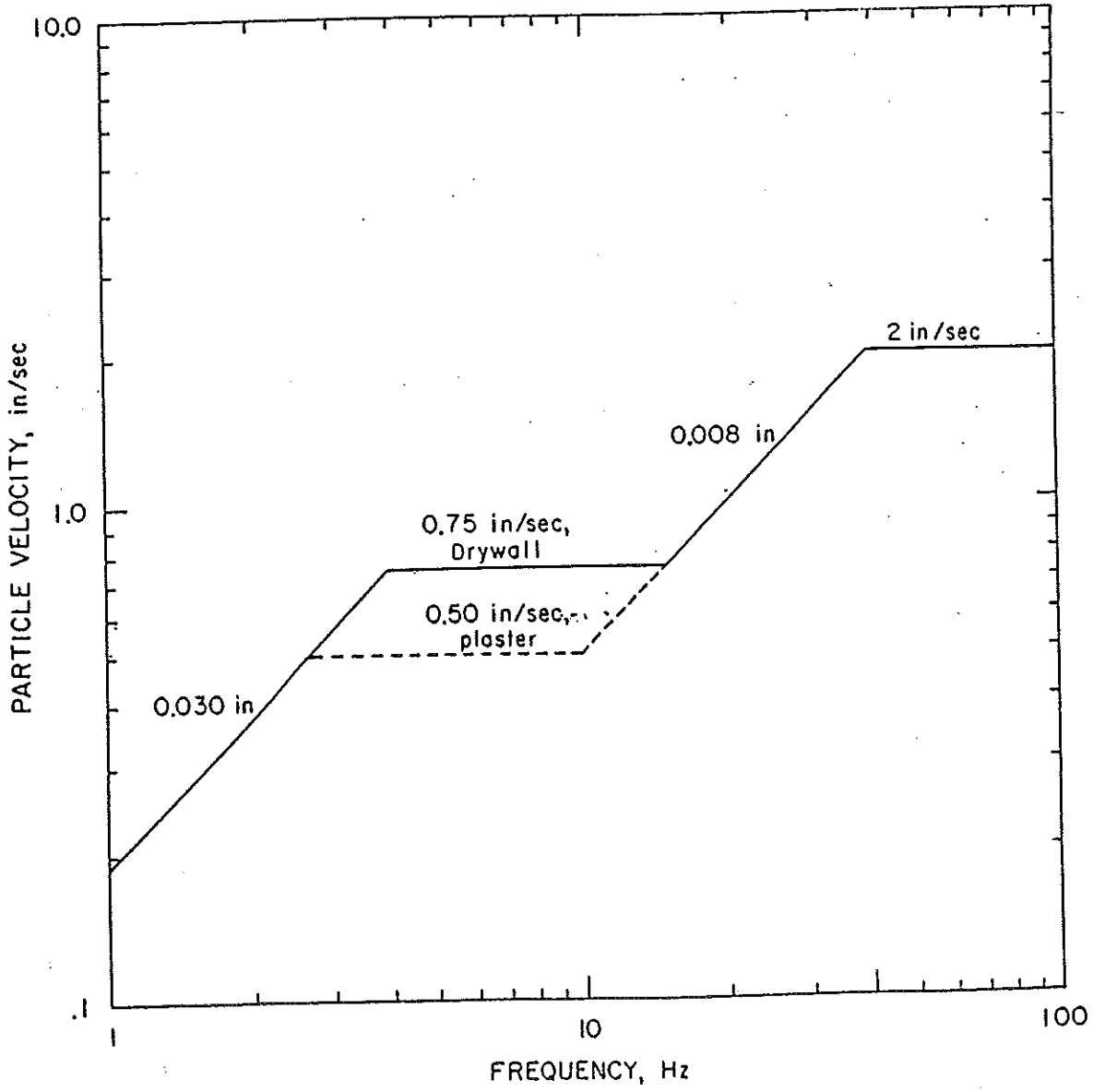


Figure B–1.—Safe levels of blasting vibration for houses using a combination of velocity and displacement.

Maine Drilling & Blasting

TIMOTHY FRAZEE
RR #7, BOX 4500
NORTHERN AVENUE
FARMINGDALE, MAINE 04344

CELL# 207/650-865A

EMPLOYMENT: Supervisor/Blaster for Maine Drilling & Blasting, Inc. since April, 1985.

WORK EXPERIENCE: In charge of various projects throughout Maine, New Hampshire, Vermont and Massachusetts

PROJECT	CONTRACTOR	DOLLAR VALUE
Site Development Randolph, MA	Old Colony Construction	$1,500,000.00
Exit 7A – Portland Jetport Portland, ME	White Brothers	$280,000.00
Site Development Waltham, MA	C. Sprito	$500,000.00
Hydro Electric Penacook, NH	Richars & Associates	$700,000.00
Worumbo Hydro Lisbon Falls, ME	Cianbro Corp.	$600,000.00
Site Development So. Portland, ME	Sable Oaks Associates	$500,000.00
Site Development Jaffrey, NH	Shattuck Inn Associates	$900,000.00

REFERENCES: Mike White
White Brothers, Westbrook, ME

Mitchell Green
Green Mountain Explosives, Auburn, NH

Maine Drilling and Blasting, Inc.
P.O. Box 1140
Brunswick Road
Gardiner, ME 04345
207 582-2338
FAX 207 582-8794

Divisional Offices:
Maine 207 582-2338
Massachusetts 508 689-2983
New Hampshire 603 647-0299
Vermont/New York 802 479-3341

Maine Drilling & Blasting

DANA A. LAWRENCE
46 FORRESTER LANE
WEST GARDINER, MAINE 04345 Cell # 207/650-7157

EMPLOYMENT: Blaster with over 14 years experience, has been with Maine Drilling & Blasting for 14 years.

EXPERIENCE:

Contractor	Location	Size of Job
Wenworth by the Sea	Newcastle, NH	$ 114,500
Fleet Construction	Smithfield, RI	$ 251,400
R. J. Grondin	Augusta, ME	$1,100,000

STATES LICENSED IN AND LICENSE NUMBERS:

New Hampshire 1151, Rhode Island 37

Maine Drilling and Blasting, Inc.
P.O. Box 1140
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Gardiner, ME 04345
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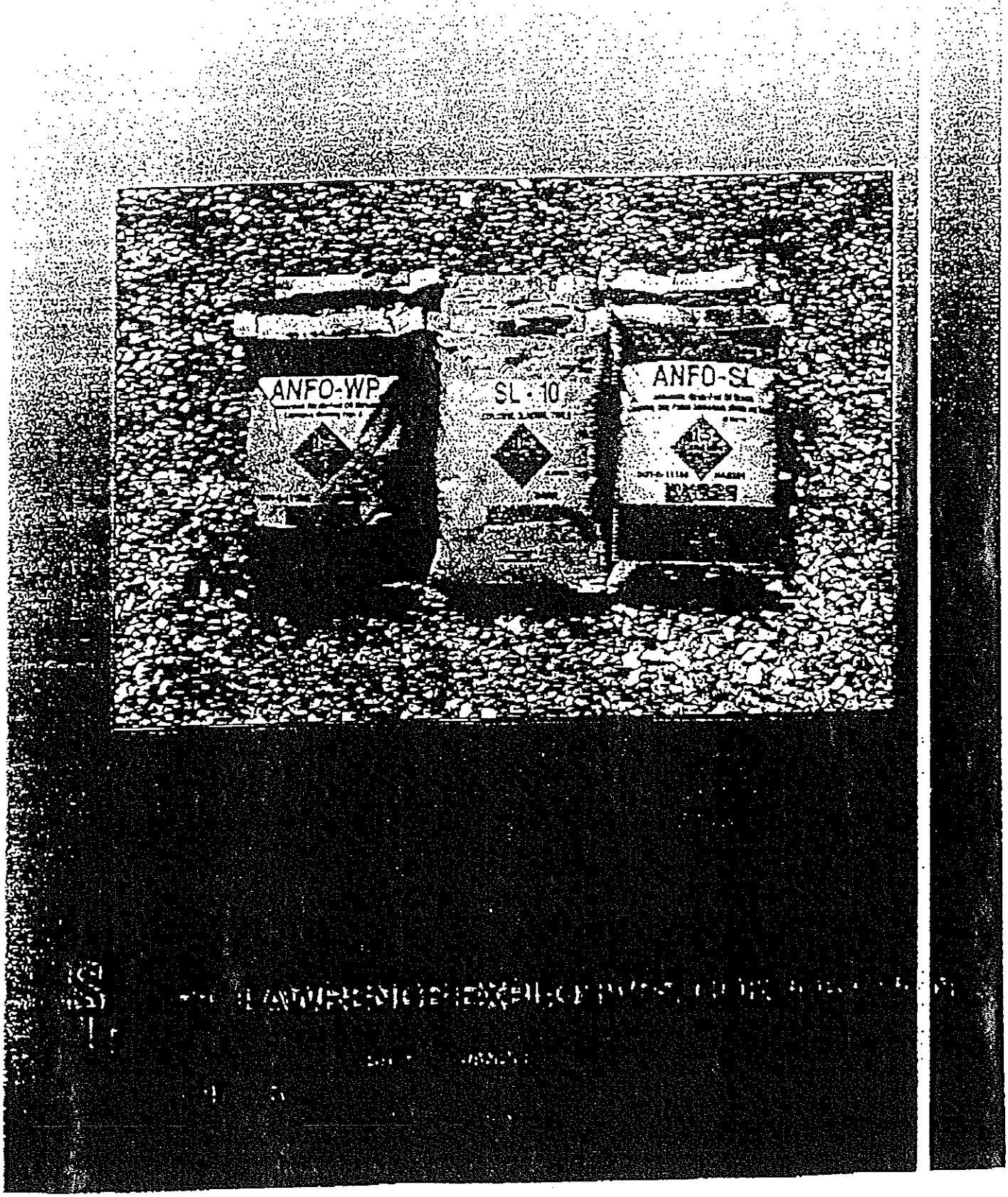
New Hampshire 603 647-0299
Vermont/New York 802 479-3341

Friday, March 17, 2000

ANFO-SL

ANFO-SL is a prilled ammonium nitrate and fuel oil blend.



DYNO
Dyno Nobel

MATERIAL SAFETY DATA SHEET
DYNO NOBEL INC
11TH FLOOR CROSSROADS TOWER
SALT LAKE CITY, UTAH 84144
801-364-4800 TELEX 388363
FOR 24 HOUR EMERGENCY CALL 800-424-9300

MSDS# 1009

DATE: 01/04/99

Supersedes MSDS
1009 12/20/97

SECTION I - PRODUCT IDENTIFICATION

Trade Name(s): ANFO
Ammonite
Ammonite HD
Bulk 100
DYNO MIX®
DYNO® MIX WR
IREMIX 100, IREMIX 100 (U.G.)
IREPAK 100

Product Class: Bulk or packaged ANFO

Product Appearance & Odor: Pale, oil-covered prills with fuel oil odor.

DOT Hazard Shipping Description: Ammonium nitrate-fuel oil mixture 1.5D NA 0331 II
For DYNO® MIX WR: Explosive Blasting Type B 1.5 UNO331 II

SECTION II - HAZARDOUS INGREDIENTS

Ingredients:	CAS#	% (Range)	TLV-ACGIH
Ammonium Nitrate	6484-52-2	92-96	No Value Established
Fuel Oil	68476-34-6	4-7	No Value Established
*Guar Gum (Nuisance Dust)	9000-30-0	0-3	5 mg/m³

* DYNO® MIX WR is the only product containing guar gum.

Ingredients, other than those mentioned above, as used in this product are not hazardous as defined under current Department of Labor regulations.

SECTION III - PHYSICAL DATA

Boiling Point: N/A

Vapor Pressure: <5 mm Hg @ 75° F

Vapor Density: > 1

Density: 0.8 to 1.0 g/cc bulk density

Percent Volatile by Volume: < 8 (Fuel oil)

Solubility in Water: Ammonium Nitrate
Very Soluble

Evaporation Rate (Butyl Acetate = 1): < 1

A Hazard Classification: N/A (See Section IV - Special Fire Fighting Procedures)

N/A = Not Applicable or Not Available

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: >100° F

Flammable Limits: N/A

Extinguishing Media: (See Special Fire Fighting Procedures section.)

Special Fire Fighting Procedures: Do not fight fires involving explosive materials. Evacuate personnel to predetermined safe location, no less than 2,500 feet in all directions.

Unusual Fire and Explosion Hazards: Can explode under fire conditions. Burning material may produce toxic vapors.

SECTION V - HEALTH HAZARD DATA

Effects of Overexposure

Eyes: May cause irritation, redness, and tearing.

Skin: Prolonged contact may cause irritation.

Ingestion: Large amounts may be harmful if swallowed.

Inhalation: May cause dizziness, nausea, intestinal upset.

Systemic or Other Effects: None known.

Emergency and First Aid Procedures

Eyes: Irrigate with running water for at least 15 minutes. If irritation persists, seek medical attention.

Skin: Wash with soap and water.

Ingestion: Seek medical attention.

Inhalation: Remove to fresh air.

Special Considerations: None.

SECTION VI - REACTIVITY DATA

Stability: Stable under normal conditions. May explode when subjected to fire, supersonic shock, or high energy projectile impact especially when confined or in large quantities.

Conditions to Avoid: Keep away from heat, flame, ignition sources, and strong shock.

Materials to Avoid (Incompatibility): Strong acids and strong alkalis.

Hazardous Decomposition Products: Carbon Monoxide (CO) and Nitrogen Oxides (NO_x)

Hazardous Polymerization: N/A

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in Case Material is Released or Spilled: In case of fire evacuate area not less than 2,500 feet in all directions. Protect from all ignition sources. Notify authorities in accordance to emergency response procedures. Only personnel trained in emergency response should respond. If no fire danger is present, and product is undamaged and/or uncontaminated, repackage product in original packaging or other clean DOT approved container. Ensure that a complete account of product has been made and is verified. Follow applicable Federal, State, and local spill reporting requirements.

Waste Disposal Method: Disposal must comply with Federal, State, and local regulations. If product becomes a waste, it is potentially regulated as a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) Title II, Subtitle C.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Ventilation: General room ventilation is normally adequate.

Respiratory Protection: None normally required.

Protective Clothing: Gloves and work clothing which reduce skin contact are suggested.

Eye Protection: Safety glasses are suggested.

Other Precautions Required: None.

SECTION IX - SPECIAL PRECAUTIONS

Precautions to be taken in handling and storage: Store in cool, dry, well-ventilated locations. Store in compliance with Federal, State, and local regulations. Keep away from heat, flame, ignition sources, and strong shock.

Other Precautions: It is recommenced that users of explosive materials be familiar with the Institute of Makers of Explosives Safety Library publications.

SECTION X - SPECIAL INFORMATION

The reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR 372 may become applicable if the physical state of this product is changed to an aqueous solution. If an aqueous solution of this product is manufactured, processed, or otherwise used, the nitrate compounds category and ammonia listing of the previously referenced regulation should be reviewed.

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MATERIAL SAFETY DATA SHEET

EMERGENCY TELEPHONE: (315) 583-5432 CHEMTREC 800-424-9300

PRODUCT IDENTIFICATION

Trade Name: Emulsion/ANFO Blends Chemical Name: Mixture

Synonyms: Extra Emulsion/ANFO Blends (Extra 500, 900, 920, 1300, 1310, etc.)

Product Appearance and Odor: Pale to opaque, viscous emulsion with visible prills. If aluminum present, silver particles will be visible. Will have a fuel odor.

DOT Shipping Name and Hazard Class:

49CFR	Blasting Agent, N.O.S.;	Blasting Agent
HM-181	Explosive, blasting, type E, 1.5D, UN0332, PG 11	

HAZARDOUS INGREDIENTS

Ingredients:	CAS#	%	TLV
Ammonium Nitrate	6484-52-2	70 - 90	None
Fuel Oil	68476-30-2	3 - 12	5 mg/m3 (mist)
Aluminum	7429-90-5	0 - 16	10 mg/m3

An emulsified water in oil mixture of ammonium nitrate, fuel oil, mineral oil, emulsifiers, which may include aluminum and/or hollow micro spheres.

PHYSICAL DATA

Boiling Point: NA Vapor Pressure: 0.4mm Hg @ 68 F

Vapor Density: NA Specific Gravity: 1.1 - 1.3

Percent Volatile by Volume: NA Evaporation Rate: NA (Butyl Acetate = 1)

Solubility in Water: Although in excess of 80% of the materials are readily soluble in water, the

(43)

FIRE AND EXPLOSION HAZARD DATA

Extinguishing Media: NA

WARNING: Could explode under fire conditions. DO NOT FIGHT FIRE INVOLVING EXPLOSIVE MATERIALS. EVACUATE AREA FOR 2500 FEET IN ALL DIRECTIONS. TOXIC FUMES OF CARBON MONOXIDE OR NITRIC OXIDES MAY BE GENERATED.

HEALTH HAZARD DATA

Effects of Overexposure

Eyes:	Can cause irritation, redness, and tearing
Skin:	Prolonged contact may cause irritation
Ingestion:	Large amounts may be harmful if swallowed
Inhalation:	May cause dizziness, nausea, intestinal upset

Emergency and First Aid

Eyes:	Irrigate with running water for at least 15 minutes
Skin:	Wash with soap and water
Ingestion:	Induce vomiting, seek medical help
Inhalation:	Move to fresh air

REACTIVITY DATA

STABLE under normal conditions but protect from heat, sparks, flame, shock, confinement, strong acids, peroxides, chlorates, and alkali.

Hazardous Decomposition:	Nitrogen Oxides and Carbon Monoxide
Hazardous Polymerization:	Will not occur

SPILL OR LEAK PROCEDURES

Isolate and contain material. Protect from ignition sources, smoking, or open flame. Contact proper authorities in accordance to emergency response procedures as well as manufacturer for additional information. In the event of a major transportation spill, contact CHEMTREC at 1-800-424-9300.

SPECIAL PROTECTION EQUIPMENT

Ventilation:	Use in adequate ventilation. Avoid inhalation of blast fumes.
Clothing:	Gloves and work clothing to reduce skin contact are suggested.
Eye Protection:	Safety glasses with side shield are suggested.
Respiratory:	None usually required unless toxic fumes from fire are present.

SPECIAL PRECAUTIONS

Handling and Storage: Store in cool, dry, well-ventilated locations in compliance with Federal, State, and local regulations. Keep away from heat, shock, flame, and ignition sources. Users should familiarize themselves with the "ALWAYS" and "NEVERS" instructions as well as the Institute of Makers of Explosives Safety Library publications (SLP's).

SPECIAL INFORMATION

This product contains the following substances that are subject to the reporting requirements of Section 313 of Title 111 of SARA of 1986 and 40CFR Part 372.

Ingredients: Aluminum (dust, fumes)
Ammonium Nitrate Solution

ST. LAWRENCE EXPLOSIVES CORP. DISCLAIMER

The above information is believed to be accurate and represents the best information available to us and is offered for informational purposes only. However, we make no warranty of the accuracy of such information, expressed or implied, and assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular use.

MATERIAL SAFETY DATA SHEET

MINING SERVICES INTERNATIONAL

MSI EMGEL 250

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MANUFACTURER: Mining Services International, Inc.
8805 S. Sandy Parkway
Sandy, Utah 84070-6408

EMERGENCY PHONE NUMBER: (801)233-6000 (MSI) or (800)424-9300 (CHEMTREC

TRADE NAME: EMGEL 250

CAS NUMBER: N/A

SECTION 2 - COMPOSITION/INFORMATION ON INGREDIENTS

		Exposure Limits (mg/m³ unless noted)		% by Wgt
Component	CAS No.	ACGIH TLV	OSHA PEL	Typical
Ammonium Nitrate	6484-52-2	N/A	N/A	50 - 53
Calcium Nitrate	10124-37-5	N/A	N/A	26 - 28
Alumunum	7429-90-5	10	N/A	4 - 6

SECTION 3 - HAZARDS IDENTIFICATION

US OSHA HAZARD COMMUNICATION STANDARD: Product assessed in accordance ıith OSHA 29 CFR 1910.1200 and determined to be hazardous.

EFFECTS OF OVEREXPOSURE: Respiratory irritation, dizziness, nausea, vomiting, tachycardia. Prolonged, repeated skin contact may result in skin irritation or more seri us skin disorders. Toxic effects are unlikely to occur if good personal hygiene is practice

EMERGENCY RESPONSE DATA: Light gray in color, in a white polyethylene casing or woven polypropylene shot bag.

DOT ERG No. - 112

SECTION 4 - FIRST AID MEASURES

EFFECTS OF OVEREXPOSURE: UNKNOWN

EMERGENCY AND FIRST AID PROCEDURES:

Inhalation - Remove to a well ventilated area. If breathing difficulties persist seek medical help.

Ingestion - Do not induce vomiting. Drink large amounts of water or milk. Give liquid activated charcoal and seek medical attention.

Skin - Wash effected area with soap and rinse with large amounts of water. Launder contaminated clothing before reuse.

Eyes - Flush with copious amounts of clean or buffered water for at least 15 minutes. Seek medical attention immediately.

SECTION 5 - FIRE-FIGHTING MEASURES

FLASH POINT: Not Established **LEL:** Not Available

EXTINGUISHING MEDIA: Water - Deluge with water to cause a mass cooling.

UNUSUAL FIRE & EXPLOSION HAZARDS: System contains its own oxygen and fuel. May explode when subject to extreme heat or shock. Will release NO_x

SPECIAL FIRE FIGHTING PROCEDURES: DO NOT FIGHT AN ESTABLISHED FIRE. Clear area and allow to burn out.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:

Gather up spilled cartridges and wash any contaminated area with water.

WASTE DISPOSAL METHOD:

Place down a blast hole prior to detonation; to be utilized as part of the blast. May be burned in a shallow layer on barren ground in accordance with federal, sta e and local regulations.

SECTION 7 - HANDLING AND STORAGE

DURING HANDLING AND STORAGE:

Comply with regulations and precautions for "Blasting Agent, n.o.s." classification l y regulatory agencies. Wear chemical resistant gloves and boots.

OTHER PRECAUTIONS:

May cause shrinkage of leather shoes and gloves, avoid contact; slightly corrosiv to ferrous metals.

SECTION 8 - EXPOSURE CONTROL / PERSONAL PROTECTION

RESPIRATORY: Dust/Mist Mask is advisable

VENTILATION: Ambient

GLOVES: Chemical resistant

EYE: Safety Glasses or Goggles

OTHER PROTECTIVE EQUIPMENT: None required.

THRESHOLD LIMIT VALUE: Nitrogen dioxide = 3 ppm
Nitrous oxides = 25 ppm

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

BOILING RANGE: N/A

MELTING POINT: N/A

VAPOR DENSITY: N/A

EVAPORATION RATE: N/A

PERCENT VOLATILE BY VOLUME: N/A

SOLUBILITY IN WATER: NO

Density: 1.15 - 1.25 gm/cc

APPEARANCE AND ODOR:

Gel ; odor of fuel or mineral oil; grey in color, with solid ammonium nitrate prill throughout the mix. Packaged in 1.5 to 3 inch polyethylene cartridges and/or 3.5 to 9 inch diameter woven polypropylene shot bags, with polyethylene liner.

SECTION 10 - STABILITY AND REACTIVITY

STABILITY: Stable

CONDITIONS TO AVOID: High heat in a confined area.

HAZARDOUS DECOMPOSITION PRODUCTS: NO_2, NO_x, CO_2, Ammonia

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11 - TOXICOLOGICAL DATA

ACUTE TOXICITY: Not Established

SECTION 12 - ECOLOGICAL INFORMATION

ENVIRONMENTAL FATE AND EFFECTS: Not Established

SECTION 13 - DISPOSAL CONSIDERATIONS

WASTE DISPOSAL: The contaminated material is to be placed down a borehole to be utilized as part of the blast. If local regulations allow, it may be burned in a shallow l yer on barren ground.

RCRA INFORMATION: Any other form of disposal of this product may be subject to RC RA regulations (40 CFR 261) due to the characteristic(s)/chemical(s) listed in section 2.

SECTION 14 - TRANSPORT INFORMATION

Regulatory classifications are as follows:

DOT: Blasting Agent **OSHA:** Blasting Agent **MSHA:** Blasting Agent

USA DOT:

SHIPPING NAME: Explosive, blasting, type E, UN0332
HAZARD CLASS AND DIVISION: 1.5D
ID NUMBER: UN0332 **REFERENCE No.:** EX-9008114
PACKING GROUP: II
DANGEROUS WHEN WET: NO
POISON: NO
LABEL(s): Blasting Agent **PLACARD(s):** Blasting Agent 1. D
PRODUCT RQ: N/A **ERG NUMBER:** 112

SECTION 15 - REGULATORY INFORMATION

Governmental Inventory Status: All components comply with TSCA, and EINECS/ELINCS.

US Superfund Amendments and Reauthorization Act (SARA) Title III: This produc is considered an "Extremely Hazardous Substance". This product also contains Ammonium Nitrate which is reportable to SARA(313) toxic release program.

SECTION 16 - OTHER INFORMATION

This product meets UN standards for Blasting Agent as outlined in TDG Manual of Tests and Criteria. Second Revised Edition.

The Ensign-Bickford company

MATERIAL SAFETY DATA SHEET

SECTION I

Manufacturer's Name:

The Ensign-Bickford Company

Address:

660 Hopmeadow St., Simsbury, CT 06070

Emergency Telephone No:

(203) 658-4411
(203) 843-2276

Trade Name and Synonyms: PRIMADET® NONELECTRIC DETONATORS, EZDET, EZTL™ DETONATORS, TLBB, MSC, SLMS/SLHD, LEAD-IN-LINES

Cage Code:

152-B-059/060
92-C-207/409/413
152-C-04;08;17;26;40-43;46
152-C-78,80;90

EBCo Product Code:

NMS, NLP, NEZ, EZTL, TLBB, MSC, SLMS/SLHD, L-I-L

SECTION II - HAZARDOUS INGREDIENTS

Ingredient:	C.A.S. No.	OSHA PEL	ACGIH TL
PENTAERYTHRITOL TETRANITRATE (PETN)	78-11-5	None	None
LEAD AZIDE	13424-46-9	0.05mg(Pb)/m³	.05mg(Pb)/m
RED LEAD	1314-41-6	.05mg(Pb)/m³	.05mg(Pb)m
BARIUM CHROMATE	10294-40-3	1mg/m³	0.01mg/m³ (Insoluble Cr VI compounds
POTASSIUM PERCHLORATE	7778-74-7	None	None
OTTAWA SILICA	61790-53-2	6mg/m³	2mg/m³ (silica, fume

LEAD CHROMATE	7758-97-6	1 mg/10m³ (ceiling)	0.01mg/m³ (Insoluble Cr VI) compound:
SELENIUM	7782-49-2	0.2 mg/m³	0.2 mg/m³
MOLYBDENUM	7439-98-7	15 mg/m³	10 mg/m³
TUNGSTEN	7440-33-7	None	5 mg/m³
ALUMINUM	7429-9-5	15mg/m³ (dust) 5mg/m³(resp. frac.)	10mg/m³
LEAD	7439-92-1	.05 mg/m³	.05mg/m³
SILICON	7440-21-3	15 mg/m³ (total dust) 5mg/m³ (respirable dust)	10 mg/m³

SECTION III - PHYSICAL DATA

Boiling Point:

Lead Chromate: Decomposes
Selenium: 690° C
Molybdenum: 4825° C
Tungsten: 5900° C
Aluminum: 2450° C
Lead: 1740° C

Vapor Pressure:

Molybdenum: 1mm @ 3102° C
Aluminum: 1mm @ 1284° C
Lead: 1mm @ 973° C

Specific Gravity:

PETN @	1.773
Potassium Perchlorate@	2.52
Lead Chromate@	6.3
Selenium@	4.81-4.26
Molybdenum@	10.28
Tungsten@	19.3 @ 20
Aluminum@	2.70
Lead@	11.34
Barium Chromate@	4.50

Percent Volatile:

N/A

Vapor Density:
N/A

Evaporation Rate:
N/A

Solubility in Water:

PETN:	No
Lead Azide:	Very Slight
Potassium Perchlorate:	Yes
Lead Chromate:	No or Slight
Molybdenum:	No
Aluminum:	No
Lead:	No
Barium Chromate:	No

Melting Point:

PETN:	140° C
Potassium Perchlorate:	Decomp. at 400° C
Lead Chromate:	920° C
Molybdenum:	2622° C
Tungsten:	3410° C
Aluminum:	660° C
Lead:	327.43° C

Appearance and Odor:
Aluminum shell containing appox. 100mg of lead azide and 400-800mg of Pentaerythritol Tetranitrate (PETN) with Shock Tube (plastic) containing a dust of HMX and Aluminum powder.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point:
N/A

Explosive Limits:
LEL:N/A UEL:N/A

Extinguishing Media:
Do not fight fires involving explosives. Water may be applied through fixed extinguishing system (sprinklers) as long as people need not be present for the system to operate.

Special Fire Fighting Procedures:
DO NOT FIGHT FIRES INVOLVING EXPLOSIVES. ISOLATE THE AREA. EVACUATE PERSONNEL TO A SAFE PLACE. EXPLOSIVE DETONATION CAN OCCUR.

Unusual Fire and Explosion Hazards:
May detonate if exposed to shock, heat, impact, sparks or friction. Nitrogen, Oxides, Carbon Monoxide and Carbon Dioxide are released when this product is burned.

Auto Ignition Temperature:
PETN 190°

The Ensign-Bickford company

MATERIAL SAFETY DATA SHEET

SECTION V - ROUTES OF ENTRY/EFFECTS OF OVEREXPOSURE

Threshold Limit Value:	Product is fully contained and presents low risk of skin contact, ingestion, or inhalation of chemical constituents during normal handling. Personnel could be exposed to by-products during functional detonation of the unit and post clean-up.
Eye Contact:	Dust can irritate, corneal injury may result. Flush immediately with running water for at least 15 minutes. Seek medical attention.
Skin Contact:	Irritation and Eczema may result. If exposure occurs, wash thoroughly with soap and water. If skin irritation occurs seek medical attention.
Inhalation:	Breathing dust can cause nasal and respiratory irritation and lowering of blood pressure. PETN can lower blood pressure. PETN is a vasodilator. Lead exposure at high levels can cause acute or chronic symptoms which can range from eye and skin irritation to permanent brain damage, vomiting, convulsions. ACGIH classifies lead as an "Animal Carcinigen" and insoluble chromium VI compounds as "Confirmed Human Carcinogens". Seek medical attention.
Ingestion:	See Inhalation.

SECTION VI - EMERGENCY FIRST AID PROCEDURES

Emergency and First Aid Procedures

Eye Contact:	Flush using running water for 15 minutes. If irritation persists, seek medical attention.
Skin Contact:	Wash thoroughly with soap and water. If skin irritation occurs, seek medical attention.
Inhalation:	Remove victim to fresh air. If not breathing administer artificial respiration. Seek medical attention.
Ingestion:	Seek medical attention.

SECTION VII - REACTIVITY DATA

Stability:	Stable, but improper handling can result in accidental detonation.
Conditions To Avoid:	Heat, shock, friction, impact, static charge.
Incompatibility:	Incompatible with acids, alkalis.
Hazardous Decomp Products:	Detonation will produced Nitrogen, Oxides, Carbon Dioxide and Carbon Monoxide. Airborne particulates, including the metals i Section II, may be released.
Hazardous Polymerization:	Will not occur.

SECTION VIII - SPILLS OR LEAK PROCEDURES

Steps To Be Taken In Case Material Is Released Or Spilled:	Review Fire and Explosive Hazards and Safety Precautions before Proceeding with Clean-Up. Use appropriate Personal Protective Equipment during clean up. Isolate the spill area; removing all sources of ignition from the location. Carefully collect the spilled material and place in a (Velostat) conductive bag. Contamination of this material with sand, grit, or dirt will render material more sensitive to detonation. If safe separate material that is not contaminated from contaminated material. "Loose" powder spills should be wetted down and cleaned using a damp rag or sponge. Store all collected material in a secure area, to await proper disposal. Detonators contain Lead Azide; in the event of any spill of loose powder, such as from a broken cap all spilled material should be treated with Cerric Ammonium Nitrate killing solution (10%). This will chemically decompose the Lead Azide, but the PETN and pyrotechnic will remain reactive, and all residue materials must be assumed to be explosive - contaminated until proper waste disposal of the reactive material (see below) is complete. Only qualified personnel should perform any clean-up and disposal of material.

The Ensign-Bickford company

MATERIAL SAFETY DATA SHEET

Waste Disposal Method:	Waste detonators are classified as a hazardous waste with the characteristic reactivity, EPA Hazardous Waste Number of D003; see CFR 40 Section 261. Any such waste should be handled and stored in accordance with local, stat and federal regulations. The current preferred method of waste treatment f waste detonators is detonation in a confined chamber. The open (unconfinec detonation of waste detonators may result in the release of lead particulate. Open burning of detonators is likely to result in detonation, and is not recommended. Any treatment of waste detonators must be performed by qualified personnel and at licensed facilities.

SECTION IX - SPECIAL PROTECTION INFORMATION

Respiratory Protection:	See page 4, Inhalation. A dual cartridge negative pressure respirator with high efficiency dust, mist and fume cartridges should be worn if exposure is found to be between 50 and 500 micrograms (Pb) per cubic meter of air (ug/m³). Powered air purifying respirators or other higher forms of respiratory protection should be worn if exposure levels exceed 500 ug/m³.
Ventilation:	Product is intended for outside use and in underground mines. Ventilation should be provided if used in underground mines or if any special testing is to be performed indoor.
Protective Gloves:	Not required for normal use. Protective gloves should be worn during post clean-up operations.
Eye Protection::	Safety glasses

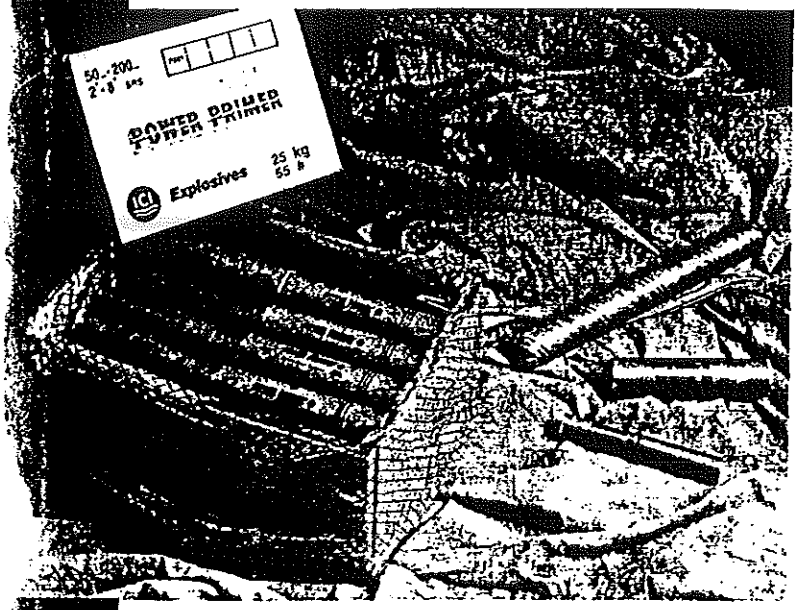
SECTION IX - REACTIVITY DATA

Precautions To Be Taken In Handling And Storing:	Transportation and storage must be in accordance with Federal, State and Local Regulations. Store away from sparks or other ignition sources. Avoid heat , shock and impact.
Other Precautions:	Refer to Manufacturer's Instructions and Warnings supplied with product.
SARA 313 Information:	Manufactured unit contains Aluminum, Barium compounds, Chromium compounds, Lead and Selenium which fall under the reporting requirements of SARA Title III; Section 313.

Last Data Sheet Revision: 05/05/94

POWER PRIMER™

Ammonia Gelatin Dynamite



Uses

- construction projects
- underground development and stoping
- shaft sinking
- surface quarries and open pit mines
- high energy bottom charge
- priming blasting agents
- alternate velocity loading charge

Benefits

- resistant to dynamic precompression
- high detonation pressure
- effective with extended burdens and massive, hard breaking formations
- excellent performance under high static pressure
- excellent gap sensitivity
- easy to load, high density cartridges

Properties

POWER PRIMER	
Cartridge Density (g/cc)	1.42
Velocity of Detonation (ft/s)* 1 1/4"	17,500
Water Resistance	Excellent
Relative Weight Strength (RWS)**	96
Relative Bulk Strength (RBS)**	161
Detonation Pressure (kilobars)	168
Fume Class*	1

* unconfined at 41°F

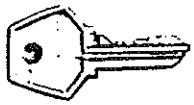
** All ICI Explosives energy values are calculated using IDeX™, the computer code developed by ICI Explosives for the exclusive use of its companies. Other computer codes may give different values.

* POWER PRIMER is Fume Class 1 in diameters less than two inches.

Priming

To initiate, use a high strength detonator or detonating cord.

A L W A Y S



LOCK UP EXPLOSIVE MATERIALS AND KEEP THEM FROM CHILDREN.

ICI

Explosives

POWER PRIMER

Ammonia Gelatin Dynamite

POWER PRIMER

Packaging

POWER PRIMER is packed in tampable convolute or spiral-wound paper shells.

Shelf Life

One year from time of manufacture under good storage conditions.

Common Sizes

Cartridge Size (inches)	Average cartridge count per 55 lb. case
convolute shells	
1 x 8	161 - 174
1 1/4 x 8	111 - 120
1 1/2 x 8	76 - 83
1 1/2 x 16	35 - 42
1 3/4 x 16	27 - 31
2 x 8	42 - 46
2 1/2 16	13 - 15
spiral-wound shells	
2 x 16	21 - 23
2 1/2 x 16	13 - 15
3 x 5 lb.	11
4 x 5 lb.	11
spiral-wound shells 50 lb. cases	
5 x 12 1/2 lb.	4
5 x 25 lb.	2

Storage

For best results, store at moderate temperatures and dry conditions in a well ventilated, approved explosives magazine.

Hazardous Materials Shipping Description

Explosive, Blasting, Type A, Class 1.1D, UN0081, II.

ICI Explosives USA Inc.
15301 Dallas Parkway, #1200
Dallas, Texas 75248-4629
(214) 387-2400

1M/10-94

Printed in the U.S.A.

MATERIAL SAFETY DATA SHEET

Explosives

POWER PRIMER

ICI Explosives USA Inc.
15301 Dallas Parkway, Suite 1200
Dallas, Texas, USA 75248-4629

ICI Canada Inc.
90 Sheppard Avenue East
North York, Ontario, Canada M2N 6H2

Date Issued: 94 08 01

For emergencies involving chemical spill or release, call Chemtrec 1-800-424-9300 or, in Canada, the ICI Canada Transportation Emergency Response System 1-800-561-3636. For lost, stolen or misplaced explosives, also call: BATF 1-800-424-9555 (USA) or CANUTEC 1-613-996-6666 (Canada).

MATS Index: 14541
MSDS Number: 40014

COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous Ingredients	%(w/w)	TLV-TWA	ACGIH CAS NO.	Section 313 %by (w)
Ammonium Nitrate	30-60	Not Listed	6484-52-2	N/A
Ethylene Glycol Dinitrate/ Nitroglycerin (EGND/NG)	30.5	0.46 mg/m3 (skin)	55-63-0	0-11.0
Sodium Nitrate	10-30	Not Listed	7631-99-4	N/A

Product Use: A detonator-sensitive gelatin explosive used in surface applications.

HAZARDS IDENTIFICATION

Emergency Overview: Risk of explosion by shock, friction, fire or other sources of ignition. May cause fire. Very toxic if swallowed. Irritating to eyes, respiratory system and skin. May cause methemoglobinemia. May cause sensitization by skin contact.

FIRST AID MEASURES

General: If you feel unwell seek medical advice (show the label where possible).

Inhalation: Move victim to fresh air. Give artificial respiration ONLY if breathing has stopped. Give cardiopulmonary resuscitation (CPR) if there is no breathing AND no pulse. Oxygen administration may be beneficial in this situation but should only be administered by personnel trained in its use. Obtain medical attention IMMEDIATELY.

Skin Contact: Wash affected areas with soap and water. If irritation, redness, or burning sensation developes and persists, obtain medical advice.

Eye Contact: Immediately flush eyes with running water for a minimum of 20 minutes. Hold eyelids open during flushing. If irritation persists, repeat flushing and obtain medical attention.

Ingestion: If victim is alert and not convulsing, rinse out mouth and give 200-300 mL (1 cup) of water to dilute material. DO NOT induce vomiting. If spontaneous vomiting occurs, have victim lean forward with head down to avoid breathing in of vomitus, rinse mouth and administer more water. IMMEDIATELY transport victim to an emergency facility.

Note to Physicians: Symptomatic. Administer oxygen if there are signs of cyanosis. If clinical condition deteriorates, administer 10 cc Methylene Blue intravenously. It is unlikely for this to be required with methemoglobin level of less than 40%. Do not give vasopressor drugs (e.g. epinephrine, adrenalin, ephedrine, etc.) as there may be danger of producing cardiac arrhythmia. Medical conditions that may be aggravated by exposure to this product include hypotension and skin disorders.

FIRE-FIGHTING MEASURES

Flash Point (Deg. C): 54.86°F.
Flammable Limits (Lower): Not Applicable
Flammable Limits (Upper): Not Applicable
Auto Ignition Temperature (Deg. C): 338°F.
Decomposition Temperature (Deg. C): 120°F (Nitroglycerin)
Rate of Burning: Will burn at atmospheric pressure.
Explosive Power: 380 kj/100 G
Sensitivity to Mechanical Impact: Expected to be sensitive to mechanical impact.
Sensitivity to Static Discharge: Not expected to be sensitive to static discharge.
Hazardous Reactions: See "Fire & Explosion Hazards".
Fire and Explosion Hazards: Explodes on overheating and, thus, fires involving large quantities of the material should not be fought. This product is a high explosive with a mass detonation hazard.
Extinguishing Media: If water is used, very large quantities are required. Water may be used on small fires. Do not attempt to fight large fires.
Fire Fighting Procedures: DO NOT FIGHT FIRES INVOLVING EXPLOSIVE MATERIALS. Immediately evacuate all personnel from the area.
Fire Fighting Protective Equipment: Use self-contained breathing apparatus and special protective clothing.

NOTE: Also see "Section 10 - Stability and Reactivity".

ACCIDENTAL RELEASE MEASURES

Spills, Leaks, or Releases: Collect product and contaminated soil for re-use or disposal. Contain storm water runoff by dyking with earth or other barrier, to minimize the spread of contamination. Notify applicable government authority if release is reportable or could adversely affect the environment. Avoid the use of metal tools. Be careful to avoid shock, friction, and contact with grit.

Deactivating Chemicals: Nitroglycerin destroyer solution may be used, which ICI Explosives will supply upon request.

HANDLING AND STORAGE

Handling: This product is an explosive and should only be used under the supervision of an experienced blaster. Take all precautions to avoid personal contact. Avoid contact with eyes, skin or clothing. Wash thoroughly with soap and water after handling. Wash contaminated clothing thoroughly before re-use. Use only with adequate ventilation and avoid breathing vapors. Locate safety shower and eyewash station close to chemical handling area.

Storage Requirements: Store in a cool, well-ventilated area. Keep away from heat, sparks and flames. Keep containers closed. (104°F).

Storage Temperature: Ideal storage temperature is 10-27 Deg. C (50-80°F). Do not expose sealed containers to temperatures above 40 Deg. C (104°F).

EXPOSURE CONTROLS/PERSONAL PROTECTION

PREVENTATIVE MEASURES

Recommendations listed in this section indicate the type of equipment which will provide protection against overexposure to this product. Conditions of use, adequacy of engineering or other control measures, and actual exposures will dictate the need for specific protective devices at your workplace.

Engineering Controls: General ventilation is recommended.

PERSONAL PROTECTIVE EQUIPMENT

Eye Protection: Use chemical safety goggles when there is potential for eye contact.
Skin Protection: Gloves and protective clothing made from rubber should be impervious under conditions of use. User should verify impermeability under normal conditions of use prior to general use.
Respiratory Protection: A NIOSH/MSHA-approved respirator, if required.

EXPOSURE GUIDELINES

PRODUCT: None established for product.

HAZARDOUS INGREDIENT(S):

Nitroglycerin:
ACGIH TWA 0.46 mg/m3 (skin)
OSHA Z1A STEL 0.1 mg/m3 (skin)

PHYSICAL AND CHEMICAL PROPERTIES

Alternate Name: Not available.
Chemical Name: Not available.
Chemical Family: Gelatin High Explosive.
Molecular Formula: Not Available.
Appearance: Brownish - Yellow gelatin.
Odour: A characteristic NG smell.
pH: (Neutral)
Vapour Pressure (mm Hg at 20 Deg. C): [illegible] Nitroglycerin
Vapour Density (Air=1): Not Applicable
Boiling Point: 410°F
Melting Point: 55.4 °F (Nitroglycerin) to [illegible]
Solubility (Water): (Completely Soluble
Solubility (Other): Not Available.
Specific Gravity: 1.37
Evaporation Rate: Not Applicable.
% Volatile by Volume: 0%
% Volatile Organic Compounds: 0%
Additional Properties: Bulk Density (cartridge density): 1.36g/cu.cm. Vapour Pressure: Approx. 0.1 at 30°C.

STABILITY AND REACTIVITY

Hazardous Decomposition Product(s): Thermal decomposition products are toxic and may include hydrocarbons, oxides of carbon and nitrogen.
Chemical Stability: Stable at room temperature.
Conditions to Avoid: Keep away from heat , impact and friction.
Incompatibility with other Substances: Strong oxidizing and reducing agents.
Hazardous Polymerization: Will not occur.

TOXICOLOGICAL INFORMATION

Summary: May cause irritation. May cause skin sensitization or other allergic responses. May cause methemoglobinemia. May cause cardiovascular disorders.

Toxicological Data:

PRODUCT: None established for product.

ALL INGREDIENTS:

Ammonium Nitrate:
Oral LD50 (rat) = 2217 mg/kg
Dermal LD50 (rabbit) = 3000 mg/kg

Sodium Nitrate:
Oral LD50 (rat) = 3236 mg/kg

Nitroglycerin:
Oral LD50 (rat) = 105 mg/kg

POTENTIAL HEALTH EFFECTS:

Inhalation: Inhalation is not a likely route of exposure at normally encountered temperatures and is thus not applicable.

Skin Contact: May cause skin irritation. Can be absorbed through skin. Human evidence has indicated that this product can cause skin sensitization.

Eye Contact: Moderate irritant causing moderate initial pain.

Ingestion: Highly unlikely under normal industrial use. Ingestion may cause irritation to the gastrointestinal tract.

Subchronic Effects: This product may cause methemoglobinemia. Initial manifestation of methemoglobinemia is cyanosis, characterized by navy blue lips, tongue and mucous membranes, with skin colour being slate grey. Further manifestation is characterized by headache, weakness, dyspnea, dizziness, stupor, respiratory distress and death due to anoxia.

If ingested, nitrates may be reduced to nitrites by bacteria in the digestive tract. Signs and symptoms of nitrite poisoning include methemoglobinemia, nausea, dizziness, increased heart rate, hypotension, fainting and, possible, shock.

Sensitization is the process whereby a biological change occurs in the individual because of previous exposure to a substance and, as a result, the individual reacts more strongly when subsequently exposed to the substance. Once sensitized, an individual can react to extremely low airborne levels, even below the TLV, or to skin contact.

Chronic effects: Individuals with prolonged or repeated exposure to Nitroglycerin or Ethylene Glycol Dinitrate may develop a tolerance to organic nitrates from compensation due to chronic dilation of the blood vessels. This tolerance disappears rapidly after a few days away from exposure and withdrawal symptoms consisting of angina and fatal heart attack have been reported in chronically exposed workers. Another type of tolerance loss is the "Monday morning disease", where workers experience headaches, dizziness, postural weakness and other symptoms.

Carcinogenicity: The ingredient(s) of this product is (are) not classified as carcinogenic by ACGIH (American Conference of Governmental Industrial Hygienists) or IARC (International Agency for Research on Cancer), not regulated as carcinogens by OSHA (Occupational Safety and Health Administration), and not listed as carcinogens by NTP (National Toxicology Program).

Mutagenicity: There is no evidence of mutagenic potential.

Reproductive Effects: No information is available and no adverse reproductive effects are anticipated.

Teratogenicity and Fetotoxicity: No information is available and no adverse teratogenic/embryotoxic effects are anticipated.

Synergistic Materials: Consumption of alcohol increases toxic effects.

ECOLOGICAL INFORMATION

Ecotoxicological Information: Harmful to aquatic life at low concentrations.

Environmental Effects: Do not contaminate domestic or irrigation water supplies, lakes, streams, ponds, or rivers.

Persistence and Degradation: Nitroglycerin is water-soluble and remains explosive.

DISPOSAL CONSIDERATIONS

Burn under supervision of an expert at a government-approved explosive burning ground or destroy, by detonation in boreholes, in accordance with applicable local, provincial and federal regulations. Call upon the services of an ICI Explosives U.S.A. Technical Representative.

TRANSPORT INFORMATION

U. N./ U. S. DOT/Canadian TDG Act Shipping Description:
Name: Explosive, Blasting, Type A
Class/Division: 1.1D
PIN Number: UN 0081
Packaging Group: II
Transportation Emergency Telephone Number: 1-800-424-9300
1-800-561-3636 (Canada)
Read the entire MSDS for the complete hazard evaluation of this product.

REGULATORY INFORMATION

CANADIAN CLASSIFICATION

This product has been classified in accordance with the hazard criteria of the CPR (Controlled Products Regulations) and this MSDS (Material Safety Data Sheet) contains all the information required by the CPR.

Controlled Products Regulations (WHMIS) Classification: This product is an explosive and is not regulated by WHMIS.

CEPA/Canadian Domestic Substances List (DSL): This substance(s) in this product is/are on the Canadian Domestic Substances List (CEPA DSL).

IARC Classification: None of the components of this product are listed on IARC.

USA CLASSIFICATION

Other Regulations/Legislation which apply to this product: Massachusetts Right-to Know, Pennsylvania Right-to-Know, New Jersy Right-to-Know. CERCLA.

OSHA Classification:

Physical: Flammable solid. Explosive. Oxidizer.
Health: Highly toxic. Skin sensitizer. Irritant.
Target Organ: Skin. Respiratory tract. Gastrointestinal tract. Blood/ hematopoietic system. Cardiovascular system.

SARA Regulations sections 313 and 40 CFR 372: This product contains the following toxic chemical(s) subject to reporting requirements: 30.5% Nitroglycerin (55-63-0).

This product does not contain nor is it manufactured with ozone depleting substances.

OTHER INFORMATION

Label Text: Danger! Explosive! Strong Oxidizer! May be harmful if ingested. Avoid contact with skin and eyes. This product contains Nitrate esters. Minimize inhalation and skin contact. Overexposure may cause headache, nausea and blood vessel dilation. Ventilate magazine before entering.

REFERENCES:

RTECS-Registry of Toxic Effects of Chemical Substances. On-line search. Canadian Centre for Occupational Health and Safety RTECS database. Vol I-V. 1985-1986 edition. Doris V. Sweet, Ed., National Institute for Occupational Safety and Health, U. S. Dept. of Health and Human Services. Cincinnati. 1992.

Supplier's Material Safety Data Sheets

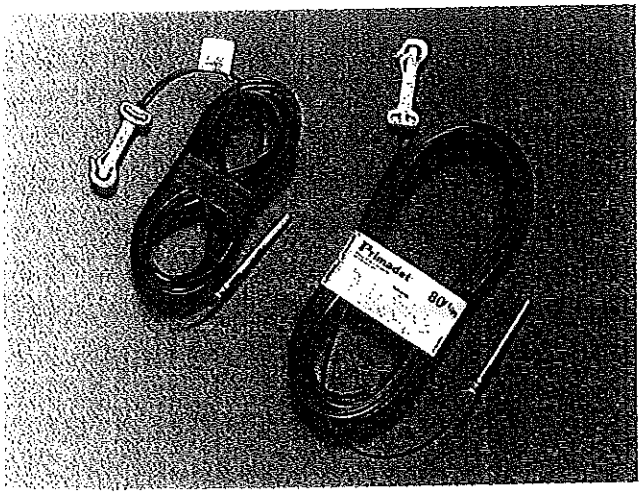
"CHEMINFO", through "CCINFOdisc", Canadian Centre for Occupational Health and Safety. Hamilton, Ontario, Canada. Sax, N. Irving, Dangerous Properties of Industrial Materials 7th ed., Van Nostrand Reinhold Co., New York, 1989.

Prepared by: Safety, Health and Environment
(416) 229-8252.

TECHNICAL BULLETIN

Primadet®

Nonelectric delay detonators



EZ Det® NONELECTRIC BLAST INITIATION SYSTEMS

Precise, EZ-to-use, non-electric detonators for construction, surface and underground blasting applications.

The EZ Det® nonelectric blast initiation systems were developed for various types of blasting applications. It eliminates the need for inventorying various in-hole delays, provides a fast, simple hook-up while allowing an unlimited number of holes to be shot with independent hole initiation.

DESCRIPTIONS

EZ Det® nonelectric blast initiation systems are comprised of four major components.

A shock tube to transmit a signal to the delay cap. Shock tube is a small diameter laminated plastic tube with a very thin layer of reactive material; only one pound of material per 100,000 feet of tube. When initiated, shock tube reliably transmits a low energy signal at approximately 6,500 feet per second from one point to another. This shock wave phenomenon, which is similar to a dust explosion, will propagate through most sharp bends, knots and kinks in the tube. The detonation is sustained by such a small quantity of reactive material, the outer surface of the tube remains intact during and after functioning.

A precise nonelectric in-hole detonator. This detonator will initiate all dynamites and cap sensitive explosives.

A precise surface delay housed in a plastic connector. This surface connector will reliably initiate 1 to 6 properly connected shock tube(s) in both directions.

A color-coded delay tag which indicates the nominal firing time of both the surface connector and the in-hole detonator.

ADVANTAGES

Simple-Flexible EZ Det® nonelectric blast initiation systems are factory assembled, no field cutting and assembly of initiation components is required. They can be readily and simply connected to accommodate both basic and complex blast initiation requirements.

Reliable EZ Det® nonelectric blast initiation systems are factory assembled under stringent quality specifications to insure reliable performance in the field, blast after blast.

Nonelectric Shock tube cannot be initiated by high frequency radio transmissions, static or stray electrical energy, flame, friction or impact found in normal mining conditions. However, blasting caps are far more sensitive to these conditions. Requires no knowledge of electric circuitry. No need to instruct blasters on intricacies of electric circuits. No need for elaborate training and retraining of blasters.

Noiseless EZ Det® nonelectric blast initiation systems are quiet. The signal moving through an initiated tube is so quiet that it can be called Noiseless.

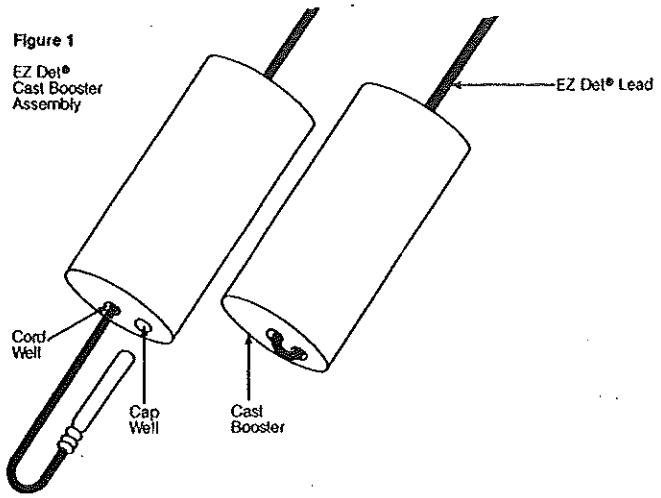
Economical EZ Det® nonelectric blast initiation systems allow for a reduced inventory resulting from the elimination of stocking various lengths of a complete delay series.

PRIMER ASSEMBLIES

The EZ Det® nonelectric blast initiation system can be used with all cast primers, dynamites and cap sensitive high explosives.

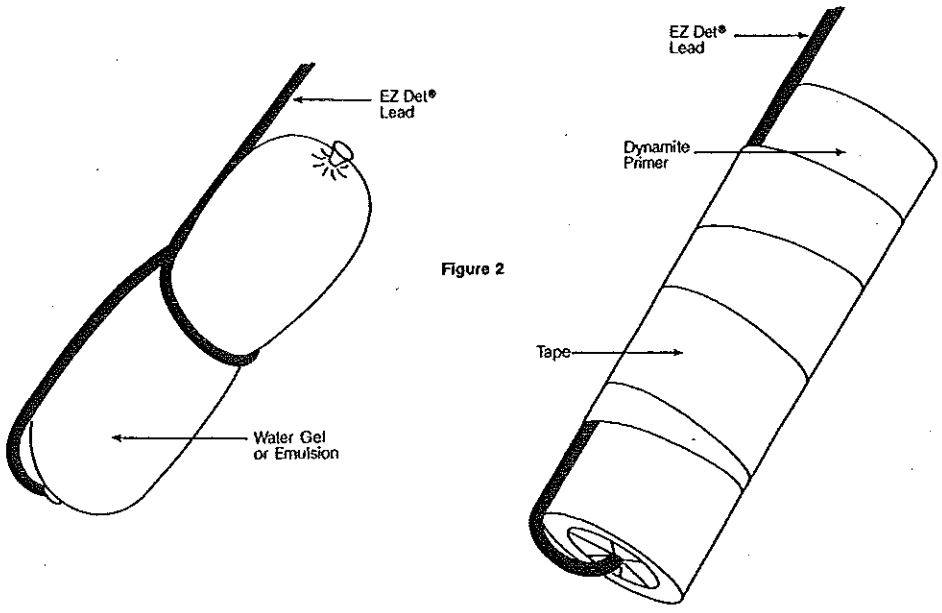
The EZ Det® of appropriate length is threaded through the cord well of the cast primer and inserted to full depth into the cap well (Figure 1).

Figure 1



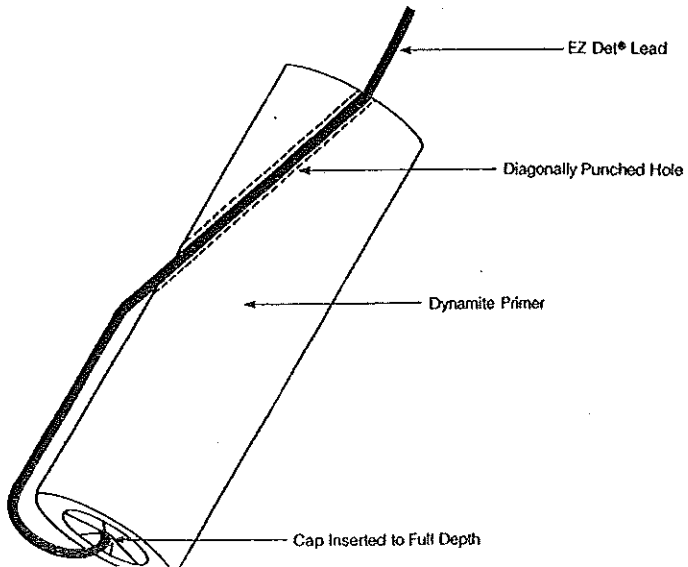
With a soft package primer a hole of proper depth is punched into the primer using a non-sparking powder punch. The EZ Det® detonator is then fully inserted into the cartridge. The EZ Det® lead can then be half-hitched or taped around the cartridge (Figure 2).

Figure 2



When using paper cartridge primers, such as dynamites, a hole can be punched, using a non-sparking tool, diagonally starting at the top and exiting out of the side. The EZ Det® detonator can then be threaded through this hole and then inserted to full depth into the cartridge (Figure 3).

Figure 3

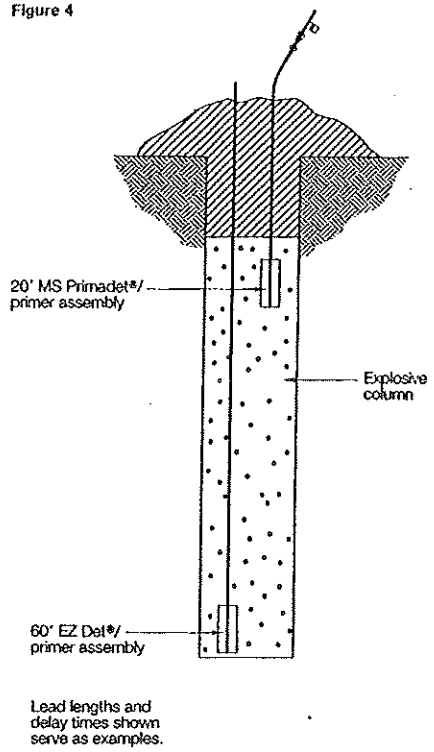


LOADING PROCEDURES

SOLID COLUMN LOADED HOLES

1. An EZ Det®/primer assembly is lowered into the borehole and the surface relay is secured at the borehole collar.
2. Explosive material is loaded into the borehole.
3. A Millisecond (MS) Primadet® nonelectric delay detonator/primer assembly of the appropriate delay is lowered to the top of the explosive column. See Figure 4. (If a double trunkline or twin path hook-up is desired, then a second EZ Det®/ primer assembly can be used).

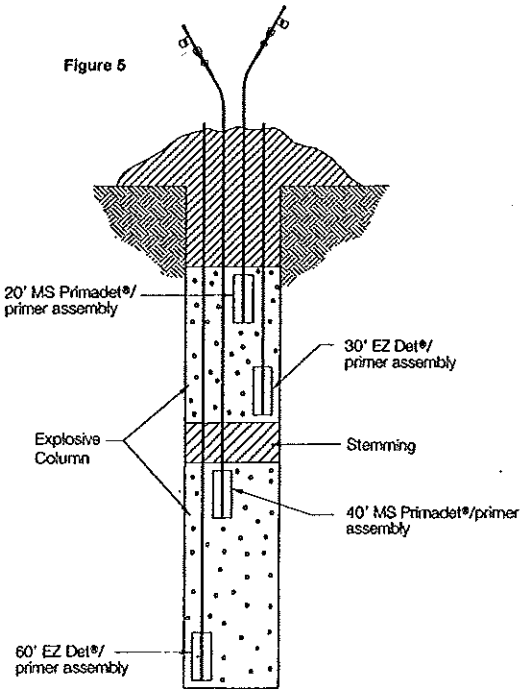
Figure 4



DECK LOADED HOLES

1. An EZ Det®/primer assembly is lowered into the borehole and the surface delay is secured at the borehole collar.
2. Explosive material is loaded into the borehole.
3. An MS Primadet®/primer assembly of the appropriate delay is lowered to the top of the explosive column. (If a double trunkline or twin path hook-up is desired, then a second EZ Det®/primer assembly can be used).
4. Stemming material for decking is loaded.
5. The above procedure is then repeated until the appropriate amount of decks are completed. See Figure 5.

Figure 5



SURFACE HOOK-UP

HOOK-UP OF EZ DET® NONELECTRIC BLAST INITIATION SYSTEMS WITH PRIMADET® NONELECTIC DELAY DETONATOR NOICELESS TRUNKLINE DELAYS (NTD) OR EZ™ TRUNKLINE DELAYS (EZTL).

1. Attach the surface connector end of the EZ Det® detonator coming from the hole that is to be fired first in the blast onto the shock tube(s) of the Primadet® and/or EZ Det® detonator from the second hole. It is important that the surface connector be properly attached to the shock tube(s). Be sure that the shock tube(s) is properly inserted into the connector block so that the head of the connector block rises to accept the shock tube and returns to a closed position with an audible click. It is recommended that one shock tube at a time be inserted into the connector block to prevent the possibility of shock tube crossovers in the connector block. (Figure 6). A surface connector can accommodate 1 to 6 shock tube(s).
2. After inserting the shock tube(s) securely into the surface connector, slide the surface connector along the shock tube(s) into the stemming at the collar of the hole.
3. Attach the surface connector end of the EZ Det® detonator coming from the second hole onto the shock tube(s) of the Primadet® and/or EZ Det® detonator coming from the third hole.
4. After inserting the shock tube(s) securely into the surface connector, slide the surface connector along the shock tube(s) into the stemming at the collar of the hole.
5. Repeat this process until all the holes have been connected using the surface connectors (Figure 7).
6. Primadet® nonelectric delay detonator Noiseless Trunkline Delays (NTD) or EZ™ Trunkline Delays (EZTL) may be used in a surface hook-up to provide time between rows of EZ Det® units (Figure 7). This is accomplished by inserting the shock tube(s) of an NTD or EZTL into the surface connector of the EZ Det® (Figure 7, Hole #3).

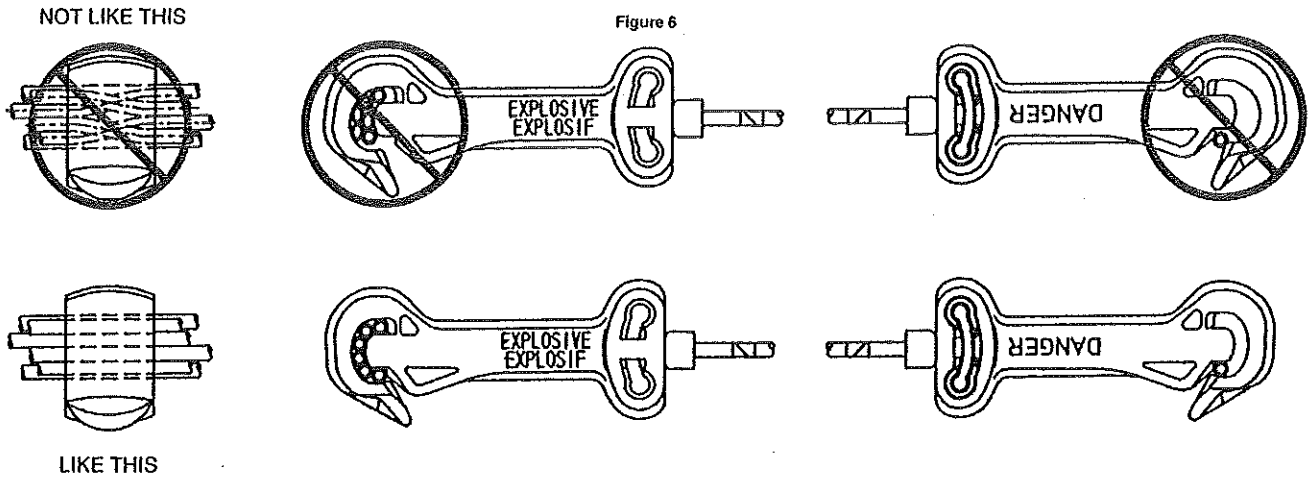


Figure 6

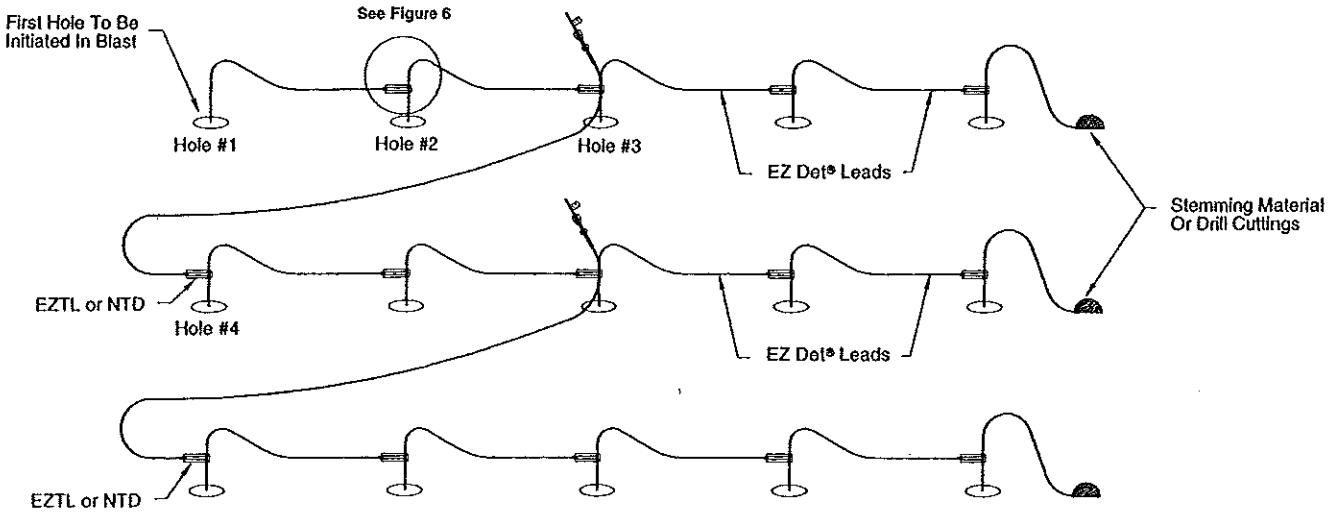


Figure 7

7. Attach the incoming NTD to the EZ Det® shock tube leads at the next row by positioning the NTD so that it will initiate the EZ Det® shock tube leads in both directions (Figure 7, Hole #4). Snap the lid of the Bunch Block closed. If EZTL units are used, be sure they are properly attached to the shock tube(s). See Figure 6.
8. All outgoing shock tube leads should leave the Bunch Block in a straight line for at least 1 foot. Never bend the shock tubes around the front of the Bunch Block, back over the top of the Bunch Block, or allow the outgoing shock tubes to loop back near the Bunch Block or surface connector. Any of these conditions may result in a cut-off due to shrapnel from the exploding Bunch Block.
9. Make a thorough inspection of the hook-ups for proper connection after all the blast holes are connected.
10. Turn each Bunch Block connection upside down and cover with drill cuttings, stemming, or other similar material to prevent cut-offs and to control noise.
11. The surface connector end of the EZ Det® detonator from the last hole, of each row in the blast, is an extra connector and should be covered with drill cuttings or stemming material to keep the connections neat and prevent any confusion.

NOTE: If the shot is to be covered with blasting mats and/or backfill material, it is recommended that the surface connectors be covered with at least 6 inches of gravel or drill cuttings. Backfilling and matting of shots should be done carefully to avoid any damage to the surface connector and EZ Det® leads which may result in a misfire or premature detonation.

SPECIAL APPLICATIONS — TRENCH BLASTING

EZ Det® nonelectric blast initiation systems are ideal for various types of trench blasting. EZ Det® units can accommodate both simple and complex trench blasting design patterns. Solid column and deck loaded holes can be designed with simplicity and ease. Figure 8 illustrates the simplicity of design and hook-up for a trench blast which utilizes 25ms/350ms EZ Det® units in both solid column and deck loaded holes. 25ms/350ms EZ Det® units provide an unlimited number of constant, precise 25ms delay intervals between holes and/or decks in trench blasting applications. The 350ms in-hole detonator minimizes the risk of cut-off downlines or trunklines due to ground movement since the actual detonation time of the blast hole is greater than the surface detonation time.

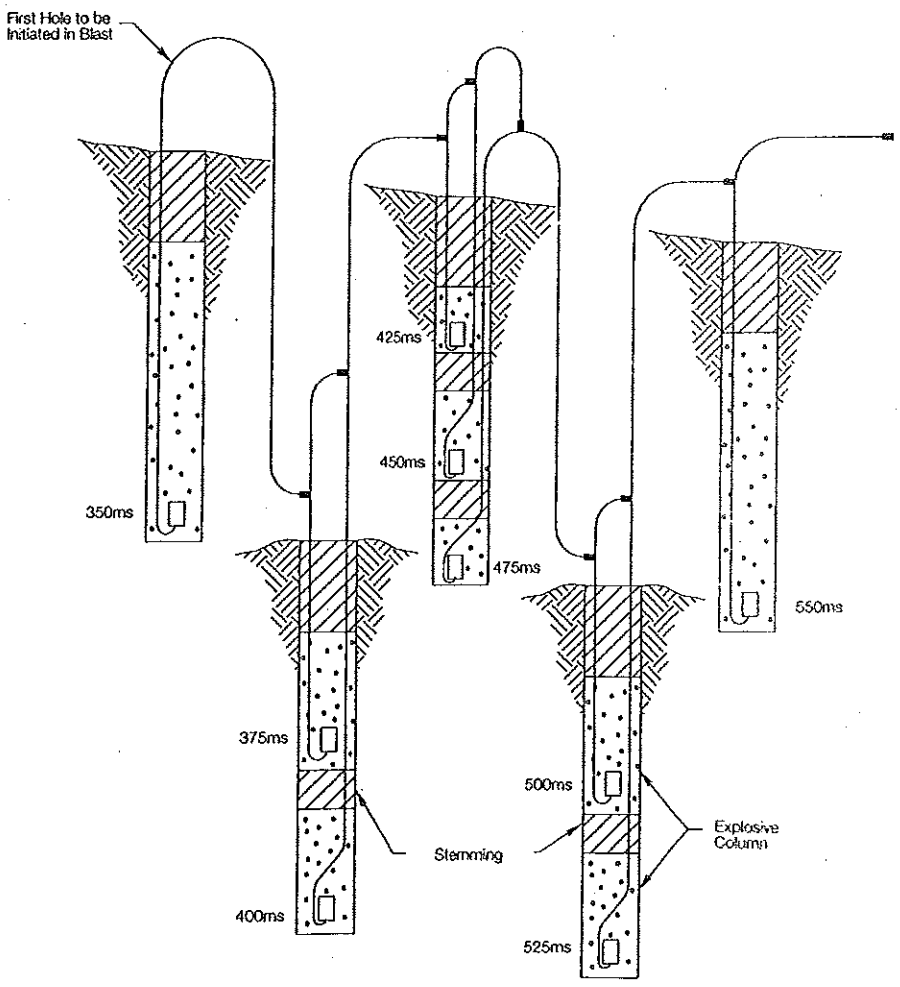


Figure 8

INITIATING THE SHOT

After all the proper connections have been made and the blast area has been cleared, the primary initiating cap can be attached to the opening hole of the shot. The recommended primary initiating devices are (1) Primadet® nonelectric delay detonator Noiseless Lead-In-Line (NLIL), or (2) an electric blasting cap.

When attaching the primary initiator to the EZ Det® lead of the opening hole, it is important to position the initiating cap so that it will initiate the EZ Det® lead in both directions as shown in Figures 9 and 10.

After the primary initiator has been attached, make sure the outgoing leads extend out in a straight line for at least one foot. Never bend the leads around the nose of the Bunch Block or the electric detonator back over the top of the connection, or allow the outgoing leads to loop back near the connection. Any of these may result in a cut-off due to shrapnel from the exploding detonator.

Cover the connection with drill cuttings, stemming, or other similar material to prevent cut-offs and control noise.

Figure 9

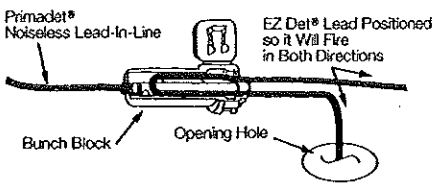
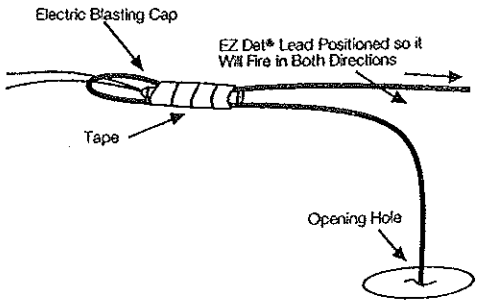


Figure 10



IMPORTANT INSTRUCTIONS

Never attempt to disassemble the delay cap from the plastic connector block, or use the cap by itself without the block.

The surface connectors contain blasting caps and are subject to detonation caused by abuse such as impact, the same as all detonators.

The shock tube should not be cut or damaged; moisture entering the tube will cause misfires.

Never drive vehicles over shock tube. rupturing or damaging the tube may also cause misfires.

Always remember that the surface connector end of this product contains a delay detonator. Holes loaded with this product and awaiting firing should be guarded or barricaded and posted, or flagged against unauthorized entry.

Never attach the primary initiator the round or shot until after all ..e connections have been made and the blasting area has been cleared.

Never load Primadet® nonelectric delay detonators or EZ Det® nonelectric blast initiation systems into a hot hole or expose them to temperatures above 150°F.

Not approved for use in flammable, gassy or dusty atmospheres.

NEVER leave loaded blast-holes out of the main blast pattern tie-in. Loaded blast-holes that are not tied into the main pattern (shot break practices) may be initiated from the shock energy of an adjacent blast-hole(s). This practice may cause damage to explosives and initiation systems which may result in misfires. Misfires, unless handled properly, may result in injury or death.

Refer to **Product Information Bulletins** for packaging, lead length and delay time availability.

For additional warnings and instructions see case insert packaged in every case of product.

DISCLAIMERS

ATTENTION

The information and recommendations described in this bulletin cannot possibly cover every application of the product or variation of conditions under which the product is used. The recommendations herein are based on the manufacturer's experiences, research, and testing. They are believed to be accurate, but no warranties are made, express or implied. Also, the specifications contained herein are all nominals which represent our current production. The product described may be subject to change. Please feel free to contact The Ensign-Bickford Company for verifications.

NO WARRANTIES OR LIABILITIES

The product described herein is sold "AS IS" and without any warranty or guarantee, express or implied, arising by law or otherwise, including without limitation any warranty of merchantability or fitness for any purpose. Buyer and user agree further to release and discharge seller from any and all liabilities whatsoever arising out of the purchase or use of any product described herein whether or not such liability is occasioned by seller's negligence or based upon strict products liability or upon principles of indemnity or contribution.

EZ Det® nonelectric blast initiation systems are manufactured under U.S. Patent #4,607,573, U.S. Patent #5,031,538, U.S. Patent #5,129,514, and other patents pending.

TRANSPORTATION AND STORAGE

EZDet® nonelectric blast initiation systems are classified as **Detonator Assemblies, nonelectric; 1.1B** and/or **1.4B Explosives.** They must be transported and stored in accordance with all Federal, State and Local Regulations

The Ensign-Bickford company

Simsbury, Connecticut 06070 USA

Sales Offices:

P.O. Box 483
660 Hopmeadow Street
Simsbury, CT 06070-0483
860/658-4411

514 Earth City Expressway STE 141
Earth City, MO 63045-1303
Main # 314/291-0081

601 Perimeter Drive
Suite 120
Lexington, KY 40517
606/268-2690

P.O. Box 310
Spanish Fork, UT 84660-0310
801/798-2850

55 Mary Street West
Suite 202
Lindsay, ON
K9V 5Z6
Canada
705/324-6270

2000-9/92, 2500-2/93, 10,000-Rev. 1/96 #114-B

HAZARDOUS MATERIALS POLICY

A Hazardous Materials Policy has been developed to assist the Company in its efforts to eliminate or reduce personal injury and property loss and to demonstrate public responsibilities.

To assure compliance with regulatory and statutory requirements, each office will be provided with a copy of:

- Federal Motor Carrier Safety Regulations Pocketbook.
- NFPA #495 Code for the Manufacturer, Transportation and Use of Explosive Material.
- Copies of State Regulations.
- OSHA Manual
- MSDS Manual

The Company Hazardous Materials Policy includes procedures for:

- Gas Welding
- Arc Welding
- Explosives Handling
- Emergency Procedures

The Hazardous Materials Policy is subject to all Company safety and emergency policies and procedures.

The Hazardous Materials Policy requires that:

- Hazardous materials data lists be available at all job sites and offices. This list is to contain the types of hazardous materials being used, the product manufacturer and an emergency # for the product manufacturer.

- Any accident involving hazardous materials that occurs, must be recorded and reported.

- All employees handling hazardous materials be trained in the proper handling of hazardous materials.

- All hazardous materials be clearly marked and rated according to the National Fire Protection Association and regulatory authorities.

- All job site employee be trained in Company hazardous materials procedures and are to follow Company emergency policies in the event of an accident/incident.

EMERGENCY PROCEDURES – PERSONAL INJURY/PROPERTY DAMAGE

All employees are to follow company policies and procedures for handling of emergencies in the event of an accident or incident involving hazardous materials.

PROCEDURES:

When handling or working with hazardous materials these procedures is to be followed at all times:

Gas/Arc Welders:

- Fire extinguishers will be available on all operations.
- All cylinders or bottles will be handled in accordance with OSHA and ANSL standards.
- Cylinders
  - Transported in vertical position
  - Secured or chained to prevent tipping
  - Caps installed when not in use
  - 0 will not be stored with any other gas including inert gases. 0 requires 20' distance from other gases in storage or non-combustible barrier separating them. (I.e. transit, asbestos, board, metal or 5/8" minimum wall board).
- Frames of all Arc welding/cutting machines shall be grounded.
- All cables shall be completely insulated and flexible – capable of handling maximum current requirements.
- Flash shields will be used whenever possible.
- Eye protection will be sued by welder/cutter and helper.

Explosives:

- Fire extinguishes will be available on all operations.
- No smoking, matches, flames or spark – producing devices or firearms within 50' of any explosives or flammable material.
- Do not throw or drop explosives.
- Keep types and sizes together.
- Store cases flat, topside up, code date out.
- Stack to avoid possibility of collapse.
- Keep boxes closed.
- Store only explosive materials (no tools, tires, etc.)
- Store detonators separately.
- Remove oldest stock first.

VIOLATIONS:

Violation of any of the above could result in disciplinary action per company Noncompliance Policy.

COMPANY RESPONSIBILITIES

The Company will provide for:

- Education and training of all employees in procedures pertinent to hazardous materials.
- Hazardous materials data lists for posting at all job sites.
- All necessary forms for purposes of documentation and compliance with reporting requirements.
- Telephone #'s and locations of manufactures and emergency medical care providers.

EMPLOYEE RESPONSIBILITIES

Division Managers and Safety Engineers are responsible for training employees in hazardous materials procedures.

Safety Engineers, Supervisors and Blaster Foreman are responsible for providing:

- all job site personnel with the job site location of the hazardous materials data list
- all job site personnel with directions to established health care providers and the nearest emergency health care provider

Supervisors and Blaster Foreman are responsible for completing an investigation and submitting a Loss Control Report for any incident/accident involving hazardous materials.

All employees required by statute must:

- participate in hazardous materials training sessions
- stay current on regulatory requirements involving hazardous materials
- request assistance from Safety Engineers if they are unsure of standards, regulations, etc. of hazardous materials.

HAZARDOUS MATERIALS SPILL POLICY

All on and off site work areas are subject to the control of the Federal and State DEP regulations. There are penalties and fines for regulatory noncompliance for employers and employees. Standards, procedures and reporting requirements must be followed.

COMPANY RESPONSIBILITIES

The Company will provide for:

* Education and training of employees in DEP regulations And requirements for hazardous material spills.

* Maintain current information on regulatory requirements.

* All necessary forms for purposes of documentation and Compliance with reporting requirements

* Reporting of all spills and the delivery of a Spill Kit to the site.

* Telephone numbers and locations of DEP offices and Contact persons, if available.

EMPLOYEE RESPONSIBILITIES

* Division Managers and the Safety Department are responsible For training employees in hazardous material spill procedures And regulatory changes.

* Division Managers and the Safety Department are responsible for All documentation and follow-up activities and required Corrective action.

* Supervisors and Blaster-Foremen are responsible for completing An investigation and submitting an Incident Report.

* All employees are responsible for taking action to contain the Spill immediately.

* All employees are to contact the Safety Department as soon As possible to report the spill.

Maine Drilling and Blasting, Inc.

BLAST REPORT

Shot No. ______________________ Name of Company ______________________________________

Date ______________________ Address ______________________________________

Time ______________________ Operation ______________________________________

Hole No.	Depth of Water (Ft.)	Burden (Ft.)	Spacing (Ft.)	Depth of Hole (Ft.)	Tons or Yds. Per Hole	EXPLOSIVES						Stemming (Ft.)	MS Cap No. or Shot Duration
						Size ___	Size ___	Size ___	Size ___	Size ___	Total per Hole Pounds		
TOTALS													

Height of Face ____________ ft. Size of Hole ____________ in. Sub-Drilling ____________ ft. Horizontal ☐ Vertical ☐

Cap Mfg. ____________ Length of Wire __ __ __ __ No. of Series ____________ No. Cap Each Series ____________

Ohms Each Series ______________________________ Det. Cord Kind ______________________________ ft.

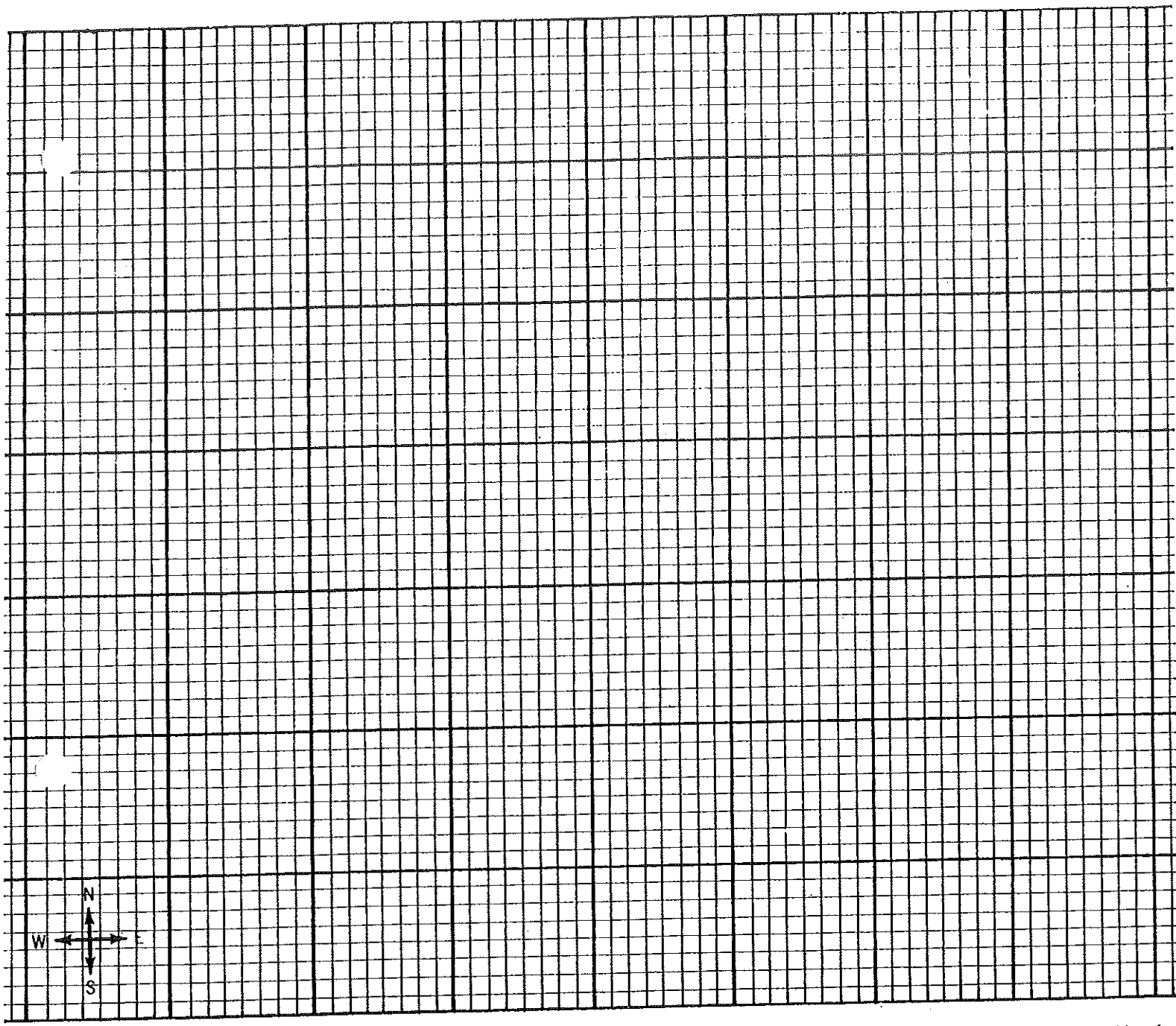
Weather Conditions ____________; Temp. ____________; Wind Direction ____________; Speed ____________

Powder Factor: Lbs. of Explosives per Ton/Yd. ____________ Cost Per Ton/Yd.

Customer's Supt. ____

Blaster ______________________________ License Number ______________________________

Fill out this report completely. Use back for shot diagram. SIGNATURE ______________________________



Direction of Shot

Scale Distance — Weight of Explosives = $\left(\frac{\text{Distance in Ft.}}{50\text{—}60}\right)^2$ = _____

Scale Distance — $\frac{\text{Distance in Ft.}}{\text{Weight Per Delay Period}}$ = _____

Check Your State and Federal Laws for the Proper Scale Distance.

Type of Blasting Machine Used:

Sequential ( )
CD 450 ( )
VME 225-450 ( )
Other _____ ( )

No. Delays Used _____; Max. Lbs. Per Delay _____; Max. No. Holes Per Delay _____

Blast Direction & Location _____

Distance From Nearest Dwellings, Buildings _____ Highways or Railroads _____

Other Possible Hazards: Overhead wires _____ Underground pipes _____ Other _____

Types of Terrain: Hilly _____ Flat _____ Underground _____ Other _____

Was Mat Used? Yes _____ No _____ Type Mat _____ Other precautions _____

ıct Location of Seismograph _____

Seismograph Operator _____

Seismograph # _____ Distance/direction _____ Location _____

Seismograph # _____ Distance/direction _____ Location _____

Seismograph # _____ Distance/direction _____ Location _____

AFFIRMATIVE ACTION PLAN

It is the continuing policy of Maine Drilling & Blasting, Inc. to hire and employ qualified, reliable and productive employees without regard to race, creed, religion, color, sex, national origin, age, veteran's status and mental or physical handicap unless a lawful and stated bona fide occupational disqualification exists. In order to implement this policy, the company has adopted an affirmative action program.

Maine Drilling & Blasting, Inc. will:

Advertise for employment opportunities as an EEO Employer. All employment advertisement will encourage women and minority applicants to apply.

Maintain contact with community resources for applicant referral purposes.

Provide OJT training and allow for in-house advancement for employees without regard to race, creed, religion, color, sex, age, national origin, disabled or Vietnam Era veteran status, or physical or mental handicap.

Cooperate with federal, state or local government agencies who have the responsibility to observe our actual compliance with various laws relating to employment.

Furnish such reports, records, etc. as required to document and promote a program of equal opportunity for all persons regardless of race, creed, religion, color, sex, age, national origin, disabled or Vietnam Era veteran status, or physical or mental handicap.

Appoint a Corporate EEO Officer who will be charged with the responsibility of compliance issues of this plan.

Post the identity of the Corporate EEO Officer on company bulletin boards.

Provide EEO training of Officers, Managers and Supervisors who have the overall responsibility of carrying out company Equal Employment Opportunity policies in their respective work areas.

Provide training on an annual basis for employees with regard to EEO and Sexual Harassment Policies.

MAINE DRILLING & BLASTING
EQUAL EMPLOYMENT OPPORTUNITY

The Company recognizes the dignity of the individual employee and the right of all employees to work in an environment where people are treated fairly, allowed to grow and achieve their potential. Federal and State law and Company policy require all employees or potential employees be hired and/or promoted without regard to race, color, religion, handicap or disability, Vietnam Era veteran status, sex, age or national origin. It is the intent of the Company through this policy to provide a working environment that provides for equal employment opportunities to all.

The company has an action plan to ensure that minority group individuals, women, handicapped persons and disabled Vietnam Era veterans are given opportunities to know of openings and are encouraged to seek promotions. Equal opportunity and equal consideration will be given to all applicants and employees in personnel actions which include recruiting and hiring, selection for training, promotion, demotion, discipline, rates of pay or other compensation, transfer, termination, recalls and social and recreational programs.

Every manager, supervisor and human resource personnel are required to follow equal opportunity employment practices at all times.

Any violations of these equal opportunity policies by any manager, supervisor or other employee must be reported immediately to:

Lucinda L. Long
Employee Services Manager
Maine Drilling & Blasting, Inc.
PO Box 1140
Gardiner, Maine 04345
207-582-2338

HOW TO REPORT AN EEO COMPLAINT:

1. Report the complaint to the Corporate EEO Officer.
2. If the individual who is the subject of the complaint is the EEO officer, report the complaint directly to the President.

EEO COMPLAINT REPORT REQUIRED ACTION

An investigation of all EEO complaints will be conducted by the Corporate EEO Officer to determine if particular action or incident is either prohibited behavior or is discriminatory under EEO guidelines.

When a complaint is filed, the corporate EEO Officer will:

- Immediately notify the President and any personnel directly involved or named in the complaint. Such notice will provide information on the nature and type of complaint.
- Conduct an investigation of the complaint.
- Determine all available facts and information regarding the matter.
- Provide a written report outlining the results of the investigation including any recommendations for corrective actions or complaint resolution.
- In cases of gross misconduct and/or clear violation of the law, immediate and directive action will be taken.

CORRECTIVE ACTION/COMPLAINT RESOLUTION

The Company will:

- Inform the complainant of the results of the investigation.
- Conduct an arbitration hearing to resolve the complaint through mutual conciliation.
- The complainant shall agree to all actions taken on his/her behalf including the specific actions to be taken by the employer.

Employees are protected at all times from retaliation or punishment when making and EEO complaint.

DISCIPLINARY ACTION

Violation of the EEO Policy is unacceptable conduct and will not be condoned or tolerated by the company. It undermines the integrity of the employment relationship, destroys morale and interferes with performance. Violation of the EEO policy is considered grounds for disciplinary action which may include suspension or termination of employment.

RESPONSIBILITY

Managers, Supervisors and employees at all levels are responsible for:

- Implementing and enforcing this policy.
- Assisting in investigating and processing complaints quickly, professionally and with respect for all parties.
- Assuring the prevention of any discriminatory practices within their areas of responsibility.

Every employee is responsible for reporting any incident of discrimination that he/she learns of or witnesses. Management will maintain the highest degree of confidentiality possible with respect to such complaints and is obligated to investigate all complaints.

LEGAL RIGHTS

This policy governs only the internal enforcement of the principles of Equal Employment Opportunity and is not intended to alter whatever rights an employee has to pursue a complaint under applicable State or Federal regulations.

BLAST VIBRATION EFFECTS ON WATER WELLS

David S. Bowling
Consulting Geophysicist
White Engineering Associates, Inc.
Joplin, Missouri

INTRODUCTION

Water is the single most abundant substance on this planet. It is alone one of the most important for without it all life would cease. While water is abundant, like most other natural resources, it is rarely distributed in a form convenient to our need.

Areas that are blessed with an abundant supply of fresh water generally prosper, while those that are not must import it to survive. In view of the absolute necessity for water, it si little wonder that people view any perceived threat to their water supply, either real or imagined, with great apprehension or outright hostility.

A significant portion of this country's water supply is derived from underground sources. These sources are typically tapped by wells. Within the continental United States, these wells produce from rock or soil formations that have been divided into ten distinct and separate regions, according to their controlling geologic units. (3)

Blast effects on structures have been studied extensively, and a substantial quantity of data have been collected and published on this subject. However, blast effects on water wells have not been studied extensively. A search for literature turned up two publications that directly addressed commercial blasting in relation to water wells and one of these has only recently been released to the public by the United States Bureau of Mines. (4)

The U.S.B.M. publication contains data obtained from a year long study recently completed in the coal fields of Pennsylvania, Ohio and West Virginia. (4) The other publication contains date pertaining to seismic exploration shooting conducted in eastern Montana. (1) The results of both these studies may be indicative of the inherent safety from blast effects enjoyed by wells, and the conclusions drawn from these studies may also be indicative of the results that would, and perhaps will, be obtained from similar studies made in other regions. However, it must be pointed out, that factual data obtained from research is still the best means of defining

charge weights and other limitations applicable to water well safety. Because of this fact, there is a strong need for additional data of the type presented in the recent U.S.B.M. study. (4)

Settling claims and disputes, by way of litigation, is becoming more and more prevalent in our society. With such a tendency, it becomes necessary that technical literature not only delineate the conditions under which water well damage may occur as a result of blasting operations, but it is equally important that the same literature point out the numerous ways that the performance of water wells may be affected by naturally occurring conditions, or by lack of proper maintenance.

It is the purpose of this paper to address some of the conditions under which water wells may be damaged as result of blasting operations. It is its further purpose to address claims for damages alleged to have resulted from blasting, but which cannot be supported. For this purpose, case histories have been drawn from the files of White Industrial Seismology, a company founded in 1951, by Harold H. White, which has continuously served the public in the field of blast vibration monitoring, and in the analysis of blast effects since that time.

Before discussing particular cadre histories, let us briefly consider some general background information pertaining to the science of hydrology and the occurrence of ground water.

HYDROLOGY

Hydrology is the study of the earth's water. Central to the science of hydrology is the hydrologic cycle. The hydrologic or water cycle is the mechanism by which water is extracted from the oceans and other reservoirs, and is dispersed upon the land masses. In brief, the cycle can be described in three words: evaporation, transportation and precipitation.

The sun causes evaporation from the oceans and other bodies of water. The water vapor is transported, by way of the wind, to highest altitudes, where it moves out over the continents, forms into clouds, condenses, and falls back to the earth's surface as rain, snow or ice. An idealized version of the hydrologic cycle is illustrated in Figure #1.

It has been estimated that 1.1 trillion tons of fresh water are precipitated upon the continental lands each year. (3) It is the precipitation that provides the water for recharging the underground sources for wells.

GROUND WATER

The term, "ground water," pertains to water that is contained within and below, the earth's surface. Water that falls from the atmosphere and percolates down through the soil makes up the largest portion of ground water. This is referred to as meteoric water. There is also two other sources of ground water. They are magmatic or juvenile water and connate water.

Magmatic water is derived from within the earth's interior. It is chemically formed from molton masses of rock and is typically associated with hot springs, geysers and other geothermal phenomena.

Connate water was originally stored in rock formations lying beneath ancient seas and lakes. Catastrophic or other types of uplifts entrapped this water. Connate water may be fresh, but more often it is salty. This type of water is typically associated with oil deposits and is an undesirable contaminant of ground water supplies. Both magmatic and connate water constitute a small but significant percentage of the earth's total ground water supply.

Ground water, in the earth, is divided into two distinct zones. They are : the vadose zone, or the zone of aeration, and the phreatic zone, or the zone of saturation. The vadose zone includes three subzones which are: 1) an area near the surface of the ground that contains soil moisture, 2) a mid zone that is percolation area, where moisture migrates downward, and 3) a bottom zone that is a capillary fringe area, where the down migrating water approaches the zone of saturation. The top of the phreatic zone is generally referred to as the water table. A generalized near-surface water section is illustrated in Figure #2.

The depth of the water table will vary widely. It is dependent upon the topography of the land, the type of soil and rocks that make up an area, and the quantity of rainfall that an area receives. Generally, the surface of the water table conforms to an area's topographic surface. The table's exact elevation, within a given area, will fluctuate with the change of the seasons and the quantity of rainfall available for recharge. The water table and its seasonal variations should always be considered in the construction of wells. The seasonal variation of the water table and a well that is properly placed in relation to this variation, is illustrated in Figure #2.

The water table occasionally intersects the surface of the ground at springs and streams. Some streams are fed by ground water and may transfer ground water from one area to another.

Streams are classed as, "effluent," if they take water from the ground and, "influent," if they give up water to the ground. (3)

The quantity of water that may be held and stored in a given area is highly dependent upon the porosity and permeability of the rock formations in that area. Rock formations that readily hold water and allow for its movement, due to their interconnected an open pore spaces are generally referred to as aquifer. Because of their joint patterns and solution cavities, limestones typically make good aquifers. On the other hand, clays and shales, due to their fine grained character, do not make good aquifers.

Sometimes conditions occur, within the vadose zone, that serve as a barrier to the downward migration of water. When these conditions occur, they are called perchments, or perched water tables. These perchments may be very small and inconsequential, or very large and substantial. When perchments are large they can serve as a significant source of water. Figure #3 illustrates an idealized perchment.

Water always flows from higher to lower levels until it reaches as state of equilibrium. Consequently, rainfall in one area may enter as aquifer and due to the hydraulic gradient, this water may flow for great distances.

When aquifers are overlain by an impermeable bed, such as shale, they are said to be confined. When wells penetrate confined aquifers, the well's level will stand above the top of the aquifer formation. When a confined aquifer dips significantly, and the hydraulic gradient is sufficiently great, wells in the aquifer will flow out upon the land's surface. This type of condition is referred to as an artesian system. In both confined and artesian systems, the level to which water will rise, in a well that is cased to a sufficiently high level, is known as the piezometric level. Figure #4 illustrates an idealized artesian aquifer where the piezometric level is portrayed as being above the ground surface.

Ground water conditions vary greatly from area to area and it is not uncommon, in some places, for wells located within a few hundred feel of each other to have vastly different production capacities. Unfortunately, one is not able to tell the exact subsurface conditions, or the quantity or quality of an area's water, until the drill has done its work.

Due to the constraints of this paper, the discussion of hydrology and ground water are necessarily simple and brief. However, many good texts are available on these subjects for those who wish to study them further.

BLAST EFFECTS

When one considers the industrial operations that require explosives as an energy source, there are three basic ways that such operations are generally said to cause damage to a well or water system. They are;

1) A well could be damaged from the direct shock and vibration of a blast.
2) The water source may be diverted and thus diminish a well's producing capacity or perhaps rob it entirely.
3) The drilling and shooting could release contaminants into an aquifer and thus pollute the water supply.

Each of theses damage possibilities will be discussed separately.

DIRECT SHOCK AND VIBRATION

Blast effects on buried structures have always been considered to be less severe than the same blast effects on surface structures. Historically, the underground bunker has provided shelter from blast effects since the invention of gunpowder grenade. Almost everything that is to be protected from blasting or violent elements is typically placed underground. Drilled wells also enjoy a similar level of safety from ground shock.

Atomic testing has defined the limit for light damage to buried structures. The definition of light damage is given as a broken connection in a pipeline. Damages are shown to be confined to areas within a distance of three times the radius of the crater produced by an atomic explosion. (2)

David Siskind has shown that damages to rock, within the immediate vicinity of blast holes, do not extend into rock mass for distances greater that 55 times the hole or charge radius. (5) & (6)

In 1951, Harold White recorded in an underground mine, the seismic effects produced by six blastholes drilled in the surface above the mine. The recording position was 207 feet below the bottom of the shots. The blast holes contained 4.986 pounds of explosives detonated on three

millisecond delay periods. White was also able to show that the seismic amplitude underground was approximately 20 per cent of the surface amplitude at a similar distance. (7)

In 1957, White conducted studies of blast effects on an oil well and a pipeline, that were situated within an area of highly saturated and unconsolidated sediments. This study was initiated with the intent of determining the maximum charge weights that could be used near these facilities before damage occurred. The charges were standardized at 150 pound per hole and buried to a depth of 150 feet. Larger charges required firing two or more holes at the same time. This project eventually was terminated when blast loading exceeded the maximum levels that the oil well and pipeline were expected to receive and no evidence of damage had occurred.

Two seismograms from this 1957 study are shown in Figure #5. They depict the low frequencies that were generated by these shots. Note the fact that at a distance of 100 feet. 300 pounds of explosives was enough to completely overdrive the seismograph, but it was not enough to damage the pipeline.

In 1977 and 1079, this writer made measurements of the blast effects produced from four very large surface mine blasts. One seismic instrument used to monitor these effects was located approximately 400 feet underground, in a mine. Measurements obtained by underground instrument were approximately 40 per cent of the surface measurements recorded by instruments at similar scaled distances from the shots. All four tests were conducted in the same surface mining operation.

The United States Bureau of Mines' recently released study on Appalachian water wells is the only detailed scientific study available today that examines the specific history of wells located very close to mining areas. Four separate mining sites, each with several wells on their sites, were investigated during this study. (4)

The charge weight to distance relationships for shots fired at these sites ranged from a low of 27 pounds per delay, at 550 feet, for a scaled distance of 105.9, to 738 pounds per delay, at 64 feet, for a scaled distance of 2.4. (4) The maximum resultant peak particle velocity measured at the well head in question was 0.04 inches per second for the 27 pounds per delay shot and 5.02 inches per second for the 738 pounds per delay shot. (4) A number of seismic measurements were taken at the bottom of wells during this study. However, no measurements were apparently taken there for the maximum and minimum scaled distance shots.

No reported instance of shock or vibration damage to liners, seals or pumping equipment occurred during the Appalachian study. However, at one site there was some surface damaged caused by flying debris that was produced as the result of a close blast. (4)

All of the down hole measurements of the seismic effects were lower than corresponding measurements taken at the surface. The down hole measurements were 9 to 92 percent lower than the surface measurements. (4) The only instances where the bottom hole measurements exceeded 50 percent of the surface measurements occurred when blasting for a coal seam was extremely close to the wells and the elevation of the shot and the wells was similar. In no case did the bottom hole measurement equal the measurement at the surface.

The only reported instance of possible shock effect occurred near the end of this U.S.B.M. study, when the researchers were unable to get their sounding probe back to full depth in one unlined well, due to a bridging effect. Between soundings, this well had withstood five blasts, at distances ranging from 70 to 150 feet and charge weights per delay ranging from 250 pounds to 766 pounds. (4) These shots were scattered over a four month period during which only one of the four wells at this site experienced this bridging effect. (4)

The maximum peak particle velocity measurements taken at the surface during this time period ranged from 0.78 to 4.43 inches per second. (4) One measurement taken at a distance of 85 feet, from a 250 pound per delay shot, caused vibration in excess of the range of the instrument used to report this shot. (4) Due to this factor, the peak signal produced during this time may have actually been higher than 4.43 inches per second.

The U.S.B.N.'s Appalachian report reveals that 2.00 inches per second peak particle velocity, measured at the well's head, is a limit that will provide an adequate margin of safety from the standpoint of seismic effects. (4) Certainly the results of the Appalachian study serve to once again confirm that wells generally enjoy an extremely wide margin of safety from the shock and vibration effects produced from blasting. Anyone faced with devising a blasting program to protect well and water system from shock and vibration can do so by adhering to this generally recognized criteria for safety.

SOURCE ROBBERY OR DIMINISHMENT

Diminishment of a water source, although extremely rare, can and does occur as a result of drilling and shooting operations. It does not occur as a result of blasting per se, but more because of a particular action taken. Most diminishment conditions occur because the drilling or excavation interrupts a condition of stability within they system.

Construction and geophysical companies probably have a greater risk of encountering conditions by which diminishment might be caused. For example, a road cut could intersect a perched water system allowing water to drain into the cut. If this peerchment provided a water source for individuals living at higher elevations than the cut, the water level in their wells could be reduced. Exploration drilling crews can also encounter similar situations. By action of their drilling, these crews might performate an impervious layer supporting perched water and allow the perchment to partially drain.

Figure #6 illustrates a case from the files and personal experience of this writer. In this particular instance, there was an artesian aquifer of local and areal extent. High on a hill a farmer had a flowing well. A seismic crew drilled a shot hole down the hill from his farmstead. It was known that most holes drilled in this area produced water, but up to this time, the holes responded to the sealing methods being used by the seismic crew. After the down hill shot was fired, the shothole began to flow profusely. By the following day, the farmer's well had almost ceased flowing. Attempts were made to plug the seismic shothole, but these only achieved partial success. However, it was expected that the farmer's well flow would return with the next recharge season.

In this case it was reasonably certain that the well and the shothole were interconnected in some way. The seismic shot developed the aquifer down dip from the well, lowering the piezometric level past the flow point of the well. Certainly it would be agreed that diminishment, whether permanent or not, did occur.

Robertson et al, in the recent report on blast effects on ground water supplies in Appalachia, found that test wells diminished when the mine cuts approached to within 300 feet of them. However, it was found that this was not a permanent diminishment. The next rainy cycle recharged the system in all but one of the test wells. These wells ended their testing period by producting as well as, or better than, they did before blasting occurred. (4)

The authors of the Appalachian ground water publication have theorized that this effect was due to stress relief. Stress relief supposedly increased both the porosity and permeability of the aquifers and accordingly increased the volume of storage. When the new storage capacity was recharged, the wells benefited from this increased storage capacity. (4)

It is this writer's contention that diminishment of a water supply is a very remote possibility, that is only probable under extremely ideal conditions. Significant distances, of 500 feet or more, between a shot and a well site, minimize or eliminate even this minor possibility.

POLLUTION

The most significant part of all rock drilling is now accomplished with air drills. Consequently, the only possible contaminants that might be left in an aquifer as a result of drilling, would be a negligible quantity of oil and grease.

The detonation products of all commercial explosives are gases that vent to the atmosphere upon completion of the detonation reaction.

Seismic shotholes and other exploratory drill holes, if they are allowed to remain open, could channel pollutants into an aquifer. However, the majority of these holes are plugged and scaled after use and in most areas, the holes would quickly seal themselves even if they were left open.

Certainly the possibility for pollutants to leach from abandoned mines and spoil piles is valid, but any consideration for drilling and blasting to be a source of pollution for ground water or surface water would be beyond reason. The worst that could be expected from the act of drilling and shooting would be minor changes in suspended matter that would normally be found within a particular well system.

INVALID CLAIMS

Up to this point, this paper has been illustrating the fact that it is extremely difficult to cause damage to an aquifer, or water well system, by the act of drilling and blasting. How then can so many claims for damages be filed by citizens at distances, and other conditions, that border on the unbelievable? The following two examples will illustrate such claims.

Figure #7 illustrates a geological situation in which a seismic party passed a property with a water well that lay at a distance of 6,100 feet, or more, from the shooting site. The party drilled

and shot three holes within this distance range. Each hole contained twenty pounds of explosives and was fired singly. Shortly after the holes were fired, a claim was filed by the owner of the water well for the following alleged damages:

1) The day of the shooting the property owner's well pump had broken.
2) The owner, after fixing the well pump, found that the water level in the well had fallen to the point that the pump could only work for a few minutes without allowing for recovery.
3) The owner's well water had been very good before the seismic party's shooting, but afterwards it was very bad and had both an odor and an oily taste.

It does not take most people long to see that the seismic party's shots were at such a distance from this well that only blasts of many times their magnitude could have produced a damaging vibration level. A simple study of the area's geology reveals that no connection exists by which shotholes could have caused diminishment. Similarly, there was no clear channel of migration for pollutants to reach the well. If there had been, normal transmission rates would have required weeks or even months for pollutants to reach the well over a distance of 6,100 feet. In this case the real problem was a poorly completed well, inadequate maintenance, an extra dry year and avarice.

Figure #8 illustrates another water well damage claim. In this situation some people had purchased a property which had a well system noted on Figure #8 as, "Well No. 1." Within a short time after their taking possession of the property, a seismic crew passed it and fired a ten pound charge in the shothole, as noted on the figure. The distance from the shot to the well was in excess of 600 feet.

The land owner claimed that the shot caused Well No. 1 to be contaminated with coal dust. He also claimed that the shot was responsible for causing Well No. 2 to go dry several months later. Well No. 2 had not been drilled when the shot in question took place. Due to its physical placement, Well No. 2 was a seasonal well and as such a normal rainfall year could allow it to produce for an entire year. This second part of the land owner's claim was dropped when winter and spring recharge allowed Well No. 2 to recover.

Investigation revealed that when the claimant had purchased this property, Well No. 1 had a 200 gallon sand filter located between the well and the house. There were two synchronized

pumps, one to charge the sand filter and one with a pressure tank to supply the house from the sand filter. The claimant stated that he had seen no reason to have two pumps working in line with each other and therefore had taken the sand filter out of line and pumped directly from the well to his house.

In this particular area the coal seams make the best aquifers. Other near surface rocks are made up of thin bedded sandstone and shale that have a very poor yield. The original owner of the property had gone to a great deal of expense to build a top quality sand filter in order to remove the coal dust from this water supply.

CONCLUSIONS

This paper had attempted to show, in brief, that:

1) The ground water supply is controlled by the hydrologic cycle and the storage capacity of the geologic condition at a particular site,

2) In order for shock and vibration to be considered a cause of well damage, a very small charge weight to distance relationship must exist.

3) In order for drilling and blasting to be considered to be a cause for water source diminishment, a unique physical and geologic condition must exist between the position of the blast and the producing well in question.

4) Ground water pollution cannot be considered to result from drilling and blasting since there is nothing induced into the ground, by these acts, to cause pollution.

This paper has illustrated, both valid and invalid, claims for water well damages and its writer supports additional studies of the type recently released by the U.S.B.M.. (4) so that the actual condition of wells prior to, during and after blasting operations may be documented. Such studies are necessary in order to define, to the fullest extent, the condition under which water well damages may occur in all regions of the United States.

REFERENCES

1. Bond, E. W. Study of the Influence of Seismic Shotholes on Ground Water and Aquifers in Eastern Montana. Mont. BuMines Geol., Spec. Publ. No. 67, May 1975, 87 pp.
2. Glasstone, Samuel, and Philip J. Dolan, eds. The Effects of Nuclear Weapons, 3rd Ed. U.S. Dept. of Defense and U. S. Dept. of Energy, 1977.
3. Johnson Div. UOP Inc., Ground Water and Wells, 1980, Johnson Div. UOP Inc., St. Paul, Minesota.
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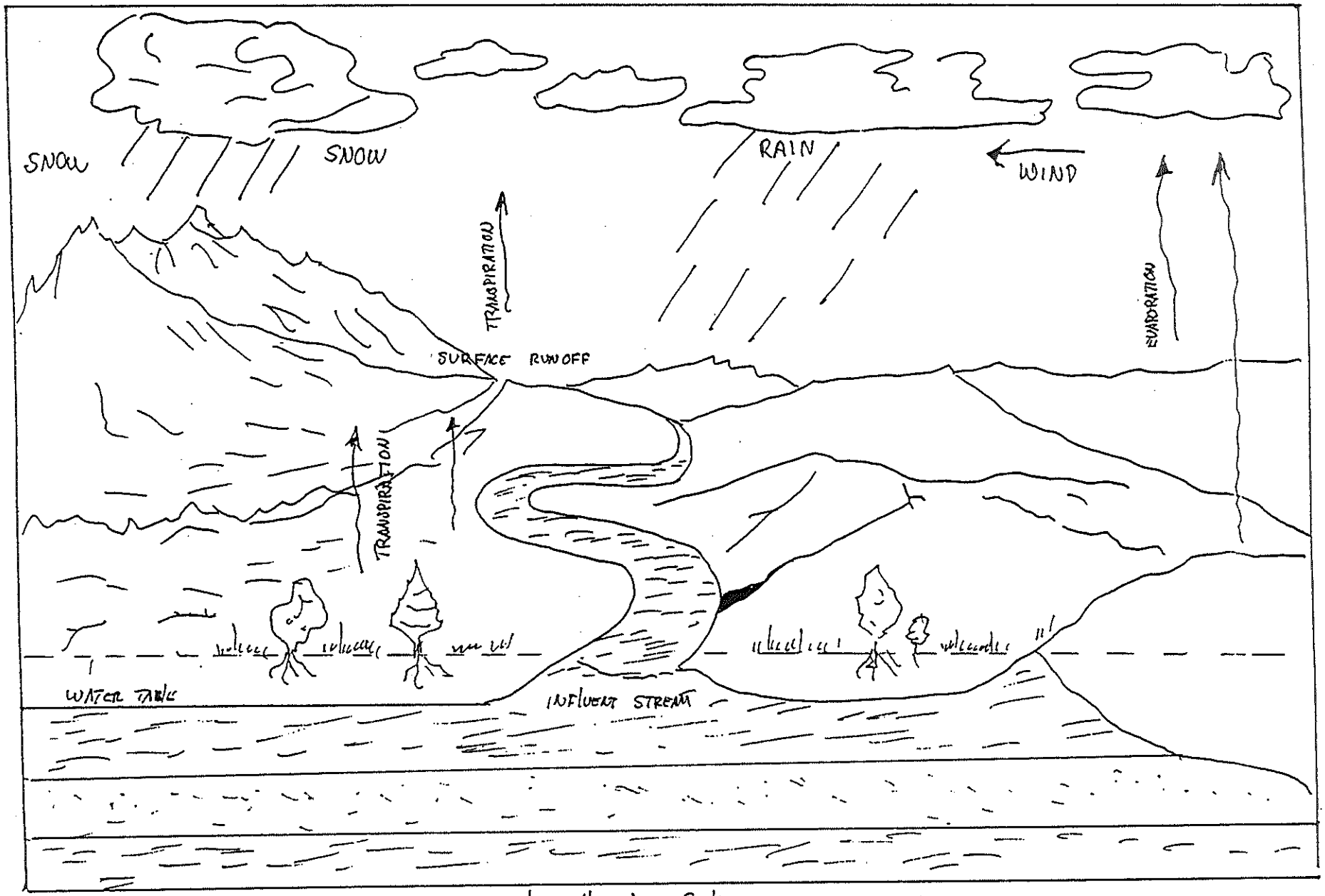
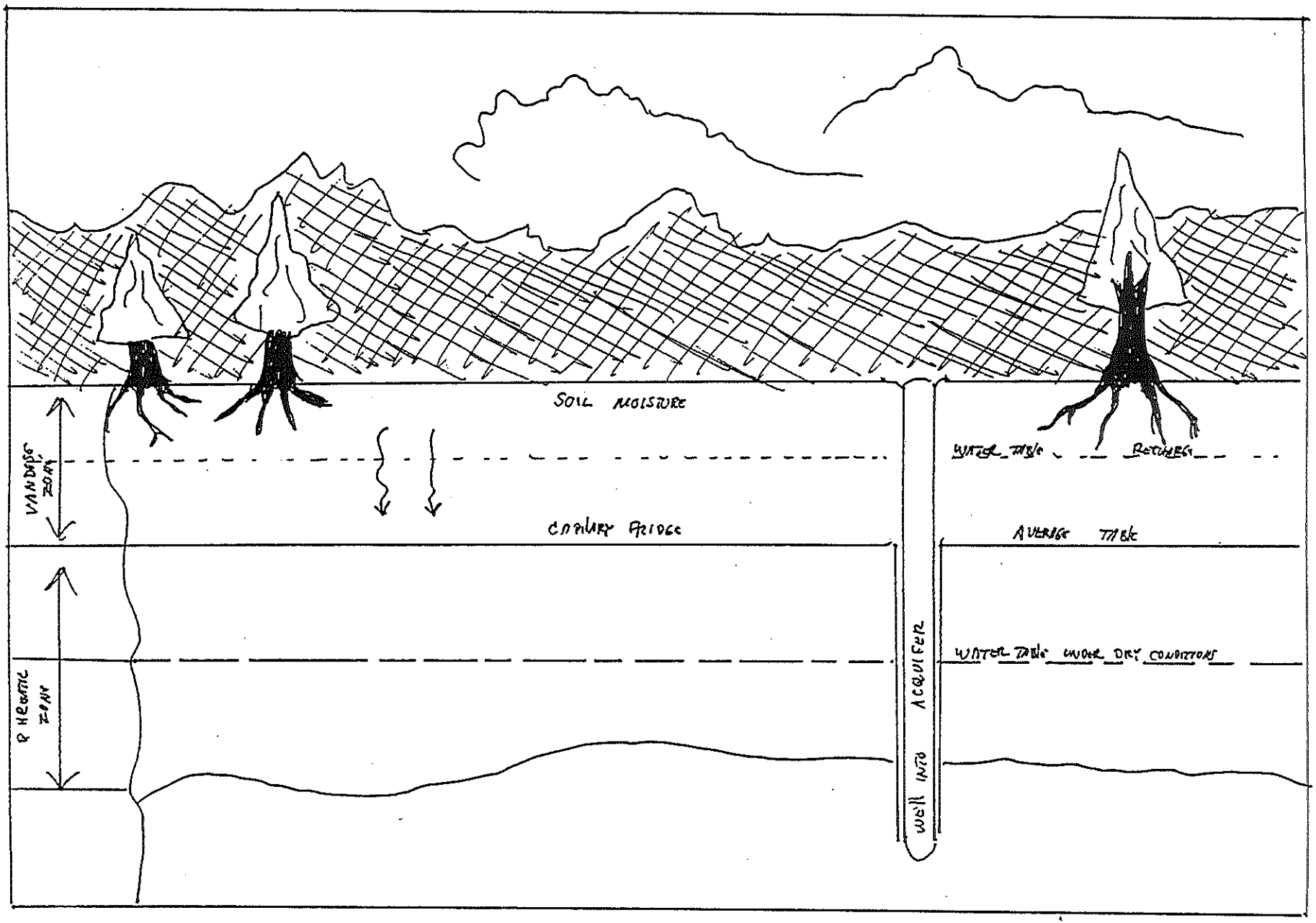
5. Siskind, D. E. and R. R. Fumanti. Blast Produced Fractures of Lithonia Granite. BuMines RI 7901, 1974, 38 pp.
6 Siskind, D. E., R.C. Steckley and J. J. Olson. Fracturing in the Zone Around a Blasthole, White Pine, Michigan. BuMines RI 7753, 1973, 20 pp.
7 White, Harold H. The Effect of Vibration from Commercial Blasting. Lusher and Lusher, Hazleton, PA, 1953.

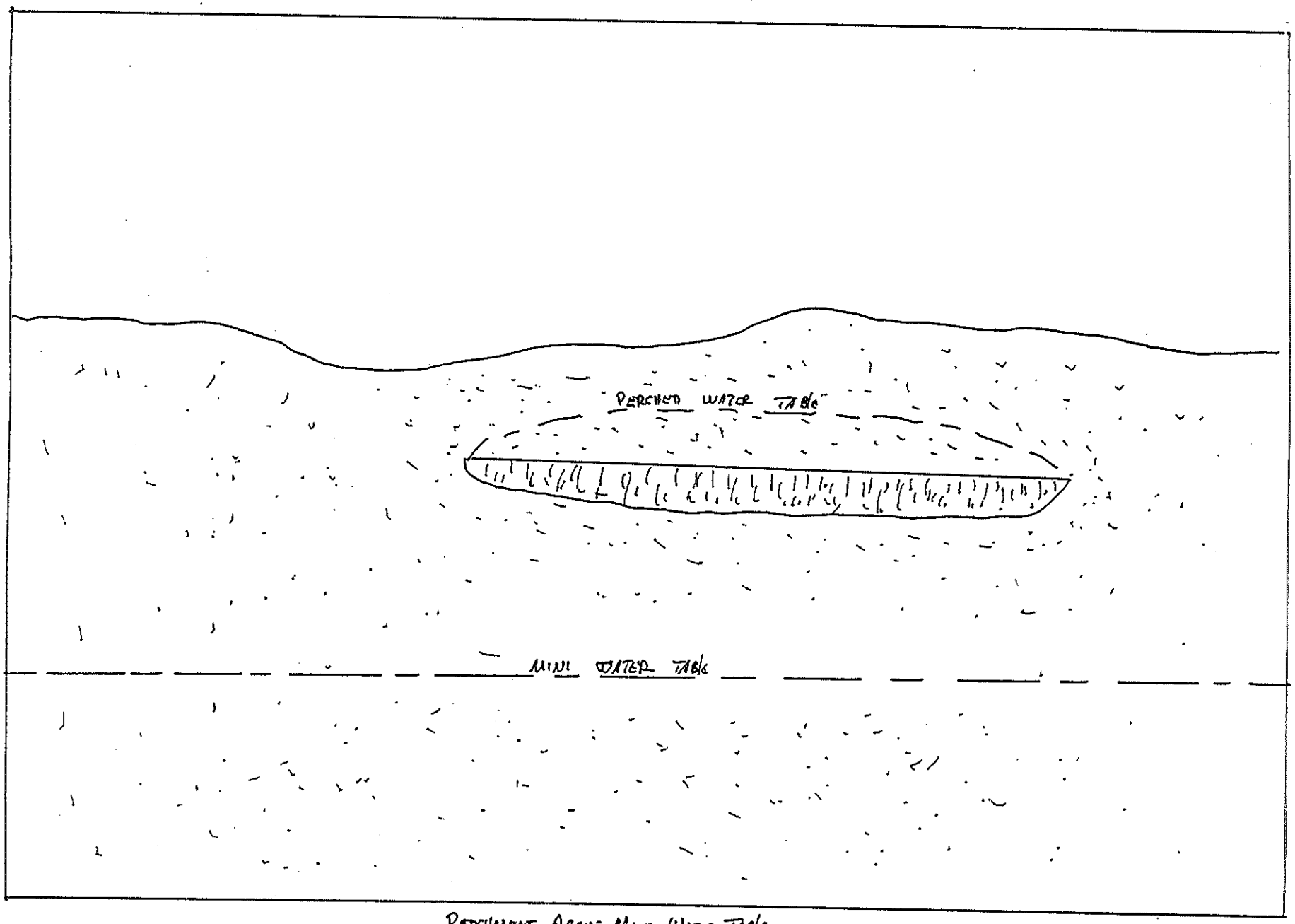
For those interested: Source #4 may be obtained from the U. S. Department of Commerce - National Technical Information Service, Springfield, VA 22161 (PBS2-152125)



IDEALIZED Hydrologic Cycle

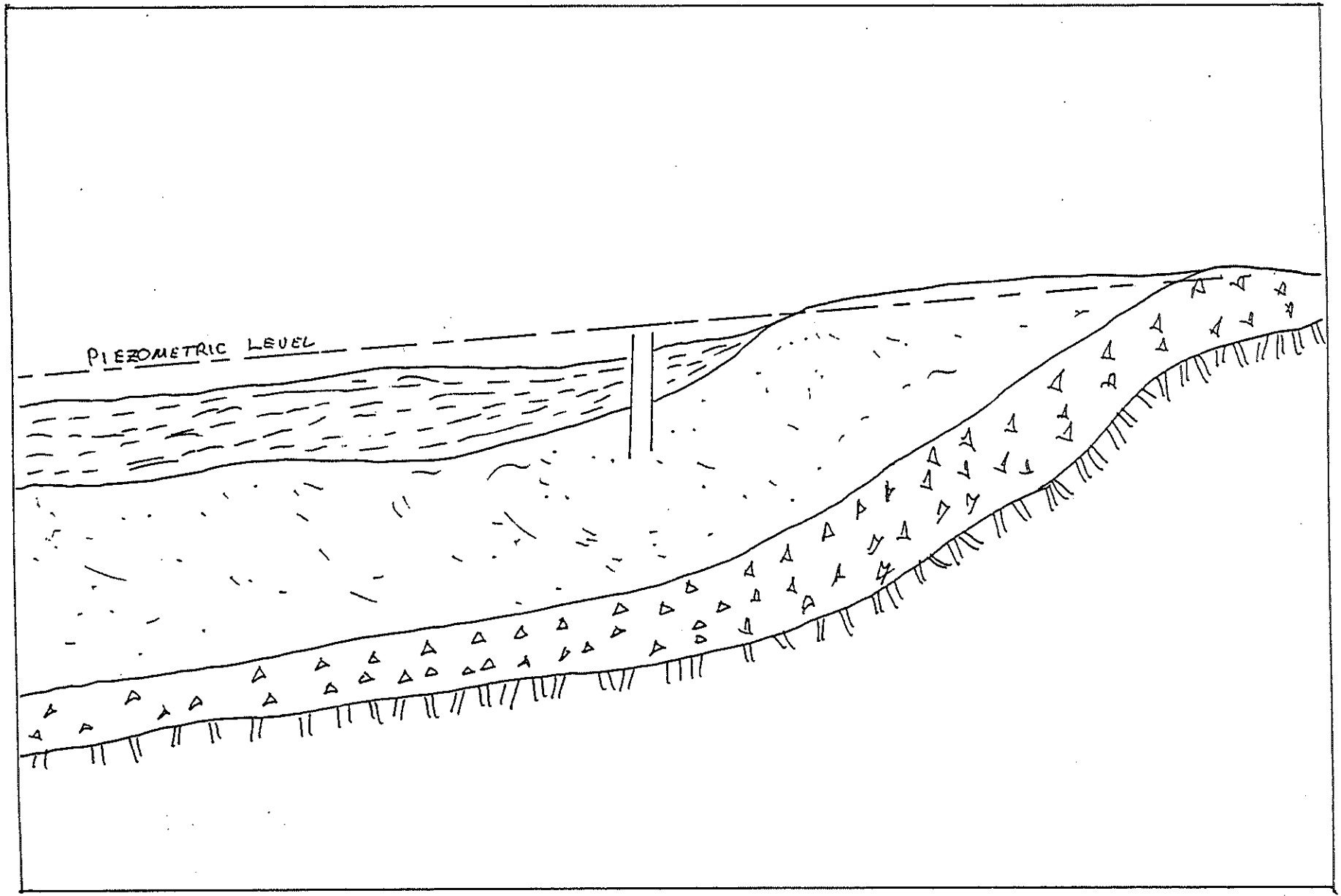
FIGURE #1


SOIL MOISTURE
VADOSE ZONE
CAPILLARY FRINGE
WATER TABLE RECHARGE
AVERAGE TABLE
WATER TABLE UNDER DRY CONDITIONS
PHREATIC ZONE
WELL INTO AQUIFER



PERCHMENT ABOVE MAIN WATER TABLE

FIGURE #13



ARTESIAN AQUIFER

FIGURE 4

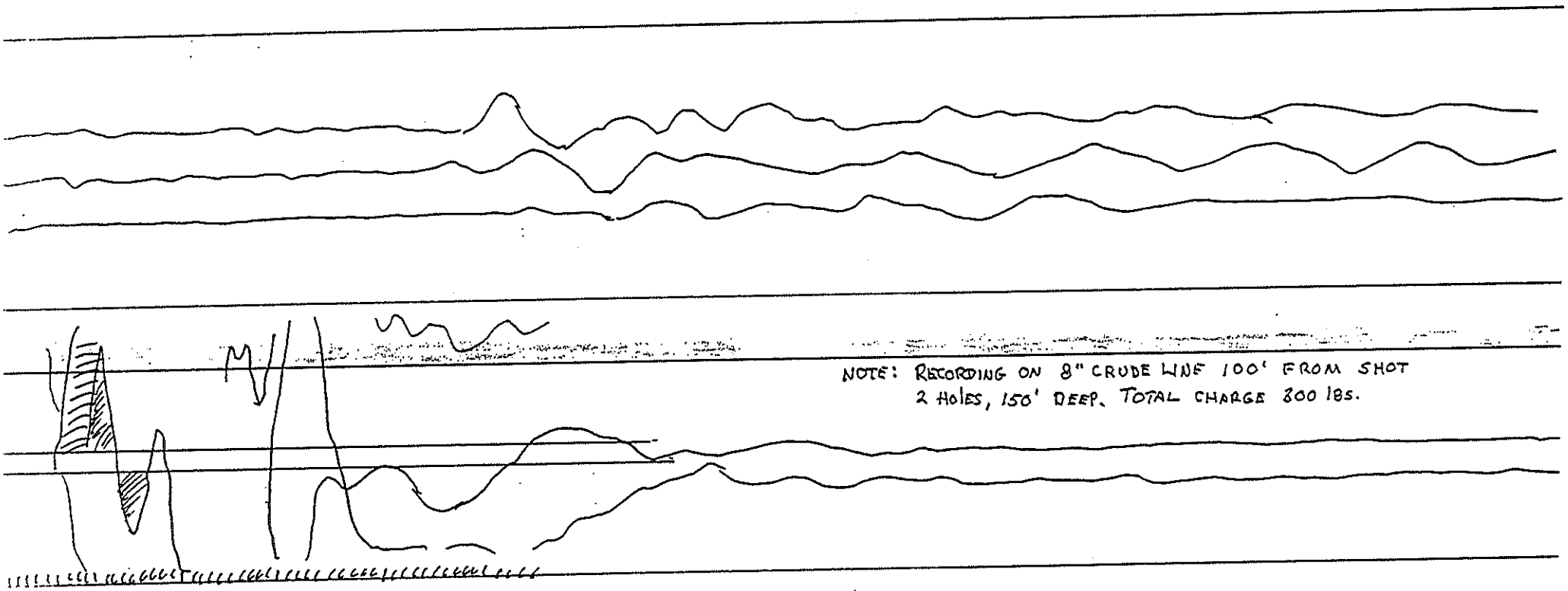
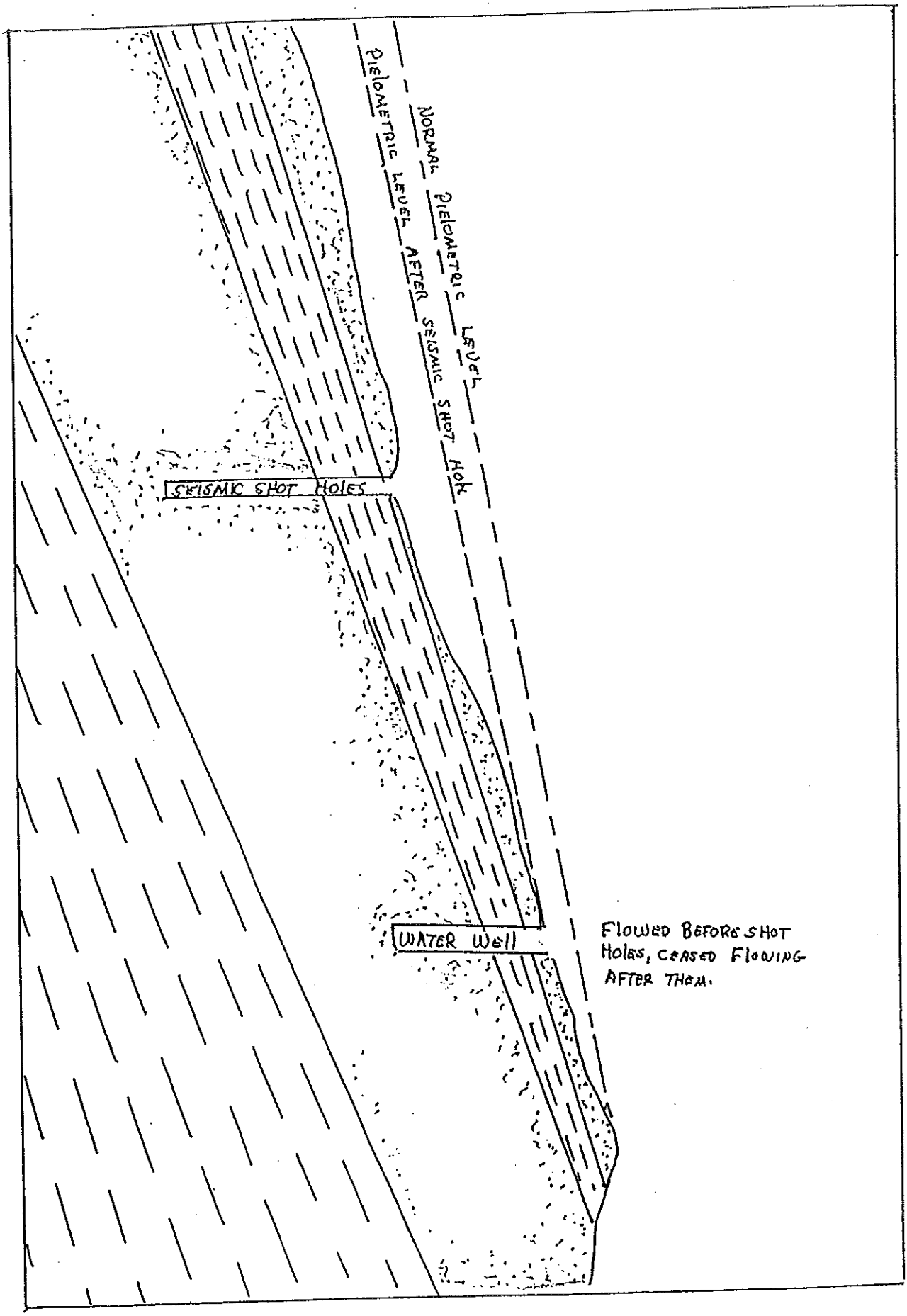
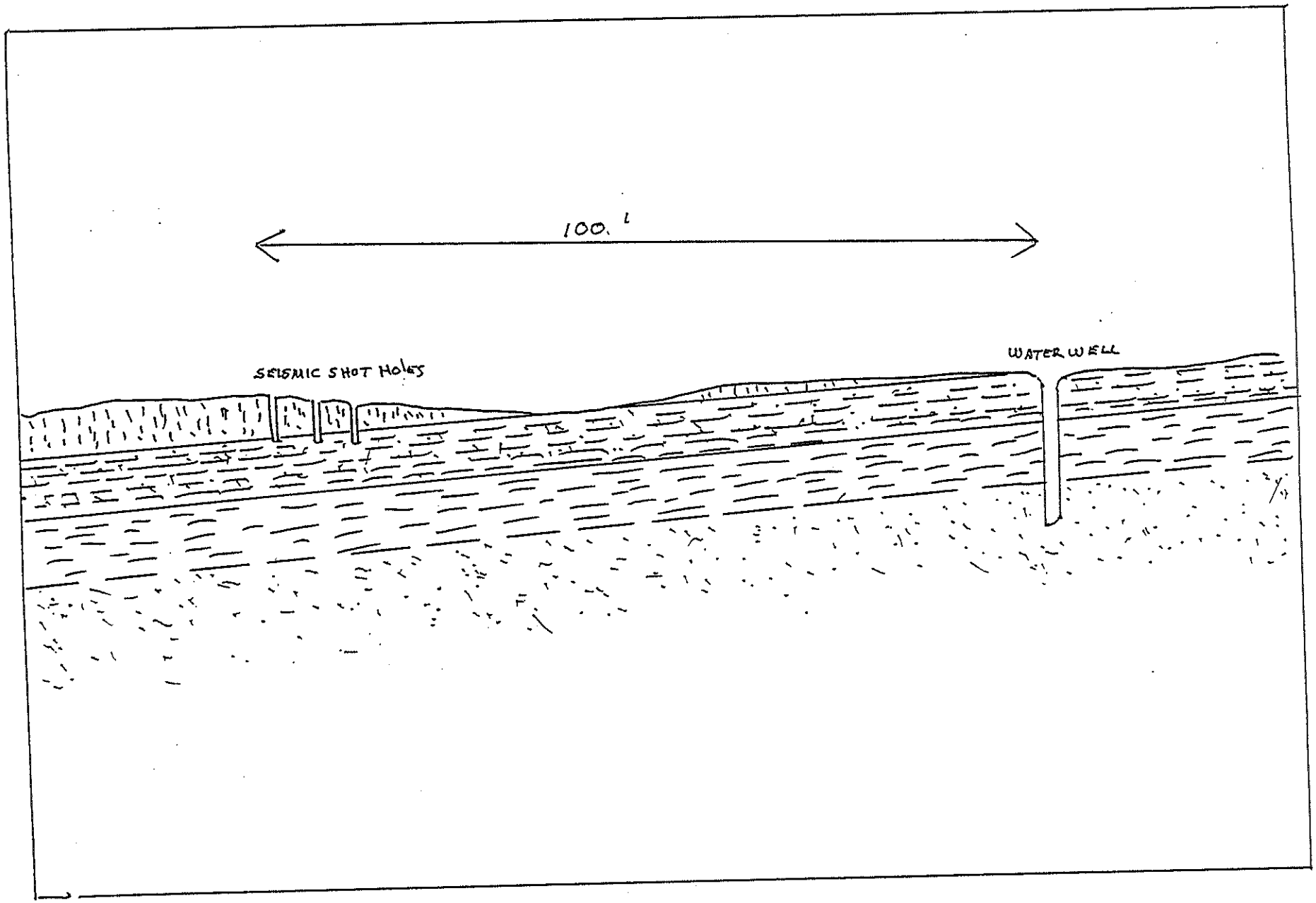
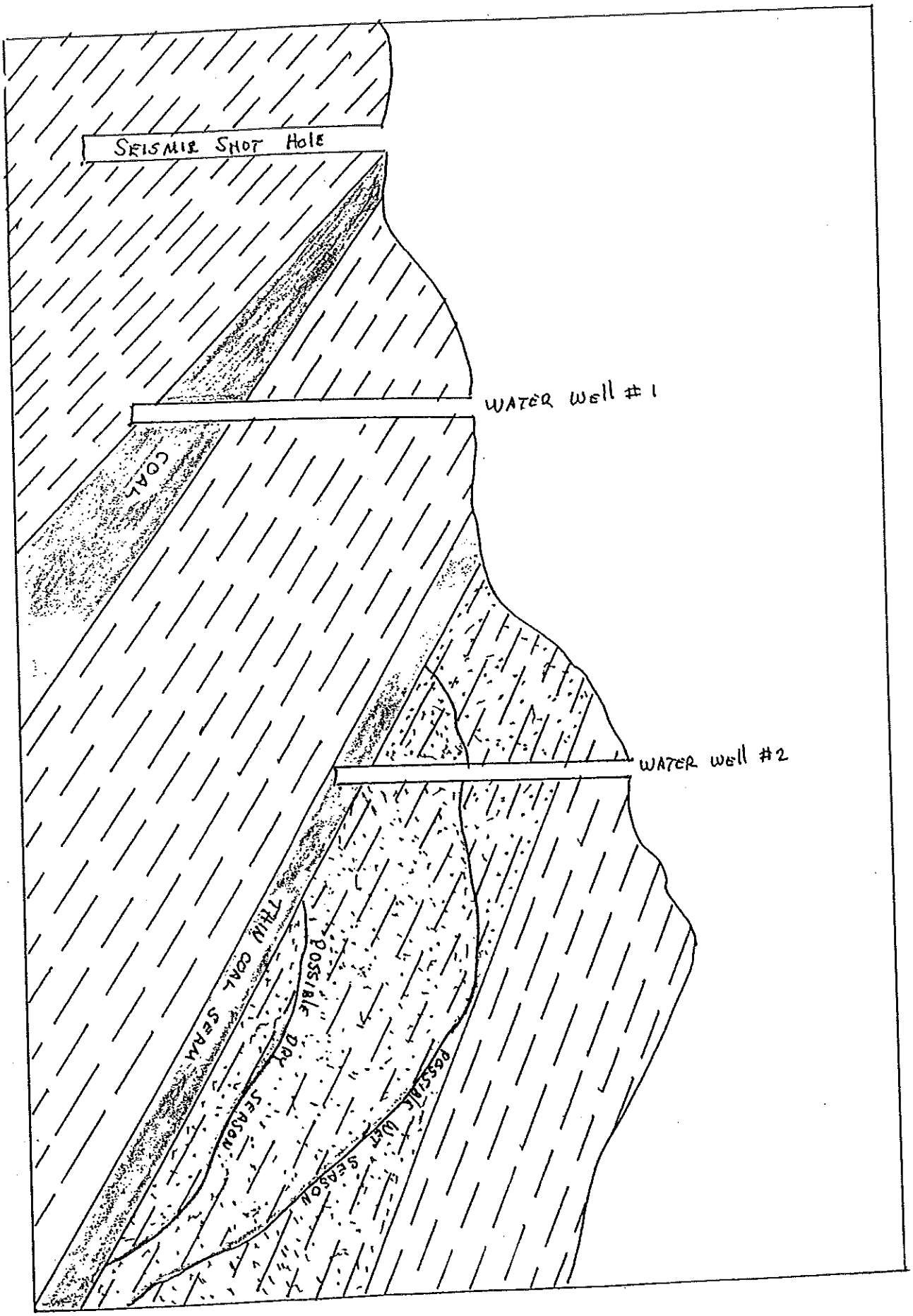

NOTE: RECORDING ON 8" CRUDE LINE 100' FROM SHOT
2 HOLES, 150' DEEP. TOTAL CHARGE 300 lbs.

FIGURE 5


NORMAL PIEZOMETRIC LEVEL
PIEZOMETRIC LEVEL AFTER SEISMIC SHOT HOLE
SEISMIC SHOT HOLES
WATER WELL
FLOWED BEFORE SHOT HOLES, CEASED FLOWING AFTER THEM.


100.'
SEISMIC SHOT HOLES
WATER WELL


SEISMIC SHOT HOLE
WATER well #1
COAL
WATER well #2
THIN COAL SEAM
POSSIBLE DRY SEASON
POSSIBLE WET SEASON

Additional Submittal Notes:

Dates and times of Blasts will be determined when the submittal is approved and the General contractor determines a construction schedule.

All blasting is the responsibility of Maine Drilling and Blasting. A certificate of insurance will be issued for the project with limits of $ 5,000,000.

Brian J Skehan

Resume for Preblast Surveyor and Blast Monitor at Ocean Ridge in Portland Maine

Job Description

ADJACENT PROPERTY RISK MANAGEMENT

Review tax maps to have names and contact information for all structures within 1000 feet of blasting
Meet each resident and inspect structure in full compliance with Maine Drilling and Blasting standards as well as the specifications.
Communicate to each resident the impact of blasting, the schedule, and the alarm signals.
Leave a telephone contact for each resident to facilitate answers to questions as the blasting continues.
Log in private wells locations
Review preblast surveys with Blasting Consultant for submittal to the City of Portland.

BLAST MONITORING

Work with Maine Drilling and Blasting blaster in charge to monitor compliance with the submittal for each blast design
Establish seismograph locations and calibration compliance.
Assemble seismograph data and blast design for each shot for submittal to City of Portland.
Record all incidents of non compliance from specifications or Maine Drilling and Blasting standards.

REPORTING PROCESS
Prepare and submit notification list and procedures.
Prepare and submit through blasting consultant all preblast surveys.
Prepare and submit all seismograph and blast reports for each shot.
Prepare a non compliance report (NCR) for any deviations.

Past experience relating to blasting, preblast surveys, and building management

1969 Began working at Maine Drilling and Blasting as a drill operator.
1970 Began purchasing rental property real estate and assumed role as general contractor in renovation and rehabilitation of properties.
1973 Blaster and project foreman for Maine Drilling and Blasting in Maine , New Hampshire, and Massachusetts. Specialized in close areas such as: Eastern Maine Medical Center Expansion in Bangor, Maine Yankee Nuclear Power Plant in Wiscasset, One City Center in Portland.
1974 Continued in pursuit of personal real estate rental and renovation business. Approximately 40 units as well as on going rental of properties.
1980 Began seismograph monitoring of some projects.

1986 to 2002 Worked as a Federal Employee.

2002 Preblast surveying as an independent contractor working exclusively for Maine Drilling and Blasting. Working throughout New England States. This work includes a significant amount of public relations work with home and business owners. Each owner needs an explanation of blasting operations and its impact on their structure.

CURRENT SUCCES RATE:

I have performed approximately 250 preblast surveys. Of these surveys I have had 6 recalls to assess possible damages. To my knowledge there are no dis-satisfied parties from this effort.

Stephen W. Blaisdell
207-582-2338
State of Maine Professional Engineer #3605

Resume for Blasting Consultant at Ocean Ridge in Portland, Maine

Job Description:

ADJACENT PROPERTY RISK MANAGEMENT
Review and approve structure inspections of all pre blast surveys within 1000 feet. Insure adequate documentation to

- communicate effectively with the property owner
- insure adequate risk management
- compliance with the project specifications
- evaluate needs of flow and water quality testing of private wells

Submit preblast surveys of each structure with a professional engineers stamp.
Insure all preblast surveys are complete prior to blasting.
Follow up claims and calls from adjacent structures with communications and inspection of complaint. Report all claims to City of Portland within 5 days.

EXPLOSIVE DESIGN
Establish rock modulus for particle velocity calculations.
Approve pounds of explosives per delay to manage impact on adjacent property.
Monitor seismograph readings to determine rock modulus, observe compliance with specifications, explosive densities per delay.

REPORTING PROCESS
Submittal of blast plan per the specifications to Sebago Technics
Submittal of the preblast notification document to the City of Portland.
Submittals of all preblast surveys with a P.E. stamp to Sebago Technics.
Weekly submittals of all seismograph results for every blast.
Issue non-compliance reports (NCR) for any blasting activity that creates impact on adjacent property or vibrations beyond the specifications.

Past Experience relating to blasting, earth movement, and building evaluation

1973 Civil Engineer degree from the University of Maine at Orono
1974 Engineer for Augusta Water District with responsibilities including blasting of trench rock.
1977 Professional Engineers License State of Maine # 3605
1978 Project Engineering Manager at Cianbro on Brunswick-Topsham Hydroelectric. Cianbro self performed blasting with our blast designs to control the vibrations at the adjacent Lewis Building Mill Complex. Central Maine Power approved submittals for spacing, burdens, and

pounds per delay. Seismographs were used on daily shots for over one year.

1993 Project Manager at Cianbro on LL Bean Desert Road. Construction of 400,000 square feet of buildings. This Design Build responsibility included numerous building connection details and building allowable movements.

1999 Support of Excavation Structures Manger at Kiewit Construction. Central Artery Project in Boston. The support of excavation soil mix temporary walls were designed and constructed with limits on piezometric head from the water table in the argillite under the excavated clay at the base of the 60 foot cut. Other limits of movement included the allowable anchor elongation for embedment in clay. These $ 30 million dollar walls protected adjacent property, and workers in the hole as the 1,000,000 cubic yard excavation was completed.

2001 Construction Manager for Maine Drilling and blasting. Duties include spacing, burden, explosive selection, and pounds per delay for major bids including Ocean Ridge. Other duties include management of a nitrate claim for groundwater contamination at a Home Depot Site in Merrimack, NH.

Completed for each location

PREBLAST SURVEY CHECKLIST

DATE _____ SAFETY SPECIALIST _____
LOCATION _____ JOB NUMBER _____

NAME OF RESIDENT OR OCCUPANT _____
ADDRESS OF PROPERTY _____
MAILING ADDRESS (IF DIFFERENT) _____
TELEPHONE NUMBER HOME ( ) _____ WORK ( ) _____

TYPE OF STRUCTURE	AGE OF BLDG	WATER	DIST. TO BLASTING
___ WOOD	_____ YEARS	____ WELL	_____ FEET
___ STEEL		____ TOWN	
___ MASONRY			
___ COMBO			
___ _____			

FOUNDATION TYPE	RETAINING WALLS	ANIMALS IN BUILDING
___ STONE	TYPE _____	_____
___ BLOCK		_____
___ POURED		_____
___ MORTARED		_____

POOL ON PROPERTY (TYPE) _____

CHIMNEY ON HOUSE (TYPE) _____

DAMAGE TO INTERIOR IF UNABLE TO DOCUMENT WITH VIDEO

_____
_____
_____
_____
_____

DAMAGE TO EXTERIOR IF UNABLE TO DOCUMENT WITH VIDEO

_____
_____
_____
_____

WINDOWS THAT ARE BROKEN(LOCATION) _____
_____
_____

NOTIFICATION ONLY

Maine Drilling & Blasting

NOTICE

Dear Property/Tenant:

We at Maine Drilling & Blasting would like to take this opportunity to introduce you to our company, and advise you that we have been selected to conduct a rock drilling and blasting operation for the OCEAN RIDGE CONDOMINIUMS/ MAIETTA CONSTRUCTION

The site will be well marked with highly visible signs that detail the whistle warning sequence that will be sounded prior to commencement of each blast. All blasting operation will be conducted during daylight hours and no explosives will be stored at the construction site overnight.

If you happen to be in the building during the initiation of the blast, you may experience low levels of ground vibration. We will strive to minimize the amplitude of the blast and will be utilizing the most advanced technologies available to the blasting industry to measure the seismic effect to the area. Please be assured that ground vibrations associated with the blasting will not exceed the established limits that could potentially cause damage.

Since the nature of blasting itself can be annoying, we encourage you to contact our office at 800-370-2338, from the hours of 7:00 AM to 5:00 PM and we will respond to your concerns in a timely manner.

Sincerely,

Brian J. Skehan

Brian J. Skehan
Safety Specialist

Maine Drilling and Blasting, Inc.
P.O. Box 1140
Brunswick Road
Gardiner, ME 04345
207 582-2338
FAX 207 582-8794

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Massachusetts 508 689-2983
New Hampshire 603 647-0299
Vermont/New York 802 479-3341