AC Rochester

P.O. Box 1790
Rochester, New York 14692-1790 USA

July 7, 1992

Mr. Dixon Rollins
Regional Hazardous Waste Engineer
Division of Hazardous Substance Regulation
NYS Department of Environmental Conservation
6274 East Avon-Lima Road
Avon, New York 14414

Re: Blast Vibration Monitoring - Bedrock Trench/Recovery Well Construction

Dear Mr. Rollins:

Enclosed please find two copies of the report on "Blast Vibration Monitoring - Bedrock Trench/Recovery Well Construction, Lexington Avenue Facility. The report summarizes the observations and records of vibrations resulting from construction of the 1200 ft. bedrock trench in the north parking lot at AC Rochester's Lexington Avenue Facility.

Please call me at (716) 647-4766 if you have any questions concerning the report.

Sincerely,

Richard C. Eisenman

Richard C. Eisenman
Senior Environmental Engineer

cc: Mr. Richard Elliott, Monroe County Department of Health
Mr. Philip Steinfeldt, Monroe County Department of Engineering

AC Rochester

P.O. Box 1790
Rochester, New York 14692-1790 USA

October 26, 1992

Mr. Dixon Rollins
Regional Hazardous Waste Engineer
Division of Hazardous Substance Regulation
NYS Department of Environmental Conservation
6274 East Avon-Lima Road
Avon, New York 14414

Re: Response to DEC letter dated September 24, 1992;
Revisions to Blast Vibration Monitoring
Bedrock Trench/Recovery Well Construction
AC Rochester North Parking Lot
Lexington Avenue Facility, Rochester, New York

Dear Mr. Rollins:

Enclosed is a letter from H & A of New York, dated October 16, 1992, responding to your comments contained in your letter dated September 24, 1992. In their letter H & A presents additional explanation and field information to address DEC concerns with respect to the above referenced report.

The text of the Blast Vibration Monitoring Report has been revised to incorporate all appropriate modifications discussed in H & A's letter. This revised text is enclosed. Please remove the original report pages up to the "Tables" tab and insert the revised text. AC Rochester believes that the revised text provides a complete and accurate description of the blasting activities at the site.

An additional report describing installation and start-up of the migration control system will be prepared in early 1993. In the meantime, if you have any questions please give me a call.

Sincerely,

Richard C. Eisenman

Richard C. Eisenman
Senior Environmental Engineer

cc (with revised text only): Mr. Richard Elliott, Monroe County Department of Health
Mr. Philip Steinfeldt, Monroe County Department of Engineering

H & A OF NEW YORK

Geotechnical Engineers &
Environmental Consultants

16 October 1992
File No. 70014-43

AC Rochester
Box 1790
Rochester, New York 14692-1790

Attention: Mr. Richard C. Eisenman
Senior Environmental Engineer

Subject: Review NYSDEC Letter dated 24 September 1992
Blast Vibration Monitoring
Drainage Trench/Recovery Well Construction
AC Rochester
Lexington Avenue Facility
Rochester, New York

Gentlemen:

This letter responds to the comments the New York State Department of Environmental Conservation (NYSDEC) included in a letter to AC Rochester, dated 24 September 1992, concerning the Blast Vibration Monitoring report prepared by H&A of New York for AC Rochester, dated 24 June 1992.

The four comments are presented as suggested revisions to H&A's report. NYSDEC indicates the comments are suggested to make the report accurately reflect the field operations and the thresholds for Peak Particle Velocity (PPV) near structures

In preparing our response to the four comments, we reviewed our records and discussed the comments with the field personnel who were at the site during the blasting and monitoring activities.

H&A of New York's response follows each respective NYSDEC comment.

NYSDEC
Comment 1 Paragraph 3, Page 4: "In this paragraph it is stated that each hole was loaded with 30 to 32.5 pounds of Austin Extra Gel 40 percent. However, on April 22 a total of 50 pounds per hole (4 decks at 12.5 lb/delay) was loaded for blast event #1. therefore, this paragraph should identify the range of loading as "...30 to 50 pounds ..." ".

189 North Water Street
Rochester, NY 14604
716/232-7386

Affiliate
Haley & Aldrich, Inc.
Cambridge, Massachusetts
Glastonbury, Connecticut
Scarborough, Maine
Bedford, New Hampshire

H&A Response: This paragraph describes the production blasting procedures and Paragraph 4 on page 4 explains that the test blast program did have more than 32.5 pounds of explosive per hole.

We will issue a revised page 4 as an addendum to the report which includes paragraph 3 as follows:

"Each hole, except the six holes in the test blast program, was loaded with 30 to 32.5 pounds of ..."

NYSDEC Comment 2

Paragraph 4, Page 4: "This paragraph describes the test-blast program. It is stated that test blast #1 consisted of 10 pounds/delay. I was present for the final loading and detonation of test blast #1. After the blast Mr. Joe Socko (blaster) stated that 15 pounds/delay was actually loaded (although Mr. Oosterbaan may have instructed 10 pounds/delay be loaded). This paragraph should be revised to reflect this loading."

H&A Response: Our review of field notes indicates that two holes were drilled and loaded in Test Blast No. 1. Four decks of 10 pounds per delay were used in hole 1 while hole 2 had three decks of 10 pounds and one deck with 12.5 pounds, for a total of 42.5 pounds per hole and a maximum of 12.5 pounds per delay

Test Blast No. 2 included four holes loaded with 15 pounds in each of three decks, or 45 pounds per hole with maximum of 15 pounds per delay.

We will amend paragraph 4 to include the following:

"The test program consisted of two blasts of two and four holes, respectively. In Test Blast No. 1, four decks of 10 pounds per delay were used in hole 1 while hole 2 had three decks of 10 pounds and one deck with 12.5 pounds, for a total of 42.5 pounds per hole and a maximum of 12.5 pounds per delay.

Test Blast No. 2 included four holes loaded with 15 pounds in each of three decks, or 45 pounds per hole with a maximum of 15 pounds per delay."

NYSDEC Comment 3

Paragraph 5, Page 4: "This paragraph describes the threshold peak particle velocity (PPV) criteria developed for blasting. It is important that more detail and qualification be included in any of discussion of PPV criteria development. Specifically, the PPV of 7 inches per second (ips) was never interpreted as a threshold criteria by the NYSDEC or the Monroe County Department of Engineering. The NYSDEC imposed PPV thresholds as depicted by a Blast Level Chart included in a letter from Dixon Rollins to Richard C. Eisenman (April 8, 1992). This threshold was developed for monitoring at off-site structures. According to the chart a PPV of 2 ips

would only be considered allowable at frequencies greater than (approximately) 35 Hertz. As a result of the frequency/PPV relationship depicted by the chart, frequency monitoring was also required as a condition in the above referenced letter.

Also outlined in the April 8, 1992 letter was the requirement of an agreement between AC Rochester and the Monroe County Department of Engineering establishing the means by which the 7' sewer tunnel would be monitored and protected. As part of this independent agreement the Monroe County Department of Engineering established a PPV threshold of 5 ips measured at or near the tunnel lining (letter from Philip Steinfeldt to Dixon Rollins, May 15, 1992). This section should be revised so that the development of PPV for off-site structures and the 7' sewer tunnel are treated separately and accurately.

H&A Response: Paragraph 5 describes the maximum PPV criteria H&A of New York developed in 1991 as a design recommendation, based on our experience on many blasting projects and our analysis of the conditions at the AC Rochester site. The criteria for maximum PPV were included in the documents sent to bidders and in the contract for the blasting work performed by Nothnagle Enterprises, Inc. as follows:

Blasting Vibration Limit Criteria:

1. Peak Particle Velocity Limits: The Contractor shall conduct all blasting in such a manner that the resulting peak velocity does not exceed the following limits at the ground line adjacent to the following structures:

Structure	Maximum Peak Particle Velocity (inches per second)
7-foot diameter Sewer Tunnel	7.0
All Other Occupied Structures (Including AC Rochester Facilities and Commercial Structures in the Area) Below-ground Tanks and Utility Pipes in the Area	2.0

2. Airblast Overpressure Limit: The Contractor shall conduct all blasting activities in such a manner that the peak airblast overpressure measured at the location of the nearest occupied, above-ground structure to blasts (considering wind direction) does not exceed 0.014 psi.

The criteria of 2 ips and 7 ips were stated in the specifications as the "maximum at the ground line adjacent to the structures". Structures, as noted in the specifications, refers to occupied AC Rochester Facilities and other commercial structures in the area.

At an informational meeting conducted on 22 January 1992 at the AC Rochester Lexington Avenue Facility, attended by representatives of AC Rochester, NYSDEC, Monroe County Department of Engineering (MCDOE), and H&A of New York, Mr. Steinfeldt (MCDOE) indicated satisfaction with the proposed blasting program, if it was modified to include test blasts to verify the PPV values predicted at the tunnel. A test blasting program subsequently was developed and performed as stated in H&A of New York's 24 June 1992 report.

However, the 8 April 1992 letter from NYSDEC to AC Rochester included General Conditions and Blasting Conditions for AC Rochester concurrence before proceeding with construction of the blasted trench.

The General Conditions identified by NYSDEC in the 8 April 1992 correspondence included a provision for an agreement between AC Rochester and the Monroe County Department of Engineering to define the means by which the structural integrity of the sewer tunnel would be protected and monitored.

The monitoring program developed by H&A of New York, AC Rochester, and MCDOE included:

- periodic monitoring of ground surface vibrations above the tunnel,
- periodic monitoring of vibrations adjacent to the invert of the tunnel using a geophone set in a drill hole extended into bedrock,
- periodic inspections of the tunnel by Monroe County Pure Waters personnel,
- telephone notification to Mr. Steinfeldt when measured vibrations above and adjacent to the tunnel exceeded 2.0 ips.

Inspection of the tunnel on 12 May 1992 by Monroe County Pure Waters personnel indicated no change in the condition of the tunnel lining. On

15 May 1992, in response to the apparent non-effect of blasting operations on tunnel integrity, Mr. Steinfeldt (MCDOE) modified the reporting criteria to require notification only when the PPV exceeded 5 ips at or near the tunnel lining. The modification included the provision that blasting would stop and Monroe County would inspect the tunnel if the PPV exceeded 5 ips.

The monitoring program and associated notifications were implemented during the blasting program to the apparent satisfaction of the MCDOE.

The Blasting Conditions suggested by NYSDEC included the criterion that ground vibrations from blasting should not exceed the limits on the blast level chart submitted by NYSDEC (apparently a copy from RI 8507, U.S. Bureau of Mines). The chart indicates a variable criterion with a maximum PPV of 2 ips for frequencies above 35 Hz. This chart is based on studies of cracking and plaster damage in surface residential structures due to nearby blasting operations and is not applicable as a "safe limit" or an indication of a threshold of potential damage to engineered structures such as tunnels or the types of industrial structures at and near the AC Rochester site.

The frequency of the vibrations associated with the blast events was automatically recorded by the seismographs along with the information on PPV for each event as stated on page 2 of the report. The PPV and air over-pressure data is summarized in Appendix A of H&A's 24 June 1991 report. The raw data is available for review.

Paragraph 5, Page 4 will be modified as follows:

"A maximum PPV criteria of 2 and 7 ips at the ground surface was specified by H&A of New York for nearby building structures and above the Pure Waters Tunnel, respectively. The specified limit for air pressure was 0.014 psi. Additionally, it was agreed with the Monroe County Department of Engineering to notify them if PPV exceeded 5 ips at or near the tunnel lining."

NYSDEC Comment 4

"Page 7. Summary: "As discussed above, the PPV thresholds of 2 ips and 7 ips are misleading and inaccurate. The threshold specified by the NYSDEC for off-site structures for frequencies less than 35 Hertz would not

translate to 2 ips. The threshold PPV established for the 7' tunnel was 5 ips, measured at or near the tunnel lining. The statement "...the limits of PPV specified by NYSDEC for off-site structures and the PPV of 5 ips as specified by the Monroe County Department of Engineering for the sewer tunnel were not exceeded..." would be accurate.

H&A Response: We believe the summary statement on page 7 is correct in that the PPV noted by onsite and off site seismographs did not exceed the respective specified limits of 2 ips and 7 ips, which are the technical and contractual limits recommended by H&A of New York during the design of the project.

The recorded maximum PPV were less than the 5 ips in proximity of the sewer tunnel which required verbal notification to MCDOE. In fact, the maximum PPV recorded at the ground surface in proximity to the tunnel was less than 1.3 ips, the maximum PPV recorded in the rock adjacent to the tunnel was less than 3.4 ips, and the maximum PPV inside the tunnel was less than 3.9 ips as noted on page 6.

Furthermore, the PPV observed at the offsite monitoring locations ranged from less than 0.15 ips (instrument trigger level) to 0.630 ips. The average PPV observed at the offsite monitoring location was approximately 0.35 ips, with frequencies ranging from 16 to 100 H_z, well below the offsite vibration criteria specified in NYSDEC's 8 April 1992 letter.

The summary statement on page 7 will be modified and expanded as follows:

"In summary, the PPV monitored by the onsite seismographs did not exceed the limits specified in the blasting contract which were 2 ips at the ground surface near AC Rochester or off-site structures, and 7 ips at the ground surface above the Pure Waters Tunnel.

The recorded maximum PPV were also less than the 5 ips threshold requiring verbal notification to MCDOE. The maximum PPV recorded at the ground surface in proximity to the tunnel was less than 1.3 ips, and the maximum PPV inside the tunnel was less than 3.9 ips.

The maximum PPV observed at the offsite monitoring locations ranged from less than 0.15 ips to 0.630 ips, well below offsite vibration (and frequency) criterion suggested by NYSDEC or required by the blasting contract for offsite structures.

The interior of the tunnel was visually examined by Pure Waters personnel on 11 May 1992 and on 1 June 1992. Monroe County Department of Engineering personnel reported that no unusual conditions or damage was noted during the two inspections (Appendix B)."

Please contact us if you have any questions about this letter.

Sincerely yours,
H&A OF NEW YORK

Marvin D. Oosterbaan, P.E.
Senior Consultant

Jeffrey E. Loney
Senior Hydrogeologist

Stanley E. Walker, P.E.
Vice President

MDO/SEW/jc/jel:lreise03

Enclosures: Revised Text

BLAST VIBRATION MONITORING
BEDROCK TRENCH/RECOVERY WELL CONSTRUCTION
AC ROCHESTER, NORTH PARKING LOT
LEXINGTON AVENUE FACILITY
ROCHESTER, NEW YORK

by

H&A of New York
Rochester, New York

for

AC Rochester
Rochester, New York

File No. 70014-43
October 1992

H & A OF NEW YORK

Geotechnical Engineers &
Environmental Consultants

Revised 16 October 1992
24 June 1992
File No. 70014-43

AC Rochester
Box 1790
Rochester, New York 14692-1790

Attention: Mr. Richard C. Eisenman
Environmental Activities Engineer

Subject: Blast Vibration Monitoring
Bedrock Trench/Recovery Well Construction
AC Rochester, North Parking Lot
Lexington Avenue Facility
Rochester, New York

Gentlemen:

This report summarizes the observations and records H&A of New York (H&A) personnel made from 14 April 1992 to 28 May 1992 of the vibrations resulting from blasting a 1200 foot long trench in bedrock in the North Parking Lot of the AC Rochester facility on Lexington Avenue. The trench was constructed to assist in the control of the groundwater flow in the vicinity of Driving Park Avenue.

H&A of New York personnel were on site to monitor the contractor's procedures and to record vibrations generated by each blast. Daily Field Reports, included as Appendix A in this report, were prepared by our field staff to document the contractor's activities and the vibration monitoring.

The site location is indicated on Figure 1, Project Locus. Figure 2 shows the position of the blasted bedrock trench in the North Parking Lot and the stationing used to reference the limits of each blast. Figure 2 also includes the locations of nearby ground water monitoring wells, the two recovery wells, nearby structures, the Monroe County Lexington Avenue Pure Waters Tunnel, a Rochester Gas and Electric 6-inch diameter gas main, and Driving Park Avenue which bounds the north side of the site.

PURE WATERS TUNNEL

The 7-foot Lexington Avenue combined sewer tunnel owned and operated by the Rochester Pure Waters District (Pure Waters Tunnel) is generally parallel to Driving Park Avenue and the blasted bedrock trench. The tunnel is 150 to 175 feet southwest of Driving Park Avenue and 65

189 North Water Street
Rochester, NY 14604
716/232-7386

Affiliate
Haley & Aldrich, Inc.
Cambridge, Massachusetts
Glastonbury, Connecticut
Scarborough, Maine
Bedford, New Hampshire

to 110 feet northeast of the blasted rock trench. Due to the difference in alignment of the two facilities, the tunnel is 65 feet from the southeast end of the blasted trench at Sta. 12+20 and 110 feet from the northwest end of the blasted trench at Sta. 0+00.

The Pure Waters Tunnel was constructed in 1938 with most of the 7-foot semi-elliptical reinforced concrete arch structure supported in a trench blasted in bedrock. However, southeast of Tunnel Station 66+60, Figure 2, the tunnel was constructed by blasting an arch section in bedrock and using steel ribs and liner plates with the standard "A" cross-section. Figure 3 illustrates a general cross-section of the arch section of the tunnel including the Station 63 Manhole. One exception to full rock support along the invert is noted on the as-built tunnel drawings from Station 52+54 to Station 54+00 where the rock surface is recorded as being below the tunnel structure. Part of this area is opposite Sta. 0+00 to Sta. 0+35+/- on the blasted rock trench.

PRE-BLAST CONDITION SURVEY

On 1 and 2 August 1991 H&A of New York staff walked the Pure Waters Tunnel to perform a visual pre-blast condition survey. Access into and ventilation of the tunnel structure was provided by Rochester Pure Waters District. A report of observed crack widths and locations, including photographs of typical interior conditions, titled "Lexington Avenue Sewer Tunnel Observations", was prepared by H&A of New York on 13 December 1991 and issued on 28 January 1992.

The exposed foundations of AC Rochester structures within approximately 250 feet of the blasted trench were visually examined on 15 April 1992 to check the general conditions prior to blasting. The surface condition was recorded on VHS format tape by a video camera with verbal comments on location, size, and condition of small cracks.

VIBRATION MONITORING EQUIPMENT

Four seismographs with associated geophones were set at various locations during the blasting events to obtain records of ground motion. Two GeoSonics Model 2000DK Safeguard Seismic Units and two Instatel Model DS477 Blastmate Units were used to collect and record pertinent information. Each geophone responds to ground motion in three orthogonal directions and is position to record ground motions which are longitudinal, transverse, and vertical with respect to the blast. Air overpressures generated by each blast were recorded by a separate microphone.

The seismographs recorded the maximum particle acceleration, velocity, and displacement for each orthogonal direction along with the frequency, the time of each maximum, and the maximum vector sum of the individual particle velocities sensed by the geophone. The maximum vector sum is usually reported as the Peak Particle Velocity (PPV) and is noted in the Daily Field Reports as Resultant (Res.) Peak Particle Velocity. The information is recorded on a paper tape to graphically portray the vibrations with time and to summarize the pertinent data for each blast.

Vibrations resulting from blasting operations are usually reported as PPV in inches per second (ips) with Scaled Distance (SD). Scaled Distance is computed as the distance to the blast in feet divided by the square root of the explosive weight per delay in pounds. On a log-log plot of PPV and SD the data tend to form a straight line relationship but usually have some scatter.

The daily records were summarized on a log-log plot of PPV vs SD as the blasting progressed. Summary plots of PPV with SD are presented in this report for different zones and structures on the site.

BACKGROUND MONITORING

Prior to production blasting the seismographs were set at sixteen locations to check the background vibrations and air pressure resulting from existing site conditions and traffic. The locations are described on Table I-1 and shown on Figure 2.

Table I summarizes the maximum PPV and air pressure noted at specific dates and times. A maximum background PPV of 0.31 ips was for on-site vehicular traffic at MP-3 and 0.17 ips for vehicular traffic on Driving Park Avenue.

MONITORING BLAST VIBRATIONS

During blasting operations the four geophones and seismographs were moved in stages as the blasting progressed from Sta. 0+00 to Sta. 12+20. Monitoring locations were selected provide vibration information in the following areas or structures:

- the ground surface on the northeast side of Driving Park Avenue;
- the ground surface by AC Rochester buildings and structures;
- door sills of the Die Cast Building;
- on the 6-inch diameter RG&E gas main which crosses the blasted trench at Station 8+88 and is approximately four feet below ground surface;
- the ground surface above the Pure Waters Tunnel;
- rock at invert elevation for the Pure Waters Tunnel approximately 15 feet from tunnel centerline; and
- inside the Monroe County Pure Waters tunnel at Manhole 63.

The data recorded in each area or at each relative position are summarized on plots of PPV with SD and included in this report for reference.

BLASTING OPERATIONS

AC Rochester contracted Nothnagle Enterprises Inc. of Scottsville, New York (Nothnagle) to install the blasted-bedrock trench which included drilling a total of 245 holes at 5-foot intervals along the proposed trench alignment to depths of 48 to 50 feet. The holes typically encountered both soil overburden and rock.

The thickness of soil varied from 18 to 33 feet. Soil depths of 28 to 33 feet were noted from Sta. 2+90 to 3+00 and depths of 27 and 28 feet were noted from Sta. 3+95 to 4+20 and from Sta. 10+25 to Sta. 10+70. The soil thickness encountered in the remainder of the trench typically ranged from 18 to 23 feet.

Each hole, except the six holes in the test blast program, was loaded with 30 to 32.5 pounds of Austin Extra Gel 40 percent and detonated in sequence of 10 to 17.5 pounds per delay using 25 millisecond delays.

Prior to production blasting, a test blast program was conducted on 21 April 1992 to evaluate the site response. The test program consisted of two blasts of two and four holes, respectively. In Test Blast No. 1, four decks of 10 pounds per delay were used in hole 1 while hole 2 had three decks of 10 pounds and one deck with 12.5 pounds, for a total of 42.5 pounds per hole and a maximum of 12.5 pounds per delay.

Test Blast No. 2 included four holes loaded with 15 pounds in each of three decks, or 45 pounds per hole with a maximum of 15 pounds per delay.

A maximum PPV criteria of 2 and 7 ips at the ground surface, was specified by H&A of New York for nearby building structures and above the Pure Waters Tunnel, respectively. The specified limit for air overpressure was 0.014 psi. Additionally, it was agreed with the Monroe County Department of Engineering to notify them if PPVs exceeded 5 ips at or near the tunnel lining.

SUMMARY OF VIBRATION MONITORING

The following sections summarize the data recorded by the seismographs at selected locations near the blasted trench.

Background Conditions

The background vibration and air overpressure values recorded at the 16 locations noted on Figure 2 are summarized on Table I. The maximum background PPV ranged from 0:02 to 0.31 ips. The higher values were noted at MP2, MP6, MP8 and MP13 and were associated with vehicle traffic on Driving Park Avenue or in the AC Rochester plant. Background air overpressure values ranged from 94 to 136 decibels, or approximately 0.0001 to 0.018 psi.

Ground Surface North of Driving Park Avenue

This area generally coincides with the boundary edge of the nearest private property and ranges from 270 to 335 feet from the blasted rock trench. Vibrations were recorded at eight locations during 27 production blasts from 22 April to 28 May 1992 with the seismograph set for a trigger level of 0.15 ips.

The PPV values with SD for this area are presented on Figure 4. PPV ranged from 0.18 to 0.63 ips and frequencies ranged from 16 to 100 hz. Air overpressures recorded at these locations ranged from 0.00087 to 0.00116 psi.

Ground Surface At AC Rochester Structures

Vibrations at ground surface adjacent to AC Rochester structures were monitored at four locations between 22 and 30 April 1992 during blasts 1 through 8. The ground distances ranged from 78 to 307 feet from the blast point.

Figure 5 shows the general relation of PPV to Scaled Distance for this area. PPV ranged from 0.27 to 2.17 ips and frequencies varied from 29 to 51 hz. Air overpressures recorded at these locations ranged from 0.00116 to 0.00319 psi.

Building Door Sills At Die Cast Building

Vibrations at the North end of the Die Cast structure were monitored at three door sills during blasts 8, 16, 17, and 18 which occurred between 30 April 1992 and 13 May 1992. The building foundation apparently consists of a reinforced concrete grade beam wall supported on drill pier foundations bearing on rock. Approximately 6 feet of the grade beam is exposed at the north end of the Die Cast Building.

Ground distances from the Die Cast Building to the blasted rock trench ranged from 118 to 148 feet. The PPV with Scaled Distance data are plotted and specifically noted on Figure 5 for reference to the data obtained just outside the building. On this structure the recorded PPV ranged from 0.23 to 0.43 ips and frequencies ranged from 31 to 100 hz. Air overpressures recorded at these locations ranged from 0.00145 to 0.002 psi.

Six-inch Diameter Gas Main

Vibrations on the 6-inch diameter RG&E gas main which crosses the blasted trench at Sta. 8+88 were monitored by a geophone on the gas main. The location of the gas main was marked by Rochester Gas and Electric (RG&E) personnel on 21 April 1992 and the gas main was exposed by Nothnagle on 14 May 1992 with observation by RG&E personnel. The geophone was installed on the gas main and held in place with a sandbag and loose fill in the excavation.

Vibrations were monitored during eleven blasts from 14 May to 28 May 1992. During that time the ground distances from the geophone to the blast hole ranged from 2 to 257 feet. The plot of PPV with Scaled Distance is shown on Figure 6. PPV ranged from 0.18 to 8.04 ips and frequencies varied from 9 to 56 hz. Air over-pressures recorded at these locations ranged from 0.00116 to 0.00493 psi.

Ground Surface Above Pure Waters Tunnel

Vibrations at the ground surface above the Pure Waters Tunnel were monitored at three locations during blasts 7, 8, 9, 10, 15, 29 and 30 which occurred between 29 April and 28 May 1992. The ground distances ranged from 58 to 194 feet from the blasted trench.

The general relation of PPV to Scaled Distance for this zone is shown on Figure 7. The recorded PPV ranged from 0.63 to 1.27 ips and frequencies varied from 11 to 47 hz. Air overpressures recorded at these locations ranged from 0.0016 to 0.0052 psi.

Rock At Pure Waters Tunnel Invert

Vibrations in the bedrock at approximate tunnel invert elevations were monitored at three locations marked as GB-1, GB-2 and GB-3 on Figure 2. The geophone was set in a borehole drilled approximately 15 feet from the tunnel centerline. The special geophone for the drillhole consisted of a 3-inch diameter by 5-inch high unit with a 50 foot long cable to allow reading at the surface. The geophone was set in a 5-inch diameter borehole and surrounded with tamped sand to hold the geophone in position and provide approximately 5 feet of cover.

Vibrations at the three locations were monitored during 28 blasts which occurred between 22 April and 28 May 1992. The ground distances ranged from 56 to 264 feet from the blasted rock trench.

Figure 8 summarizes the data recorded in rock near the tunnel invert. The PPV ranged from 0.34 to 3.38 ips with frequencies varying from 16 to 86 hz. Air overpressures recorded at the surface at these locations ranged from 0.00094 to 0.00355 psi.

Pure Waters Tunnel At Manhole 63

Vibrations on the sidewall in the tunnel were monitored at one location adjacent to the Station 63 Manhole on the Pure Waters Tunnel. The Station 63 Manhole is approximately 67 feet north of Sta. 8+45 on the blasted rock trench. The geophone was mounted on a steel bracket bolted to the vertical side of the tunnel on 15 May 1992 and installed under the oversight of Rochester Pure Waters District personnel. Figure 3 indicates the approximate position of the geophone inside the tunnel. The geophone cable was extended to the surface to allow daily monitoring without entering the tunnel.

Vibrations in the tunnel were monitored for eleven blasts between 15 and 28 May 1992. The ground distances ranged from 67 to 356 feet from the blast points and the recorded PPV with Scaled Distance are shown on Figure 9. The PPV ranged from 0.156 to 3.9 ips. Air overpressures recorded at the ground surface at Manhole 63 ranged from 0.00087 to 0.00312 psi.

SUMMARY

In summary, the PPV monitored by the onsite seismographs did not exceed the limits specified in the blasting contract which were 2 ips at the ground surface near AC Rochester or off-site structures, and 7 ips at the ground surface above the Pure Waters Tunnel

The recorded maximum PPV were also less than the 5 ips threshold requiring verbal notification to MCDOE. The maximum PPV recorded at the ground surface in proximity to the tunnel was less than 1.3 ips, and the maximum PPV inside the tunnel was less than 3.9 ips.

The maximum PPV observed at the offsite monitoring locations ranged from less than 0.15 ips to 0.630 ips, well below offsite vibration (and frequency) criterion suggested by NYSDEC or required by the blasting contract for offsite structures.

The interior of the tunnel was visually examined by Pure Waters personnel on 11 May 1992 and on 1 June 1992. Monroe County Department of Engineering personnel reported that no unusual conditions or damage was noted during the two inspections (Appendix B).

Please contact us you have any questions about this information or require additional information.

Sincerely yours,
H&A OF NEW YORK

Marvin D. Oosterbaan, P.E.
Senior Consultant

Jeffrey E. Loney
Senior Hydrogeologist

Stanley E. Walker, P.E.
Vice President

MDO/SEW/jc/mdo:048
Enclosures: