# HYDROGEOLOGIC INVESTIGATION/ BACKGROUND DATA REVIEW:

# THE IMPACT OF SAND AND GRAVEL MINING ON GROUNDWATER RESOURCES

AUGUST 12, 1988

Presented By:

BCI GEONETICS, INC.

Airport Road
P.O. Box 529
Laconia, NH 03247

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## I. INTRODUCTION

BCI has completed a Hydrogeologic Investigation of the impact of sand and gravel mining on groundwater resources. The intent of this investigation was to evaluate whether or not the excavation of gravel above and below the water table has or has not been detrimental to groundwater quality and quantity. BCI's work was based on a comprehensive systematic review of existing studies and data that would provide scientific evidence for either scenario.

This study was divided into three parts which include the following:

1) A comprehensive scientific literature review to identify any previously completed hydrogeologic research related to the impacts of gravel mining on groundwater resources.

2) A review of interviews conducted with 40 Water Superintendents who manage groundwater resources in New Hampshire which are proximal to gravel mining activities.

3) An investigation of the impacts that gravel mining has had on New Hampshire municipal groundwater supplies.

## II. INFORMATION SOURCES

### A) Literature Research

In order to minimize the redundancy of completing work that may have already been accomplished elsewhere, this project began with a systematic computer library search of available documents related to gravel mining and groundwater resources. Since we did not anticipate discovering substantial local research that was relevant to this project's concerns, we expanded our computer search service to cover both national and international data bases.

Sources of information used in this investigation includes the following:

1) United States Soil Conservation Service (SCS)

2) NERAC, Inc.
NERAC, Inc. is a NASA-sponsored technology transfer service established in 1966 to provide American industry access to technical and business information drawn from NASA and other government agencies, as well as professional and academic organizations worldwide. NERAC is the world's largest university- based computerized information retrieval center and has one of the most complete document retrieval and forwarding services available. Through NERAC's services, BCI obtains reports, periodicals, conference papers, annual reports, product literature, and test reports, as well as U.S. and foreign patent information, from major libraries and information centers worldwide.

3) National Ground Water Information Center (NGWIC)
The National Ground Water Information Center Data Base, Ground Water On-line (GWOL) is a computerized bibliographic data retrieval service operated by the National Water Well Association. Users of GWOL can design and conduct customized searches of over 50,000 documents pertaining to groundwater and related fields. Indexed documents include trade and technical journals and newsletters, significant books, and government documents, with special emphasis on EPA project reports. State publications, university reports, and proceedings of national and international conferences and symposia are also cited.

4) U.S. Bureau of Mines

5) United States Geological Survey (USGS)

6) State groundwater and mining regulatory agencies in New Hampshire, Massachusetts, New York, Maine, Connecticut, Vermont, and Ohio.

Only fifteen documents were identified through these computerized data base searches that were related to impacts of gravel mining on groundwater resources. Appendix I lists the identified reference materials BCI had available for review. We found relatively few documents which describe observed hydrogeologic impacts on groundwater related to active gravel mining operation. Many references focus primarily on the use of gravel pits after operations have ceased. Furthermore, we found no scientific documentation containing evidence that the activity of mining gravel above or below the water table was detrimental to an underlying aquifer.

The following provides a brief description/summary of several of the most relevant documents.

Landberg, J., 1982, Hydrogeologic Consequences of Excavating Gravel Pits Below the Water Table in Glaciofluvial Deposits.

This paper, submitted as a doctoral thesis in Sweden, represents a fairly comprehensive study on the relationship between gravel pit lakes and groundwater with respect to impacts on groundwater flow. Landberg developed a mathematical model of the groundwater budget for gravel pit lakes based upon two shape factors which relate the geometry of the lake to horizontal and vertical groundwater flow. Combining this model with the specific hydrogeological characteristics of each site, the groundwater inflow and outflow of gravel pit lakes was estimated. Hydrogeologic data collection included the emplacement of monitoring wells which documented the effects on groundwater gradients.

Landberg suggested that a possible effect of a gravel pit lake on the hydrologic system would be the modification of the groundwater gradient. He had gathered information from German studies that indicated that a build-up of sediment developed along the down-gradient margin of such lakes, thus resulting in the raising and lowering of the water table on the downstream and upstream margins of the lake, respectively. In Sweden, however, he could not document any significant sediment build-up even on 25 year-old gravel pit lakes. Landberg attributes this to the high permeability of the sediments in his study area. His work concludes that the impacts on groundwater gradients in gravel pit excavations in permeable sand and gravel deposits (common to most aggregate excavation operations) is likely to be negligible.

Svedarsky, W. Daniel, Crawford, Richard D., eds, 1982, Wildlife values of gravel pits' symposium proceedings, June 24-26, 1982.

The symposium proceedings describes numerous examples and approaches to the utilization of gravel pit lakes as a wildlife refuge. This publication serves as an invaluable source of information on all aspects of wildlife development in gravel pit ponds and lakes created by gravel mining activity. In Gustav Swanson's summary of the symposium he states, "sand and gravel mining is a temporary land use. When the aggregate has been mined, the area will simply be abandoned or put to some other use. The abandonment, so usual in earlier days occurs much less often today because so many states and local governments have reclamation requirements. Our interest at this meeting is that the potential for fish and wildlife, being the "other use," shall be recognized and considered."

Gustav Swanson goes on to say,

"For a bit of historical perspective we must go to Britain where they have accurate information on the sand and gravel industry as early as the last century. The wildlife values of gravel pits were widely recognized rather suddenly in 1931 when a nationwide census of the rare and spectacular Great Crested Grebe revealed that many of them were using gravel pits. Later that same decade the first nesting record for Britain of the Little Ringed Plover was at a gravel pit. The latest census of these two exceptionally interesting species showed 22% of the Great Crested Grebes and 70% of the Little Ringed Plover inhabiting gravel pits. It is clear that the availability of the gravel pits has contributed substantially to the increase of these two species."

"Thus, the British experience with gravel pits as wildlife habitat, both managed and unmanaged, is much longer than ours here in the States, so it is fortunate for us that Dr. Tydeman could be here to describe it to us. His description of the sequence of events in Britain is helpful, because we, a few decades later, will be going through the same general sequence and we should be able to learn from their experience."

"The four phases which Tydeman recognized in Britain's historical sequence are just as applicable here: First is ignorance of the value of pits to wildlife, then awareness, then conflict, and finally cooperation. We are still largely in the ignorance phase, and we hope that this symposium will help bring us along to the awareness phase so that progress can be accelerated."

This symposium had thirty-six papers submitted related to the positive impacts that gravel pits had on wildlife development. Gustav Swanson summarized and lists sixteen management recommendations for maximizing wildlife development in gravel pit lakes and gravel pit excavations.

Mulamoottil, A. and Robert Farvolden, 1975, Planning for the rehabitation of gravel pits, Water Resources Bulletin, Vol. 11, No. 3, pp 599-604.

A paper by Mulamoottil and Farvolden (1975) indicates that no variation in natural groundwater flow rates or the total water budget were detected as a result of the creation of gravel pit lakes.

Karn, Richard W., 1977, Reclamation of open-pit quarries for multiple uses, Journal of Urban Planning and Development Division, Vol. 103, No. UP1, pp 127-135.

Karn (1977) provides examples of former gravel operations being used as artificial groundwater recharge zones. One water district has been using artificial recharge for 30 years and plans to expand the operation.

B) Case Studies - Impacts of Sand and Gravel Mining

BCI's data research also identified several undocumented case histories of mining activities and their impact on groundwater resources.

1) Dover, New Hampshire

A municipal well field in Dover, New Hampshire, depends on the artificial recharge caused by a nearby sand and gravel wash operation to supply the necessary water for extraction. When the sand and gravel mining and wash operation shut down for a period of years, one of the wells dewatered to a point where no more water could be extracted without damaging the pump. After operations at the wash operation started up again, artificial recharge increased the water available to the wells, thus increasing potential well yields. As a result of the wells' dependency on the sand and gravel wash operation for recharge, the City of Dover now artificially recharges the aquifer when the sand and gravel mining operation is not operating.

To date, the water quality in the well field is excellent, with no indication that the sand and gravel operation on which the wells depend has degraded the groundwater quality in any way.

2) Dayton, Ohio

The City of Dayton, Ohio enhances the total capacity of its well field considerably through artificial recharge via surface water bodies created by excavating sand and gravel resources (personal communication, Mr. Ben Parquette, Dayton Water Department, 1988). The total potential yield of the well field exceeds 100 million gallons per day from 53 wells. In addition, American Aggregates Corporation has excavated over 350 acres of lakes in or proximal to the Dayton, Ohio well field, creating a multiple-use facility for recreation and groundwater recharge (personal communication, Gary Johnson, American Aggregates, 1988). A quote from a report concerning the Dayton, Ohio, Mad River Well Field states that "The construction of man-made lakes, ponds, and aqueduct systems has caused more than a two fold increase in available quantity of water, while generally not compromising the quality of the water supply," (Bonded Concrete, 1987).

The operation of the well field begins with the diversion of water from the Mad River into a series of ponds excavated by sand and gravel mining operations. The water is naturally cleansed as it infiltrates through the sand and gravel, and it is then removed through a series of wells for treatment (the water is treated for hardness, because of the naturally high concentration of calcium and magnesium) and eventual consumption. Gravel mining has occurred since the 1920's in and around the Dayton, Ohio well field with no detrimental impact on water quality. In fact, regular dredging of the ponds to remove silts deposited by the diverted surface water is accomplished while the well field is in operation with no evidence of water quality degradation.

Ordinarily, the specific yield of a sand and gravel aquifer is around 0.20 or 20% of the volume of the subsurface material that is available to store water. The creation of an open water body allows 100% of that volume to be used for water storage thereby increasing the specific yield of the aquifer. A review of the historical performance of the Dayton well field clearly illustrates that the creation of ponds and lakes, via gravel mining, has provided the City of Dayton with positive benefits by increasing the groundwater withdrawal capacity of the aquifer.

3) Bonded Concrete, Rotterdam, NY

Bonded Concrete, Inc. of Watervliet, New York, operates a sand and gravel mine in Rotterdam, New York, near the Mohawk River. They have conducted a detailed hydrogeologic investigation on the impact of the operation on nearby wells, with special emphasis on the impacts of gravel mining on water quantity and quality relative to the expansion of a pond (Bonded Concrete, 1987). The results of their study demonstrate that the expansion of the pond will increase the flow rate through the aquifer in the vicinity of the well by 130 to 250 percent. This is a significant expansion of the capacity of the aquifer to provide water to pumping wells.

The geometry of the aquifer and the location of the pumping well causes water from the Mohawk River to flow into the aquifer. This increases the availability of water, but also represents the introduction of relatively dirty surface water into the aquifer. The study by Bonded Concrete (1987) indicates that the natural filtering capacity of the sands and gravels left in place is sufficient to purify any water which is entering the operation from the Mohawk River, even though there is a decreased filtering capacity caused by the removal of the excavated material. The creation of a lake within the aquifer minimizes the concentration of harmful micro-organisms because they are not likely to survive in the physical and chemical setting of a gravel pit lake. Those that do exist are filtered by the remaining material, so that the lake-aquifer system acts as a double filter system which acts to purify aquifer water better than the natural cover which was previously in place (Bonded Concrete, 1987).

4) For Ossipee Aggregates facility, Ossipee, New Hampshire, see Appendix III.

## III) New Hampshire Groundwater Supplies -- A Study of Potential Impacts of Sand and Gravel Mining on Municipal Wells

### A) Geographic Location Review

In order to determine the geographic relationship between New Hampshire sand and gravel excavations and New Hampshire public supply wells a thorough map review was undertaken. Latitude and longitude data for public supply wells were taken from Reference No. 1*. These well location data were then plotted on to 1:24,000 scale U.S. Geological Survey Topographic Maps. These maps were reviewed to determine the number of sand and gravel excavations within a one half mile radius of the wellhead. The results of this review are summarized below.

- 232 Public Supply wells were identified comprising 74 water supply systems. There are a total of 116 water supply systems in the state.
- There are 91 wells with one or more gravel excavations within a one half mile radius.

*Reference No. 1: New Hampshire Water Supply and Pollution Control Commission, 1983, Public Water Supplies Facilities and Policy Summary, Concord, New Hampshire

- There are 28 wells with one or more gravel excavations within a 1000 foot radius.

- There are 17 wells with one or more gravel excavations within a 500 foot radius.

- 41 of the 63 topographic quadrangle maps utilized were updated between 1978 and 1987.

- 29 of the 63 topographic quadrangle maps utilized were updated between 1984 and 1987.

Given the age of the data utilized in this analysis these statistics are fairly representative. However, many of the newer operations are not highlighted on topographic maps and some of the older ones are developed or have been reclaimed with vegetation. Because the number of public supply wells has increased since 1983 and the number of new gravel excavation locations has also increased, the number of wells proximal to gravel excavations is likely to be greater than the statistics above indicate.

B) Water Superintendent Interviews

In order to gain some perspective on this issue from the water suppliers point of view, seventy-four (74) water systems were identified for contact by reviewing Reference No. 1. The identified water systems were listed as having one or more wells. Of the seventy-four systems identified, forty (40) water superintendents were contacted and asked the following questions:

- Do you know of any active or inactive gravel mining operations within one-half mile of your well(s)?

- Do you know of any water quality trends in your well(s) that you think may be attributable to sand and gravel mining operations?

- Do you feel that sand and gravel mining may have a detrimental impact on groundwater quality?

A summary of the statements made b y the New Hampshire Water Superintendents during the interview are included below:

- There are a total of 110 wells that are part of the 40 water systems contacted (some of the wells are part of a well field).

- 34 of the 110 wells were reported to have an active or abandoned gravel operation within a one-half mile radius.
- No water superintendents reported any water quality trends that they attributed to impacts from sand and gravel operations.
- 5 water superintendents feel that sand and gravel mining operations may pose a threat to groundwater quality - with particular concern about on-site operation practices.
- One water superintendent was concerned with the potential for groundwater quantity reductions from sand and gravel mining operations.

## IV. GROUNDWATER QUALITY INVESTIGATIONS RELATIVE TO NEW HAMPSHIRE MUNICIPAL WATER SUPPLIES

Water quality data for 18 gravel-packed or naturally- developed gravel municipal wells located within 1000 feet of an active or abandoned gravel mining operation were obtained from the State of New Hampshire, Department of Environmental Services. Our review of this information, along with the histories of the mining operations, was performed in an attempt to identify any documented water quality data that suggested gravel mining activities had detrimentally impacted municipal water supplies.

### A) Selection of Municipal Wells Proximal to Mining Operations For Analysis

Information collected during the Geographic Location Review and the Water Superintendent Interviews was used to locate wells within 1000 feet of existing or abandoned gravel pits. A field visit to each of the locations confirmed the existence of the mining operations and their proximity to municipal wells or well fields. Eighteen (18) municipal gravel-packed or naturally-developed gravel wells were identified in eleven (11) well fields. These well field are located within ten (10) different communities (Figure 1). The characteristics of individual wells and associated mining operations are listed in Table I.

The municipal wells are located an average of approximately 500 feet away from the mining operations, and have operated an average of 26 years each. Sixteen (16) of the municipal wells are located down-gradient from the gravel mining operations under natural groundwater flow conditions (Table I). However, because of the transmissive nature of sand and gravel aquifers, all of the wells will create a cone of depression under pumping conditions which will extend beneath the gravel pits. Therefore, some of the water which is being removed from the aquifer is being contributed from the area of the mining operation in each case. The actual amount being contributed to each well is site specific and is dependent on the pumping rate, the transmissivity of the aquifer, natural flow conditions, and the size of the mining operation. Most contributing areas to a well or well field are large when compared to the size of many gravel pits, so that if changes in water chemistry occurred, they would be minor.

The gravel mining operations have been operating for an average of about 23 years and have an average size of 40 acres. However, only five (5) of the mining operations have areas greater than or equal to twenty acres. The activity at each operation varies from a simple sand borrow operation with no trucks stored on site to large-scale mining operations including mining, crushing, and washing with the storage of trucks and fuel on site (Table I).

B) Water Quality Results

In general, the water quality results (which the State of New Hampshire has on file) suggest that the water quality is excellent in all eighteen (18) wells. Some violations of secondary drinking water standards can be found, but no parameters can be found above standards which present a health risk. Furthermore, it was found that the limited number of violations in secondary standards were not associated with the activity of excavating sand and gravel. The number of samples taken from a well since 1975 depends on the age of the well and varies between one and nine, most wells have had at least six samples taken. A total of 114 different samples were collected by the State of New Hampshire from the eighteen (18) wells over the period of sampling. Some samples contained a limited number of parameters and others included an entire suite of water quality parameters. No sample results were obtained for wells which do not exist near gravel pits. All water quality data has been included in Appendix II.

1) Primary Drinking Water Standards

Primary Drinking Water Standards have been established for parameters which present a health risk to water users. A total of 104 water quality samples which included at least one primary pollutant were taken from the 18 municipal wells since 1975 and the results are as follows:

* No volatile organic compounds (VOC) were detected in any of the wells throughout the sampling period. Volatile organic compound contamination from petroleum products (fuel, hydraulic fluid, etc.) is among the largest concerns of operating a mining

# SELECTED MUNICIPAL :LLS PROXIMAL TO GRAVEL PITS
# NEW HAMPSHIRE

| TOWN | NAME | YEARS OF WELLFIELD OPERATION | NUMBER OF WATER QUALITY TESTS COMPLETED | APPROX. DISTANCE FROM PIT | UP OR DOWN GRADIENT | SIZE OF OPERATION (ACRES) | YEARS OF PIT OPERATION | TYPE OF OPERATION | FUEL STORAGE |
|---|---|---|---|---|---|---|---|---|---|
| Dover | Griffin | 12 | 9 | 100' | Down | 60 | 33 | Sieve, Crush, Washing | Yes |
| Dover | Ireland | 28 | 7 | 200' | Down | 60 | 33 | Sieve, Crush, Washing | Yes |
| Dover | Calderwood | 16 | 9 | 300' | Down | 5+ | 15+ | Borrow Pit | No |
| Newmarket | Bennett | 14 | 4 | 400' | Up | 5 | 10+ | Abandoned | No |
| Somersworth | GPW 1 | 53 | 2 | 500' | Down | 6-7 | 10-20 | Sand Borrow Pit | No |
| Somersworth | GPW 2 | 50 | 5 | 500' | Down | 6-7 | 10-20 | Sand Borrow Pit | No |
| Franconia | McGowen 350' | 37 | 7 | 700' | Down | 2.5 | 40+ | Borrow Pit | No |
| Pembroke | GPW 2 | 24 | 6 | 1000' | Down | 20 | 2 | Sand Borrow, Truck Storage | No |
| Pembroke | GPW 3 | 37 | 6 | 1000' | Down | 20 | 2 | Sand Borrow, Truck Storage | No |
| Hooksett | GPW Route 3 | 32 | 8 | 200' | Down | 200+ | 30-40 | Sieves, Crushers | No |
| Hooksett | Manchester Gravel | 23 | 9 | 200' | Down | 200+ | 30-40 | Sieves, Crushers | No |
| Hooksett | Industrial Park | 32 | 8 | 200' | Down | 200+ | 30-40 | Sieves, Crushers | No |
| Concord | GPW 1 | 60 | 7 | 600' | Down | 5 | 2 | Sand Borrow Pit | No |
| Concord | GPW 5 | 11 | 6 | 600' | Down | 5 | 2 | Sand Borrow Pit | No |
| Concord | GPW 7 | 11 | 6 | 900' | Down | 5 | 2 | Sand Borrow Pit | No |
| Belmont | GRW 2 (newer) | 9 | 8 | 800' | Down | 100 | 40 | Sand Borrow Pit | No |
| Hanover | Well #1 | 22 | 6 | 50' | Up | 2-3 | 50 | Sand Borrow Pit, Truck Storage | No |
| Durham | GPW-Lee | 2 | 1 | 400' | Down | 15 | ? | Sand Borrow Pit | No |

Table I

## NEW HAMPSHIRE COMMUNITIES WITH MUNICIPAL WELLS NEAR GRAVEL PITS, INCLUDED IN THE STUDY

Belmont
Concord
Dover
Durham
Franconia
Hanover
Hooksett
Newmarket
Pembroke
Somersworth

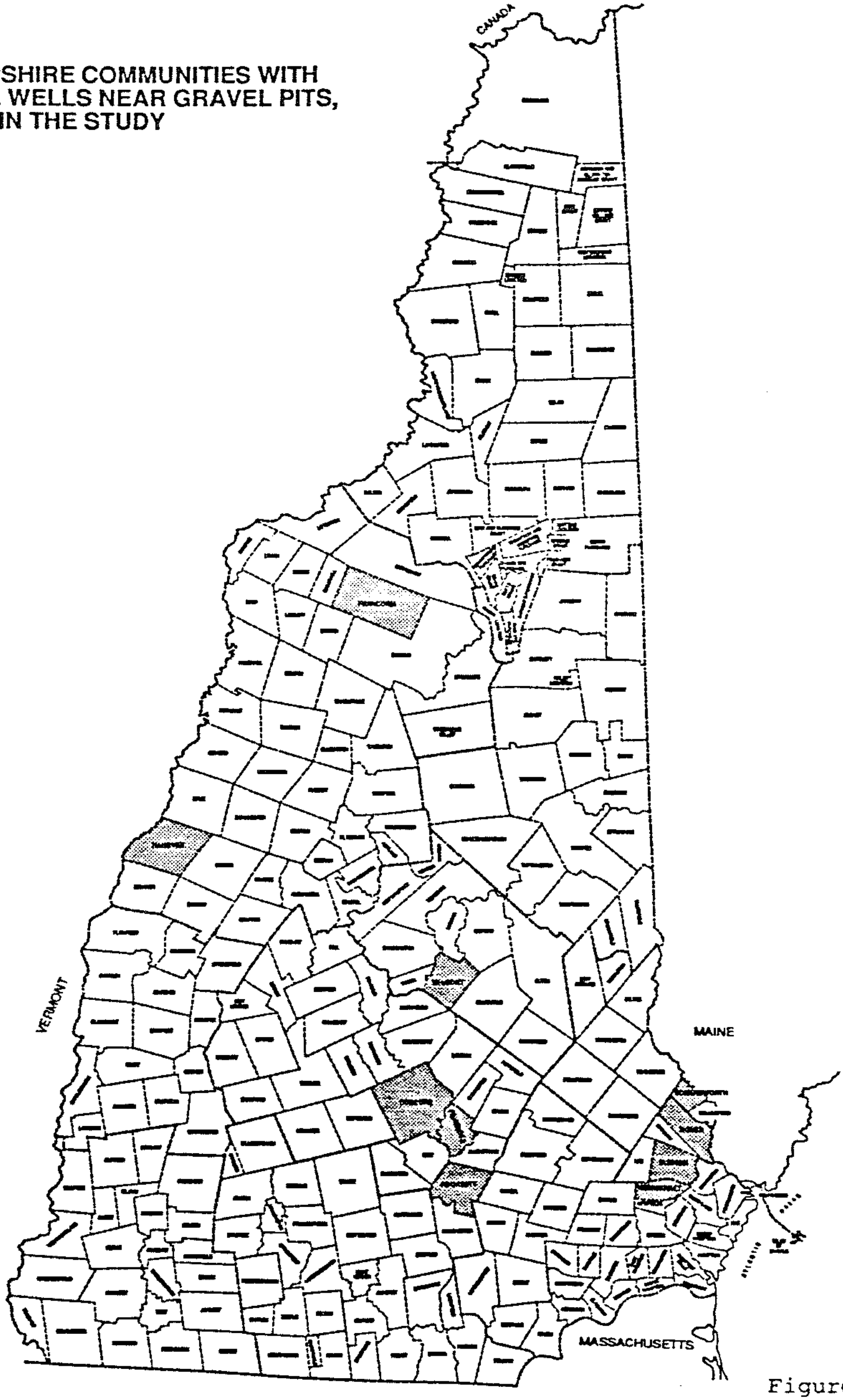



Figure 1

operation, but it has never appeared in any samples from the eighteen municipal wells near the mining operations.

* None of the eighteen (18) municipal wells showed primary water quality parameters above Drinking Water Standards for an extended period of time. Only three (3) of the eighteen wells had isolated samples with heavy metal (arsenic, selenium, and mercury) results above standards, but later tests showed all parameters were back below standards. These instances are likely attributed to analytical error in the laboratory. Arsenic, selenium, and mercury are not associated with any aspects of the operation of gravel mining.

Three wells each had one isolated occurrence of coliform bacteria above primary drinking water standards, but the bacteria was undetected in later tests.

2) Secondary Drinking Water Standards

Secondary Drinking Water Standards have been established for water quality parameters which do not pose a threat to the health of water users, but do create annoyances (i.e., staining of fixtures, color, taste). The three (3) major secondary parameters which are a problem in New Hampshire are iron, manganese, and pH.

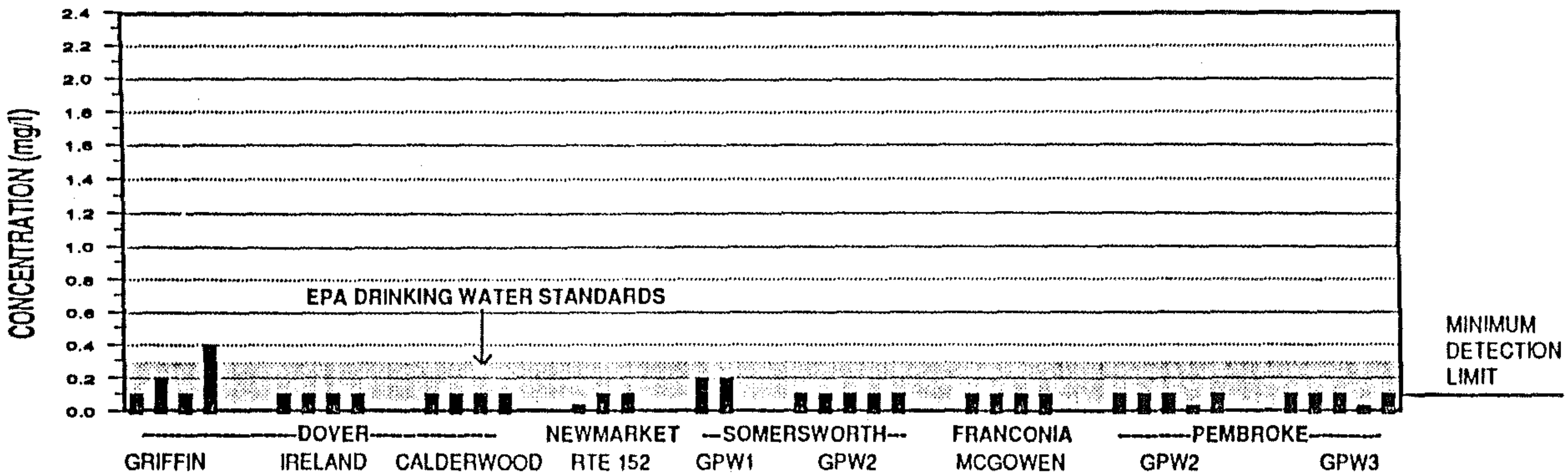
a) Iron

High concentrations of iron occur naturally in New Hampshire sand and gravel deposits, because many of the minerals which are found in the sand and gravel deposits contain iron. Although it is a common problem, only seven samples out of seventy-five (75) in the state files showed iron above secondary standards (Figure 2). These seven samples came from four wells and one well, Belmont GPW 2, had four of them. The well field in Concord, New Hampshire, illustrates the variation of iron concentrations in space and time. Concord well, GPW #7, had the highest concentration of iron observed from all eighteen wells (2.2 mg/l), yet three other samples from the same well are below standards (0.3 mg/l). The additional Concord wells in the same well field, GPW #1 and GPW #5, had a total of eight samples taken and not one showed iron concentrations above standards.

There is no evidence to suggest that iron concentrations have been increased by gravel mining operations existing adjacent to municipal well fields. There are no consistent trends among the wells to show a degradation of water quality over time in wells located near gravel mining operations. The variation in iron concentrations is likely a function of local geologic conditions, rather than the land use proximal to a well field.

## STATE OF NEW HAMPSHIRE WATER QUALITY DATA
## MUNICIPAL WELLS NEAR GRAVEL PITS
## 1975 - 1988

### IRON CONCENTRATIONS



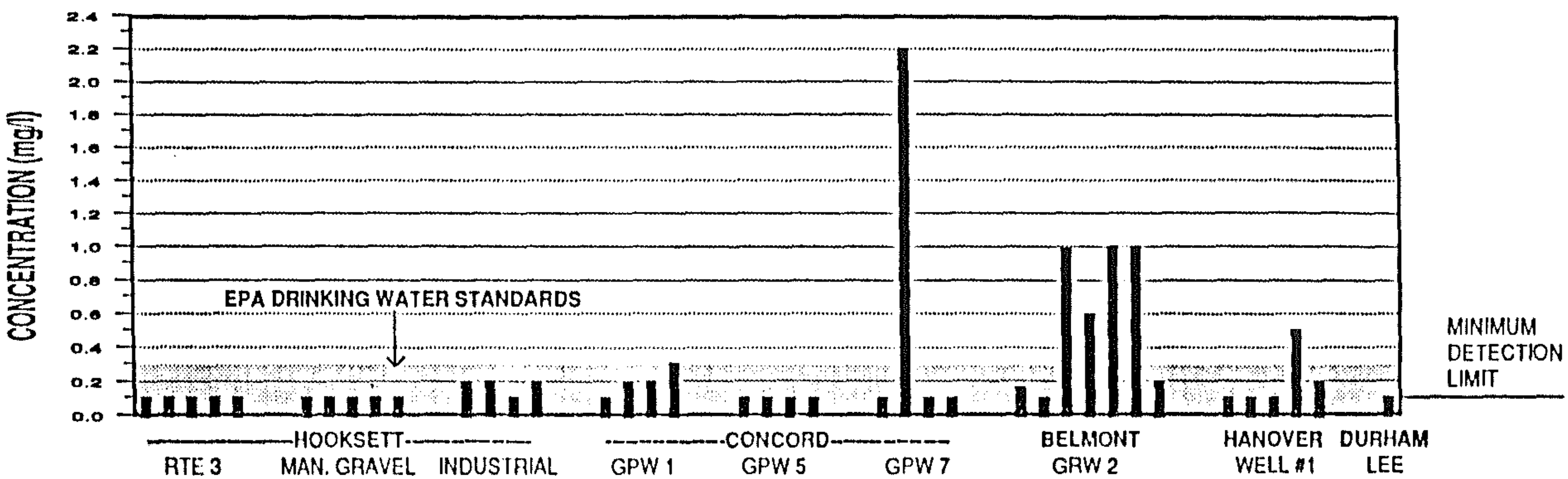




Figure 2

b) Manganese

Manganese occurs in similar environments as iron and is a common problem for many water suppliers in the State of New Hampshire. Like iron, manganese is often found above secondary standards and is variable in space and time (Figure 3). Pembroke Well GPW #2 and Concord Well GPW #7 have the highest concentrations of manganese out of all eighteen (18) wells, yet the gravel mining operations proximal to each have only been operating for two years. All of the samples at Concord were taken before the mining operation began. Only one sample was taken from Pembroke Well GPW #2 after mining began. This sample showed the lowest concentration of manganese ever measured in that well. It is evident that elevated levels of manganese in the water were not influenced by the excavation of sand and gravel in these two cases.

Overall, no water quality trends could be identified relative to manganese concentrations in these municipal water supplies. One-half of all the wells which data was obtained for showed levels of manganese above standards. Again, local hydrogeologic conditions are likely responsible for the variable, and sometimes unexpectedly high levels of manganese in groundwater.

c) pH

There is concern that gravel mining operations reduce the buffering capacity of subsurface materials by removing the soil layer from an area. The reduction in buffering capacity makes the groundwater sensitive to pH change and with the advent of acidic precipitation, groundwater pH values might be expected to be lowered.

The pH measurements collected from the State of New Hampshire show wide variations in the same well and between different wells (Figure 4). No water quality trends can be inferred from the data which suggest that pH values from wells near gravel mining operations are increasing or decreasing over time.

d) Other Secondary Standards

There were no other secondary standards (out of 13 others designated by the EPA) tested by the State of New Hampshire which showed a change in water quality from wells located near sand and gravel mining operations. Alkalinity and total hardness (Figures 5 and 6) did vary over time in several wells, but showed no trends. Both parameters remained well within the range expected of good quality drinking water in New Hampshire.

## STATE OF NEW HAMPSHIRE WATER QUALITY DATA
## MUNICIPAL WELLS NEAR GRAVEL PITS
## 1975 - 1988

### MANGANESE CONCENTRATIONS

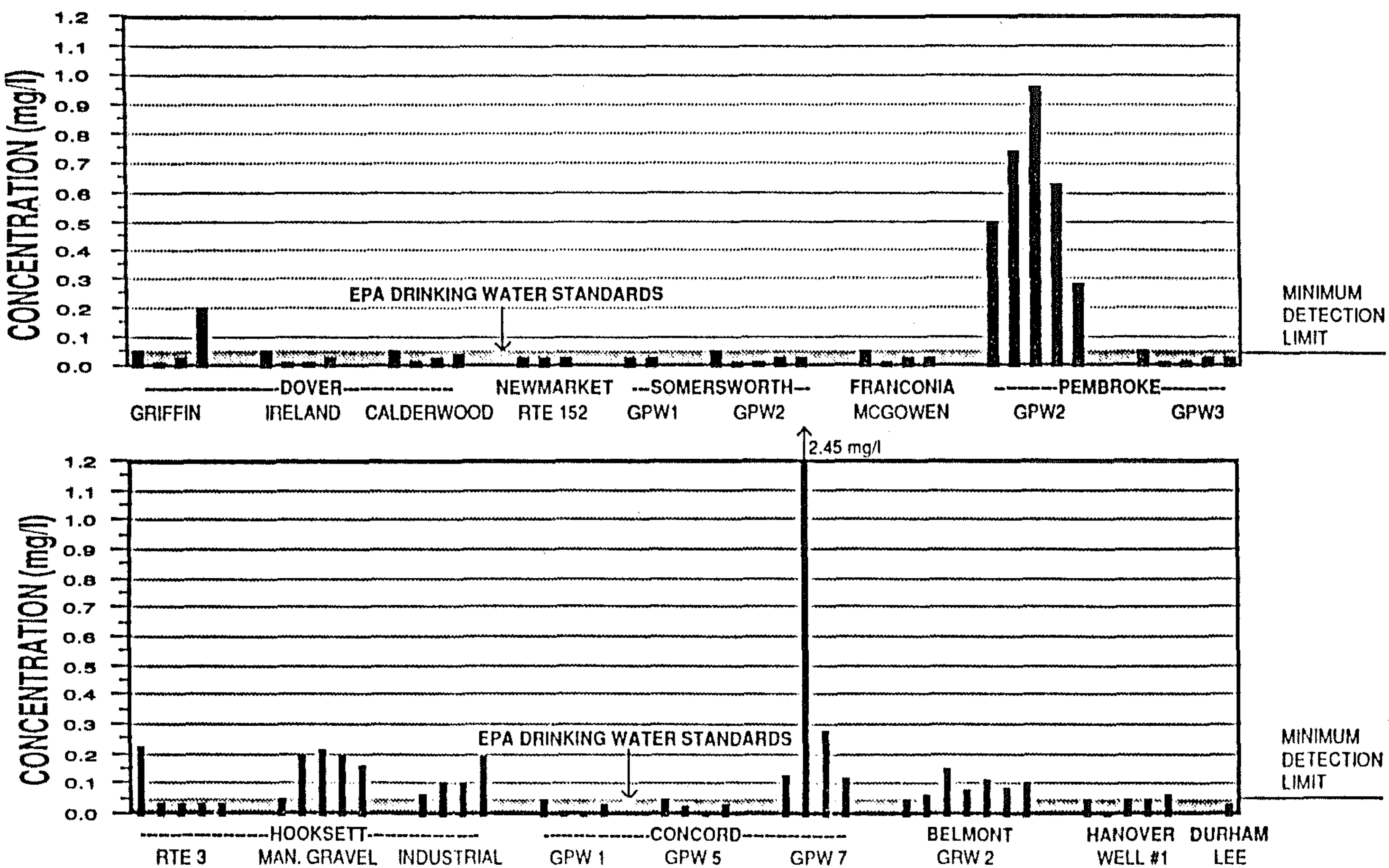
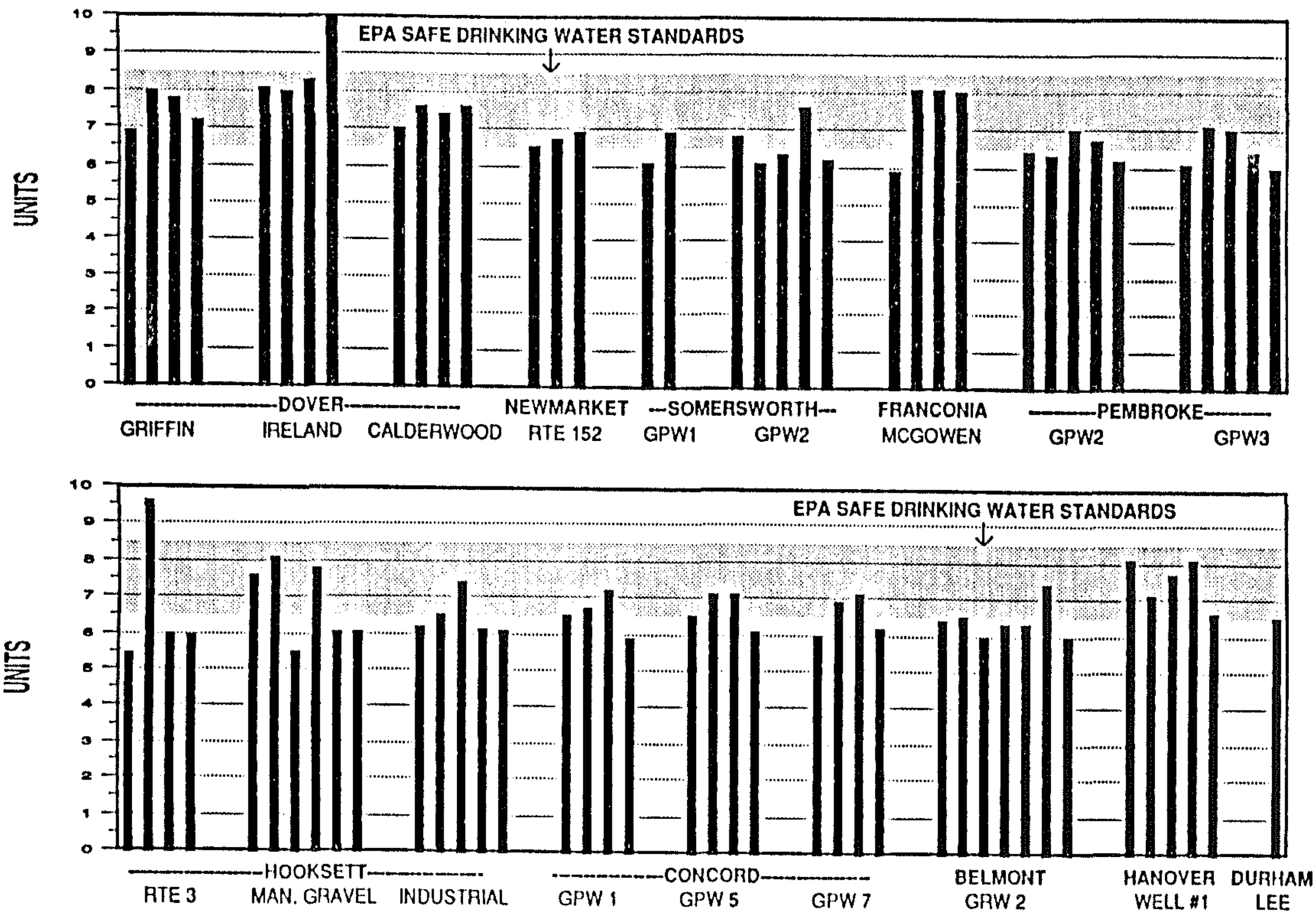



Figure 3

## STATE OF NEW HAMPSHIRE WATER QUALITY DATA
## MUNICIPAL WELLS NEAR GRAVEL PITS
## 1975 - 1988

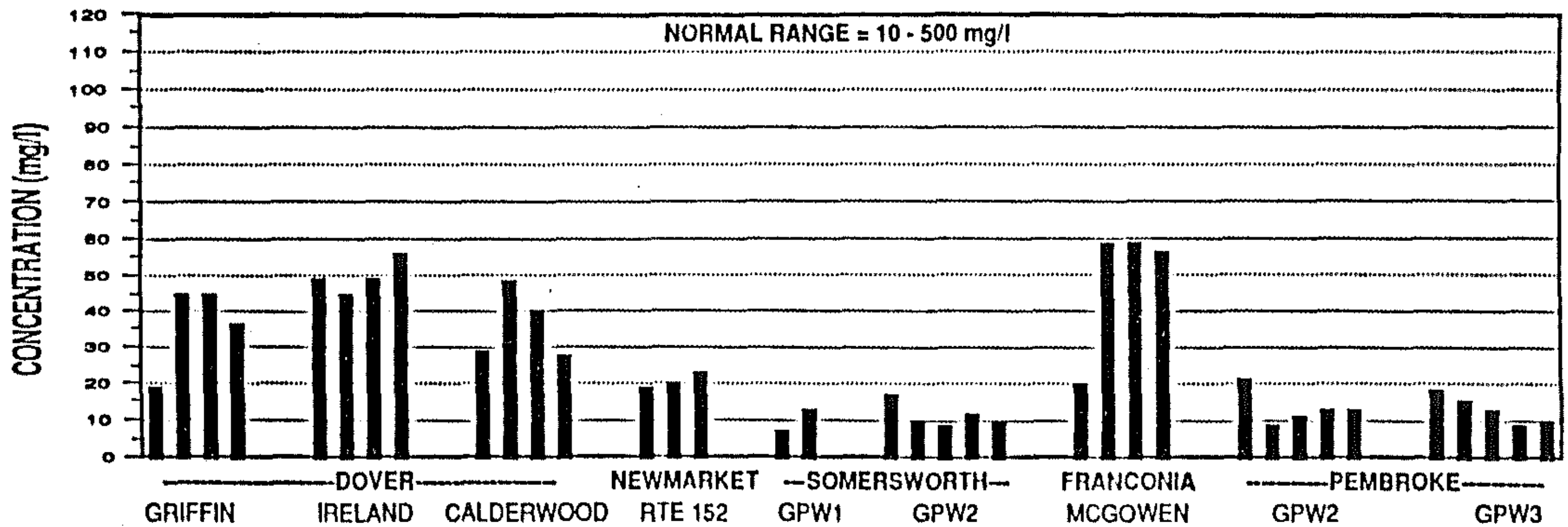
### pH MEASUREMENTS




Fiqure 4

## STATE OF NEW HAMPSHIRE WATER QUALITY DATA
## MUNICIPAL WELLS NEAR GRAVEL PITS
## 1975 - 1988

### ALKALINITY ($CaCO_3$)



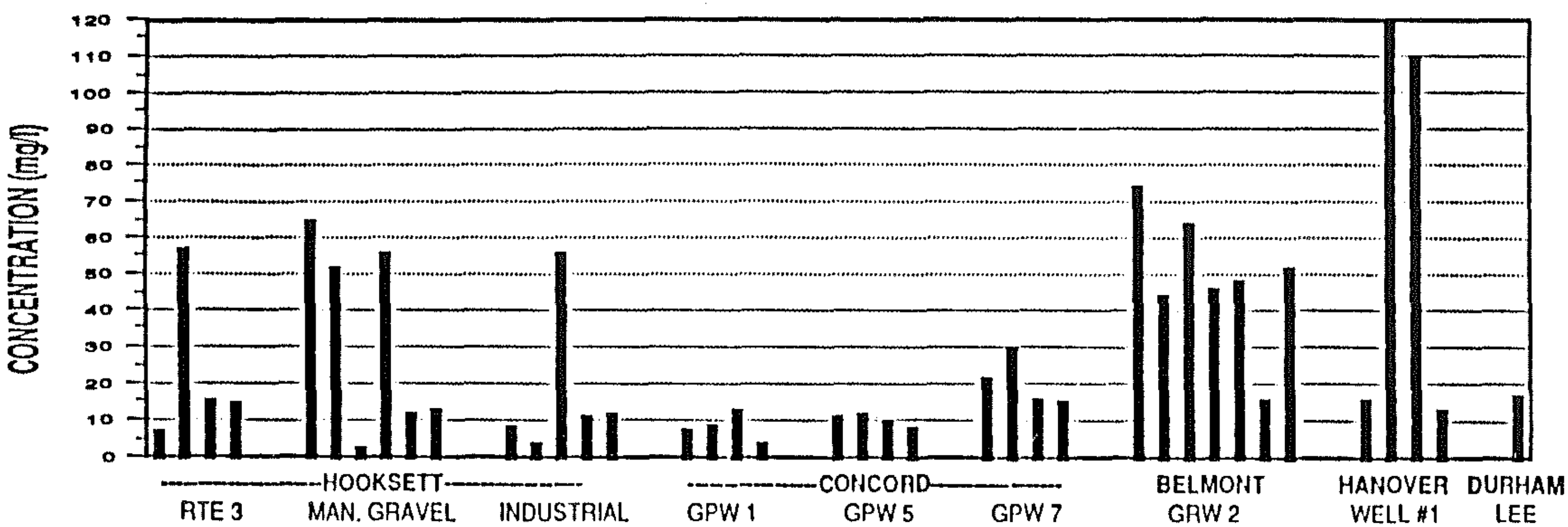




Figure 5

## STATE OF NEW HAMPSHIRE WATER QUALITY DATA
## MUNICIPAL WELLS NEAR GRAVEL PITS
## 1975 - 1988

### TOTAL HARDNESS ($CaCO_3$)

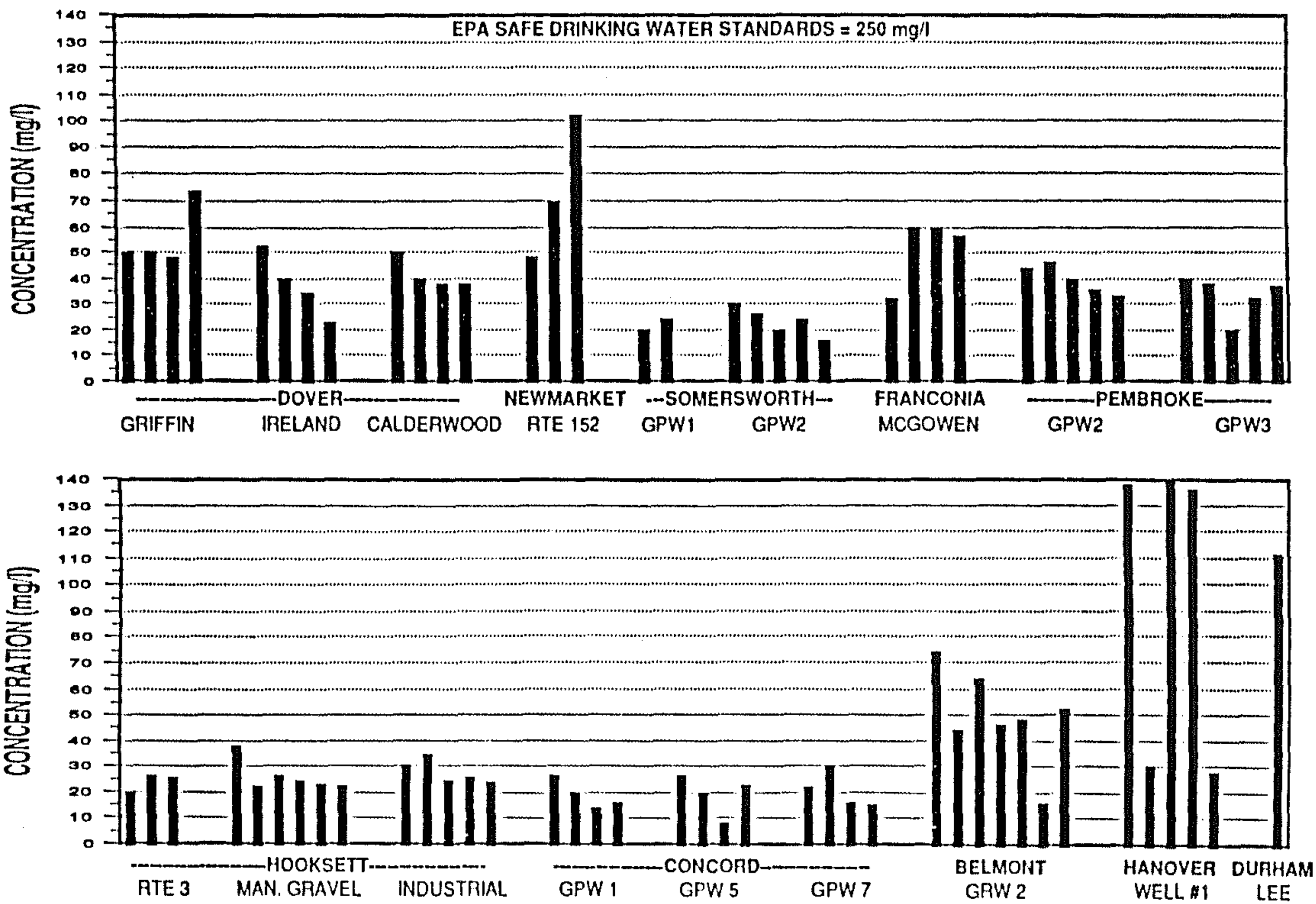



Figure 6

Values for total hardness did not exceed 140 mg/l in any well, the recommended EPA Safe Drinking Water Standard is 250 mg/l. The acceptable range for alkalinity ranges from 0 to 500 mg/l; the values of the eighteen wells ranged from 3 to 120 mg/l.

## V. SUMMARY AND CONCLUSIONS

After an extensive computer literature search, BCI has identified numerous papers and abundant reference material regarding the operation and subsequent closure and restoration of sand and gravel operations. Many of these references were concerned primarily with the use of gravel pits after mining had ceased. We found that relatively few publications were available which documented hydrogeologic impacts related to active mining operations. Furthermore, we found no scientific documentation containing evidence that excavating gravel above or below the water table was detrimental to an underlying aquifer.

Regulating agencies at various state government levels throughout the Northeast and Midwest have taken diversified and sometimes opposing positions with respect to the acceptability of mining sand and gravel beneath the water table, yet have no documented studies to support their positions.

BCI also collected, compiled, and analyzed data available through the State of New Hampshire, Department of Environmental Services, for eighteen (18) wells located within 1000 feet of an active or abandoned gravel mining operation. BCI has found no evidence to suggest that the excavation of sand and gravel has detrimentally impacted municipal groundwater supplies in New Hampshire.

# APPENDIX I

## LIST OF REFERENCES COLLECTED AS PART OF THE WORLDWIDE LITERATURE REVIEW

APPENDIX I

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# APPENDIX II

## WATER QUALITY DATA
## COLLECTED BY
## THE STATE OF NEW HAMPSHIRE
## FROM 18 WELLS
## WITHIN 1000 FEET OF
## ACTIVE OR ABANDONED
## GRAVEL MINING OPERATIONS

| | | | DOVER WATER WORKS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | QPW GRIFFIN | | | | | | | | |
| EPA NUMBER | | | 651015 | 651015 | 651015 | 651015 | 651015 | 651015 | 651015 | 651015 | 651015 |
| SAMPLE NUMBER | | | -998615 | -998580 | -998581 | -987178 | -998531 | 56867 | 56888 | 63671 | 92309 |
| SAMPLING DATE | | | 03-01-77 | 02-11-80 | 03-18-81 | 03-18-81 | 02-17-82 | 05-08-86 | 05-08-86 | 09-04-86 | 01-12-88 |
| | | MCL | | | | | | | | | |
| rsenic | mg/L | 0.05 | < 0.05 | | < 0.05 | | | | | 0.005 | |
| anum | mg/L | 1 | < 1.00 | | < 0.01 | | | | | < 0.50 | |
| Cadmium | mg/L | 0.01 | < 0.01 | | < 0.005 | | | | | < 0.005 | |
| Chromium | mg/L | | < 0.05 | | < 0.01 | | | | | < 0.10 | |
| Lead | mg/L | 0.05 | < 0.05 | | 0.015 | | | | | < 0.005 | |
| Mercury | mg/L | 0.002 | < 0.001 | | < 0.001 | | | | | < 0.001 | |
| Nitrogen, NO2+NO3, N | mg/L | 10 | 0.33 | 0.25 | 0.26 | | | | | 0.5 | |
| Selenium | mg/L | 0.01 | < 0.01 | | < 0.005 | | | | | < 0.005 | |
| Silver | mg/L | 0.05 | < 0.05 | | < 0.01 | | | | | < 0.03 | |
| Fluoride | mg/L | 4 | < 0.10 | < 0.10 | < 0.10 | | | | | < 0.10 | |
| | | | | | | | | | | | |
| Total trihalomethanes | ug/k | | | | | | 0 | | | | |
| Screen Alpha | pCi/L | | < 1.00 | | | 1.8 | | | | 1.02 | |
| Radon gas | pCi/L | 20000 | | | | | | | | 580 | |
| Radium 226 | pCi/L | 5 | | | | | | | | | |
| Uranium | pCi/L | | | | | | | | | | |
| | | | | | | | | | | | |
| Aluminum | mg/L | | | | | | | | | < 0.025 | |
| Vanadium | mg/L | | | | | | | | | < 0.01 | |
| Molybdenum | mg/L | | | | | | | | | < 0.01 | |
| Nickel | mg/L | | | | | | | | | < 0.10 | |
| Antimony | mg/L | | | | | | | | | < 0.01 | |
| | | | | | | | | | | | |
| Chloride | mg/L | 250 | < 10.00 | 11 | 21.5 | | | | | 27 | |
| Color | units | 15 | 0 | | | | | | | | |
| Copper | mg/L | 1 | < 0.10 | | < 0.10 | | | | | < 0.10 | |
| Iron | mg/L | 0.3 | 0.11 | 0.2 | 0.1 | | | | | 0.4 | |
| Manganese | mg/L | 0.05 | < 0.05 | 0.01 | 0.03 | | | | | 0.2 | |
| pH | units | | 6.9 | 8 | 7.8 | | | | | 7.2 | |
| Total Hardness (CaCO3) | mg/L | | 50 | 50 | 48 | | | | | 73.6 | |
| Calcium Hardness | mg/L | | | | | | | | | 32.5 | |
| Alkalinity (CaCO3) | mg/L | | 19 | 45 | 45 | | | | | 36.2 | |
| Specific Conductance | uMHOs | | | | | | | | | 253 | |
| Sodium | mg/L | 250 | | 24 | 19 | | | | | 19 | |
| Sulfate | mg/L | 250 | | | | | | | | 27 | |
| Zinc | mg/L | | | | | | | | | < 0.03 | |
| Potassium | mg/L | | | | | | | | | | |
| Phosphate, Dis.Ortho P | mg/L | | | | | | | | | | |
| Phosphorous, Total, P | mg/L | | | | | | | | | | |
| Total filterable (TDS) | mg/L | 500 | | | | | | | | | |
| Calcium | mg/L | 0.05 | | | | | | | | | |
| Magnesium | mg/L | | | | | | | | | | |
| | | | | | | | | | | | |
| Noncorrosive, Langelier | S.I. | | | | | | | | | -1.8454 | |
| Turbidity | NTU | | 1 | | | | | | | | |
| Coliform, Tot. | cts/100ml | 1 | < 1.00 | | | | | | | 0 | |
| Non-Coliform | cts/100ml | 201 | | | | | | | | 0 | |
| | | | | | | | | | | | |
| Beryllium | mg/L | | | | | | | | | < 0.03 | |
| VOC's | | | | | | | 31 ND | 32 ND | 29 ND | 32 ND | |
| Ethylene, trichloro | ug/k | | | | | | 0 | SC 0.00 | < 5.00 | ND | ND |
| Ethylene, tetrachloro | ug/k | | | | | | 0 | SC 0.00 | < 5.00 | ND | ND |
| 1,2Dichloroethylene c+t | ug/k | | | | | | | SC 0.00 | < 5.00 | ND | |
| Ethylene, chloro | ug/k | | | | | | | SC 0.00 | ND | ND | |
| Styrene | ug/k | | | | | | | SC 0.00 | ND | ND | ND |
| Cyclohexane | ug/k | | | | | | | SC 0.00 | ND | ND | ND |
| ChlorofluoroMethane | ug/k | | | | | | | SC 0.00 | ND | ND | ND |
| DichlorodifluoroMethane | ug/k | | | | | | | SC 0.00 | ND | ND | ND |
| DichlorotrifluoroEthane | ug/k | | | | | | | SC 0.00 | ND | ND | |
| Thallium | mg/L | | | | | | | | | < 0.10 | |
| Acrolein | ug/k | | | | | | | | | | |
| Acrylonitrile | ug/k | | | | | | | | | | |
| Ether2chloroethylvinyl | ug/k | | | | | | | | | | |
| Methane, bromo | ug/k | | | | | | | | | | |
| Methane, chloro | ug/k | | | | | | | | | | |
| Methyl t-butyl ether | ug/k | | | | | | | | | | ND |
| Nitrate-N | mg/L | 10 | | | | | | | | | |
| Silica | mg/L | | | | | | | | | | |
| Benzene | ug/k | | | | | | | | | | ND |
| ethane, dichloro- | ug/k | | | | | | | | | | ND |
| ethane, trichloro- | ug/k | | | | | | | | | | ND |
| oluene | ug/k | | | | | | | | | | ND |
| | | | | | | | | | | | |
| | | | | | | SC = SCREENED | | | ND = NOT DETECTED | | |

| | | | DOVER WATER WORKS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | GPW IRELAND | | | | | | |
| | | | | | | | | | |
| EPA NUMBER | | | 651017 | 651017 | 651017 | 651017 | 651017 | 651017 | 651017 |
| SAMPLE NUMBER | | | -998576 | -998574 | -998575 | -967180 | 56889 | 63674 | 92306 |
| SAMPLING DATE | | | 03-01-77 | 02-11-80 | 03-18-81 | 03-18-81 | 05-08-86 | 09-04-86 | 01-13-88 |
| | | MCL | | | | | | | |
| Arsenic | mg/L | 0.05 | < 0.05 | | < 0.005 | | | 0.005 | |
| Barium | mg/L | 1 | < 1.00 | | < 0.10 | | | < 0.50 | |
| Cadmium | mg/L | 0.01 | < 0.01 | | < 0.005 | | | < 0.005 | |
| Chromium | mg/L | | < 0.05 | | < 0.01 | | | < 0.10 | |
| Lead | mg/L | 0.05 | < 0.05 | | 0.015 | | | < 0.005 | |
| Mercury | mg/L | 0.002 | < 0.001 | | < 0.001 | | | < 0.001 | |
| Nitrogen, NO2+NO3, N | mg/L | 10 | 0.34 | 0.35 | 0.35 | | | < 0.25 | |
| Selenium | mg/L | 0.01 | < 0.01 | | < 0.005 | | | < 0.005 | |
| Silver | mg/L | 0.05 | < 0.05 | | 0.01 | | | < 0.03 | |
| [illegible] | mg/L | 4 | 0.13 | < 0.10 | < 0.10 | | | < 0.10 | |
| | | | | | | | | | |
| Total trihalomethanes | ug/k | | | | | | | | |
| Screen Alpha | pCi/L | | < 1.00 | | | 1.4 | | < 1.00 | |
| Radon gas | pCi/L | 20000 | | | | | | 700 | |
| Radium 226 | pCi/L | 5 | | | | | | | |
| Uranium | pCi/L | | | | | | | | |
| | | | | | | | | | |
| Aluminum | mg/L | | | | | | | < 0.025 | |
| Vanadium | mg/L | | | | | | | < 0.01 | |
| Molybdenum | mg/L | | | | | | | < 0.01 | |
| Nickel | mg/L | | | | | | | < 0.10 | |
| Antimony | mg/L | | | | | | | < 0.01 | |
| | | | | | | | | | |
| Chloride | mg/L | 250 | 15 | 12.5 | 12 | | | 12 | |
| Color | units | 15 | 5 | | | | | | |
| Copper | mg/L | 1 | < 0.10 | | < 0.10 | | | < 0.10 | |
| Iron | mg/L | 0.3 | < 0.10 | < 0.10 | < 0.10 | | | < 0.10 | |
| Manganese | mg/L | 0.05 | < 0.05 | 0.01 | 0.01 | | | < 0.03 | |
| pH | units | | 8.1 | 8 | 8.3 | | | >10.00 | |
| Total Hardness (CaCO3) | mg/L | | 52 | 40 | 34 | | | 22.4 | |
| Calcium Hardness | mg/L | | | | | | | 15 | |
| Alkalinity (CaCO3) | mg/L | | 49 | 45 | 49 | | | 56.1 | |
| Specific Conductance | uMHOs | | | | | | | 201 | |
| Sodium | mg/L | 250 | | 20 | 24 | | | 20 | |
| Sulfate | mg/L | 250 | | | | | | 10 | |
| Zinc | mg/L | | | | | | | < 0.03 | |
| Potassium | mg/L | | | | | | | | |
| Phosphate, Dis.Ortho P | mg/L | | | | | | | | |
| Phosphorous, Total, P | mg/L | | | | | | | | |
| Total filterable (TDS) | mg/L | 500 | | | | | | | |
| [illegible] | mg/L | 0.05 | | | | | | | |
| Magnesium | mg/L | | | | | | | | |
| | | | | | | | | | |
| Noncorrosive, Langelier | S.I. | | | | | | | 0.8051 | |
| Turbidity | NTU | | 0.12 | | | | | | |
| Coliform, Tot. | cts/100ml | 1 | < 1.00 | < 1.00 | | | | 0 | |
| Non-Coliform | cts/100ml | 201 | | | | | | 0 | |
| | | | | | | | | | |
| Beryllium | mg/L | | | | | | | < 0.03 | |
| VOC's | | | | | | | 32 ND | 32 ND | |
| Ethylene, trichloro | ug/k | | | | | | | | ND |
| Ethylene, tetrachloro | ug/k | | | | | | | | ND |
| 1,2Dichloroethylene c-t | ug/k | | | | | | | | |
| Ethylene, chloro | ug/k | | | | | | ND | ND | |
| Styrene | ug/k | | | | | | ND | ND | ND |
| Cyclohexane | ug/k | | | | | | ND | ND | ND |
| ChlorofluoroMethane | ug/k | | | | | | ND | ND | ND |
| DichlorodifluoroMethane | ug/k | | | | | | ND | ND | ND |
| DichlorotrifluoroEthane | ug/k | | | | | | ND | ND | |
| Thallium | mg/L | | | | | | | 0.1 | |
| Acrolein | ug/k | | | | | | | | |
| Acrylonitrile | ug/k | | | | | | | | |
| Ether2chloroethylvinyl | ug/k | | | | | | | | |
| Methane, bromo | ug/k | | | | | | | | |
| Methane, chloro | ug/k | | | | | | | | |
| Methyl t-butyl ether | ug/k | | | | | | | | ND |
| Nitrate-N | mg/L | 10 | | | | | | | |
| Silica | mg/L | | | | | | | | |
| Benzene | ug/k | | | | | | | | ND |
| Methane, dichloro- | ug/k | | | | | | | | ND |
| Ethane, trichloro- | ug/k | | | | | | | | ND |
| Toluene | ug/k | | | | | | | | ND |
| | | | | | | | | | |
| | | | | | | | | ND = NOT DETECTED | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | DOVER WATER WORKS | | | | | | | | |
| | | | GPW CALDERWOOD (HOPPERS) | | | | | | | | |
| EPA NUMBER | | | 651012 | 651012 | 651012 | 651012 | 651012 | 651012 | 651012 | 651012 | 651012 |
| SAMPLE NUMBER | | | -998647 | -998645 | -998646 | -987175 | -998644 | -998642 | -987174 | 63672 | 92304 |
| SAMPLING DATE | | | 03-01-77 | 02-11-80 | 03-18-81 | 03-18-81 | 08-19-82 | 04-06-83 | 04-06-83 | 09-04-86 | 01-15-88 |
| | | MCL | | | | | | | | | |
| Arsenic | mg/L | 0.05 | < 0.05 | | < 0.05 | | | | | < 0.005 | |
| ianum | mg/L | 1 | < 1.00 | | < 0.10 | | | | | < 0.50 | |
| Cadmium | mg/L | 0.01 | < 0.01 | | < 0.005 | | | | | < 0.005 | |
| Chromium | mg/L | | < 0.05 | | < 0.01 | | | | | < 0.10 | |
| Lead | mg/L | 0.05 | < 0.05 | | 0.015 | | | | | < 0.005 | |
| Mercury | mg/L | 0.002 | < 0.001 | | < 0.001 | | | | | < 0.001 | |
| Nitrogen, NO2+NO3, N | mg/L | 10 | 0.08 | 0.05 | 0.08 | | | | | < 0.25 | |
| Selenium | mg/L | 0.01 | < 0.01 | | < 0.005 | | | | | < 0.005 | |
| Silver | mg/L | 0.05 | < 0.05 | | 0.01 | | | | | < 0.03 | |
| Fluoride | mg/L | 4 | 0.11 | 0.14 | < 0.10 | | | | | 0.2 | |
| | | | | | | | | | | | |
| Total trihalomethanes | ug/l | | | | | | 0 | 0 | 0 | | |
| Screen Alpha | pCi/L | | < 1.00 | | | < 1.00 | | | 1.2 | 0.36 | |
| Radon gas | pCi/L | 20000 | | | | | | | | 1500 | |
| Radium 226 | pCi/L | 5 | | | | | | | | | |
| Uranium | pCi/L | | | | | | | | | | |
| | | | | | | | | | | | |
| Aluminum | mg/L | | | | | | | | | < 0.025 | |
| Vanadium | mg/L | | | | | | | | | < 0.01 | |
| Molybdenum | mg/L | | | | | | | | | < 0.01 | |
| Nickel | mg/L | | | | | | | | | < 0.10 | |
| Antimony | mg/L | | | | | | | | | < 0.01 | |
| | | | | | | | | | | | |
| Chloride | mg/L | 250 | 22 | 16.5 | 14 | | | | | 15 | |
| Color | units | 15 | 0 | | | | | | | | |
| Copper | mg/L | 1 | < 0.10 | | < 0.10 | | | | | < 0.10 | |
| Iron | mg/L | 0.3 | < 0.10 | 0.1 | 0.1 | | | | | < 0.10 | |
| Manganese | mg/L | 0.05 | < 0.05 | 0.02 | 0.03 | | | | | 0.04 | |
| pH | units | | 7 | 7.6 | 7.4 | | | | | 7.6 | |
| Total Hardness (CaCO3) | mg/L | | 50 | 40 | 38 | | | | | 37.6 | |
| Calcium Hardness | mg/L | | | | | | | | | 17.5 | |
| Alkalinity (CaCO3) | mg/L | | 29 | 48 | 40 | | | | | 27.7 | |
| Specific Conductance | uMHOs | | | | | | | | | 147 | |
| Sodium | mg/L | 250 | | 26 | 21 | | | | | 13 | |
| Sulfate | mg/L | 250 | | | | | | | | 13 | |
| Zinc | mg/L | | | | | | | | | < 0.03 | |
| Potassium | mg/L | | | | | | | | | | |
| Phosphate, Dis.Ortho.P | mg/L | | | | | | | | | | |
| Phosphorous, Total, P | mg/L | | | | | | | | | | |
| Total filterable (TDS) | mg/L | 500 | | | | | | | | | |
| Calcium | mg/L | 0.05 | | | | | | | | | |
| Magnesium | mg/L | | | | | | | | | | |
| | | | | | | | | | | | |
| Noncorrosive, Langelier | S.I. | | | | | | | | | -1.8345 | |
| Turbidity | NTU | | 0.14 | | | | | | | | |
| Coliform, Tot. | cts/100ml | 1 | < 1.00 | < 1.00 | | | | | | 0 | |
| Non-Coliform | cts/100ml | 201 | | | | | | | | 0 | |
| | | | | | | | | | | | |
| Beryllium | mg/L | | | | | | | | | < 0.03 | |
| VOC's | | | | | | | 31 ND | 31 ND | 31 ND | 32 ND | |
| Ethylene, trichloro | ug/l | | | | | | | | | | ND |
| Ethylene, tetrachloro | ug/l | | | | | | | | | | ND |
| 1,2Dichloroethylene c+t | ug/l | | | | | | | | | | |
| Ethylene, chloro | ug/l | | | | | | | | | ND | |
| Styrene | ug/l | | | | | | | | | ND | ND |
| Cyclohexane | ug/l | | | | | | | | | ND | ND |
| ChlorofluoroMethane | ug/l | | | | | | | | | ND | ND |
| DichlorodifluoroMethane | ug/l | | | | | | | | | ND | ND |
| DichlorotrifluoroEthane | ug/l | | | | | | | | | ND | |
| Thallium | mg/L | | | | | | | | | < 0.10 | |
| Acrolein | ug/l | | | | | | | | | | |
| Acrylonitrile | ug/l | | | | | | | | | | |
| Ether2chloroethylvinyl | ug/l | | | | | | | | | | |
| Methane, bromo | ug/l | | | | | | | | | | |
| Methane, chloro | ug/l | | | | | | | | | | |
| Methyl t-butyl ether | ug/l | | | | | | | | | | ND |
| Nitrate-N | mg/L | 10 | | | | | | | | | |
| Silica | mg/L | | | | | | | | | | |
| Benzene | ug/l | | | | | | | | | | ND |
| Methane, dichloro- | ug/l | | | | | | | | | | ND |
| ethane, trichloro- | ug/l | | | | | | | | | | ND |
| luene | ug/l | | | | | | | | | | ND |
| | | | | | | | | | | ND = NOT DETECTED | |

| | | | NEWMARKET WATER WORKS | | | |
|---|---|---|---|---|---|---|
| | | | GPW RTE 152, BENNETT | | | |
| EPA NUMBER | | | 1731016 | 1731018 | 1731016 | 1731016 |
| SAMPLE NUMBER | | | 23944 | 26423 | 45995 | 46745 |
| SAMPLING DATE | | | 03-07-84 | 05-15-84 | 08-20-85 | 09-05-85 |
| | | MCL | | | | |
| Arsenic | mg/L | 0.05 | < 0.01 | | 0.093 | < 0.005 |
| Barium | mg/L | 1 | | | | < 0.50 |
| Cadmium | mg/L | 0.01 | | | | < 0.006 |
| Chromium | mg/L | | | | | < 0.03 |
| Lead | mg/L | 0.05 | 0.055 | 0.02 | < 0.01 | 0.015 |
| Mercury | mg/L | 0.002 | | | | 0.0046 |
| Nitrogen, NO2+NO3, N | mg/L | 10 | 1.5 | | 1.41 | 3.05 |
| Selenium | mg/L | 0.01 | < 0.005 | | < 0.005 | 0.005 |
| Silver | mg/L | 0.05 | | | | < 0.03 |
| Fluoride | mg/L | 4 | 0.08 | | < 0.10 | < 0.10 |
| | | | | | | |
| Total trihalomethanes | ug/k | | | | | |
| Screen Alpha | pCi/L | | | | | |
| Radon gas | pCi/L | 20000 | 1700 | | | |
| Radium 226 | pCi/L | 5 | | | | |
| Uranium | pCi/L | | | | | |
| | | | | | | |
| Aluminum | mg/L | | 0.07 | | < 0.05 | 0.085 |
| Vanadium | mg/L | | | | | |
| Molybdenum | mg/L | | < 0.02 | | | |
| Nickel | mg/L | | < 0.01 | | < 0.03 | < 0.03 |
| Antimony | mg/L | | < 0.01 | | | |
| | | | | | | |
| Chloride | mg/L | 250 | 37 | | 46 | 95 |
| Color | units | 15 | | | | |
| Copper | mg/L | 1 | | | | < 0.10 |
| Iron | mg/L | 0.3 | < 0.03 | | 0.1 | 0.1 |
| Manganese | mg/L | 0.05 | < 0.03 | | < 0.03 | < 0.03 |
| pH | units | | 6.52 | | 6.7 | 6.9 |
| Total Hardness (CaCO3) | mg/L | | 48 | | 69.2 | 102 |
| Calcium Hardness | mg/L | | 41 | | 42.3 | 87 |
| Alkalinity (CaCO3) | mg/L | | 19 | | 20 | 22.8 |
| Specific Conductance | uMHOs | | 157 | | 234 | 435 |
| Sodium | mg/L | 250 | 16 | | 20 | 31 |
| Sulfate | mg/L | 250 | 6.1 | | 6.69 | 8.7 |
| Zinc | mg/L | | < 0.10 | | 0.03 | < 0.03 |
| Potassium | mg/L | | | | | |
| Phosphate, Dis.Ortho,P | mg/L | | | | | |
| Phosphorous, Total, P | mg/L | | | | | |
| Total filterable (TDS) | mg/L | 500 | | | | |
| Calcium | mg/L | 0.05 | | | | |
| Magnesium | mg/L | | | | | |
| | | | | | | |
| Noncorrosive, Langelier | S.I. | | -2.7085 | | -2.4926 | -1.9225 |
| Turbidity | NTU | | | | | |
| Coliform, Tot. | cts/100ml | 1 | | | 0 | 0 |
| Non-Coliform | cts/100ml | 201 | | | < 100.00 | < 100.00 |
| | | | | | | |
| Beryllium | mg/L | | | | | |
| VOC's | | | 30 ND | | | 32 ND |
| Ethylene, trichloro | ug/k | | | | | |
| Ethylene, tetrachloro | ug/k | | | | | |
| 1,2Dichloroethylene c+t | ug/k | | | | | |
| Ethylene, chloro | ug/k | | ND | | | |
| Styrene | ug/k | | | | | |
| Cyclohexane | ug/k | | | | | |
| ChlorofluoroMethane | ug/k | | | | | |
| DichlorodifuloroMethane | ug/k | | | | | |
| DichlorotrifluoroEthane | ug/k | | | | | |
| Thallium | mg/L | | | | | |
| Acrolein | ug/k | | ND | | | |
| Acrylonitrile | ug/k | | ND | | | |
| Ether2chloroethylvinyl | ug/k | | ND | | | |
| Methane, bromo | ug/k | | ND | | | |
| Methane, chloro | ug/k | | ND | | | |
| Methyl t-butyl ether | ug/k | | | | | |
| Nitrate-N | mg/L | 10 | | | | |
| Silica | mg/L | | | | | |
| Benzene | ug/k | | | | | |
| Methane, dichloro- | ug/k | | | | | |
| Ethane, trichloro- | ug/k | | | | | |
| Toluene | ug/k | | | | | |
| | | | | | | |
| | | | | | ND = NOT DETECTED | |

| | | | SOMERSWORTH WW | |
|---|---|---|---|---|
| | | | GPW1 | |
| | | | | |
| EPA NUMBER | | | 2151011 | 2151011 |
| SAMPLE NUMBER | | | -997259 | -997258 |
| SAMPLING DATE | | | 02-25-80 | 01-13-83 |
| | | MCL | | |
| Arsenic | mg/L | 0.05 | < 0.005 | < 0.005 |
| Barium | mg/L | 1 | < 0.01 | < 0.50 |
| Cadmium | mg/L | 0.01 | < 0.005 | < 0.005 |
| Chromium | mg/L | | 0.01 | < 0.03 |
| Lead | mg/L | 0.05 | < 0.01 | < 0.01 |
| Mercury | mg/L | 0.002 | < 0.001 | < 0.001 |
| Nitrogen, NO2+NO3, N | mg/L | 10 | 0.18 | 0.25 |
| Selenium | mg/L | 0.01 | < 0.005 | 0.008 |
| Silver | mg/L | 0.05 | < 0.01 | < 0.005 |
| Fluoride | mg/L | 4 | < 0.10 | < 0.10 |
| | | | | |
| Total trihalomethanes | ug/k | | | |
| Screen Alpha | pCi/L | | < 1.00 | |
| Radon gas | pCi/L | 20000 | | |
| Radium 226 | pCi/L | 5 | | |
| Uranium | pCi/L | | | |
| | | | | |
| Aluminum | mg/L | | | |
| Vanadium | mg/L | | | |
| Molybdenum | mg/L | | | |
| Nickel | mg/L | | | |
| Antimony | mg/L | | | |
| | | | | |
| Chloride | mg/L | 250 | < 10.00 | < 10.00 |
| Color | units | 15 | | |
| Copper | mg/L | 1 | 0.1 | < 0.10 |
| Iron | mg/L | 0.3 | 0.2 | 0.2 |
| Manganese | mg/L | 0.05 | 0.03 | < 0.03 |
| pH | units | | 6.1 | 6.93 |
| Total Hardness (CaCO3) | mg/L | | 20 | 24 |
| Calcium Hardness | mg/L | | | 12 |
| Alkalinity (CaCO3) | mg/L | | 7 | 13 |
| Specific Conductance | uMHOs | | | |
| Sodium | mg/L | 250 | 4.8 | 5 |
| Sulfate | mg/L | 250 | | |
| Zinc | mg/L | | | |
| Potassium | mg/L | | | |
| Phosphate, Ds.Ortho P | mg/L | | | |
| Phosphorous, Total, P | mg/L | | | |
| Total filterable (TDS) | mg/L | 500 | | |
| Calcium | mg/L | 0.05 | | |
| Magnesium | mg/L | | | |
| | | | | |
| Noncorrosive, Langelier | S.I. | | | -2.9969 |
| Turbidity | NTU | | | |
| Coliform, Tot. | cts/100ml | 1 | < 1.00 | < 1.00 |
| Non-Coliform | cts/100ml | 201 | | |
| | | | | |
| Beryllium | mg/L | | | |
| VOC's | | | | |
| Ethylene, trichloro | ug/k | | | |
| Ethylene, tetrachloro | ug/k | | | |
| 1,2Dichloroethylene c+t | ug/k | | | |
| Ethylene, chloro | ug/k | | | |
| Styrene | ug/k | | | |
| Cyclohexane | ug/k | | | |
| ChlorofluoroMethane | ug/k | | | |
| DichlorodifluoroMethane | ug/k | | | |
| DichlorotrifluoroEthane | ug/k | | | |
| Thallium | mg/L | | | |
| Acrolein | ug/k | | | |
| Acrylonitrile | ug/k | | | |
| Ether2chloroethylvinyl | ug/k | | | |
| Methane, bromo | ug/k | | | |
| Methane, chloro | ug/k | | | |
| Methyl t-butyl ether | ug/k | | | |
| Nitrate-N | mg/L | 10 | | |
| Silica | mg/L | | | |
| Benzene | ug/k | | | |
| Methane, dichloro- | ug/k | | | |
| Methane, trichloro- | ug/k | | | |
| Toluene | ug/k | | | |
| | | | | |
| | | | ND = NOT DETECTED | |

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|---|---|---|---|---|---|---|---|
| | | | SOMERSWORTH WATER WORKS | | | | |
| | | | GPW2 | | | | |
| EPA NUMBER | | | 2151012 | 2151012 | 2151012 | 2151012 | 2151012 |
| SAMPLE NUMBER | | | -997236 | -997233 | -997235 | -997234 | 91924 |
| SAMPLING DATE | | | 10-15-77 | 02-25-80 | 04-25-80 | 02-03-83 | 01-06-88 |
| | | MCL | | | | | |
| Arsenic | mg/L | 0.05 | < 0.05 | | < 0.005 | < 0.005 | < 0.005 |
| Barium | mg/L | 1 | < 1.00 | | < 0.01 | < 0.50 | < 0.50 |
| Cadmium | mg/L | 0.01 | < 0.01 | | < 0.005 | < 0.005 | < 0.001 |
| Chromium | mg/L | | < 0.05 | | 0.01 | < 0.03 | < 0.03 |
| Lead | mg/L | 0.05 | < 0.05 | | < 0.01 | < 0.01 | < 0.005 |
| Mercury | mg/L | 0.002 | < 0.002 | | < 0.001 | < 0.001 | < 0.001 |
| Nitrogen, NO2+NO3, N | mg/L | 10 | 0.1 | < 0.05 | 0.07 | < 0.25 | |
| Selenium | mg/L | 0.01 | < 0.01 | | 0.005 | < 0.005 | < 0.005 |
| Silver | mg/L | 0.05 | 0 | | 0.01 | < 0.05 | < 0.03 |
| Fluoride | mg/L | 4 | < 0.10 | < 0.10 | < 0.10 | < 0.10 | 0.16 |
| | | | | | | | |
| Total trihalomethanes | ug/k | | | | | | |
| Screen Alpha | pCi/L | | < 1.00 | | < 1.00 | < 1.00 | < 1.00 |
| Radon gas | pCi/L | 20000 | | | | | 800 |
| Radium 226 | pCi/L | 5 | | | | | |
| Uranium | pCi/L | | | | | | |
| | | | | | | | |
| Aluminum | mg/L | | | | | | < 0.05 |
| Vanadium | mg/L | | | | | | < 0.01 |
| Molybdenum | mg/L | | | | | | < 0.01 |
| Nickel | mg/L | | | | | | < 0.03 |
| Antimony | mg/L | | | | | | < 0.01 |
| | | | | | | | |
| Chloride | mg/L | 250 | < 10.00 | < 10.00 | < 10.00 | < 10.00 | 5 |
| Color | units | 15 | 5 | | | | |
| Copper | mg/L | 1 | < 0.10 | | < 0.10 | < 0.10 | 0.1 |
| Iron | mg/L | 0.3 | 0.1 | 0.1 | 0.1 | < 0.10 | 0.1 |
| Manganese | mg/L | 0.05 | < 0.05 | 0.01 | 0.01 | < 0.03 | < 0.03 |
| pH | units | | 6.8 | 6.1 | 6.3 | 7.6 | 6.2 |
| Total Hardness (CaCO3) | mg/L | | 30 | 26 | 20 | 24 | 15.6 |
| Calcium Hardness | mg/L | | | | | 12 | 8.2 |
| Alkalinity (CaCO3) | mg/L | | 17 | 10 | 9 | 12 | 9.7 |
| Specific Conductance | uMHOs | | | | | | 61.6 |
| Sodium | mg/L | 250 | 4 | 4 | 3.5 | 4 | 5 |
| Sulfate | mg/L | 250 | | | | | 6 |
| Zinc | mg/L | | | | | | 0.03 |
| Potassium | mg/L | | | | | | |
| Phosphate, Dis.Ortho P | mg/L | | | | | | |
| Phosphorous, Total, P | mg/L | | | | | | |
| Total filterable (TDS) | mg/L | 500 | | | | | |
| Calcium | mg/L | 0.05 | | | | | |
| Magnesium | mg/L | | | | | | |
| | | | | | | | |
| Noncorrosive Langelier | S.I. | | | | | -2.3616 | |
| Turbidity | NTU | | 0.3 | | | | |
| Coliform, Tot. | cts/100ml | 1 | | 1 | < 1.00 | < 1.00 | 0 |
| Non-Coliform | cts/100ml | 201 | | | 70 | | 0 |
| | | | | | | | |
| Beryllium | mg/L | | | | | | |
| VOC's | | | | | | | |
| Ethylene, trichloro | ug/k | | | | | | ND |
| Ethylene, tetrachloro | ug/k | | | | | | ND |
| 1,2Dichloroethylene c+t | ug/k | | | | | | |
| Ethylene, chloro | ug/k | | | | | | ND |
| Styrene | ug/k | | | | | | ND |
| Cyclohexane | ug/k | | | | | | ND |
| ChlorofluoroMethane | ug/k | | | | | | ND |
| DichlorodifluoroMethane | ug/k | | | | | | ND |
| DichlorotrifluoroEthane | ug/k | | | | | | ND |
| Thallium | mg/L | | | | | | < 0.10 |
| Acrolein | ug/k | | | | | | |
| Acrylonitrile | ug/k | | | | | | |
| Ether2chloroetylvinyl | ug/k | | | | | | |
| Methane, bromo | ug/k | | | | | | |
| Methane, chloro | ug/k | | | | | | |
| Methyl t-butyl ether | ug/k | | | | | | ND |
| Nitrate-N | mg/L | 10 | | | | | 0.06 |
| Silica | mg/L | | | | | | |
| Benzene | ug/k | | | | | | ND |
| Methane, dichloro- | ug/k | | | | | | ND |
| Methane, trichloro- | ug/k | | | | | | ND |
| Toluene | ug/k | | | | | | ND |
| | | | | | | | |
| | | | | | | ND = NOT DETECTED | |

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|---|---|---|---|---|---|---|---|---|---|
| | | | FRANCONIA VILLAGE WATER | | | | | | |
| | | | MCGOWEN WELL 350' | | | | | | |
| EPA NUMBER | | | 841013 | 841013 | 841013 | 841013 | 841013 | 841013 | 841013 |
| SAMPLE NUMBER | | | -999921 | -999919 | -999920 | -999918 | -999886 | -987222 | 96900 |
| SAMPLING DATE | | | 05-09-78 | 02-13-81 | 11-18-81 | 12-12-83 | 12-12-83 | 12-12-83 | 04-06-88 |
| | | MCL | | | | | | | |
| Arsenic | mg/L | 0.05 | < 0.05 | | < 0.005 | < 0.015 | | | < 0.005 |
| Barium | mg/L | 1 | < 1.00 | | < 0.10 | 0 | | | < 0.50 |
| Cadmium | mg/L | 0.01 | < 0.01 | | < 0.005 | 0 | | | < 0.001 |
| Chromium | mg/L | | < 0.05 | | < 0.03 | 0 | | | < 0.04 |
| Lead | mg/L | 0.05 | < 0.05 | | < 0.01 | < 0.01 | | | 0.007 |
| Mercury | mg/L | 0.002 | 0.001 | | < 0.001 | 0 | | | < 0.001 |
| Nitrogen, NO2+NO3, N | mg/L | 10 | 0.52 | | < 0.25 | < 0.25 | | | |
| Selenium | mg/L | 0.01 | < 0.01 | | 0.008 | < 0.005 | | | < 0.005 |
| Silver | mg/L | 0.05 | < 0.05 | | < 0.03 | 0 | | | < 0.03 |
| Fluoride | mg/L | 4 | 0.17 | | 1 | 0.85 | | | 1.1 |
| | | | | | | | | | |
| Total trihalomethanes | ug/k | | | | | | 0 | | |
| Screen Alpha | pCi/L | | 9.1 | 15 | | | | | 6 |
| Radon gas | pCi/L | 20000 | | | | | | 6000 | 2500 |
| Radium 226 | pCi/L | 5 | < 0.10 | 0.1 | | | | | < 0.10 |
| Uranium | pCi/L | | | 12.9 | | | | | |
| | | | | | | | | | |
| Aluminum | mg/L | | | | | 0.02 | | | |
| Vanadium | mg/L | | | | | < 0.03 | | | |
| Molybdenum | mg/L | | | | | < 0.02 | | | |
| Nickel | mg/L | | | | | < 0.05 | | | < 0.03 |
| Antimony | mg/L | | | | | < 0.01 | | | < 0.01 |
| | | | | | | | | | |
| Chloride | mg/L | 250 | 16 | | < 10.00 | < 10.00 | | | 5 |
| Color | units | 15 | 0 | | | | | | |
| Copper | mg/L | 1 | < 0.10 | | < 0.10 | | | | < 0.10 |
| Iron | mg/L | 0.3 | < 0.10 | | 0.1 | 0.1 | | | < 0.10 |
| Manganese | mg/L | 0.05 | < 0.05 | | < 0.01 | < 0.03 | | | < 0.03 |
| pH | units | | 5.9 | | 8.1 | 8.1 | | | 8.05 |
| Total Hardness (CaCO3) | mg/L | | 32 | | 60 | 60 | | | 56 |
| Calcium Hardness | mg/L | | | | | 42 | | | 55 |
| Alkalinity (CaCO3) | mg/L | | 20 | | 59 | 59 | | | 56.2 |
| Specific Conductance | uMHOs | | | | | 148.5 | | | 143 |
| Sodium | mg/L | 250 | 7.1 | | 7 | 7 | | | 5 |
| Sulfate | mg/L | 250 | | | | 5 | | | 6 |
| Zinc | mg/L | | | | | < 0.03 | | | 0.19 |
| Potassium | mg/L | | | | | | | | |
| Phosphate, Dis.Ortho,P | mg/L | | | | | | | | |
| Phosphorous, Total, P | mg/L | | | | | | | | |
| Total filterable (TDS) | mg/L | 500 | | | | | | | |
| Calcium | mg/L | 0.05 | | | | | | | |
| Magnesium | mg/L | | | | | | | | |
| | | | | | | | | | |
| Noncorrosive, Langelier | S.I. | | | | | -0.6259 | | | |
| Turbidity | NTU | | | | | | | | |
| Coliform, Tot | cts/100ml | 1 | | | | < 1.00 | | | 0 |
| Non-Coliform | cts/100ml | 201 | | | | | | | 0 |
| | | | | | | | | | |
| Beryllium | mg/L | | | | | | | | |
| VOC's | | | | | | | 31 ND | | |
| Ethylene, trichloro | ug/k | | | | | | | | |
| Ethylene, tetrachloro | ug/k | | | | | | | | |
| 1,2Dichloroethylene c+t | ug/k | | | | | | | | |
| Ethylene, chloro | ug/k | | | | | | | | |
| Styrene | ug/k | | | | | | | | |
| Cyclohexane | ug/k | | | | | | | | |
| ChlorofluoroMethane | ug/k | | | | | | | | |
| DichlorodifluoroMethane | ug/k | | | | | | | | ND |
| DichlorotrifluoroEthane | ug/k | | | | | | | | |
| Thallium | mg/L | | | | | | | | |
| Acrolein | ug/k | | | | | | | | |
| Acrylonitrile | ug/k | | | | | | | | |
| Ether2chloroethylvinyl | ug/k | | | | | | | | |
| Methane, bromo | ug/k | | | | | | | | |
| Methane, chloro | ug/k | | | | | | | | |
| Methyl t-butyl ether | ug/k | | | | | | | | |
| Nitrate-N | mg/L | 10 | | | | | | | 0.05 |
| Silica | mg/L | | | | | | | | |
| Benzene | ug/k | | | | | | | | ND |
| Methane, dichloro- | ug/k | | | | | | | | ND |
| Methane, trichloro- | ug/k | | | | | | | | ND |
| Toluene | ug/k | | | | | | | | ND |
| | | | | | | | | | |
| | | | | | | | ND = NOT DETECTED | | |

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|---|---|---|---|---|---|---|---|---|
| | | | PEMBROKE WATER WORKS | | | | | |
| | | | GPW2 CONCORD | | | | | |
| | | | | | | | | |
| EPA NUMBER | | | 1861012 | 1861012 | 1861012 | 1861012 | 1861012 | 1861012 |
| SAMPLE NUMBER | | | -997948 | -997946 | -997947 | -997952 | -997941 | 84036 |
| SAMPLING DATE | | | 09-20-77 | 02-05-80 | 01-23-81 | 02-28-83 | 05-04-83 | 08-20-87 |
| | | MCL | | | | | | |
| Arsenic | mg/L | 0.05 | < 0.05 | | < 0.005 | < 0.005 | | 0.011 |
| Barium | mg/L | 1 | < 1.00 | | < 0.10 | < 0.50 | | < 0.50 |
| Cadmium | mg/L | 0.01 | < 0.01 | | < 0.005 | < 0.005 | | 0.001 |
| Chromium | mg/L | | < 0.05 | | < 0.01 | < 0.03 | | < 0.03 |
| Lead | mg/L | 0.05 | < 0.05 | | < 0.01 | < 0.01 | | < 0.01 |
| Mercury | mg/L | 0.002 | < 0.001 | | < 0.001 | < 0.001 | | < 0.01 |
| Nitrogen, NO2+NO3, N | mg/L | 10 | 0.78 | 0.53 | < 0.05 | 0.6 | | |
| Selenium | mg/L | 0.01 | < 0.01 | | < 0.005 | 0.011 | | < 0.005 |
| Silver | mg/L | 0.05 | < 0.05 | | < 0.01 | < 0.001 | | < 0.03 |
| Fluoride | mg/L | 4 | 0.27 | | < 0.10 | 0.1 | | 0.1 |
| | | | | | | | | |
| Total trihalomethanes | ug/L | | | | | | 0 | |
| Screen Alpha | pCi/L | | < 1.00 | | < 1.00 | | | < 1.00 |
| Radon gas | pCi/L | 20000 | | | | | | 430 |
| Radium 226 | pCi/L | 5 | | | | | | |
| Uranium | pCi/L | | | | | | | |
| | | | | | | | | |
| Aluminum | mg/L | | | | | | | < 0.20 |
| Vanadium | mg/L | | | | | | | < 0.01 |
| Molybdenum | mg/L | | | | | | | < 0.01 |
| Nickel | mg/L | | | | | | | < 0.03 |
| Antimony | mg/L | | | | | | | < 0.01 |
| | | | | | | | | |
| Chloride | mg/L | 250 | 64 | 80 | 90 | 66 | | 60 |
| Color | units | 15 | 5 | | | | | |
| Copper | mg/L | 1 | 0.17 | | 0.1 | 0.06 | | 0.1 |
| Iron | mg/L | 0.3 | < 0.10 | < 0.10 | 0.1 | 0.03 | | < 0.10 |
| Manganese | mg/L | 0.05 | 0.5 | 0.74 | 0.96 | 0.83 | | 0.28 |
| pH | units | | 6.4 | 6.3 | 7 | 6.7 | | 6.18 |
| Total Hardness (CaCO3) | mg/L | | 44 | 46 | 40 | 36 | | 32.8 |
| Calcium Hardness | mg/L | | | | | 22.4 | | 15 |
| Alkalinity (CaCO3) | mg/L | | 21 | 9 | 11 | 13 | | 13 |
| Specific Conductance | uMHOs | | | | | | | 254 |
| Sodium | mg/L | 250 | 27 | 60 | 53 | 39 | | 38 |
| Sulfate | mg/L | 250 | | | | | | 7 |
| Zinc | mg/L | | | | | | | 0.03 |
| Potassium | mg/L | | | | | | | |
| Phosphate, Dis.Ortho P | mg/L | | | | | | | |
| Phosphorous, Total P | mg/L | | | | | | | |
| Total filterable (TDS) | mg/L | 500 | | | | | | |
| Calcium | mg/L | 0.05 | | | | | | |
| [illegible] | mg/L | | | | | | | |
| | | | | | | | | |
| Noncorrosive, Langelier | S.I. | | | | | -2.9558 | | -3.65 |
| Turbidity | NTU | | < 0.01 | | | | | |
| Coliform, Tot. | cts/100ml | 1 | | < 1.00 | | < 1.00 | | |
| Non-Coliform | cts/100ml | 201 | | | | | | |
| | | | | | | | | |
| Beryllium | mg/L | | | | | | | < 0.03 |
| VOC's | | | | | | | 31 ND | 33 ND |
| Ethylene, trichloro | ug/L | | | | | | | |
| Ethylene, tetrachloro | ug/L | | | | | | | |
| 1,2Dichloroethylene c+t | ug/L | | | | | | | |
| Ethylene, chloro | ug/L | | | | | | | ND |
| Styrene | ug/L | | | | | | | ND |
| Cyclohexane | ug/L | | | | | | | ND |
| ChlorofluoroMethane | ug/L | | | | | | | ND |
| DichlorodifluoroMethane | ug/L | | | | | | | ND |
| DichlorotrifluoroEthane | ug/L | | | | | | | ND |
| Thallium | mg/L | | | | | | | < 0.10 |
| Acrolein | ug/L | | | | | | | |
| Acrylonitrile | ug/L | | | | | | | |
| Ether2chloroethylvinyl | ug/L | | | | | | | |
| Methane, bromo | ug/L | | | | | | | |
| Methane, chloro | ug/L | | | | | | | |
| Methyl t-butyl ether | ug/L | | | | | | | ND |
| Nitrate-N | mg/L | 10 | | | | | | 0.46 |
| Silica | mg/L | | | | | | | |
| Benzene | ug/L | | | | | | | |
| Methane, dichloro- | ug/L | | | | | | | |
| Methane, trichloro- | ug/L | | | | | | | |
| Toluene | ug/L | | | | | | | |
| | | | | | | | | |
| | | | | | | | ND = NOT DETECTED | |

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|---|---|---|---|---|---|---|---|---|
| | | | PEMBROKE WATER WORKS | | | | | |
| | | | GPW3 CONCORD | | | | | |
| EPA NUMBER | | | 1861013 | 1861013 | 1861013 | 1861013 | 1861013 | 1861013 |
| SAMPLE NUMBER | | | -997945 | -997943 | -997944 | -997953 | -997939 | 84037 |
| SAMPLING DATE | | | 09-16-77 | 02-06-80 | 01-28-81 | 03-01-83 | 05-19-83 | 08-20-87 |
| | MCL | | | | | | | |
| Arsenic | mg/L | 0.05 | < 0.05 | | < 0.005 | < 0.005 | | 0.008 |
| Barium | mg/L | 1 | < 1.00 | | < 0.10 | < 0.50 | | < 0.50 |
| Cadmium | mg/L | 0.01 | < 0.01 | | < 0.005 | < 0.005 | | 0.001 |
| Chromium | mg/L | | < 0.05 | | 0.01 | < 0.03 | | < 0.03 |
| Lead | mg/L | 0.05 | < 0.05 | | < 0.01 | < 0.01 | | < 0.01 |
| Mercury | mg/L | 0.002 | < 0.002 | | < 0.001 | < 0.001 | | < 0.001 |
| Nitrogen, NO2+NO3, N | mg/L | 10 | 1.03 | 0.82 | 1 | 0.95 | | |
| Selenium | mg/L | 0.01 | < 0.01 | | 0.022 | 0.008 | | < 0.005 |
| Silver | mg/L | 0.05 | < 0.05 | | < 0.01 | < 0.001 | | < 0.03 |
| Fluoride | mg/L | 4 | 0.22 | < 0.10 | < 0.10 | < 0.10 | | < 0.10 |
| | | | | | | | | |
| Total trihalomethanes | ug/l | | | | | | 0 | |
| Screen Alpha | pCi/l | | < 1.00 | | < 1.00 | 1.3 | | 1.8 |
| Radon gas | pCi/L | 20000 | | | | | | 750 |
| Radium 226 | pCi/L | 5 | | | | | | |
| Uranium | pCi/L | | | | | | | |
| | | | | | | | | |
| Aluminum | mg/L | | | | | | | < 0.20 |
| Vanadium | mg/L | | | | | | | < 0.01 |
| Molybdenum | mg/L | | | | | | | < 0.01 |
| Nickel | mg/L | | | | | | | < 0.03 |
| Antimony | mg/L | | | | | | | < 0.01 |
| | | | | | | | | |
| Chloride | mg/L | 250 | 25 | 26.5 | 30 | 32 | | 32 |
| Color | units | 15 | 0 | | | | | |
| Copper | mg/L | 1 | 0.1 | | 0.1 | 0.07 | | 0.2 |
| Iron | mg/L | 0.3 | < 0.10 | < 0.10 | < 0.10 | < 0.03 | | 0.1 |
| Manganese | mg/L | 0.05 | < 0.05 | 0.01 | 0.02 | < 0.03 | | 0.03 |
| pH | units | | 6.1 | 7.1 | 7 | 6.4 | | 5.98 |
| Total Hardness (CaCO3) | mg/L | | 40 | 36 | 20 | 32 | | 36.8 |
| Calcium Hardness | mg/L | | | | | 15 | | 25 |
| Alkalinity (CaCO3) | mg/L | | 18 | 15 | 13 | 9 | | 10.2 |
| Specific Conductance | uMHOs | | | | | | | 150 |
| Sodium | mg/L | 250 | 15 | 24 | 31 | 14 | | 16 |
| Sulfate | mg/L | 250 | | | | | | 6 |
| Zinc | mg/L | | | | | | | < 0.03 |
| Potassium | mg/L | | | | | | | |
| Phosphate, Di-Ortho P | mg/L | | | | | | | |
| Phosphorous, Total, P | mg/L | | | | | | | |
| Total filterable (TDS) | mg/L | 500 | | | | | | |
| Calcium | mg/L | 0.05 | | | | | | |
| Magnesium | mg/L | | | | | | | |
| | | | | | | | | |
| Noncorrosive, Langelier | S.I. | | | | | -3.5897 | | -3.7335 |
| Turbidity | NTU | | < 0.01 | | | | | |
| Coliform, Tot. | cts/100ml | 1 | | < 1.00 | | < 1.00 | | |
| Non-Coliform | cts/100ml | 20 | | | | | | |
| | | | | | | | | |
| Beryllium | mg/L | | | | | | | < 0.03 |
| VOC's | | | | | | | 31 ND | 33 ND |
| Ethylene, trichloro | ug/l | | | | | | | |
| Ethylene, tetrachloro | ug/l | | | | | | | |
| 1,2Dichloroethylene c+t | ug/l | | | | | | | |
| Ethylene, chloro | ug/l | | | | | | | ND |
| Styrene | ug/l | | | | | | | ND |
| Cyclohexane | ug/l | | | | | | | ND |
| ChlorofluoroMethane | ug/l | | | | | | | ND |
| DichlorodifluoroMethane | ug/l | | | | | | | ND |
| DichlorotrifluoroEthane | ug/l | | | | | | | ND |
| Thallium | mg/L | | | | | | | < 0.10 |
| Acrolein | ug/l | | | | | | | |
| Acrylonitrile | ug/l | | | | | | | |
| Ether2chloroethylvinyl | ug/l | | | | | | | ND |
| Methane, bromo | ug/l | | | | | | | |
| Methane, chloro | ug/l | | | | | | | |
| Methyl t-butyl ether | ug/l | | | | | | | |
| Nitrate-N | mg/L | 10 | | | | | | ND |
| Silica | mg/L | | | | | | | |
| Benzene | ug/l | | | | | | | |
| Methane, dichloro- | ug/l | | | | | | | |
| Ethane, trichloro- | ug/l | | | | | | | |
| Toluene | ug/l | | | | | | | |
| | | | | | | | | |
| | | | | | | | ND = NOT DETECTED | |

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| | | | CENTRAL HOOKSETT WATER PRECINCT | | | | | | | |
| | | | GPW ROUTE 3 | | | | | | | |
| | | | | | | | | | | |
| EPA NUMBER | | | 1181011 | 1181011 | 1181011 | 1181011 | 1181011 | 1181011 | 1181011 | 1181011 |
| SAMPLE NUMBER | | | -996468 | -996470 | -996469 | 24913 | 79864 | 80199 | 84075 | 88504 |
| SAMPLING DATE | | | 08-20-81 | 05-08-82 | 05-08-82 | 04-04-84 | 07-08-87 | 07-09-87 | 06-20-87 | 10-29-87 |
| | | MCL | | | | | | | | |
| Arsenic | mg/L | 0.05 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | | < 0.005 | | |
| Barium | mg/L | 1 | < 0.20 | < 0.20 | < 0.20 | | | < 0.50 | | |
| Cadmium | mg/L | 0.01 | < 0.002 | < 0.002 | < 0.002 | | | < 0.001 | | |
| Chromium | mg/L | | | | | | | < 0.03 | | |
| Lead | mg/L | 0.05 | 0.005 | < 0.005 | < 0.005 | < 0.01 | | < 0.01 | | |
| Mercury | mg/L | 0.002 | < 0.0005 | < 0.0005 | < 0.0005 | | | < 0.001 | | |
| Nitrogen, NO2+NO3, N | mg/L | 10 | 1.1 | | | 0.6 | | 0.69 | | |
| Selenium | mg/L | 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | | < 0.005 | | |
| Silver | mg/L | 0.05 | | | | | | < 0.03 | | |
| Fluoride | mg/L | 4 | 0.1 | | | 0.18 | | 0.11 | 0.19 | |
| | | | | | | | | | | |
| Total trihalomethanes | ug/k | | | | | | | | | |
| Screen Alpha | pCi/L | | | | | | | 1.4 | 1.3 | |
| Radon gas | pCi/L | 20000 | | | | 1700 | | 3000 | 3200 | |
| Radium 226 | pCi/L | 5 | | | | | | | | |
| Uranium | pCi/L | | | | | | | | | |
| | | | | | | | | | | |
| Aluminum | mg/L | | 0.3 | 0.1 | 0.1 | 0.074 | | 0.065 | | |
| Vanadium | mg/L | | | | | 0.062 | | < 0.01 | | |
| Molybdenum | mg/L | | | | | < 0.01 | | < 0.01 | | |
| Nickel | mg/L | | | | | < 0.03 | | 0.03 | | |
| Antimony | mg/L | | | | | < 0.01 | | | | |
| | | | | | | | | | | |
| Chloride | mg/L | 250 | < 10.00 | | | < 10.00 | | 24 | 15 | |
| Color | units | 15 | 1 | | | | | | | |
| Copper | mg/L | 1 | < 0.02 | 0.05 | 0.03 | | | 0.1 | | |
| Iron | mg/L | 0.3 | 0.11 | < 0.10 | < 0.10 | < 0.10 | | < 0.10 | | |
| Manganese | mg/L | 0.05 | 0.22 | < 0.03 | < 0.03 | < 0.03 | | 0.03 | | |
| pH | units | | 5.46 | | | 9.6 | | 6 | 5.91 | |
| Total Hardness (CaCO3) | mg/L | | | | | 20 | | 26.4 | 25.2 | |
| Calcium Hardness | mg/L | | | | | 13 | | 18 | | |
| Alkalinity (CaCO3) | mg/L | | 7 | | | 57 | | 15.2 | 14.8 | |
| Specific Conductance | uMHOs | | 85 | | | 175 | | 149 | 116 | |
| Sodium | mg/L | 250 | 4.5 | 33.4 | 33.4 | 27 | | 18 | | |
| Sulfate | mg/L | 250 | 17 | | | 12.4 | | 16 | 16 | |
| Zinc | mg/L | | < 0.02 | 0.03 | 0.03 | < 0.01 | | < 0.03 | | |
| Potassium | mg/L | | 0.9 | 1.9 | 1.8 | | | | | |
| Phosphate, Dis.Ortho,P | mg/L | | < 0.05 | | | | | | | |
| Phosphorous, Total, P | mg/L | | < 0.03 | | | | | | | |
| Total filterable (TDS) | mg/L | 500 | 59 | | | | | | | |
| Calcium | mg/L | 0.05 | 5.8 | 7.2 | 6.3 | | | | | |
| Magnesium | mg/L | | 1.47 | 1.41 | 1.31 | | | | | |
| | | | | | | | | | | |
| Noncorrosive, Langelier | S.I. | | | | | 0.3498 | | -3.6829 | | |
| Turbidity | NTU | | | | | | | | | |
| Coliform, Tot. | cts/100ml | 1 | | | | | | 0 | | |
| Non-Coliform | cts/100ml | 201 | | | | 0 | | 0 | | |
| | | | | | | | | | | |
| Beryllium | mg/L | | | | | | | | | |
| VOC's | | | | | | | 33 ND | 33 ND | 30 ND | 33 ND |
| Ethylene, trichloro | ug/k | | | | | | | | | |
| Ethylene, tetrachloro | ug/k | | | | | | | | | |
| 1,2Dichloroethylene c+t | ug/k | | | | | | | | | |
| Ethylene, chloro | ug/k | | | | | | ND | ND | ND | ND |
| Styrene | ug/k | | | | | | ND | ND | ND | ND |
| Cyclohexane | ug/k | | | | | | ND | ND | ND | ND |
| ChlorofluoroMethane | ug/k | | | | | | ND | ND | ND | ND |
| DichlorodifluoroMethane | ug/k | | | | | | ND | ND | 0.56 | ND |
| DichlorotrifluoroEthane | ug/k | | | | | | | | | |
| Thallium | mg/L | | | | | | | | | |
| Acrolein | ug/k | | | | | | | | | |
| Acrylonitrile | ug/k | | | | | | | | | |
| Ether2chloroethylvinyl | ug/k | | | | | | | | | |
| Methane, bromo | ug/k | | | | | | | | | |
| Methane, chloro | ug/k | | | | | | | | | |
| Methyl t-butyl ether | ug/k | | | | | | ND | ND | ND | ND |
| Nitrate-N | mg/L | 10 | | | | | | | | |
| Silica | mg/L | | 7.3 | | | | | < 0.03 | | |
| Benzene | ug/k | | | | | | ND | ND | 52.6 | ND |
| Methane, dichloro- | ug/k | | | | | | ND | ND | 1200 | ND |
| Ethane, trichloro- | ug/k | | | | | | ND | ND | 31.5 | ND |
| Toluene | ug/k | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | ND = NOT DETECTED | | |

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| | | | CENTRAL HOOKSET WATER PRECINCT | | | | | | | | |
| | | | GPW MANCHESTER GRAVEL | | | | | | | | |
| | | | | | | | | | | | |
| EPA NUMBER | | | 1181012 | 1181012 | 1181012 | [illegible]81012 | 1181012 | 1181012 | 1181012 | 1181012 | 1181012 |
| SAMPLE NUMBER | | | -996481 | -996479 | -996480 | [illegible]96488 | -996487 | 24914 | 80200 | 84076 | 88506 |
| SAMPLING DATE | | | 09-16-77 | 02-06-80 | 07-27-81 | [illegible]-19-83 | 05-19-83 | 04-04-84 | 07-09-87 | 08-20-87 | 10-29-87 |
| | | MCL | | | | | | | | | |
| Arsenic | mg/L | 0.05 | < 0.05 | | < 0.005 | | | < 0.005 | < 0.005 | | |
| Barium | mg/L | 1 | < 1.00 | | < 0.10 | | | | < 0.50 | | |
| Cadmium | mg/L | 0.01 | < 0.01 | | < 0.005 | | | | < 0.001 | | |
| Chromium | mg/L | | < 0.05 | | < 0.03 | | | | < 0.03 | | |
| Lead | mg/L | 0.05 | < 0.05 | | 0.01 | | | < 0.01 | < 0.01 | | |
| Mercury | mg/L | 0.002 | < 0.002 | | < 0.001 | | | | < 0.001 | | |
| Nitrogen, NO2+NO3, N | mg/L | 10 | 1.1 | 0.73 | 1.11 | | | 0.75 | 1.07 | | |
| Selenium | mg/L | 0.01 | < 0.01 | | < 0.005 | | | 0.005 | < 0.005 | | |
| Silver | mg/L | 0.05 | < 0.05 | | 0.01 | | | | < 0.03 | | |
| Fluoride | mg/L | 4 | 0.12 | 0.22 | 0.22 | | | 0.21 | 0.2 | 0.26 | |
| | | | | | | | | | | | |
| Total trihalomethanes | ug/L | | | | | | | | 2.6 | | |
| Screen Alpha | pCi/L | | 3.2 | | 1.5 | 0 | 0 | | | 2.58 | |
| Radon gas | pCi/L | 20000 | | | | | | 50 | | 1600 | |
| Radium 226 | pCi/L | 5 | | | | | | | | | |
| Uranium | pCi/L | | | | | | | | | | |
| | | | | | | | | | | | |
| Aluminum | mg/L | | | | | | | 0.173 | 0.25 | | |
| Vanadium | mg/L | | | | | | | 0.07 | < 0.01 | | |
| Molybdenum | mg/L | | | | | | | 0.01 | < 0.01 | | |
| Nickel | mg/L | | | | | | | 0.03 | < 0.03 | | |
| Antimony | mg/L | | | | | | | 0.01 | | | |
| | | | | | | | | | | | |
| Chloride | mg/L | 250 | < 10.00 | < 10.00 | < 10.00 | | | 10 | 5 | 7 | |
| Color | units | 15 | 0 | | | | | | | | |
| Copper | mg/L | 1 | < 0.10 | | 0.1 | | | | < 0.10 | | |
| Iron | mg/L | 0.3 | 0.1 | < 0.10 | 0.1 | | | 0.1 | 0.1 | | |
| Manganese | mg/L | 0.05 | 0.05 | 0.19 | 0.21 | | | 0.19 | 0.16 | | |
| pH | units | | 7.6 | 8.1 | 5.5 | | | 7.8 | 6.03 | 6.05 | |
| Total Hardness (CaCO3) | mg/L | | 38 | 22 | 26 | | | 24 | 22.8 | 22 | |
| Calcium Hardness | mg/L | | | | | | | 17 | 15 | | |
| Alkalinity (CaCO3) | mg/L | | 65 | 52 | 3 | | | 56 | 11.8 | 13.1 | |
| Specific Conductance | uMHOs | | | | | | | 66 | 88.2 | 91.5 | |
| Sodium | mg/L | 250 | 33 | 40 | 5 | | | 24 | < 10.00 | | |
| Sulfate | mg/L | 250 | | | | | | 19 | 16 | 15 | |
| Zinc | mg/L | | | | | | | 0.01 | < 0.03 | | |
| Potassium | mg/L | | | | | | | | | | |
| Phosphate, Dis Ortho P | mg/L | | | | | | | | | | |
| Phosphorous, Total, P | mg/L | | | | | | | | | | |
| Total filterable (TDS) | mg/L | 500 | | | | | | | | | |
| Calcium | mg/L | 0.05 | | | | | | | | | |
| Magnesium | mg/L | | | | | | | | | | |
| | | | | | | | | | | | |
| Noncorrosive, Langelier | S.I. | | | | | | | -1.3414 | -3.842 | | |
| Turbidity | NTU | | | | | | | | | | |
| Coliform, Tot. | cts/100ml | 1 | < 0.01 | < 1.00 | < 1.00 | | | 0 | 0 | 0 | |
| Non-Coliform | cts/100ml | 201 | | | 201 | | | | 0 | 3 | |
| | | | | | | | | | | | |
| Beryllium | mg/L | | | | | | | | < 0.03 | | |
| VOC's | | | | | | 31 ND | 31 ND | | 33 ND | | |
| Ethylene, trichloro | ug/L | | | | | | | | | | |
| Ethylene, tetrachloro | ug/L | | | | | | | | | | |
| 1,2Dichloroethylene c+t | ug/L | | | | | | | | | | |
| Ethylene, chloro | ug/L | | | | | | | | ND | ND | ND |
| Styrene | ug/L | | | | | | | | ND | ND | ND |
| Cyclohexane | ug/L | | | | | | | | ND | ND | ND |
| ChlorofluoroMethane | ug/L | | | | | | | | ND | ND | ND |
| DichlorodifluoroMethane | ug/L | | | | | | | | ND | ND | ND |
| DichlorotrifluoroEthane | ug/L | | | | | | | | ND | 0.99 | |
| Thallium | mg/L | | | | | | | | | | |
| Acrolein | ug/L | | | | | | | | | | |
| Acrylonitrile | ug/L | | | | | | | | | | |
| Ether2chloroethylvinyl | ug/L | | | | | | | | | | |
| Methane, bromo | ug/L | | | | | | | | | | |
| Methane, chloro | ug/L | | | | | | | | | | |
| Methyl t-butyl ether | ug/L | | | | | | | | ND | ND | ND |
| Nitrate-N | mg/L | 10 | | | | | | | | | |
| Silica | mg/L | | | | | | | | | | |
| Benzene | ug/L | | | | | | | | | | |
| Methane, dichloro- | ug/L | | | | | | | | | | |
| Methane, trichloro- | ug/L | | | | | | | | | | |
| Toluene | ug/L | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | ND = NOT DETECTED | | |

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| | | | CENTRAL HOOKSETT WATER PRECINCT | | | | | | | |
| | | | INDUSTRIAL WELL | | | | | | | |
| | | | | | | | | | | |
| EPA NUMBER | | | 1181013 | 1181013 | 1181013 | 1181013 | 1181013 | 1181013 | 1181013 | 1181013 |
| SAMPLE NUMBER | | | -996482 | -996483 | -996485 | -996484 | 24915 | 33311 | 80201 | 84077 |
| SAMPLING DATE | | | 02-06-80 | 07-27-81 | 05-13-82 | 05-13-82 | 04-04-84 | 10-19-84 | 07-09-87 | 08-20-87 |
| | | MCL | | | | | | | | |
| Arsenic | mg/L | 0.05 | | < 0.005 | | | < 0.005 | | < 0.005 | |
| Barium | mg/L | 1 | | < 0.10 | | | < 0.50 | | < 0.50 | |
| Cadmium | mg/L | 0.01 | | < 0.005 | | | < 0.001 | | < 0.001 | |
| Chromium | mg/L | | | < 0.03 | | | < 0.01 | | < 0.03 | |
| Lead | mg/L | 0.05 | | 0.02 | | | < 0.01 | | 0.16 | |
| Mercury | mg/L | 0.002 | | < 0.001 | | | < 0.001 | | < 0.001 | |
| Nitrogen, NO2+NO3, N | mg/L | 10 | 2.14 | 2.29 | | | 1.2 | | 1.42 | |
| Selenium | mg/L | 0.01 | | 0.005 | | | < 0.005 | | < 0.005 | |
| Silver | mg/L | 0.05 | | 0.01 | | | < 0.001 | | < 0.03 | |
| Fluoride | mg/L | 4 | < 0.10 | 0.13 | | | 0.17 | | 0.15 | 0.2 |
| | | | | | | | | | | |
| Total trihalomethanes | ug/k | | | | 0 | 0 | | | | |
| Screen Alpha | pCi/L | | | 1.4 | | | < 1.00 | | < 1.00 | 0.81 |
| Radon gas | pCi/L | 20000 | | | | | 870 | | 700 | 790 |
| Radium 226 | pCi/L | 5 | | | | | | | | |
| Uranium | pCi/L | | | | | | | | | |
| | | | | | | | | | | |
| Aluminum | mg/L | | | | | | 0.076 | | 0.09 | |
| Vanadium | mg/L | | | | | | 0.048 | | < 0.01 | |
| Molybdenum | mg/L | | | | | | < 0.01 | | < 0.01 | |
| Nickel | mg/L | | | | | | < 0.03 | | < 0.03 | |
| Antimony | mg/L | | | | | | < 0.01 | | | |
| | | | | | | | | | | |
| Chloride | mg/L | 250 | 35.5 | 34 | | | 24 | | 49 | 41 |
| Color | units | 15 | | | | | | | | |
| Copper | mg/L | 1 | | 0.1 | | | < 0.10 | | 0.1 | |
| Iron | mg/L | 0.3 | 0.2 | 0.2 | | | 0.1 | | 0.2 | |
| Manganese | mg/L | 0.05 | 0.06 | 0.1 | | | 0.1 | | 0.19 | |
| pH | units | | 6.2 | 6.5 | | | 7.4 | | 6.11 | 6.06 |
| Total Hardness (CaCO3) | mg/L | | 30 | 34 | | | 24 | | 25.6 | 23.6 |
| Calcium Hardness | mg/L | | | | | | 19 | | 18 | |
| Alkalinity (CaCO3) | mg/L | | 8 | 4 | | | 56 | | 11.3 | 11.6 |
| Specific Conductance | uMHOs | | | | | | 251 | | 232 | 198 |
| Sodium | mg/L | 250 | 38 | 23 | | | 41 | | 36 | |
| Sulfate | mg/L | 250 | | | | | 16.3 | | 16 | 15 |
| Zinc | mg/L | | | | | | | | < 0.03 | |
| Potassium | mg/L | | | | | | | | | |
| Phosphate, Dis.Ortho.P | mg/L | | | | | | | | | |
| Phosphorous, Total, P | mg/L | | | | | | | | | |
| Total filterable (TDS) | mg/L | 500 | | | | | | | | |
| Calcium | mg/L | 0.05 | | | | | | | | |
| Magnesium | mg/L | | | | | | | | | |
| | | | | | | | | | | |
| Noncorrosive, Langelier | S.I. | | | | | | -1.6931 | | -3.7017 | |
| Turbidity | NTU | | | | | | | | | |
| Coliform, Tot | cts/100mL | 1 | < 1.00 | < 1.00 | | | 0 | | 0 | 0 |
| Non-Coliform | c.s/100mL | 201 | | | | | | | 0 | 0 |
| | | | | | | | | | | |
| Beryllium | mg/L | | | | | | | | < 0.03 | |
| VOC's | | | | | 31 ND | 31 ND | | 32 ND | 33 ND | 33 ND |
| Ethylene, trichloro | ug/k | | | | | | | | | |
| Ethylene, tetrachloro | ug/k | | | | | | | | | |
| 1,2Dichloroethylene c+t | ug/k | | | | | | | | | |
| Ethylene, chloro | ug/k | | | | | | | | ND | ND |
| Styrene | ug/k | | | | | | | | ND | ND |
| Cyclohexane | ug/k | | | | | | | | ND | ND |
| ChlorofluoroMethane | ug/k | | | | | | | | ND | ND |
| DichlorodifluoroMethane | ug/k | | | | | | | | ND | ND |
| DichlorotrifluoroEthane | ug/k | | | | | | | | ND | ND |
| Thallium | mg/L | | | | | | | | | |
| Acrolein | ug/k | | | | | | | | | |
| Acrylonitrile | ug/k | | | | | | | | | |
| Ether2chloroethylvinyl | ug/k | | | | | | | | | |
| Methane, bromo | ug/k | | | | | | | | | |
| Methane, chloro | ug/k | | | | | | | | | |
| Methyl t-butyl ether | ug/k | | | | | | | | ND | ND |
| Nitrate-N | mg/L | 10 | | | | | | | | 1.41 |
| Silica | mg/L | | | | | | | | | |
| Benzene | ug/k | | | | | | | | | |
| Methane, dichloro- | ug/k | | | | | | | | | |
| Methane, trichloro- | ug/k | | | | | | | | | |
| Toluene | ug/k | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | ND = NOT DETECTED | |

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| | | | CONCORD WATER DEPARTMENT | | | | | | |
| | | | GPW 1 800' S OF PS | | | | | | |
| EPA NUMBER | | | 50104 | 50104 | 50104 | 50104 | 50104 | 50104 | 50104 |
| SAMPLE NUMBER | | | -998937 | -998933 | -998936 | -998935 | -998919 | -998934 | 43282 |
| SAMPLING DATE | | | 10-20-77 | 02-08-80 | 12-09-80 | 02-04-81 | 10-22-88 | 06-11-83 | 07-08-84 |
| | | MCL | | | | | | | |
| Arsenic | mg/L | 0.05 | < 0.05 | | 0.3 | 0.006 | | | < 0.005 |
| Banum | mg/L | 1 | < 0.05 | | < 0.10 | | | | |
| Cadmium | mg/L | 0.01 | < 0.01 | | < 0.005 | | | | |
| Chromium | mg/L | | < 0.05 | | < 0.01 | | | | |
| Lead | mg/L | 0.05 | < 0.05 | | < 0.01 | | | | < 0.01 |
| Mercury | mg/L | 0.002 | < 0.002 | | < 0.001 | | | | |
| Nitrogen, NO2+NO3, N | mg/L | 10 | 0.11 | 0.05 | 0.18 | | | | < 0.25 |
| Selenium | mg/L | 0.01 | < 0.01 | | 0.13 | < 0.005 | | | < 0.005 |
| Silver | mg/L | 0.05 | < 0.05 | | < 0.01 | | | | |
| Fluoride | mg/L | 4 | < 0.10 | < 0.10 | < 0.01 | | | | 0.11 |
| | | | | | | | | | |
| Total trihalomethanes | ug/k | | | | | | 0 | | |
| Screen Alpha | pCi/L | | < 1.00 | | < 1.00 | | | < 1.00 | |
| Radon gas | pCi/L | 20000 | | | | | | | |
| Radium 226 | pCi/L | 5 | | | | | | | |
| Uranium | pCi/L | | | | | | | | |
| | | | | | | | | | |
| Aluminum | mg/L | | | | | | | | < 0.05 |
| Vanadium | mg/L | | | | | | | | |
| Molybdenum | mg/L | | | | | | | | |
| Nickel | mg/L | | | | | | | | < 0.10 |
| Antimony | mg/L | | | | | | | | |
| | | | | | | | | | |
| Chionde | mg/L | 250 | 11 | < 10.00 | < 10.00 | | | | 17 |
| Color | units | 15 | 0 | | | | | | |
| Cocoer | mg/L | 1 | < 0.10 | | < 0.10 | | | | |
| Iron | mg/L | 0.3 | < 0.10 | 0.2 | 0.2 | | | | 0.3 |
| Manganese | mg/L | 0.05 | < 0.05 | < 0.01 | 0.01 | | | | < 0.03 |
| pH | units | | 6.5 | 6.7 | 7.2 | | | | 5.9 |
| Total Hardness (CaCO3) | mg/L | | 26 | 20 | 14 | | | | 16 |
| Calcium Hardness | mg/L | | | | | | | | 8.5 |
| Alkalinity (CaCO3) | mg/L | | 7.5 | 9 | 13 | | | | 4.4 |
| Specific Conductance | uMHOs | | | | | | | | 66 |
| Sodium | mg/L | 250 | 5.8 | 5 | 7 | | | | 6 |
| Sulfate | mg/L | 250 | | | | | | | 5.64 |
| Zinc | mg/L | | | | | | | | < 0.10 |
| Potassium | mg/L | | | | | | | | |
| Phosphate Dis.Ortho.P | mg/L | | | | | | | | |
| Phosphorous, Total, P | mg/L | | | | | | | | |
| Total filterable (TDS) | mg/L | 500 | | | | | | | |
| Calcium | mg/L | 0.05 | | | | | | | |
| Magnesium | mg/L | | | | | | | | |
| | | | | | | | | | |
| Noncorrosive, Langelier | S.I. | | | | | | | | -4.6471 |
| Turbidity | NTU | | 0.18 | | | | | | |
| Coliform, Tot. | cts/100ml | 1 | < 1.00 | < 1.00 | < 1.00 | | | | 0 |
| Non-Coliform | cts/100ml | 201 | | | | | | | < 100.00 |
| | | | | | | | | | |
| Beryllium | mg/L | | | | | | | | |
| VOC's | | | | | | | 31 ND | | 32 ND |
| Ethylene, trichloro | ug/k | | | | | | | | |
| Ethylene, tetrachloro | ug/k | | | | | | | | |
| 1,2Dichloroethylene c+t | ug/k | | | | | | | | |
| Ethylene, chloro | ug/k | | | | | | | | |
| Styrene | ug/k | | | | | | | | |
| Cyclohexane | ug/k | | | | | | | | |
| ChlorofluoroMethane | ug/k | | | | | | | | |
| DichlorodifluoroMethane | ug/k | | | | | | | | |
| DichlorotrifluoroEthane | ug/k | | | | | | | | |
| Thallium | mg/L | | | | | | | | |
| Acrolein | ug/k | | | | | | | | |
| Acrylonitrile | ug/k | | | | | | | | |
| Ether2chloroethylvinyl | ug/k | | | | | | | | |
| Methane, bromo | ug/k | | | | | | | | |
| Methane, chloro | ug/k | | | | | | | | |
| Methyl t-butyl ether | ug/k | | | | | | | | |
| Nitrate-N | mg/L | 10 | | | | | | | |
| Silica | mg/L | | | | | | | | |
| Benzene | ug/k | | | | | | | | |
| Methane, dichloro- | ug/k | | | | | | | | |
| Methane, trichloro- | ug/k | | | | | | | | |
| Toluene | ug/k | | | | | | | | |
| | | | | | | | | | |

ND = NOT DETECTED

| | | | CONCORD WATER DEPARTMENT | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | GPW $ 700' S OF P8 | | | | | |
| EPA NUMBER | | | 501016 | 501016 | 501016 | 501016 | 501016 | 501016 |
| SAMPLE NUMBER | | | -998927 | -998924 | -998926 | -998918 | -998925 | 43285 |
| SAMPLING DATE | | | 10-20-77 | 02-08-80 | 12-09-80 | 10-22-82 | 08-11-83 | 07-08-84 |
| | | MCL | | | | | | |
| Arsenic | mg/L | 0.05 | < 0.05 | | < 0.005 | | | < 0.005 |
| Barium | mg/L | 1 | < 1.00 | | < 0.10 | | | |
| Cadmium | mg/L | 0.01 | < 0.01 | | < 0.005 | | | |
| Chromium | mg/L | | < 0.05 | | 0.01 | | | |
| Lead | mg/L | 0.05 | < 0.05 | | < 0.01 | | | 0.011 |
| Mercury | mg/L | 0.002 | < 0.002 | | < 0.001 | | | |
| Nitrogen, NO2+NO3, N | mg/L | 10 | 0.14 | 0.1 | 0.14 | | | < 0.25 |
| Selenium | mg/L | 0.01 | < 0.01 | | 0.006 | | | < 0.005 |
| Silver | mg/L | 0.05 | < 0.05 | | < 0.01 | | | |
| Fluoride | mg/L | 4 | < 0.10 | < 0.10 | < 0.10 | | | < 0.1 |
| | | | | | | | | |
| Total trihalomethanes | ug/k | | | | | 0 | | |
| Screen Alpha | pCi/L | | < 1.00 | | < 1.00 | | < 1.00 | |
| Radon gas | pCi/L | 20000 | | | | | | |
| Radium 226 | pCi/L | 5 | | | | | | |
| Uranium | pCi/L | | | | | | | |
| | | | | | | | | |
| Aluminum | mg/L | | | | | | | 0.06 |
| Vanadium | mg/L | | | | | | | |
| Molybdenum | mg/L | | | | | | | |
| Nickel | mg/L | | | | | | | < 0.10 |
| Antimony | mg/L | | | | | | | |
| | | | | | | | | |
| Chloride | mg/L | 250 | 16 | < 10.00 | < 10.00 | | | 19 |
| Color | units | 15 | 0 | | | | | |
| Copper | mg/L | 1 | < 0.10 | | < 0.10 | | | |
| Iron | mg/L | 0.3 | < 0.10 | 0.1 | 0.1 | | | 0.1 |
| Manganese | mg/L | 0.05 | < 0.05 | 0.02 | 0.01 | | | < 0.03 |
| pH | units | | 6.5 | 7.1 | 7.1 | | | 6.1 |
| Total Hardness (CaCO3) | mg/L | | 26 | 20 | 8 | | | 22.4 |
| Calcium Hardness | mg/L | | | | | | | 9.2 |
| Alkalinity (CaCO3) | mg/L | | 11 | 12 | 10 | | | 8.1 |
| Specific Conductance | uMHOs | | | | | | | 82.8 |
| Sodium | mg/L | 250 | 10.2 | 6.2 | 5.7 | | | 10 |
| Sulfate | mg/L | 250 | | | | | | 3.32 |
| Zinc | mg/L | | | | | | | < 0.10 |
| Potassium | mg/L | | | | | | | |
| Phosphate, Dis Ortho P | mg/L | | | | | | | |
| Phosphorous, Total, P | mg/L | | | | | | | |
| Total filterable (TDS) | mg/L | 500 | | | | | | |
| Calcium | mg/L | 0.05 | | | | | | |
| Magnesium | mg/L | | | | | | | |
| | | | | | | | | |
| Noncorrosive, Langelier | S.I. | | | | | | | -4.1477 |
| Turbidity | NTU | | 0.32 | | | | | |
| Coliform, Tot. | cts/100ml | 1 | 5 | < 1.00 | < 1.00 | | | 0 |
| Non-Coliform | cts/100ml | 201 | | | | | | < 100.00 |
| | | | | | | | | |
| Beryllium | mg/L | | | | | | | |
| VOC's | | | | | | 30 ND | | 31 ND |
| Ethylene, trichloro | ug/k | | | | | | | |
| Ethylene, tetrachloro | ug/k | | | | | | | |
| 1,2Dichloroethylene c+t | ug/k | | | | | | | |
| Ethylene, chloro | ug/k | | | | | | | |
| Styrene | ug/k | | | | | | | |
| Cyclohexane | ug/k | | | | | | | |
| ChlorofluoroMethane | ug/k | | | | | | | |
| DichlorodifluoroMethane | ug/k | | | | | | | |
| DichlorotrifluoroEthane | ug/k | | | | | | | |
| Thallium | mg/L | | | | | | | |
| Acrolein | ug/k | | | | | | | |
| Acrylonitrile | ug/k | | | | | | | |
| Ether2chloroethylvinyl | ug/k | | | | | | | |
| Methane, bromo | ug/k | | | | | | | |
| Methane, chloro | ug/k | | | | | | | |
| Methyl t-butyl ether | ug/k | | | | | | | |
| Nitrate-N | mg/L | 10 | | | | | | |
| Silica | mg/L | | | | | | | |
| Benzene | ug/k | | | | | | | |
| Methane, dichloro- | ug/k | | | | | | | |
| Methane, trichloro- | ug/k | | | | | | | |
| Toluene | ug/k | | | | | 0 | | < 5.00 |
| | | | | | | | | |
| | | | | | | | ND = NOT DETECTED | |

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|---|---|---|---|---|---|---|---|---|
| | | | CONCORD WATER DEPARTMENT | | | | | |
| | | | GPW 7 1000' OF PS | | | | | |
| EPA NUMBER | | | 50107 | 50107 | 50107 | 50107 | 50107 | 50107 |
| SAMPLE NUMBER | | | -998923 | -998920 | -998922 | -998917 | -998921 | 43286 |
| SAMPLING DATE | | | 10-21-77 | 02-08-80 | 12-09-80 | 10-22-82 | 08-11-83 | 07-08-84 |
| | | MCL | | | | | | |
| Arsenic | mg/L | 0.05 | < 0.05 | | < 0.005 | | | < 0.005 |
| Barium | mg/L | 1 | < 1.00 | | < 0.10 | | | |
| Cadmium | mg/L | 0.01 | < 0.01 | | < 0.005 | | | |
| Chromium | mg/L | | < 0.05 | | < 0.01 | | | |
| Lead | mg/L | 0.05 | < 0.05 | | < 0.01 | | | 0.028 |
| Mercury | mg/L | 0.002 | < 0.002 | | < 0.001 | | | |
| Nitrogen, NO2+NO3, N | mg/L | 10 | 0.22 | < 0.05 | 0.1 | | | < 0.25 |
| Selenium | mg/L | 0.01 | < 0.01 | | < 0.005 | | | < 0.006 |
| Silver | mg/L | 0.05 | < 0.05 | | < 0.01 | | | |
| Fluoride | mg/L | 4 | < 0.10 | < 0.10 | < 0.10 | | | < 0.10 |
| | | | | | | | | |
| Total trihalomethanes | ug/k | | | | | 0 | | |
| Screen Alpha | pCi/L | | < 1.00 | | < 1.00 | | < 1.00 | |
| Radon gas | pCi/L | 20000 | | | | | | |
| Radium 226 | pCi/L | 5 | | | | | | |
| Uranium | pCi/L | | | | | | | |
| | | | | | | | | |
| Aluminum | mg/L | | | | | | | 0.25 |
| Vanadium | mg/L | | | | | | | |
| Molybdenum | mg/L | | | | | | | |
| Nickel | mg/L | | | | | | | < 0.10 |
| Antimony | mg/L | | | | | | | |
| | | | | | | | | |
| Chloride | mg/L | 250 | < 10.00 | < 10.00 | 14 | | | 17 |
| Color | units | 15 | 5 | | | | | |
| Copper | mg/L | 1 | < 0.10 | | < 0.10 | | | |
| Iron | mg/L | 0.3 | < 0.10 | 2.2 | 0.1 | | | 0.1 |
| Manganese | mg/L | 0.05 | 0.13 | 2.45 | 0.28 | | | 0.12 |
| pH | units | | 6 | 6.9 | 7.1 | | | 6.2 |
| Total Hardness (CaCO3) | mg/L | | 22 | 30 | 16 | | | 15.2 |
| Calcium Hardness | mg/L | | | | | | | 9.5 |
| Alkalinity (CaCO3) | mg/L | | 16 | 15 | 9 | | | 6 |
| Specific Conductance | uMHOs | | | | | | | 78.2 |
| Sodium | mg/L | 250 | 7 | 6.5 | 8 | | | 8 |
| Sulfate | mg/L | 250 | | | | | | 6.71 |
| Zinc | mg/L | | | | | | | 0.2 |
| Potassium | mg/L | | | | | | | |
| Phosphate, Dis.Ortho P | mg/L | | | | | | | |
| Phosphorous, Total, P | mg/L | | | | | | | |
| Total filterable (TDS) | mg/L | 500 | | | | | | |
| Calcium | mg/L | 0.05 | | | | | | |
| Magnesium | mg/L | | | | | | | |
| | | | | | | | | |
| Noncorrosive, Langelier | S.I. | | | | | | | -4.1641 |
| Turbidity | NTU | | 0.78 | | | | | |
| Coliform, Tot. | cts/100ml | 1 | 0 | < 1.00 | < 1.00 | | | 0 |
| Non-Coliform | cts/100ml | 20 | | | | | | < 100.00 |
| | | | | | | | | |
| Beryllium | mg/L | | | | | | | |
| VOC's | | | | | | 31 ND | | 32 ND |
| Ethylene, trichloro | ug/k | | | | | | | |
| Ethylene, tetrachloro | ug/k | | | | | | | |
| 1,2Dichloroethylene c+t | ug/k | | | | | | | |
| Ethylene, chloro | ug/k | | | | | | | |
| Styrene | ug/k | | | | | | | |
| Cyclohexane | ug/k | | | | | | | |
| ChlorofluoroMethane | ug/k | | | | | | | |
| DichlorodifluoroMethane | ug/k | | | | | | | |
| DichlorotrifluoroEthane | ug/k | | | | | | | |
| Thallium | mg/L | | | | | | | |
| Acrolein | ug/k | | | | | | | |
| Acrylonitrile | ug/k | | | | | | | |
| Ether2chloroethylvinyl | ug/k | | | | | | | |
| Methane, bromo | ug/k | | | | | | | |
| Methane, chloro | ug/k | | | | | | | |
| Methyl t-butyl ether | ug/k | | | | | | | |
| Nitrate-N | mg/L | 10 | | | | | | |
| Silica | mg/L | | | | | | | |
| Benzene | ug/k | | | | | | | |
| Ethane, dichloro- | ug/k | | | | | | | |
| Methane, trichloro- | ug/k | | | | | | | |
| Toluene | ug/k | | | | | | | |
| | | | | | | | | |
| | | | | | | | ND = NOT DETECTED | |

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|---|---|---|---|---|---|---|---|---|---|---|
| | | | BELMONT WATER WORKS | | | | | | | |
| | | | GRW 2 NO. (NEWER) | | | | | | | |
| | | | | | | | | | | |
| EPA NUMBER | | | 201012 | 201012 | 201012 | 201012 | 201012 | 201012 | 201012 | 201012 |
| SAMPLE NUMBER | | | -988076 | -988077 | -999401 | -999400 | -988069 | -999397 | -999399 | 45087 |
| SAMPLING DATE | | | 03-06-75 | 04-27-76 | 10-25-77 | 06-25-79 | 10-28-79 | 02-05-80 | 05-19-82 | 08-06-85 |
| | | MCL | | | | | | | | |
| Arsenic | mg/L | 0.05 | | | < 0.05 | < 0.01 | | | < 0.005 | < 0.005 |
| Barium | mg/L | 1 | | | < 1.00 | < 0.10 | | | < 0.50 | |
| Cadmium | mg/L | 0.01 | | | < 0.01 | < 0.005 | | | < 0.005 | |
| Chromium | mg/L | | | | < 0.05 | 0.03 | | | < 0.03 | |
| Lead | mg/L | 0.05 | | | < 0.05 | < 0.01 | | | < 0.01 | < 0.025 |
| Mercury | mg/L | 0.002 | | | < 0.002 | < 0.001 | | | < 0.001 | |
| Nitrogen, NO2+NO3, N | mg/L | 10 | < 0.10 | 0.6 | 0.21 | 0.24 | | 0.26 | 0.35 | 0.43 |
| Selenium | mg/L | 0.01 | | | < 0.01 | < 0.01 | | | < 0.005 | < 0.005 |
| Silver | mg/L | 0.05 | | | < 0.05 | < 0.01 | | | < 0.005 | |
| Fluoride | mg/L | 4 | < 0.10 | | < 0.10 | 0.1 | | < 0.10 | < 0.10 | < 0.10 |
| | | | | | | | | | | |
| Total trihalomethanes | ug/k | | | | | | | | | < 1.00 |
| Screen Alpha | pCi/L | | | | < 1.00 | | < 1.00 | | | |
| Radon gas | pCi/L | 20000 | | | | | | | | 420 |
| Radium 226 | pCi/L | 5 | | | | | | | | |
| Uranium | pCi/L | | | | | | | | | |
| | | | | | | | | | | |
| Aluminum | mg/L | | | | | | | | | < 0.05 |
| Vanadium | mg/L | | | | | | | | | |
| Molybdenum | mg/L | | | | | | | | | |
| Nickel | mg/L | | | | | | | | | < 0.03 |
| Antimony | mg/L | | | | | | | | | |
| | | | | | | | | | | |
| Chloride | mg/L | 250 | 39 | 39 | 60 | 11 | | 65 | 30 | 37 |
| Color | units | 15 | 0 | 0 | 20 | 5 | | | | |
| Copper | mg/L | 1 | 0.57 | 0.62 | < 0.10 | 0.1 | | | 0.1 | |
| Iron | mg/L | 0.3 | 0.17 | < 0.10 | 0.99 | 0.6 | | 1 | 1 | 0.2 |
| Manganese | mg/L | 0.05 | 0.05 | 0.06 | 0.15 | 0.08 | | 0.11 | 0.09 | 0.1 |
| pH | units | | 6.4 | 6.5 | 8 | 6.3 | | 6.3 | 7.4 | 6 |
| Total Hardness (CaCO3) | mg/L | | 74 | 44 | 64 | 46 | | 48 | 16 | 52 |
| Calcium Hardness | mg/L | | | | | | | | | 15 |
| Alkalinity (CaCO3) | mg/L | | | | 18 | 11 | | 6 | 12 | 12.4 |
| Specific Conductance | uMHOs | | | | | | | | | 181 |
| Sodium | mg/L | 250 | | | 14 | 18 | | 30 | 16 | 19 |
| Sulfate | mg/L | 250 | | | | | | | | 4.82 |
| Zinc | mg/L | | | | | | | | | 0.09 |
| Potassium | mg/L | | | | | | | | | |
| Phosphate, Dis Ortho P | mg/L | | | | | | | | | |
| Phosphorous, Total, P | mg/L | | | | | | | | | |
| Total filterable (TDS) | mg/L | 500 | | | | | | | | |
| Calcium | mg/L | 0.05 | | | | | | | | |
| Magnesium | mg/L | | | | | | | | | |
| | | | | | | | | | | |
| Noncorrosive, Langelier | S.I. | | | | | | | | | -3.8505 |
| Turbidity | NTU | | 0 | 0 | 0.97 | 1.6 | | | | |
| Coliform, Tot. | cts/100ml | 1 | < 1.00 | < 1.00 | 0 | 45 | | < 1.00 | < 1.00 | 0 |
| Non-Coliform | cts/100ml | 201 | | | 200 | > 200.00 | | | | < 100.00 |
| | | | | | | | | | | |
| Beryllium | mg/L | | | | | | | | | |
| VOC's | | | | | | | | | | |
| Ethylene, trichloro | ug/k | | | | | | | | | |
| Ethylene, tetrachloro | ug/k | | | | | | | | | |
| 1,2Dichloroethylene, cis | ug/k | | | | | | | | | |
| Ethylene, chloro | ug/k | | | | | | | | | |
| Styrene | ug/k | | | | | | | | | |
| Cyclohexane | ug/k | | | | | | | | | |
| ChlorofluoroMethane | ug/k | | | | | | | | | |
| DichlorodifluoroMethane | ug/k | | | | | | | | | |
| DichlorotrifluoroEthane | ug/k | | | | | | | | | |
| Thallium | mg/L | | | | | | | | | |
| Acrolein | ug/k | | | | | | | | | |
| Acrylonitrile | ug/k | | | | | | | | | |
| Ether2chloroethylvinyl | ug/k | | | | | | | | | |
| Methane, bromo | ug/k | | | | | | | | | |
| Methane, chloro | ug/k | | | | | | | | | |
| Methyl t-butyl ether | ug/k | | | | | | | | | |
| Nitrate-N | mg/L | 10 | | | | | | | | |
| Silica | mg/L | | | | | | | | | |
| Benzene | ug/k | | | | | | | | | |
| Methane, dichloro- | ug/k | | | | | | | | | |
| Methane, trichloro- | ug/k | | | | | | | | | |
| Toluene | ug/k | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | ND = NOT DETECTED |

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|---|---|---|---|---|---|---|---|---|
| | | | HANOVER WATER WORKS | | | | | |
| | | | WELL #1 | | | | | |
| | | | | | | | | |
| EPA NUMBER | | | 1071012 | 1071012 | 1071012 | 1071012 | 1071012 | 1071012 |
| SAMPLE NUMBER | | | -996751 | -996748 | -996750 | -996749 | 45006 | 68425 |
| SAMPLING DATE | | | 05-18-77 | 02-05-80 | 06-26-80 | 12-07-82 | 08-01-85 | 12-15-86 |
| | | MCL | | | | | | |
| Arsenic | mg/L | 0.05 | < 0.05 | | < 0.005 | < 0.005 | | < 0.005 |
| Barium | mg/L | 1 | < 1.00 | | < 0.10 | | | < 0.50 |
| Cadmium | mg/L | 0.01 | < 0.01 | | < 0.005 | | | < 0.005 |
| Chromium | mg/L | | < 0.05 | | < 0.01 | | | < 0.03 |
| Lead | mg/L | 0.05 | < 0.05 | | < 0.01 | < 0.01 | | < 0.005 |
| Mercury | mg/L | 0.002 | < 0.001 | | < 0.001 | | | < 0.001 |
| Nitrogen, NO2+NO3, N | mg/L | 10 | 0.1 | < 0.05 | < 0.05 | < 0.25 | | < 0.05 |
| Selenium | mg/L | 0.01 | < 0.01 | | < 0.005 | < 0.005 | | < 0.01 |
| Silver | mg/L | 0.05 | < 0.05 | | 0.01 | | | < 0.03 |
| Fluoride | mg/L | 4 | 0.3 | < 0.10 | < 0.10 | < 0.10 | | 2.75 |
| | | | | | | | | |
| Total trihalomethanes | ug/L | | | | | | | |
| Screen Alpha | pCi/L | | 2.4 | | | | | |
| Radon gas | pCi/L | 20000 | | | | | | |
| Radium 226 | pCi/L | 5 | | | | | | |
| Uranium | pCi/L | | | | | | | |
| | | | | | | | | |
| Aluminum | mg/L | | | | | | | 0.16 |
| Vanadium | mg/L | | | | | | | < 0.01 |
| Molybdenum | mg/L | | | | | | | < 0.01 |
| Nickel | mg/L | | | | | | | < 0.03 |
| Antimony | mg/L | | | | | | | < 0.01 |
| | | | | | | | | |
| Chloride | mg/L | 250 | < 10.00 | < 10.00 | < 10.00 | < 10.00 | | 8 |
| Color | units | 15 | 0 | | | | | |
| Copper | mg/L | 1 | < 0.10 | | < 0.10 | < 0.10 | | 0.1 |
| Iron | mg/L | 0.3 | 0.1 | < 0.10 | 0.1 | 0.5 | | 0.2 |
| Manganese | mg/L | 0.05 | < 0.05 | < 0.01 | 0.05 | 0.05 | | 0.06 |
| pH | units | | 8.1 | 7.1 | 7.7 | 8.1 | | 6.61 |
| Total Hardness (CaCO3) | mg/L | | 138 | 30 | 140 | 136 | | 27.6 |
| Calcium Hardness | mg/L | | | | | 117 | | 25 |
| Alkalinity (CaCO3) | mg/L | | | 16 | 119 | 110 | | 13 |
| Specific Conductance | μMHOs | | | | | | | 92.7 |
| Sodium | mg/L | 250 | | 3.9 | 3.2 | 11 | | 7 |
| Sulfate | mg/L | 250 | | | | | | 9 |
| Zinc | mg/L | | | | | | | 0.08 |
| Potassium | mg/L | | | | | | | |
| Phosphate, Dis.Ortho P | mg/L | | | | | | | |
| Phosphorous, Total, P | mg/L | | | | | | | |
| Total filterable (TDS) | mg/L | 500 | | | | | | |
| Cadmium | mg/L | 0.05 | | | | | | |
| Magnesium | mg/L | | | | | | | |
| | | | | | | | | |
| Noncorrosive, Langelier | S.I. | | | | | 0.896 | | -3.0081 |
| Turbidity | NTU | | 0.54 | | | | | |
| Coliform, Tot. | cts/100ml | 1 | < 1.00 | 38 | < 1.00 | < 1.00 | | 0 |
| Non-Coliform | cts/100ml | 201 | | | | | | 0 |
| | | | | | | | | |
| Beryllium | mg/L | | | | | | | < 0.30 |
| VOC's | | | | | | | 32 ND | |
| Ethylene, trichloro | ug/L | | | | | | | |
| Ethylene, tetrachloro | ug/L | | | | | | | |
| 1,2Dichloroethylene c+t | ug/L | | | | | | | |
| Ethylene, chloro | ug/L | | | | | | | |
| Styrene | ug/L | | | | | | | |
| Cyclohexane | ug/L | | | | | | | |
| ChlorofluoroMethane | ug/L | | | | | | | |
| DichlorodifluoroMethane | ug/L | | | | | | | |
| DichlorotrifluoroEthane | ug/L | | | | | | | |
| Thallium | mg/L | | | | | | | < 0.10 |
| Acrolein | ug/L | | | | | | | |
| Acrylonitrile | ug/L | | | | | | | |
| Ether2chloroethylvinyl | ug/L | | | | | | | |
| Methane, bromo | ug/L | | | | | | | |
| Methane, chloro | ug/L | | | | | | | |
| Methyl t-butyl ether | ug/L | | | | | | | |
| Nitrate-N | mg/L | 10 | | | | | | |
| Silica | mg/L | | | | | | | |
| Benzene | ug/L | | | | | | | |
| Methane, dichloro- | ug/L | | | | | | | |
| Methane, trichloro- | ug/L | | | | | | | |
| Toluene | ug/L | | | | | | | |
| | | | | | | | | |
| | | | | | | | ND = NOT DETECTED | |

| | | | | |
|---|---|---|---|---|
| | | | | DURHAM |
| | | | | GPW LEE |
| | | | | |
| EPA NUMBER | | | | 891021 |
| SAMPLE NUMBER | | | | 91926 |
| SAMPLING DATE | | | | 01-06-88 |
| | MCL | | | |
| Arsenic | mg/L | 0.05 | | < 0.005 |
| Barium | mg/L | 1 | | < 0.50 |
| Cadmium | mg/L | 0.01 | | < 0.001 |
| Chromium | mg/L | | | < 0.03 |
| Lead | mg/L | 0.05 | | < 0.005 |
| Mercury | mg/L | 0.002 | | < 0.001 |
| Nitrogen, NO2+NO3, N | mg/L | 10 | | |
| Selenium | mg/L | 0.01 | | < 0.005 |
| Silver | mg/L | 0.05 | | < 0.03 |
| Fluoride | mg/L | 4 | | < 0.10 |
| | | | | |
| Total trihalomethanes | ug/k | | | |
| Screen Alpha | pCi/L | | | 1 |
| Radon gas | pCi/L | 20000 | | 3100 |
| Radium 226 | pCi/L | 5 | | |
| Uranium | pCi/L | | | |
| | | | | |
| Aluminum | mg/L | | | < 0.05 |
| Vanadium | mg/L | | | < 0.01 |
| Molybdenum | mg/L | | | < 0.01 |
| Nickel | mg/L | | | 0.06 |
| Antimony | mg/L | | | < 0.0[illegible] |
| | | | | |
| Chloride | mg/L | 250 | | 129.5 |
| Color | units | 15 | | |
| Copper | mg/L | 1 | | 0.1 |
| Iron | mg/L | 0.3 | | 0.1 |
| Manganese | mg/L | 0.05 | | < 0.03 |
| pH | units | | | 6.5 |
| Total Hardness (CaCO3) | mg/L | | | 111 |
| Calcium Hardness | mg/L | | | 88.9 |
| Alkalinity (CaCO3) | mg/L | | | 18.9 |
| Specific Conductance | uMHOs | | | 480 |
| Sodium | mg/L | 250 | | 39 |
| Sulfate | mg/L | 250 | | 6 |
| Zinc | mg/L | | | < 0.03 |
| Potassium | mg/L | | | |
| Phosphate, Dis.Ortho.P | mg/L | | | |
| Phosphorous, Total, P | mg/L | | | |
| Total filterable (TDS) | mg/L | 500 | | |
| Calcium | mg/L | 0.05 | | |
| Magnesium | mg/L | | | |
| | | | | |
| Noncorrosive, Langelier | S.I. | | | -2.4432 |
| Turbidity | NTU | | | |
| Coliform, Tot. | cts/100mL | 1 | | 0 |
| Non-Coliform | cts/100mL | 201 | | 0 |
| | | | | |
| Beryllium | mg/L | | | < 0.03 |
| VOC's | | | | 33 ND |
| Ethylene, trichloro | ug/k | | | |
| Ethylene, tetrachloro | ug/k | | | |
| 1,2Dichloroethylene c+t | ug/k | | | |
| Ethylene, chloro | ug/k | | | ND |
| Styrene | ug/k | | | ND |
| Cyclohexane | ug/k | | | ND |
| ChlorofluoroMethane | ug/k | | | ND |
| DichlorodifluoroMethane | ug/k | | | ND |
| DichlorotrifluoroEthane | ug/k | | | ND |
| Thallium | mg/L | | | < 0.10 |
| Acrolein | ug/k | | | |
| Acrylonitrile | ug/k | | | |
| Ether2chloroethylvinyl | ug/k | | | |
| Methane, bromo | ug/k | | | |
| Methane, chloro | ug/k | | | |
| Methyl t-butyl ether | ug/k | | | ND |
| Nitrate-N | mg/L | 10 | | 0.62 |
| Silica | mg/L | | | |
| Benzene | ug/k | | | |
| Methane, dichloro- | ug/k | | | |
| Methane, trichloro- | ug/k | | | |
| Toluene | ug/k | | | |
| | | | | |
| | | ND = NOT DETECTED | | |

# APPENDIX III

## EXECUTIVE SUMMARY

FINAL REPORT FOR

BOSTON SAND & GRAVEL

HYDROGEOLOGIC INVESTIGATION/GROUNDWATER IMPACT ANALYSIS

OSSIPEE AGGREGATES

OSSIPEE, NEW HAMPSHIRE

AUGUST 5, 1988

# FINAL REPORT FOR

# BOSTON SAND & GRAVEL

# HYDROGEOLOGIC INVESTIGATION/GROUNDWATER IMPACT ANALYSIS

# OSSIPEE AGGREGATES

# OSSIPEE, NEW HAMPSHIRE

# AUGUST 5, 1988

## Executive Summary/Conclusions

BCI Geonetics, Inc. was contracted by the Boston Sand & Gravel Company on June 22, 1987, to conduct Phase II of a hydrogeologic investigation specifically targeted to evaluate existing and/or potential impacts that active gravel mining, occurring at the Ossipee Aggregates Facility in Ossipee, New Hampshire, has had on local groundwater quality/quantity conditions. The Ossipee Aggregates facility overlies extensive sand and gravel glacial drift deposits which have been identified by the United States Geological Survey (USGS) as an area in Ossipee that is highly favorable for groundwater development. (Availability of groundwater in the Saco River Basin, East Central New Hampshire, USGS WRI 39-74.)

The need to conduct a study such as this had arisen from recent increased public awareness and concern for maintaining high quality groundwater supplies. Since sand and gravel excavation operations, such as the Ossipee Aggregates facility, are often located in areas deemed favorable for developing potable groundwater supplies (due to their similarities in geologic environment), conflicts in use between local governing agencies and private gravel industries have evolved. Many of these conflicts are based upon the premise that sand and gravel excavation activities serve to degrade groundwater resources which they overlie.

Based upon the results of a detailed hydreologic investigation which included the installation of 20 observation wells on site and the collection and analysis of 80 water quality samples over a period of twelve months, BCI concludes the following:

A) The Ossipee Aggregates facility overlies a substantial water-bearing aquifer capable of yielding three-to-four million gallons per day of potable groundwater on site.

B) Groundwater flows in a general northwest direction. No changes in groundwater flow rate or direction were observed between August, 1987, and July, 1988. Furthermore, a study conducted by BCI in the spring of 1983 relative to groundwater table elevations also showed groundwater flowing to the northwest. Continued monitoring of the local groundwater table demonstrates that gravel mining activities has not significantly impacted groundwater movement below the site (Plate I, Appendix A).

C) The average groundwater gradient is .0058 to .0167 ft/ft. Hydraulic conductivities calculated for subsurface sand and gravel deposits range from 13 to 26 feet/day. The average groundwater flow rate (seepage velocity) of groundwater beneath the Ossipee facility ranges from .77 ft/day to 2.23 ft/day. This indicates that if contaminants entered the groundwater environment, it would likely take between 224 to 650 days to travel 500 feet under static water level conditions.

D) The established groundwater monitoring program already in place will act as an adequate early warning system (if properly monitored) should contaminants ever enter the groundwater regime. Remedial action could then be promptly initiated.

E) The closest and only significant user of groundwater adjacent to the Ossipee facility is the Salmon Rearing Facility on Route 10. Water quality tests conducted at the fish hatchery indicate that the active mining operation has not detrimentally impacted groundwater quality at the hatchery.

F) Based upon the results of nineteen volatile organic compound (VOC) analyses which evaluated 57 organic chemicals (included as part of a list of EPA's "priority pollutants"), it was found that no volatile organic compound contamination of any kind was detected in the groundwater underlying the Ossipee facility. These samples were generally taken within the excavation area and down-hydraulic gradient of the site between August, 1987, and May, 1988. Such results indicate that past and present gravel mining operational activities have not contaminated local groundwater resources with volatile organic compounds.

G) Based upon the water quality data presented to date, concentrations of iron in groundwater generally improve (decrease) in active or previously mined areas. Iron concentrations observed in groundwater located up-hydraulic gradient of the active excavation area averaged nearly 2.5 parts per million (ppm) whereas groundwater sampled within the excavation area during the study period averaged only 0.108 ppm. This represents a very substantial improvement (i.e., order of magnitude) in groundwater quality. (The recommended limit for iron concentrations in drinking water is 0.30 ppm.)

H) Manganese concentrations observed in all the sampled wells were extremely variable. 87.5 percent of all groundwater samples taken between August, 1987, and May, 1988, in the study area, exceeded recommended levels for manganese concentrations. Elevated manganese concentrations were determined to be a locally natural phenomena as high concentrations of manganese were found in groundwater samples in areas up-hydraulic gradient from the excavation area, within the excavation area, and down-hydraulic gradient of the excavation area. The results of this study indicate that elevated concentrations of manganese in groundwater are not related to gravel mining activities.

I) pH values for groundwater were found to be moderately to slightly acidic, ranging from 4.0 to 6.5 when measured directly in the field. The average pH value for all groundwater samples as measured in the field was 5.2. However, all samples were also analyzed in several New Hampshire Department of Environmental Services' state-approved laboratories. pH values measured in the laboratory resulted in substantially higher pH values, ranging from 5.6 to 8.9. The average pH as measured in the laboratory for all groundwater samples analyzed during the year was 7.0 (neutral). This is generally considered as an ideal value for groundwater quality. In general, pH analyses completed for all sample points during the year were very irregular, ranging by as much as 2 pH values in a single monitoring point.

J) <u>pH values for groundwater measured directly in the field and in the laboratory were found to be most favorable in the gravel excavation areas.</u> The average pH for groundwater samples in the excavation area was 5.6 (field) and 7.1 (laboratory). The average pH for sampling points measured directly in the field and up gradient of the Aggregates facility was 5.3. The average pH for down gradient sampling points was 4.9 (field).

K) pH measurements for surface water sources within the Ossipee Aggregates facility area were found to be more favorable in ponds located within the active mining operation. Average pH for the excavated surface water sources was 6.3 (field) and 7.6 (lab). The average pH value measured during the period of study for all other natural surface water bodies was 5.6 (field) which represents more acidic waters which are less favorable.

L) All groundwater samples analyzed during this study period were devoid of coliform bacteria contamination.

M) Surface water sources located within the excavated pit area maintained lower bacteria levels (higher quality) than natural surface water sources outside the excavation area. For example, seven of nine samples taken within the excavation area met drinking water standards with regard to levels of coliform bacteria, whereas twelve out of sixteen samples of surface water outside the excavation area maintained unacceptable levels of coliform bacteria.

N) BCI collected and analyzed 80 water quality samples representing thirteen (13) groundwater monitoring points and thirteen (13) surface water samples over the course of twelve months (May 1987 - May 1988). The results of these analyses from groundwater resources found underlying the operating gravel pit, in all cases, meet primary drinking water standards, in accordance with EPA's Safe Drinking Water Act of 1976 and as amended in 1986. With the exception of coliform bacteria, all surface water sources sampled were found to meet EPA's Primary Drinking Water Standards. (Note: VOC's were not evaluated for all sample points.) Secondary standards (those associated with aesthetic concerns but not hazardous to health) are generally good to excellent in areas proximal to or within the mining area.

O) The results of this hydrogeologic investigation indicate that gravel mining operations present at the Ossipee Aggregates Facility can safely occur within the identified favorable groundwater environment (as defined by the USGS in Ossipee, New Hampshire) without degrading groundwater resources and can in fact improve groundwater quality with respect to certain water quality parameters.