NOV 1995

AGASSIZ
Environmental Systems
5637 Brooklyn Blvd., Suite 103 ▪ Brooklyn Center, MN 55429
Office (612) 531-8255 ▪ FAX (612) 531-8239 ▪ 1-800-362-7087

November 3, 1995

Mr. Mark Koplitz
MPCA
Tanks and Spills
520 Lafayette Road North
St. Paul, MN 55155-4194

#4002

RE: RI/CAD, Union Co-op Oil, Hector, MN Leak #68

Dear Mr. Koplitz,

Enclosed is one copy of the RI/CAD Report for the Union Co-op Oil property located in Hector, Minnesota.

Thank you. If you have any questions or comments please do not hesitate to call me at 1-612-531-8255 or 1-800-362-7097.

Respectfully,

William Cole Storm, CHMM

AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

REMEDIAL INVESTIGATION REPORT WORKSHEET
Fact Sheet #6
Minnesota Pollution Control Agency
LUST Cleanup Program
April 1993

This worksheet documents specific information gathered during the remedial investigation (RI) and must be submitted with the RI/corrective action design (CAD) report to fulfill U.S. Environmental Protection Agency requirements. The purpose of the worksheet is to facilitate Minnesota Pollution Control Agency (MPCA) evaluation of the site priority. **RI/CAD reports submitted without this worksheet, or with an incomplete worksheet, will be rejected as inadequate.**

Date form completed: **August 31, 1995**

Site Information

Leak Number: **000069**
Type of product release: **Gasoline**
Source of release: **Two 1,000 gallon gasoline USTs**

Estimated volume of product released: **Unknown**
Date investigation field work initiated: **October 15, 1974 (Fuel Recovery Company)**
Date investigation field work completed: **August 22, 1994 (Agassiz Environmental Systems, Inc.)**

Contaminated Soil

Date removed: **July 1984 soil was reportedly excavated w/ the removal of the two USTs**
Volume removed: **Unknown**
Treatment method for soil removed: **NA**
Estimated volume of contaminated soil remaining above action levels: **Unknown**

Ground Water

Ground water impacts? **Yes**
Extent of ground water contamination defined: **Yes**

Free Product

Free product observed: **None currently, however free product was encountered during earlier investigations.**
Maximum thickness of free product: **Unknown**
Interim free product recovery method: **Fuel Recovery Company reportedly recovered 300 gallons of product, and vented another 700 gallons in 1974**
Volume of free product recovered to date: **Unknown**

Drinking Water Impacts

Drinking water supply well(s) contaminated above detection limits? **Unknown.**
Drinking water well(s) contaminated above RAL's? **No**
Alternative water supply start date: **N/A**

Vapor Risk Assessment

Complete a vapor risk assessment as per MPCA fact sheet #22
Was a vapor survey required?

If no, explain:

If yes, results**: Yes, A vapor risk assessment was conducted; vapor migration has been a concern in this area.**

Were vapor mitigation actions necessary?

If yes, describe: **None currently, however, historically gasoline vapors have been noticed in neighboring properties and sewer venting had been conducted.**

EXECUTIVE SUMMARY

Agassiz Environmental Systems, Inc. of Brooklyn Center, Minnesota contracted with Mr. Scott Rohlik, Farmers Union Oil Coop to conduct a subsurface investigation and provide environmental consulting services concerning a property in Hector, Minnesota.

During the fall of 1974 an unknown quality of gasoline was released from one or both of two 1,000 gallon USTs located south of the Co-op office building; the tanks were later (reportedly, along with contaminated soils, in July 1984) removed; meanwhile the Fuel Recovery Company reportedly recovered 300 gallons of product. Another estimated 700 gallons were vented to the air through a soil venting system installed along the east property boundary. In 1981 the MPCA reported that sewer vapors had been greatly reduced, however, a sheen was still visible in the sewers.

From 1981 through 1992 periodic increases, some requiring emergency action, of petroleum vapors in the sewers and surrounding properties have occurred; additional investigations were also conducted in an attempt to determine the source(s) of the petroleum.

On October 15, 1992 a consulting firm (i.e., Dahl) released a subsurface investigation report on the Union Co-op Oil Company property; the report recommended additional investigation and the installation of a free product recovery system.

In November 4, 1993 the Union Co-op Oil Company hired Agassiz Environmental Systems, Inc. to complete the investigation activities and comply with the MPCA's request for an RI/CAD report. On March 23 & 25 and April 20, 1994 five (5) soil borings (SB-1a through SB-5a) were completed at selected locations on the subject property.

The results of Agassiz's investigation indicate that residual petroleum hydrocarbons remain in the soils associated with the UST basin and that the migration of these hydrocarbons is being intercepted by the soil venting system, which acting as a conduit, allows these hydrocarbons to travel north. The migration of these hydrocarbons appear to occur in response to rain events, occurring as a slug of material. This may explain the periodic peaks in the vent system's effluent concentration and sewer vapor reports.

Agassiz recommends continue operation of the soil venting remediation system with continued monitoring for this site; this monitoring should include quarterly groundwater sampling and analysis combined with vapor surveys of the adjacent sewer.

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1.0 INTRODUCTION

The following report was prepared in accordance with the Minnesota Pollution Control Agency (MPCA) requirements for petroleum release identification and investigation during the excavation and removal of a regulated underground storage tank (UST). The MPCA has identified the site as LEAK#00000068. The scope of the work described in this report includes:

- The completion of ten (10) soil borings;
- The sampling and analysis of soil collected from the borings;
- The installation of three (3) monitoring wells;
- The sampling and analysis of ground water collected from the monitoring wells.

The purpose for the work described in the report is to assess the impact that the release is having on the site and identify potential receptors.

The work was authorized by Mr. Scott Rohlik, Farmers Union Oil Coop. Work was performed at the site in accordance with MPCA requirements.

2.0 BACKGROUND

The site is located in Renville county, Hector township, township 115 north, range 32 west, SE 1/4, SW 1/4, NE 1/4 of section 29. The site is located at 260 Main Street in Hector, Minnesota (**Figure 1 and 2**).

The latitude and longitude are 94° 49' 23" and 44° 45' respectively.

In reviewing the existing files, a chronological log of events was developed and is presented below:

CHRONOLOGICAL LOG

1974 The MPCA inspected the site on October 15, 1974; Fuel Recovery company was on-site (Union Co-op Oil). Reportedly 300 gallons of product were recovered and an estimated 700 gallons were vented to air.

1981 On March 25, 1981 @ 11:30 am an incident report was recorded. A residence reported vapors in their home. An investigation of the residence and local area was conducted on March 26, 1981; product was visible in the sanitary sewer and traced

to within 200' of the Union Co-op property.
Information concerning the USTs located on the Union Co-op property was collected and a soil boring was completed to a depth of 3.5', by hand, between the two suspect USTs. A probe was then driven through the soil to a depth of 8.5'. Contamination was detected from 5.5' to 7.5' interval below grade.

On March 27, 1981 the MPCA informed the Union Co-op Oil Company that they must response immediately to the situation and to address the following concerns:

- Site Investigation
- Facility testing
- Recovery by vacuum
- Recovery by scavengers
- Utilizing interceptor vents
- Groundwater monitoring

On March 27, 1981 Fuel Recovery commenced interception efforts.

1981 An MPCA follow-up on April 1, 1981 revealed the installation of a vent/sewer interceptor system in place directly in front of the Union Co-op Oil Company property. Vapors are reported to have been greatly reduced, however, a film or sheen is still visible on the wastewater in the sewer at the intersection of East 2nd Street and Ginsburg's Super Value.

1982 On May 24, 1982 in a letter from National Farmers Union Insurance Company to Fuel Recovery an inquiry into whether the installation at Hector could be shut down.

1983 On November 17, 1983 in a letter from Farmers Union to Fuel Recovery, Farmers Union stated that readings collected for the vent system have had a sudden increase in readings from 0.00 ppm to 150 ppm; that persons within the Hector Bank reported a gasoline smell, and that where the Hector phone company currently sits was once a gasoline station. The Farmers Union was concerned that an additional source exists in the area.

On November 30, 1983 in a letter from Fuel Recovery to the Farmers Union, Fuel Recovery recommends that this information be passed along to the MPCA.

1984 On January 6, 1984 in a letter from the Farmers Union to the MPCA, Farmer Union relates the information concerning the increase in vent readings and the presence

of an old gasoline station at the Hector Bank. Farmers Union states that they believe an additional source is responsible for this increase and request that the MPCA look into that possibility.

On January 19, 1984 in a letter from the MPCA to Farmers Union, the MPCA states that they will investigate the possibility of an additional local source.

On March 19, 1984 in a letter from the Farmers Union to the MPCA, Farmers Union relates that another sampling event of the vents has taken place and that the levels have again increased, this time up to 500 ppm. Farmers Union also inquires whether any progress has been made in locating the suspect additional source.

1986 On February 19, 1986 in a letter from Fuel Recovery to the MPCA, Fuel Recovery request permission to terminate activities at the Union Co-op Oil Company facility; the following vent readings are submitted:

- 12/20/84 @ 100 ppm
- 4/20/85 @ 100 ppm
- 9/17/85 @ 100 ppm

On March 4, 1986 in a letter from the MPCA to Fuel Recovery, the MPCA responded to Fuel Recovery's request for termination of activities at the Hector site; the MPCA stated that since groundwater had not been monitored it must be done before the MPCA can determine whether no further action is justified

On September 18, 1986 in an office memorandum the MPCA documented a conversation with Mr. Scott Rohlik, manager at Union Co-op Oil Company. Mr. Rohlik stated that tanks were replaced in July of 1984.

1987 On January 12, 1987 in a letter from the MPCA to Farmers Union, the MPCA states that they have no record of activities in response to the MPCA's March 4, 1986 letter and instructs Farmers Union to comply with those request within 20 days.

On January 15, 1987 in a letter from Farmers Union to the MPCA, Farmers Union states that there is a communication problem and asks the MPCA if the inspection promised in the MPCA's January 19, 1984 letter had occurred.

On January 17, 1987 in a letter from Dahl & Associates to the MPCA, Dahl states that the files are incomplete; Dahl provides the following vent results:

- 1/20/85 @ 100 ppm
- 9/17/85 @ 100 ppm

On June 16, 1987 in a letter from the MPCA to Dahl, the MPCA states that they have reviewed Dahl's May 26, 1987 report and grant conceptual approval to the proposed recovery technique.

On August 5, 1987 in a MPCA memorandum an incident is documented of gasoline vapors by a Hector, MN resident. The memorandum also notes the Union Co-op Oil Company's 1981 leak and the possible USTs at Tires Plus.

On August 21, 1987 in a letter from the MPCA to Union Co-op Oil Company, the MPCA is instructing Mr. Scott Rohlik (Union Co-op Oil) that the MPCA is directing one of their contractors to install ventilation mechanisms on the sewer system to control vapors along Main Street in Hector and acknowledges the Union Co-op Oil Company's decline of the opportunity to perform this work as a PRP.

On August 21, 1987 in a MPCA office memorandum, the MPCA documents a telephone conversation between Mr. Steve Lee and Mr. Scott Rohlik concerning this new incident of vapors is discussed.

On August 24, 1987 in a letter from Bay West, Inc. to the MPCA, Bay West offers a critique of Dahl work to date and recommendations in an effort to solicit the MPCA contract.

On September 25, 1987 in a letter from the MPCA to Union Co-op Oil Company, the MPCA states that the MPCA believes a release has occurred from USTs located on the Union Co-op Oil Company's property, that the MPCA has granted conceptual approval to Dahl's recommendations as detailed in their May 1987 report, instructs the Union Co-op Oil Company to sign an "Agreement to Proceed" and states the actions (i.e., issue an Order, issue notice of violation and/or proceed with State funds) the MPCA will take if the Union Co-op Oil Company fail to sign.

On September 25, 1987 in a letter from the MPCA to Bargman Oil Company (101 Main Street, Hector, MN), the MPCA instructs the Bargman Oil Company to complete part 1 of an enclosed "Contents of Petroleum Tank Release Investigation Report" in an effort to help the MPCA identify the PRP associated with the release of petroleum in the city of Hector.

On December 4, 1987 in a letter from the MPCA to the Union Co-op Oil Association,

the MPCA states that the MPCA believes that a release has occurred from USTs located on Union Oil Co-op property as documented by a site inspection that occurred on March 26, 1987 and informs the Union Co-op Oil Company of their responsibilities.

On December 21, 1987 in a MPCA office memorandum, the MPCA documented the results of a site visit conducted by Terry Miller of Twin City Testing. No vapors/odors in basements of nearby buildings, a .19% LEL reading in manhole at intersection of Main and Birch Streets, MW on Union Co-op Oil Property found to contain free product and checked venting system (has been in operation for six years).

1988 On January 15, 1988 in a letter from Faegre & Benson (representing Union Co-op Oil Association) to the MPCA, Faegre states that contaminated soils were excavated when the USTs were removed, that Union Co-op Oil had contracted with Dahl to preform the groundwater monitoring required and that Dahl's results were submitted to the MPCA in June of 1987, that the MPCA has granted approval of the proposed remedial action plan and that the Union Co-op Oil will proceed with this remediation a timely manner.

On January 19, 1988 in a MPCA office memorandum, the MPCA documented a discussion of the project status with Faegre.

On February 2, 1988 in a letter from the MPCA to the Union Co-op Oil Association, the MPCA requests that the Union Co-op Oil Ass. sign the enclosed "letter of intent" (within 10 days), revise the May 1987 Dahl report so that it complies with the new requirements of the PTR prior to commencing remediation.

On March 1, 1988 in a MPCA office memorandum, the MPCA documented the initial results of a TCT investigation:

- all borings so far (20') are dry, dark grey mottled clay
- sewer located at 8' BG
- two MWs placed, both dry-leave remaining boring open for 36hrs, no water no MWs
- MWs on Union Co-op property show water at 6' BG

On March 1, 1988 in a MPCA office memorandum, the MPCA documented a phone conversation with Dahl; Dahl reports that the RI report will be completed by 3/4/88.

On March 2, 1988 in a MPCA office memorandum, the MPCA documented the initial findings of TCT's investigation:

- o boring near Mark's transmission and Phillips 66 are dry (15'-20'); no water, no indication of contamination
- o TCT states that the problem appears to be localized around the Union Co-op property

On March 31, 1988 in a MPCA office memorandum, the MPCA recorded verbal results on TCT investigation:

- o soil results back, no gross contamination
- o water samples still in lab
- o boring depth 19'-21', groundwater @ 12'-13'
- o sewer approx. 9'-10' deep
- o groundwater data may not be reliable-rain events more important in source of contamination movement

On June 2, 1988 in a letter from the MPCA to Dahl, the MPCA states that it has reviewed Dahl's "Cenex/Coop Services Inc., Hector, MN Off-site Contamination Assessment Proposal" and is in general agreement, however, the MPCA would like to see additional soil borings placed between the Union Coop's USTs and the Main Street sewer line (directly east of dispensers and Coop Office); also additional inventory records for 1/88,2/88,3/88 and 4/88 and methods used for inventory.

On September 12, 1988 in a MPCA office memorandum, the MPCA documented a phone conversation with Dahl on the status of the Union Co-op site; the MPCA was concerned that RI work has not begun, Dahl stated that Union Co-op's attorney has not authorized the work.

1991 On April 9, 1991 in an MPCA office memorandum, the MPCA provides a narrative on the Hector situation in reviewing cost recovery, the MPCA states that in June 1988 TCT issued a report to the MPCA which concluded that a clear, identifiable RP concerning the vapor problems could not be determined. No additional vapor problems have been reported since 1987. The MPCA believes the vapor problems were caused by an unknown RP. The memorandum recommends that cost recovery not be sought and that the leak # remain open until the Union Co-op completes its investigation/cleanup and also states that two other LUST sites were identified (Best property, a former gasoline station and Bargman Oil Company) during TCT's work

1992 On October 15, 1992 Dahl released a report entitled "Remedial Investigation Drilling Results and Recommendations, Union Oil Company, 260 Main Street, Hector, MN"

FINDINGS:

- Soil borings indicate that petroleum hydrocarbons are present in the soils beneath the site and extending off-site, with greatest concentrations occurring at 4'-9' below grade.
- Groundwater was found to be at approx. 4'-6' below grade; results indicate that petroleum hydrocarbons exist in all three MWs.
- MW-1 had the greatest concentration of PHCs with benzene @ 2,400 ppb and GRO @ 12,000 ppb.
- Three soil borings east of the subject property, in the Main Street right-of-way indicated subsurface soil contamination at the 4'-9' below grade level. Free product was observed in one of these borings (TB-6).

COMMENTS:

- Dahl notified the MPCA of the free product per guidelines on September 24, 1992. Immediate recovery per the guidelines was not possible due to relation to Main Street. Submittal of a free product recovery report is due to the MPCA within 45 days of confirming presence of free product.
- MPCA guidelines require an investigation and report to be submitted within 90 days if the free product is greater than 0.1'.
- To comply with the Petroleum Reimbursement Fund competitive biding requirements for any additional work conducted at the site the Union Co-op will need to solicit at least two bids.

RECOMMENDATIONS:

- Dahl recommends a full investigation be conducted to confirm the presence of free product and determine the vertical and horizontal extent of the free product and associated contamination.
- Some type of free product recovery should be implemented immediately.

On September 24, 1992 in a MPCA phone Memo; the MPCA documented notification from Dahl that free product was encountered during the Union Coop investigation. The MPCA informs Dahl that a free product letter requesting submission of a work plan will be sent to Union Co-op.

Figure 3 illustrates the site (UST basin, soil borings and monitoring wells).

Agassiz Environmental Systems, Inc. of Brooklyn Center, Minnesota contracted with Mr. Scott Rohlik, Union Coop Oil to complete the investigation and remediation of petroleum hydrocarbon impact to the subsurface.

3.0 ENVIRONMENTAL SETTING

3.1 Geology

The upper most bedrock unit beneath the site is the Cretaceous granite, approximately 300 feet below grade. Overlying this is approximately 50 feet of Quaternary deposits of fine sand, covered by approximately 300 feet of Quaternary/Pleistocene deposits of clay.

The site is situated at an elevation of approximately 1078 feet, National Geodetic Vertical Datum.

3.2 Soils

The soils in the vicinity of the site consist of black loam, overlying a gray, tight clay. The natural soil profile has been significantly disturbed or buried.

3.3 Hydrology

Natural drainage from the vicinity of the site is to the south toward Judical ditch number fifteen. The natural drainage patterns have been significantly altered by man-made ditches and drainage ways.

4.0 REMEDIAL INVESTIGATION RESULTS

During the period from March 23 through April 20, 1994 Agassiz completed five (5) soil borings (SB-1A through SB-5A) at selected locations on the subject property (**Figure 3**).

These soil borings were advanced as part of an investigation to determine if, and to what extend, historic activities may have impacted the subsurface with petroleum hydrocarbons at the subject property.

The soil borings were installed in accordance with MPCA Fact Sheet #17, for specific methods see **Appendix F**.

The soil vapor measurements (**Appendix F**) from the soil borings ranged from nondetectable to 9,500 ppm (**Table 1 and Figure 4**).

The native soil consisted of a black loam overlying a gray, silty clay becoming a gray tight clay with depth; depth to groundwater varied from 7' to 10' below grade. The boring logs contained in **Appendix A** summarizes the soil vapor data collected.

Selected sampling intervals were chosen for analytical testing from each soil boring based on field observations (i.e., visual, olfactory and headspace) and sample interval location.

Soil samples for analytical laboratory analysis were collected in accordance with MPCA Fact Sheet #15, for specific methods see **Appendix F**.

Soil samples were analyzed for total petroleum hydrocarbons as gasoline (GRO), including BTEX. Soil samples were submitted to Midwest Analytical Services of Cambridge, Minnesota for analysis. The results are presented on **Table 2**. The laboratory's analytical report is contained in **Appendix B**.

The concentration of GRO ranged from below detection limits to 760 ppm in the soil samples collected. The benzene concentration ranged from below detection limits to 21.3 ppb in the soil samples.

Monitoring well elevation data for the existing wells were collected on March 23, 1994 and corresponds to Agassiz's first ground water sample collection date. Groundwater elevation measurements and samples were collected in accordance with MPCA Fact Sheet #15, for specific methods see **Appendix F**.

Ground water samples were collected from two (i.e., MW-1 and MW-2) of the three existing monitoring wells located on the subject property; MW-3 was dry and therefore a sample could not be collected.

Analytical parameters selected during the ground water quality sampling included total petroleum hydrocarbons as diesel range organics (DRO) and as gasoline range organics (GRO), including BTEX.

Ground water samples were submitted to Midwest Analytical Services of Cambridge, Minnesota for analysis. The results are presented on **Table 4**. The laboratory's analytical report is contained in **Appendix B**.

Benzene concentrations were 1,596 ppb and 3.7 ppb for monitoring wells MW-1 and MW-2, respectively. The GRO concentration was 8.8 ppm and <0.1 ppm for monitoring wells MW-1 and MW-2, respectively. The DRO concentration was 0.5 ppm and <0.1

ppm for monitoring wells MW-1 and MW-2, respectively.

Table 5 presents a summary of monitoring well survey and water elevation data; **Figure 6** includes the groundwater benzene concentrations.

On August 16, 1994 the three (3) monitoring wells were abandoned and three new monitoring wells (via soil borings SB-7, SB-8 and SB-9) were installed at those locations on the subject property (**Figure 3**). In addition to these wells a new monitoring well (MW-4) was installed (via soil boring SB-10) to the north of the Union Coop Oil building and the recovery system. The unique well numbers are 548206, 548207, 548208 and 548205 for MW-1, MW-2, MW-3 and MW-4, respectively.

The wells were installed in accordance with MPCA Fact Sheet #17, for specific methods see **Appendix F**.

Table 3 contains a summary of the well construction data.

Monitoring well elevation data for the new wells were collected on August 17, 1994.

Groundwater elevations were again measured on August 23, 1994 and corresponds to Agassiz's second ground water sample collection date. Groundwater elevation measurements and samples were collected in accordance with MPCA Fact Sheet #15, for specific methods see **Appendix F**.

Analytical parameters selected during this round of ground water quality sampling included GRO, including BTEX and DRO. On September 22, 1994 Agassiz returned to the site and collected groundwater samples from MW-4; these samples were analyzed for Minnesota Department of Health (465-D) volatile organic compound list (VOC).

Ground water samples were submitted to Midwest Analytical Services of Cambridge, Minnesota for analysis. The results are presented on **Table 4**. The laboratory's analytical report is contained in **Appendix B**.

Benzene concentrations were below the detection limit of 1.0 ppb in monitoring wells MW-2, MW-3 and MW-4. Monitoring well MW-1 had a benzene concentration of 222 ppb. The GRO concentrations were below the detection limit of 0.1 ppm in monitoring wells MW-2, MW-3 and MW-4. Monitoring well MW-1 had a GRO concentration of 3.90 ppm. The DRO concentrations were below the detection limit of 0.1 ppm in monitoring wells MW-2, and MW-4. Monitoring wells MW-1 and MW-3 had a DRO concentrations of 0.6 ppm and 0.2 ppm, respectively.

The hydraulic conductivity, hydraulic gradient, ground water flow direction and ground water velocity were determined by utilizing the data collected at the site during the site monitoring activities (ground water gauging and survey). A value of 10^{-3} meters per day (m/d) for hydraulic conductivity and 50% porosity was assumed. This figure, combined with the data collected at the site was used to calculate the hydraulic gradient (0.07), direction of flow and ground water velocity. The ground water velocity based upon the assumptions presented above is 0.0001 m/d. The inferred ground water flow direction is to the northwest.

Table 5 presents a summary of monitoring well survey and water elevation data; **Figure 5** illustrates ground water elevation and flow direction. **Figure 6a** illustrates the groundwater benzene concentrations.

Groundwater elevations were again measured on November 11, 1994 and corresponds to Agassiz's third ground water sample collection date. Groundwater elevation measurements and samples were collected in accordance with MPCA Fact Sheet #15; for specific methods see **Appendix F**.

Analytical parameters selected during this round of ground water quality sampling were GRO, including BTEX and DRO.

Ground water samples were submitted to Midwest Analytical Services of Cambridge, Minnesota for analysis. The results are presented on **Table 4**. The laboratory's analytical report is contained in **Appendix B**.

Benzene concentrations were 7520 ppb, 6.5 ppb, 4.9 ppb and 6.9 ppb in monitoring wells MW-1, MW-2, MW-3 and MW-4, respectively. The GRO concentrations were below the detection limit of 0.1 ppm in monitoring wells MW-2 and MW-4. Monitoring wells MW-1 and MW-3 had a GRO concentrations of 17.5 ppm and 0.11 ppm, respectively. The DRO concentrations were below the detection limit of 0.1 ppm in monitoring wells MW-3, and MW-4. Monitoring wells MW-1 and MW-2 had a DRO concentrations of 1.0 ppm and 0.1 ppm, respectively.

The hydraulic conductivity, hydraulic gradient, ground water flow direction and ground water velocity were determined by utilizing the data collected at the site during the site monitoring activities (ground water gauging and survey). A value of 10^{-3} m/d for hydraulic conductivity and 50% porosity was assumed. This figure, combined with the data collected at the site was used to calculate the hydraulic gradient (0.01), direction of flow and ground water velocity. The ground water velocity based upon the assumptions presented above is 0.00002 m/d. The inferred ground water flow direction is to the

west.

Table 5 presents a summary of monitoring well survey and water elevation data; **Figure 5a** illustrates ground water elevation and flow direction. **Figure 6b** illustrates the groundwater benzene concentrations.

Groundwater elevations were again measured on February 8, 1995 and corresponds to Agassiz's fourth ground water sample collection date. Groundwater elevation measurements and samples were collected in accordance with MPCA Fact Sheet #15, for specific methods see **Appendix F**.

Analytical parameters selected during this round of ground water quality sampling included GRO, including BTEX and lead. In addition, VOC analyses were conducted on samples collected from MW-4.

Ground water samples were submitted to Midwest Analytical Services of Cambridge, Minnesota for analysis. The results are presented on **Table 4**. The laboratories' analytical report is contained in **Appendix B**.

Benzene concentrations were 8170 ppb, 4.9 ppb and 1.9 ppb in monitoring wells MW-1, MW-2 and MW-3, respectively. The benzene concentration in MW-4 was below the detection limit of 0.5 ppb. The GRO concentrations were below the detection limit of 0.1 ppm in monitoring wells MW-2, MW-3 and MW-4. Monitoring well MW-1 had a GRO concentration of 27.0 ppm.

The hydraulic conductivity, hydraulic gradient, ground water flow direction and ground water velocity were determined by utilizing the data collected at the site during the site monitoring activities (ground water gauging and survey). A value of 10^{-3} m/d for hydraulic conductivity and 50% porosity was assumed. This figure, combined with the data collected at the site was used to calculate the hydraulic gradient (0.01), direction of flow and ground water velocity. The ground water velocity based upon the assumptions presented above is 0.00002 m/d. The inferred ground water flow direction is to the west.

Table 5 presents a summary of monitoring well survey and water elevation data; **Figure 5b** illustrates ground water elevation and flow direction. **Figure 6c** illustrates the groundwater benzene concentrations.

Groundwater elevations were again measured on May 8, 1995 and corresponds to Agassiz's fifth ground water sample collection date. Groundwater elevation

measurements and samples were collected in accordance with MPCA Fact Sheet #15, for specific methods see **Appendix F**.

Analytical parameters selected during this round of ground water quality sampling included GRO, including BTEX.

Ground water samples were submitted to Midwest Analytical Services of Cambridge, Minnesota for analysis. The results are presented on **Table 4**. The laboratory's analytical report is contained in **Appendix B**.

Benzene concentrations were 18900 ppb and 2.0 ppb in monitoring wells MW-1 and MW-2, respectively. The benzene concentrations in MW-3 and MW-4 were below the detection limit of 1.0 ppb. The GRO concentrations were below the detection limit of 0.1 ppm in monitoring wells MW-2, MW-3 and MW-4. Monitoring well MW-1 had a GRO concentration of 81.4 ppm.

The hydraulic conductivity, hydraulic gradient, ground water flow direction and ground water velocity were determined by utilizing the data collected at the site during the site monitoring activities (ground water gauging and survey). A value of 10^{-3} m/d for hydraulic conductivity and 50% porosity was assumed. This figure, combined with the data collected at the site was used to calculate the hydraulic gradient (0.01), direction of flow and ground water velocity. The ground water velocity based upon the assumptions presented above is 0.00002 m/d. The inferred ground water flow direction is to the northwest.

Table 5 presents a summary of monitoring well survey and water elevation data; **Figure 5c** illustrates ground water elevation and flow direction. **Figure 6d** illustrates the groundwater benzene concentrations.

Groundwater elevations were again measured on August 24, 1995 and corresponds to Agassiz's sixth ground water sample collection date. Groundwater elevation measurements and samples were collected in accordance with MPCA Fact Sheet #15, for specific methods see **Appendix F**.

Analytical parameters selected during this round of ground water quality sampling included GRO, including BTEX, DRO and lead.

Ground water samples were submitted to Midwest Analytical Services of Cambridge, Minnesota for analysis. The results are presented on **Table 4**. The laboratory's analytical report is contained in **Appendix B**.

Benzene concentrations were 10000 ppb and 1.1 ppb in monitoring wells MW-1 and MW-4, respectively. The benzene concentrations in MW-3 and MW-3 were below the detection limit of 1.0 ppb. The GRO and DRO concentrations were below the detection limit of 0.1 ppm in monitoring wells MW-2, MW-3 and MW-4. Monitoring well MW-1 had a GRO and DRO concentration of 57.1 ppm and 2.23 ppm, respectively.

The hydraulic conductivity, hydraulic gradient, ground ~~wafer~~ flow direction and ground water velocity were determined by utilizing the data collected at the site during the site monitoring activities (ground water gauging and survey). A value of 10^{-3} m/d for hydraulic conductivity and 50% porosity was assumed. This figure, combined with the data collected at the site was used to calculate the hydraulic gradient (0.01), direction of flow and ground water velocity. The ground water velocity based upon the assumptions presented above is 0.00002 m/d. The inferred ground water flow direction is to the northwest.

Table 5 presents a summary of monitoring well survey and water elevation data; **Figure 5d** illustrates ground water elevation and direction. **Figure 6e** illustrates the groundwater benzene concentrations.

A vapor risk assessment was conducted based on soil type, contaminant concentration, extent of contamination, availability of subsurface conduits and other site specific factors. Historically petroleum vapors have been noticed in neighboring properties and sewer venting had been conducted. A vapor survey was conducted **Appendix E**

A ground water receptor survey (**Table 6**) was conducted to determine the location and relative direction of potential drinking water wells within one mile of the site and source of petroleum hydrocarbons impact. **Appendix D** contains the water supply well information from the MGS.

No free product has been recorded.

Field data, descriptions and calculations are contained in **Appendix E**. The changes in ground water elevations and ground water benzene concentrations are illustrated on **Table 7 and Table 8**.

5.0 DISCUSSION/CONCLUSIONS

During the fall of 1974 an unknown quality of gasoline was released from one or both of two 1,000 gallon USTs located south of the Co-op office building; the tanks were later

(reportedly, along with contaminated soils, in July 1984) removed; meanwhile the Fuel Recovery Company reportedly recovered 300 gallons of product. Another estimated 700 gallons were vented to the air through a soil venting system installed along the east property boundary.

In 1981 the MPCA reported that sewer vapors had been greatly reduced, however, a sheen was still visible in the sewers.

From 1981 through 1992 periodic increases, some requiring emergency action, of petroleum vapors in the sewers and surrounding properties have occurred; additional investigations were also conducted in an attempt to determine the source(s) of the petroleum.

On October 15, 1992 a consulting firm (i.e., Dahl) released a subsurface investigation report on the Union Co-op Oil Company property; the report recommended additional investigation and the installation of a free product recovery system.

In November 4, 1993 the Union Co-op Oil Company hired Agassiz Environmental Systems, Inc. to complete the investigation activities and comply with the MPCA's request for an RI/CAD report. On March 23 & 25 and April 20, 1994 five (5) soil borings (SB-1a through SB-5a) were completed at selected locations on the subject property.

Results from this investigation suggest that the remaining residual petroleum hydrocarbon contamination in the soils are concentrated along the east property boundary, extending from the UST basin north to the property boundary (SB-1A and SB-4A).

The contaminated soils are in contact with ground water.

The levels of benzene and total petroleum hydrocarbons (GRO) detected in MW-1 exceeded the recommended allowable limits (RALs) for these parameters (i.e., 10 ppb for benzene and 1 ppm for TPHC) during each sampling event. The RAL for benzene was exceeded in MW-4 during the August 23, 1994 sampling event.

The results of Agassiz's investigation indicate that residual petroleum hydrocarbons remain in the soils associated with the UST basin and that the migration of these hydrocarbons is being intercepted by the soil venting system, which acting as a conduit, allows these hydrocarbons to travel north. The migration of these hydrocarbons appear to occur in response to rain events, occurring as a slug of material. This may explain the periodic peaks in the vent system's effluent concentration and sewer vapor reports.

The vapor risk assessment and survey did not indicate vapor migration to be a threat at the time the survey was conducted. It is believed that during major rain events the soil venting system's ability to contain the hydrocarbons may be overwhelmed, thus resulting in elevated petroleum vapor levels within the adjacent sewer system.

A ground water receptor survey was conducted to determine the location and relative direction of potential drinking water wells within one mile of the site and source of petroleum hydrocarbons impact. Given the fact that no indication of off-site migration has been found and lack of potable wells in the affected water bearing zone within the one mile radius of the site, no drinking water supplies are endanger of being impacted from this source.

what ?

6.0 RECOMMENDATIONS

The information presented above in reference to this site and the impact that petroleum hydrocarbons have upon the site at this time, indicate that continued operation of the corrective action activities (i.e., the soil venting system) will be necessary to reduce the levels of petroleum hydrocarbons on the site.

Agassiz recommends continue operation of the soil venting remediation system with continued monitoring for this site; this monitoring should include quarterly groundwater sampling and analysis combined with vapor surveys of the adjacent sewer.

soil venting

?

TABLE 1
SOIL VAPOR RESULTS FROM SOIL BORINGS

Soil Boring Number	Soil Vapor Sample	Depth	FID Reading (PPM)
SB-1a	SV-1a	5'	75
	SV-1b	8'	6200
	SV-1c	10'	9500
	SV-1d	12'	10
	SV-1e	15'	ND
SB-2a	SV-2a	5'	ND
	SV-2b	8'	ND
	SV-2c	10'	ND
	SV-2d	13'	ND
	SV-2e	15'	ND
SB-3a	SV-3a	2'	ND
	SV-3b	5'	ND
	SV-3c	7'	ND
	SV-3d	10'	ND
	SV-3e	13'	ND
	SV-3f	15'	ND
SB-4a	SV-4a	5'	ND
	SV-4b	7'	1240
	SV-4c	10'	25
	SV-4d	13'	ND
SB-5a	SV-5a	3'	ND
	SV-5b	5'	ND
	SV-5c	7'	ND
	SV-5d	10'	ND

TABLE 1
SOIL VAPOR RESULTS FROM SOIL BORINGS

Soil Boring Number	Soil Vapor Sample	Depth	FID Reading (PPM)
	SV-5e	12'	ND
	SV-5f	15'	ND
SB-7	SV-7a	2'	ND
	SV-7b	5'	ND
	SV-7c	8'	220
	SV-7d	10'	115
	SV-7e	13'	35
	SV-7f	15'	10
	SV-7g	17'	ND
	SV-7h	19'	ND
SB-8	SV-8a	2'	ND
	SV-8b	5'	ND
	SV-8c	7'	65
	SV-8d	10'	55
	SV-8e	12'	25
	SV-8f	15'	15
	SV-8g	17'	ND
	SV-8h	19'	ND
SB-9	SV-9a	2'	ND
	SV-9b	5'	25
	SV-9c	7'	775
	SV-9d	12'	55
	SV-9e	15'	15
	SV-9f	17'	5

TABLE 1
SOIL VAPOR RESULTS FROM SOIL BORINGS

Soil Boring Number	Soil Vapor Sample	Depth	FID Reading (PPM)
	SV-9g	19'	ND
SB-10	SV-10a	2'	ND
	SV-10b	5'	ND
	SV10c	7'	ND
	SV-10d	10	ND
	SV-10e	13'	ND
	SV-10f	15'	ND
	SV-10g	17'	ND
	SV-10h	19'	ND

TABLE 2
SUMMARY OF LABORATORY SOIL ANALYSIS FROM SOIL BORINGS

Parameter							
Sample #/Depth	**Benzene (0.050)**	**Toluene (0.050)**	**Ethyl Benzene (0.050)**	**Xylenes (0.150)**	**GRO (10.0)**	**Pb**	**MTBE (0.50)**
3/23/94							
SS-1/SB-1A/9'	22.3	59.5	15.0	82.8	760	NA	NA
SS-2/SB-1A/15'	BDL	0.215	BDL	BDL	BDL	NA	NA
SS-3/SB-2A/15'	BDL	0.067	BDL	BDL	BDL	NA	NA
SS-4/SB-3A/15'	BDL	0.081	BDL	BDL	BDL	NA	NA
SS-5/SB-4A/7'	2.83	7.85	5.37	24.2	286	NA	NA
SS-6/SB-4A/15'	BDL	0.094	BDL	BDL	BDL	NA	NA
4/20/94							
SS-7/SB-5A/9'	BDL	BDL	BDL	BDL	BDL	NA	NA

Explanation:

All values are expressed in parts-per-million (ppm)
BDL - Below Detection Limits BQL - Below Quantifiable Limits
NA - Not Analyzed
(###) - Detection Limit
Laboratory: Midwest Analytical Services
GRO - Gasoline Range Organics; DRO - Diesel Range Organics

TABLE 3
SUMMARY OF WELL CONSTRUCTION

Well Construction							
Location	Depth of Boring	Water Level (TOC)	Diameter of Casing/Well Screen	Length of Casing	Top/Bottom of Screen Elevation	Length of Well Screen	Elevation (TOC)
MW-1	20.93'	9.24'	2"	5.93'	95.81/80.81	15.00'	101.74
MW-2	21.86'	9.47'	2"	6.86'	95.25/80.25	15.00'	102.11
MW-3	21.39'	8.51'	2"	6.39'	96.63/81.63	15.00'	103.02
MW-4	18.55'	16.68	2"	3.55'	96.95/81.95	15.00'	100.50

Explanation: TOC - Top of Casing

TABLE 4
GROUNDWATER ANALYTICAL DATA

Well Number	Date	Benzene	Toluene	Ethyl Benzene	Xylene	GRO*	DRO*	Lead*
MW-1	3/23/94	1596	1077	214	681	8.8	0.5	NA
	8/23/94	222	10.6	BDL	604	3.90	0.6	NA
	11/11/94	7520	913	451	1340	17.5	1.0	NA
	2/8/95	8170	2010	582	2460	27.0	NA	<0.005
	5/8/95	18900	17000	1650	9050	81.4	NA	0.015
	8/24/95	10000	9360	1540	7330	57.1	2.23	0.004
MW-2	3/23/94	3.7	2.9	1.3	4.1	BDL	BDL	NA
	8/23/94	BDL	BDL	BDL	BDL	BDL	BDL	NA
	11/11/94	6.5	16.8	2.6	13.6	BDL	0.1	NA
	2/8/95	4.9	1.6	1.2	5.2	BDL	NA	<0.005
	5/8/95	2.0	BDL	BDL	BDL	BDL	NA	<0.004
	8/24/95	BDL	BDL	BDL	BDL	BDL	BDL	<0.001
MW-3	3/23/94	DRY	DRY	DRY	DRY	DRY	DRY	DRY
	8/23/94	BDL	BDL	BDL	BDL	BDL	0.2	NA
	11/11/94	4.9	19.1	3.2	16.6	0.11	BDL	NA
	2/8/95	1.9	4.1	2.2	10.5	BDL	NA	<0.005
	5/8/95	BDL	1.1	BDL	BDL	BDL	NA	<0.004
	8/24/95	BDL	1.4	BDL	BDL	BDL	BDL	<0.001
MW-4	8/23/94	22.4	31.1	2.75	25.3	BDL	BDL	NA
	9/22/94	BDL	BDL	BDL	BDL	BDL	BDL	NA
	11/11/94	6.9	21.9	2.8	14.8	BDL	BDL	NA
	2/8/95	BDL	0.9	2.0	5.1	BDL	NA	<0.005
	5/8/95	BDL	2.1	BDL	BDL	BDL	NA	<0.004
	8/24/95	1.1	4.2	BDL	BDL	BDL	BDL	<0.001
TB	11/11/94	BDL	BDL	BDL	BDL	BDL	NA	NA
TB	2/8/95	BDL	BDL	BDL	BDL	BDL	NA	NA
TB	5/8/95	BDL	BDL	BDL	BDL	BDL	NA	NA
TB	8/24/95	BDL	BDL	BDL	BDL	BDL	BDL	NA

Explaination: Values reported in parts per billion; * = Reported in parts per million ; GRO= Gasoline Range Organics; DRO= Diesel Range Organics BDL =Below Detection Limits; NA =Not Analyzed; RW - Residentail Well; TB - Trip Blank; Laboratory: Midwest Analytical Services, Inc.

TABLE 5
GROUNDWATER ELEVATIONS

Monitoring Well Number	Date	Top of Casing	Depth to Water	Groundwater Elevation
MW-1	3/23/94	--------	9.16	--------
MW-1	8/23/94	101.74	9.24	92.50
MW-1	11/11/94	101.74	8.85	92.89
MW-1	2/8/95	101.74	10.36	91.38
MW-1	5/8/95	101.74	7.67	94.07
MW-1	8/22/95	101.74	7.66	94.08
MW-2	3/23/94	--------	9.52	--------
MW-2	8/23/94	102.11	9.47	92.69
MW-2	11/11/94	102.11	9.55	92.56
MW-2	2/8/95	102.11	10.35	91.76
MW-2	5/8/95	102.11	8.58	93.53
MW-2	8/22/95	102.11	8.78	93.33
MW-3	3/23/94	--------	DRY	NA
MW-3	8/23/94	103.02	8.51	94.51
MW-3	11/11/94	103.02	8.87	94.15
MW-3	2/8/95	103.02	10.36	92.66
MW-3	5/8/95	103.02	7.88	95.14
MW-3	8/22/95	103.02	8.32	94.70
MW-4	8/23/94	100.50	16.68	83.82
MW-4	9/22/94	100.50	7.98	92.52
MW-4	11/11/94	100.50	8.08	92.42
MW-4	2/8/95	100.50	8.78	91.72
MW-4	5/8/95	100.50	7.72	92.78
MW-4	8/22/95	100.50	7.91	92.59

Explanation: Elevations are given in feet, surveyed from a bench mark given an arbitrary value of 100.00 feet.

TABLE 6
Summary of Ground Water Receptor Survey

Unique Well #	Aquifer	Well Depth	Elevation of Well	Water Table Elevation/ SWL	USE	Screened Interval	T/R/SEC
102050	KREG	310' BG	1078	NA/NA	TEST	UNLISTED	115/32/21BCC AAA
102061	PAUD	393' BG	1075	NA/NA	TEST	UNLISTED	115/32/29AAA BAA
102062	PAUD	343' BG	1082	NA/NA	TEST	UNLISTED	115/32/29ADB BCC
102063	PAUD	405' BG	1075	NA/NA	TEST	UNLISTED	115/32/20DDC BDB
102067	QFUU	400' BG	1075	NA/NA	TEST	UNLISTED	115/32/20DDC CBD
102099	PAUD	392' BG	1075	NA/NA	TEST	UNLISTED	115/32/29CAA CAA
121596	QFUU	264' BG	1079	1049/30	DOMESTIC	CASED TO 258'	115/32/20DAB ACA
209514	PAUD	405' BG	1000	953/47	PUB.SUPPLY	UNLISTED	115/32/29ABB DDB
209515	QFUU	400' BG	1080	1020/60	PUB.SUPPLY	UNLISTED	115/32/29AAB DBB
211289	KREG	385' BG	1075	1045/30	DOMESTIC	UNLISTED	115/32/20CBC ABA
211290	PAUD	297' BG	1083	NA/NA	TEST	UNLISTED	115/32/20CBB ACB
211291	PAUD	278' BG	1083	NA/NA	TEST	UNLISTED	115/32/20CBB BDB
244382	KREG	370' BG	1080	NA/NA	UNKNOWN	CASED TO 360	115/32/29AAC
486515	UNLISTED	407' BG	NA	NA/45	DOMESTIC	CASED TO 403	115/32/28
505491	UNLISTED	412' BG	NA	NA/40	DOMESTIC	CASED TO 402	115/32/30
516256	UNLISTED	383' BG	NA	NA/22	DOMESTIC	CASED TO 377	115/32/28DAB

Explanation:

BG - below grade
NA - Not available

Table 7

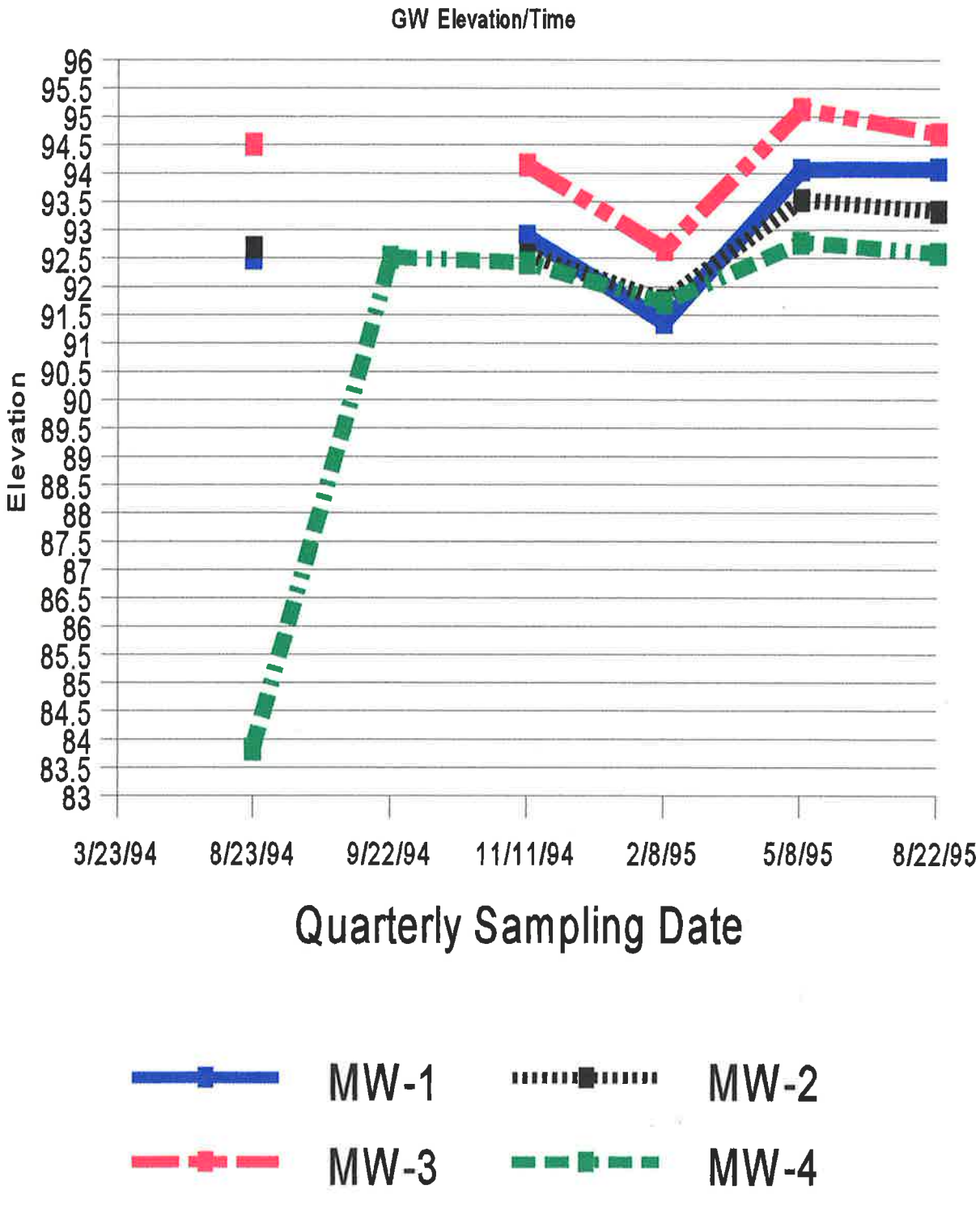
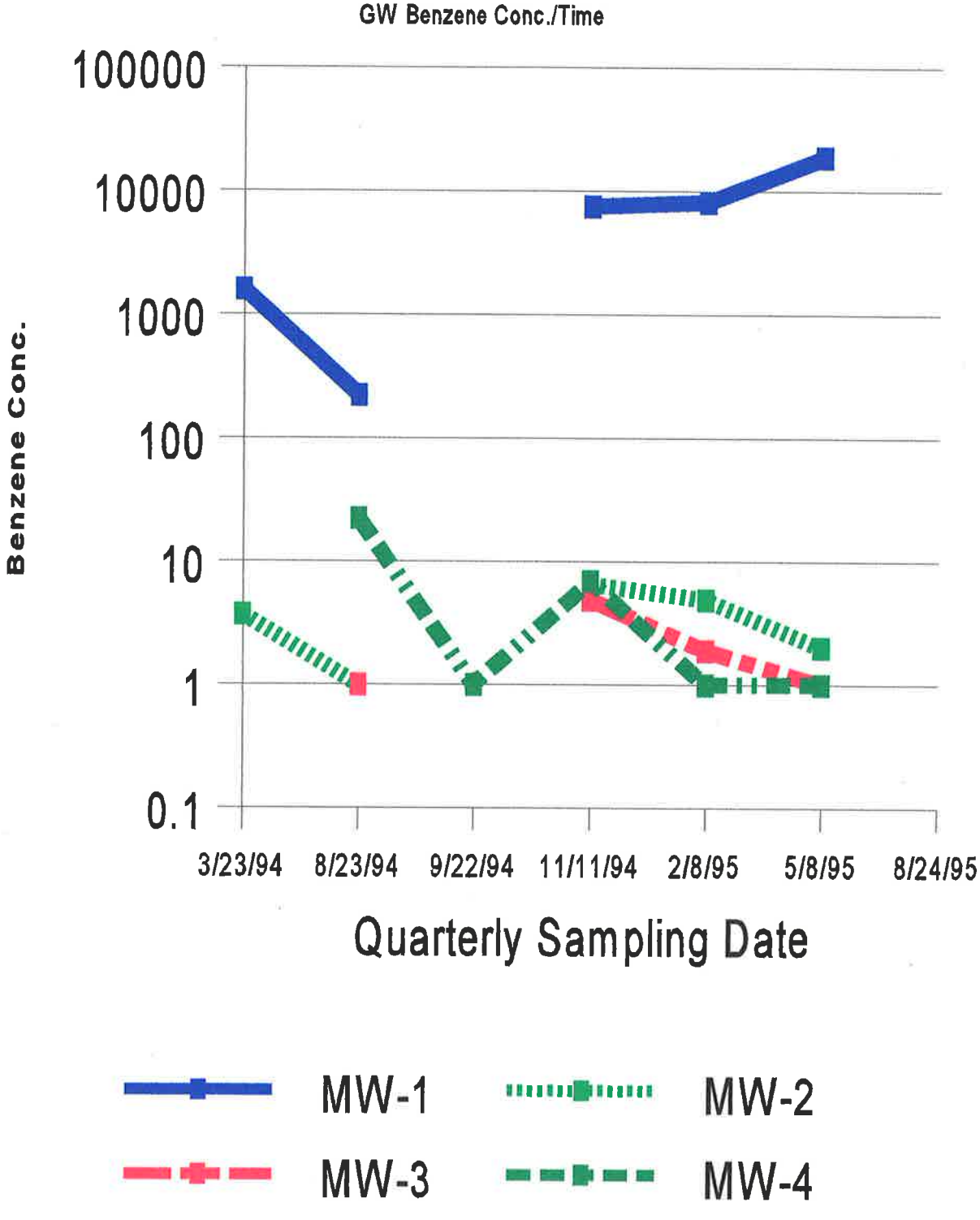
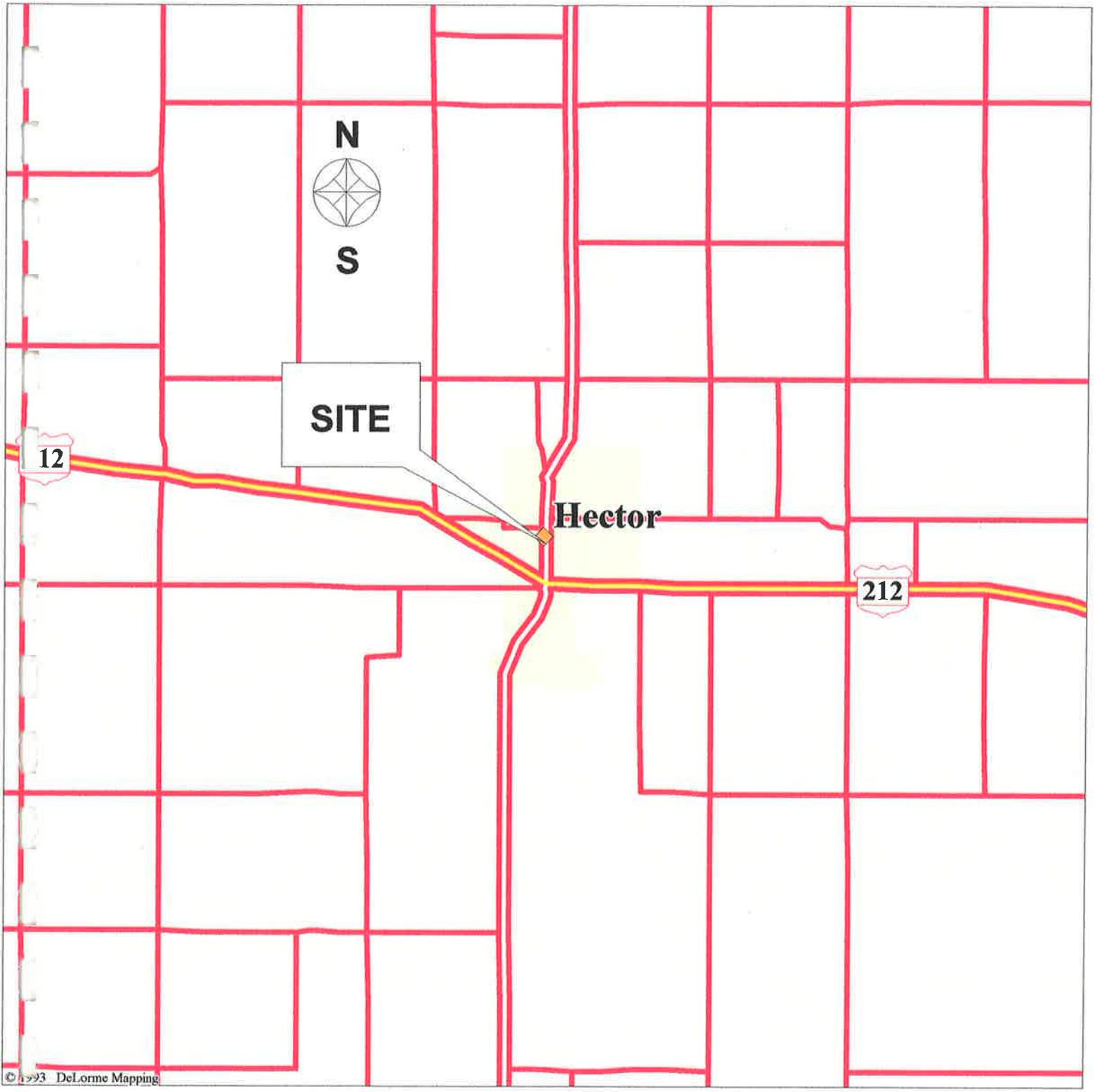

GW Elevation/Time
Elevation
96
95.5
95
94.5
94
93.5
93
92.5
92
91.5
91
90.5
90
89.5
89
88.5
88
87.5
87
86.5
86
85.5
85
84.5
84
83.5
83
3/23/94
8/23/94
9/22/94
11/11/94
2/8/95
5/8/95
8/22/95
Quarterly Sampling Date
MW-1
MW-2
MW-3
MW-4

Table 8


GW Benzene Conc./Time
Benzene Conc.
100000
10000
1000
100
10
1
0.1
3/23/94
8/23/94
9/22/94
11/11/94
2/8/95
5/8/95
8/24/95
Quarterly Sampling Date
MW-1
MW-2
MW-3
MW-4



LEGEND

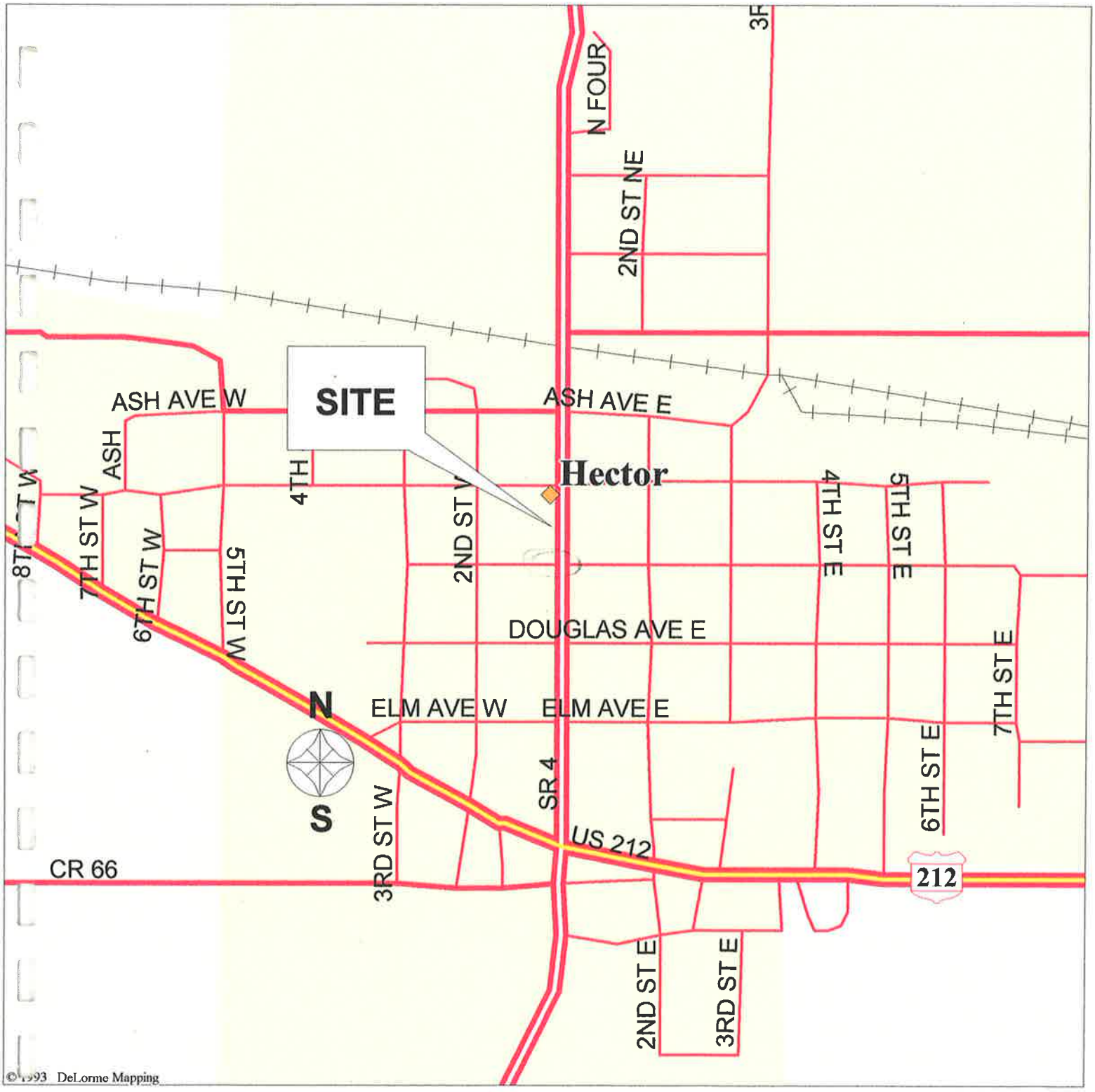
- Town, Small City
- US Highway
- County Boundary
- Population Center
- Major Street/Road
- State Route
- US Highway

Scale 1:62,500 (at center)

1 Miles

2 KM

FIGURE 1 SITE MAP: REGIONAL
Mag 12.00
Tue Sep 12 11:04:04 1995



LEGEND

- Town, Small City
- US Highway
- Population Center
- Street, Road
- Major Street/Road
- State Route
- US Highway
- Railroad
- River

Scale 1:7,813 (at center)

500 Feet

200 Meters

FIGURE 2 SITE MAP: LOCAL
Mag 15.00
Tue Sep 12 10:47:31 1995

AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

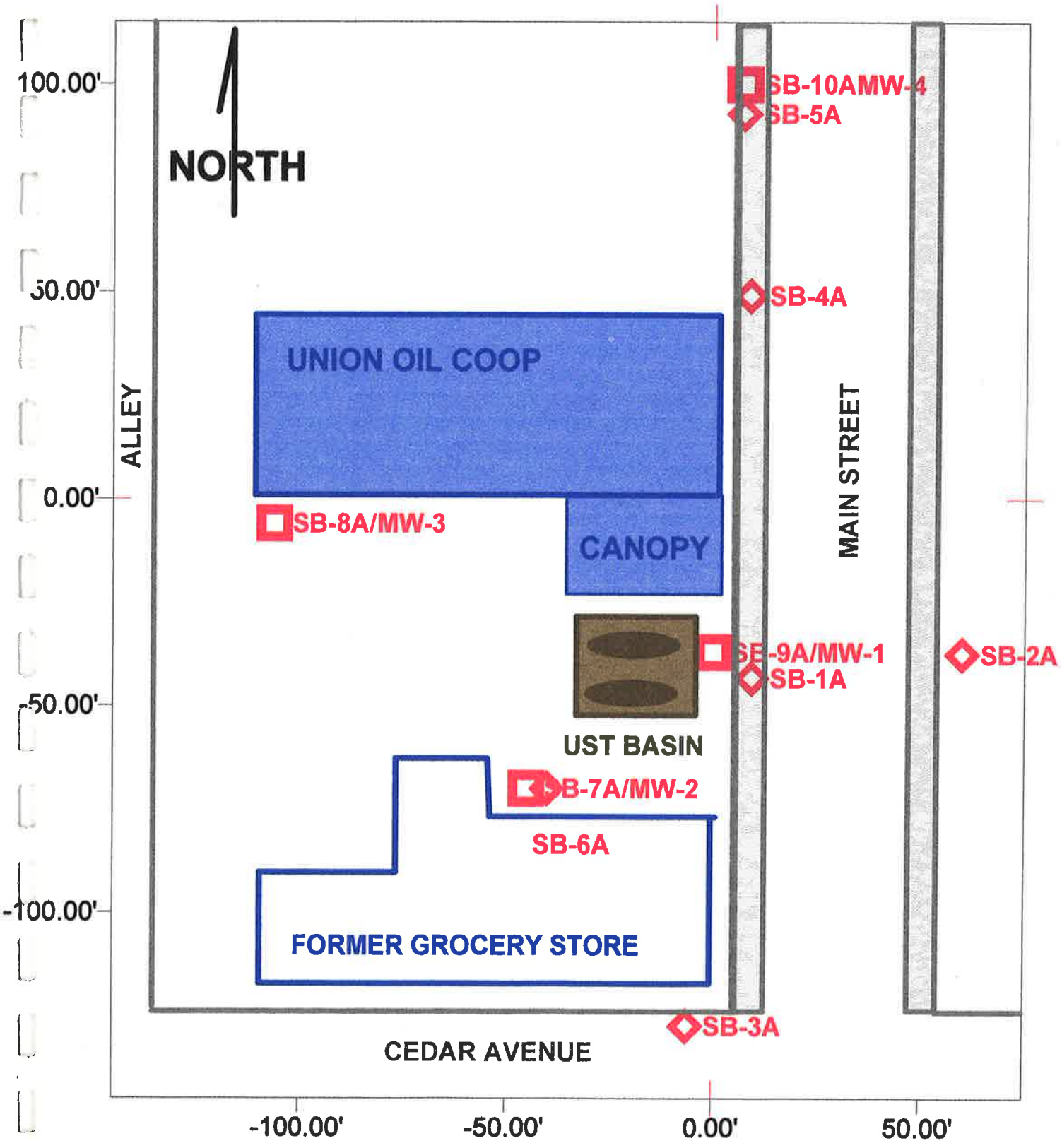


FIGURE 3 SITE MAP

AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

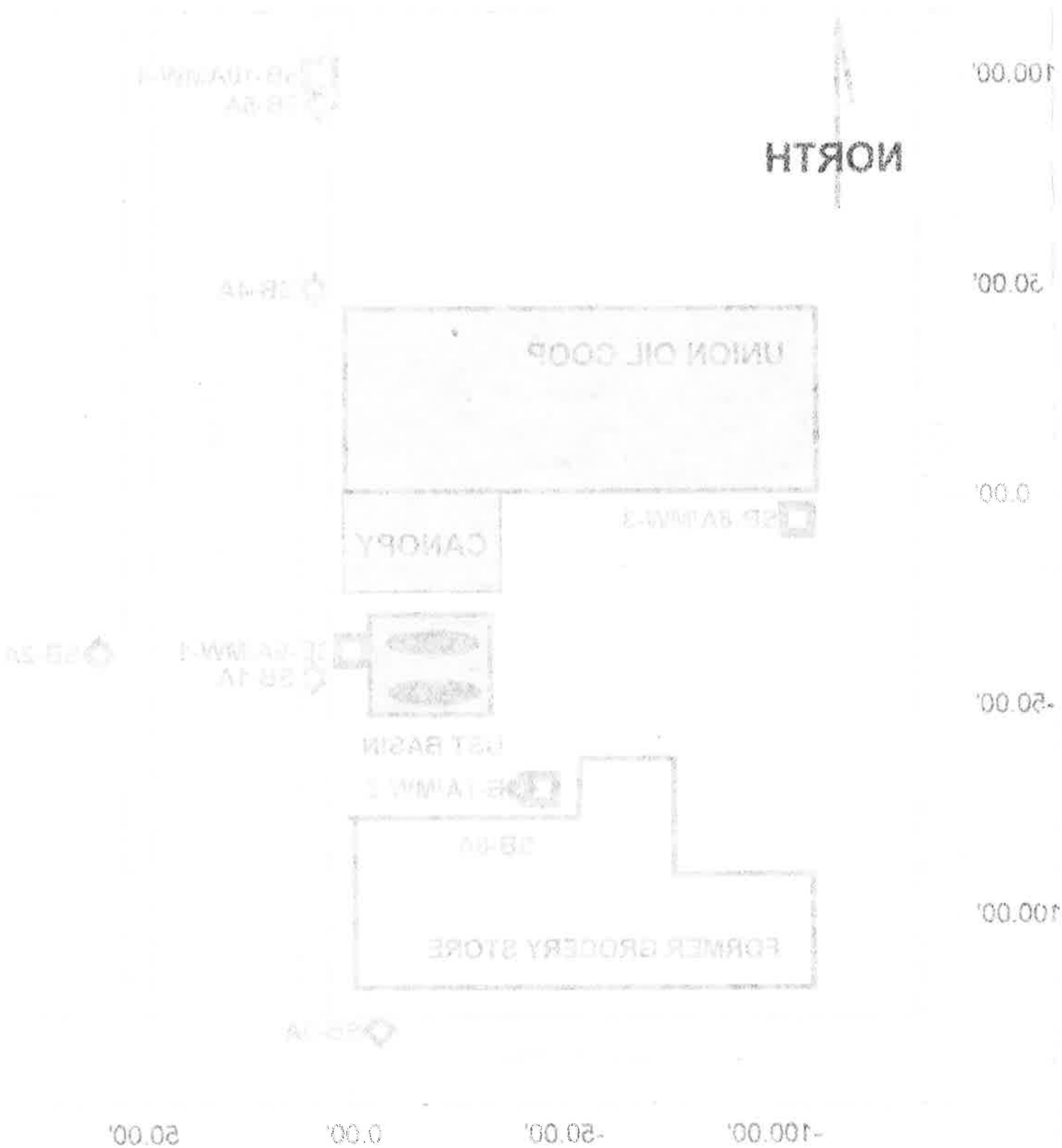


FIGURE 3 SITE MAP

AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

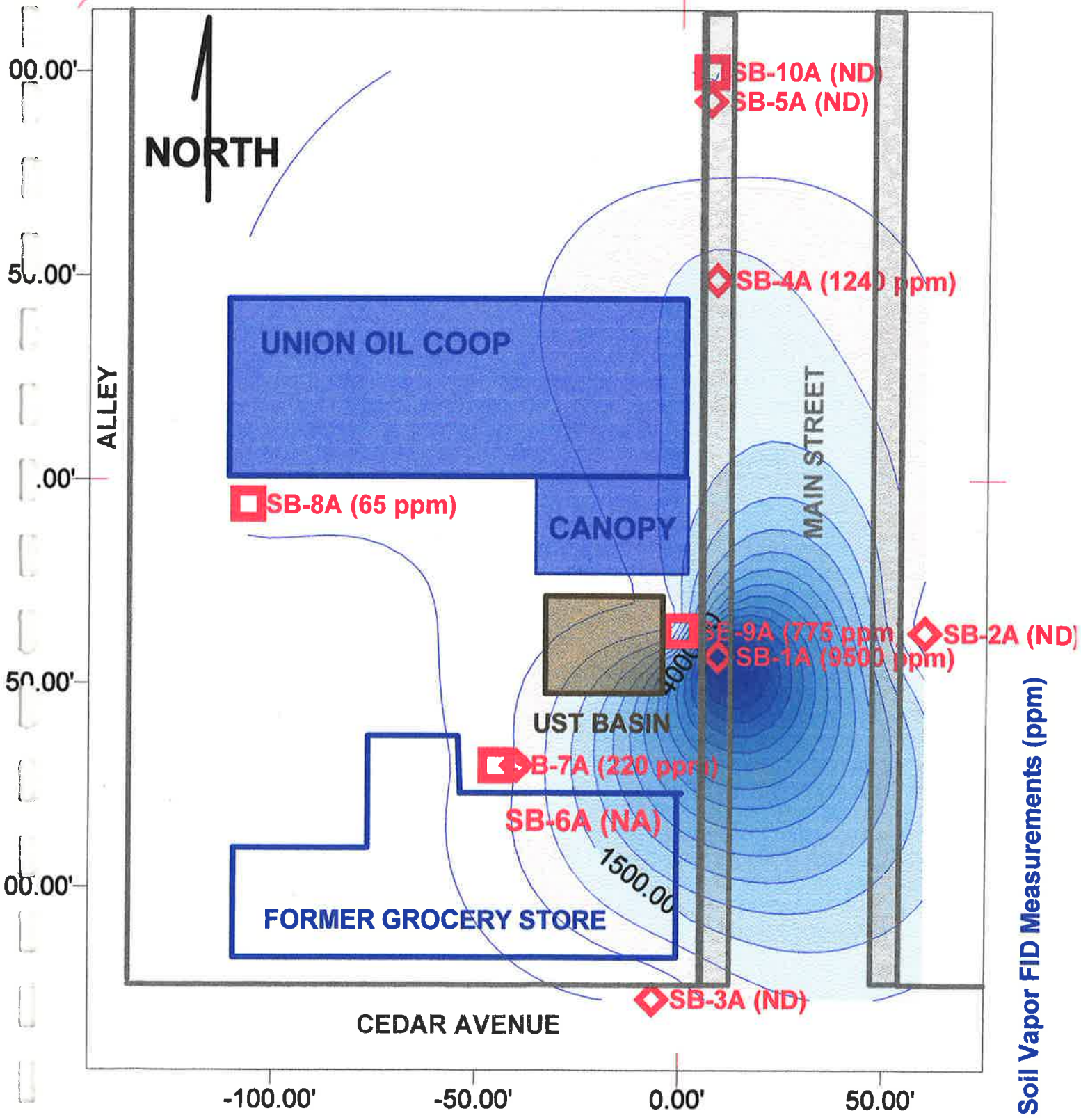
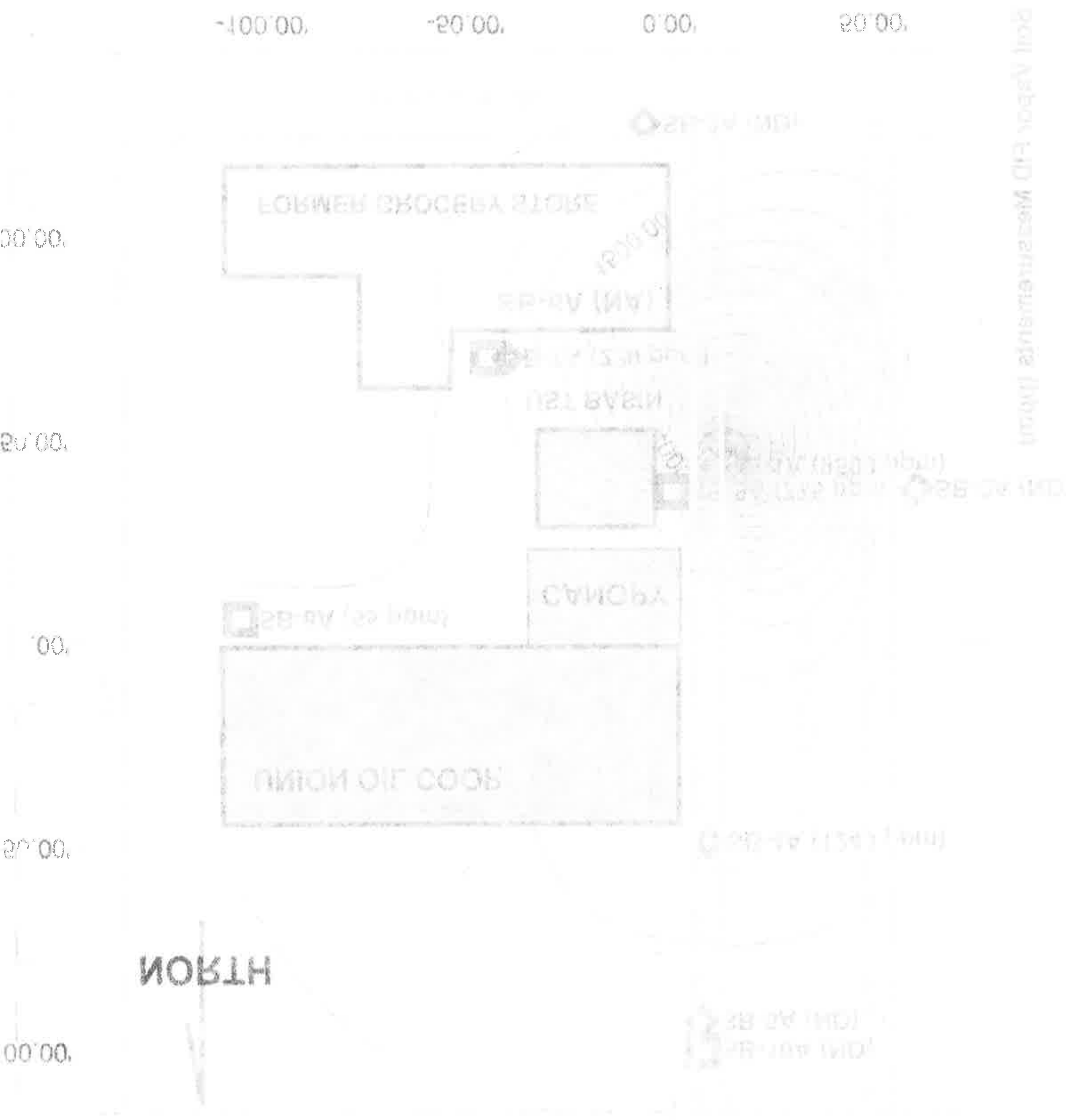


FIGURE 4 SOIL VAPOR MAP - 3/23/94 & 4/20/94

FIGURE 4 SOIL VAPOR MAP - 3/23/94 & 4/20/94



AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

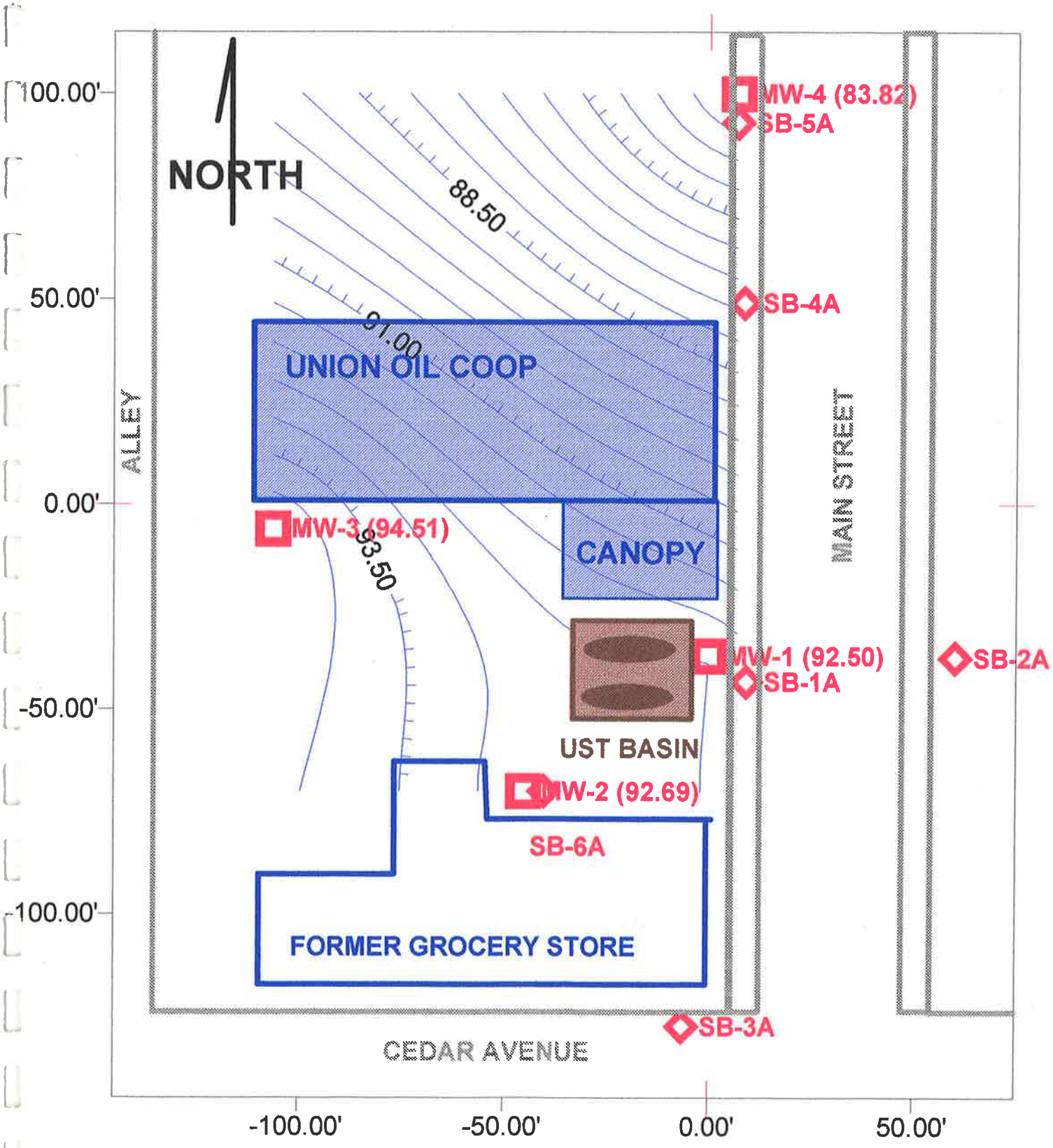


FIGURE 5 GW CONTOUR MAP - 8/23/94

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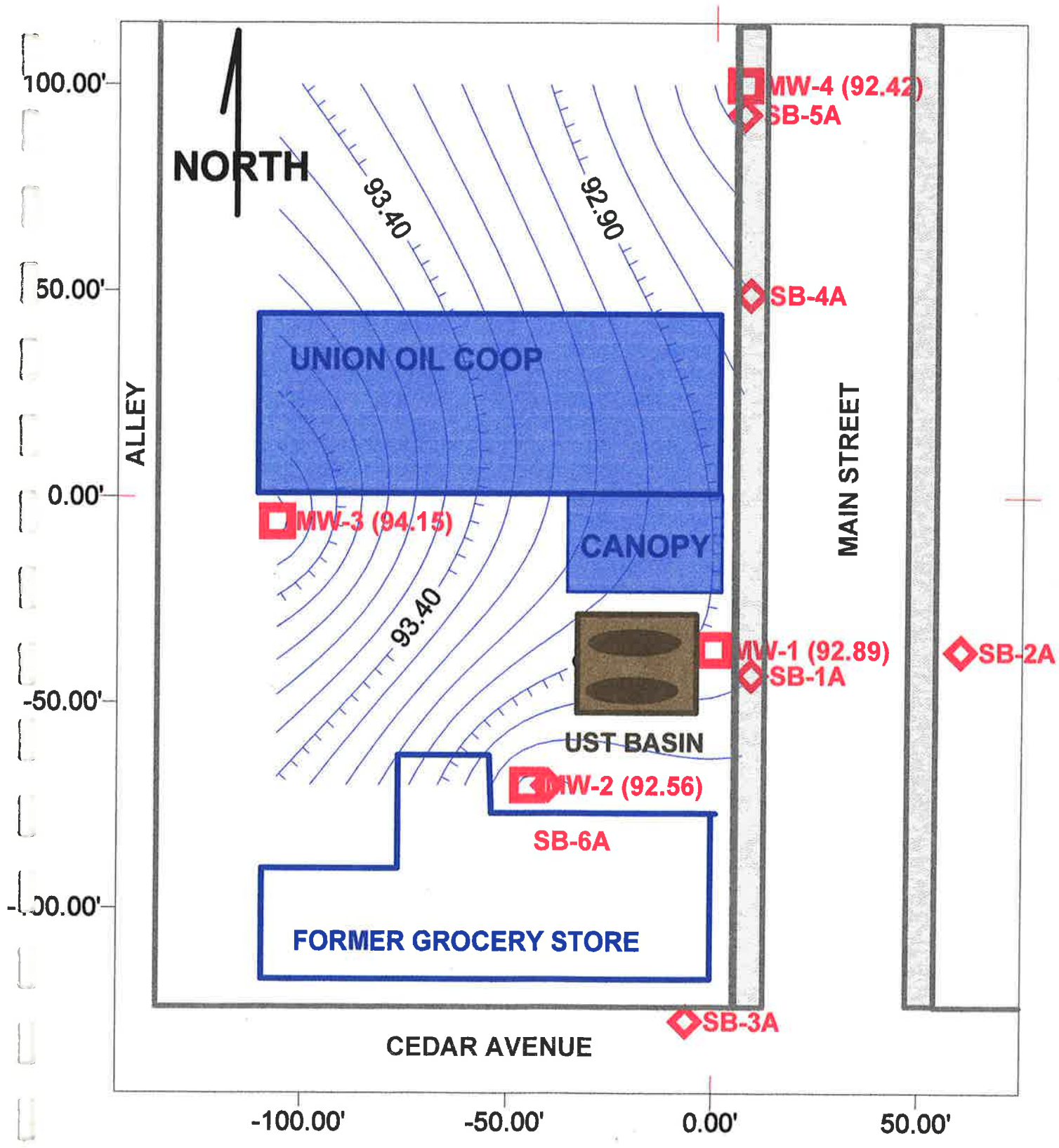
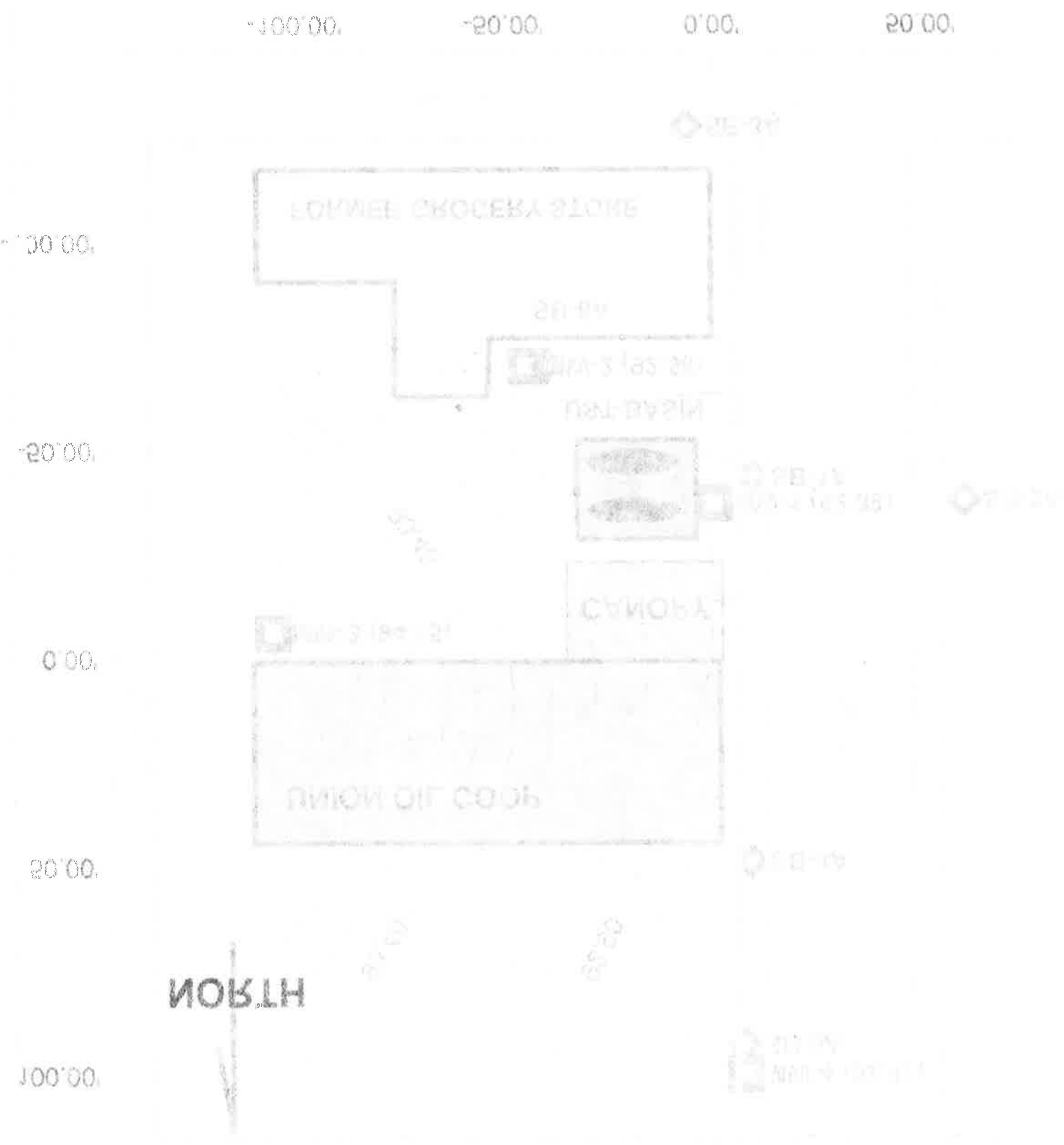


FIGURE 5a GW CONTOUR MAP - 11/11/94

FIGURE 5a GW CONTOUR MAP - 11/11/94



AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

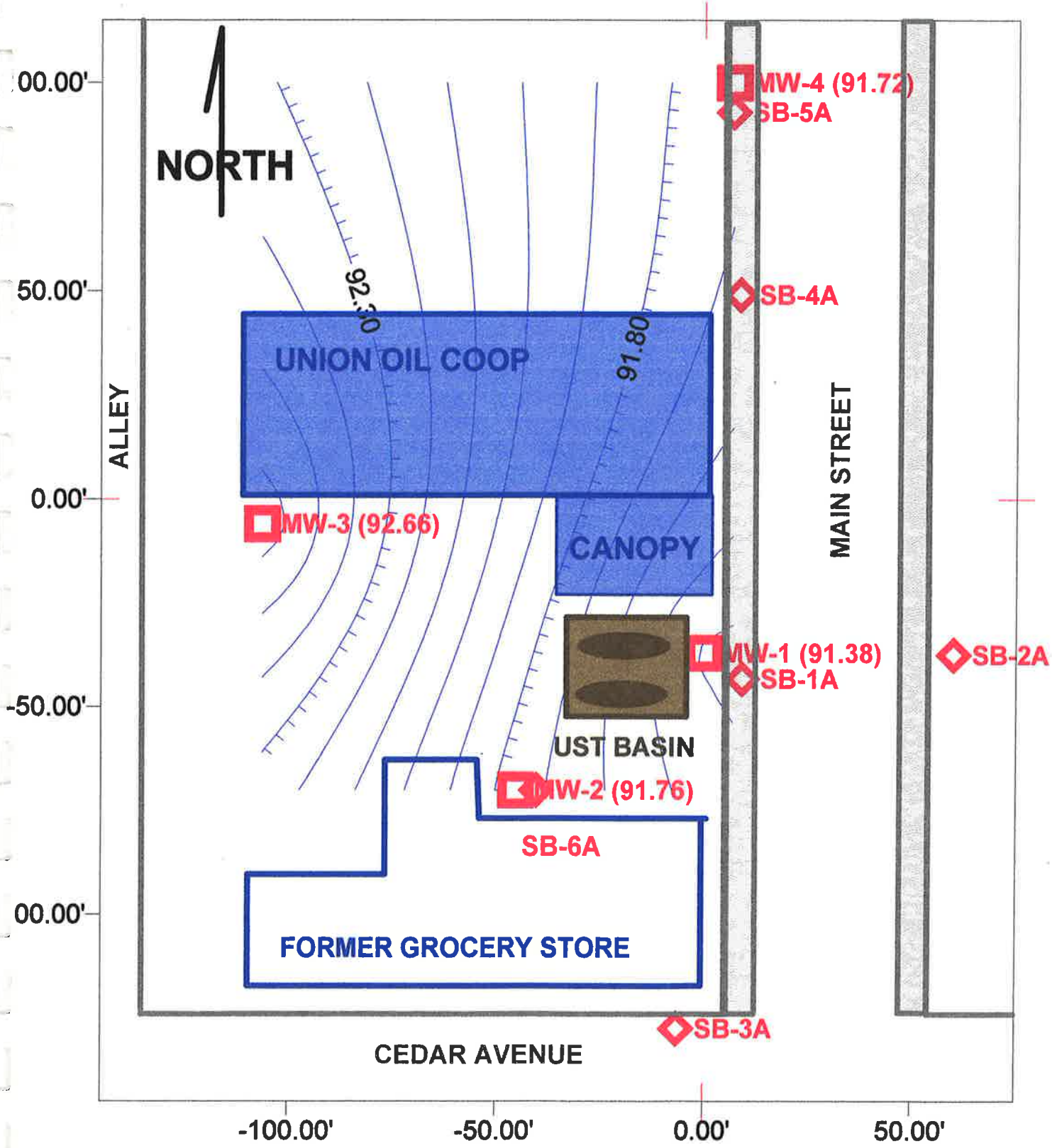
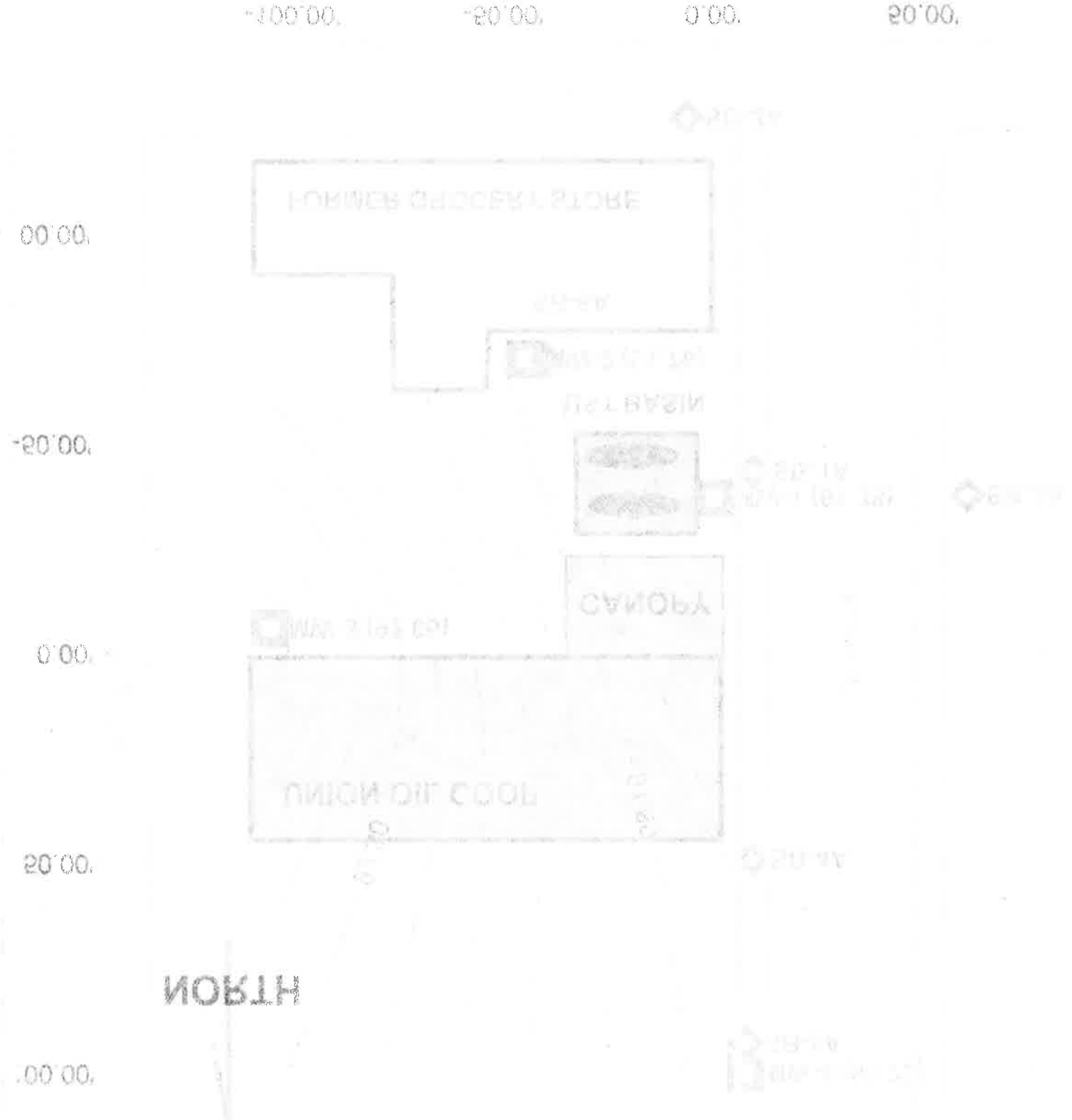


FIGURE 5b GW CONTOUR MAP - 2/8/95

FIGURE 3D GW CONTOUR MAP - 2/8/95



AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

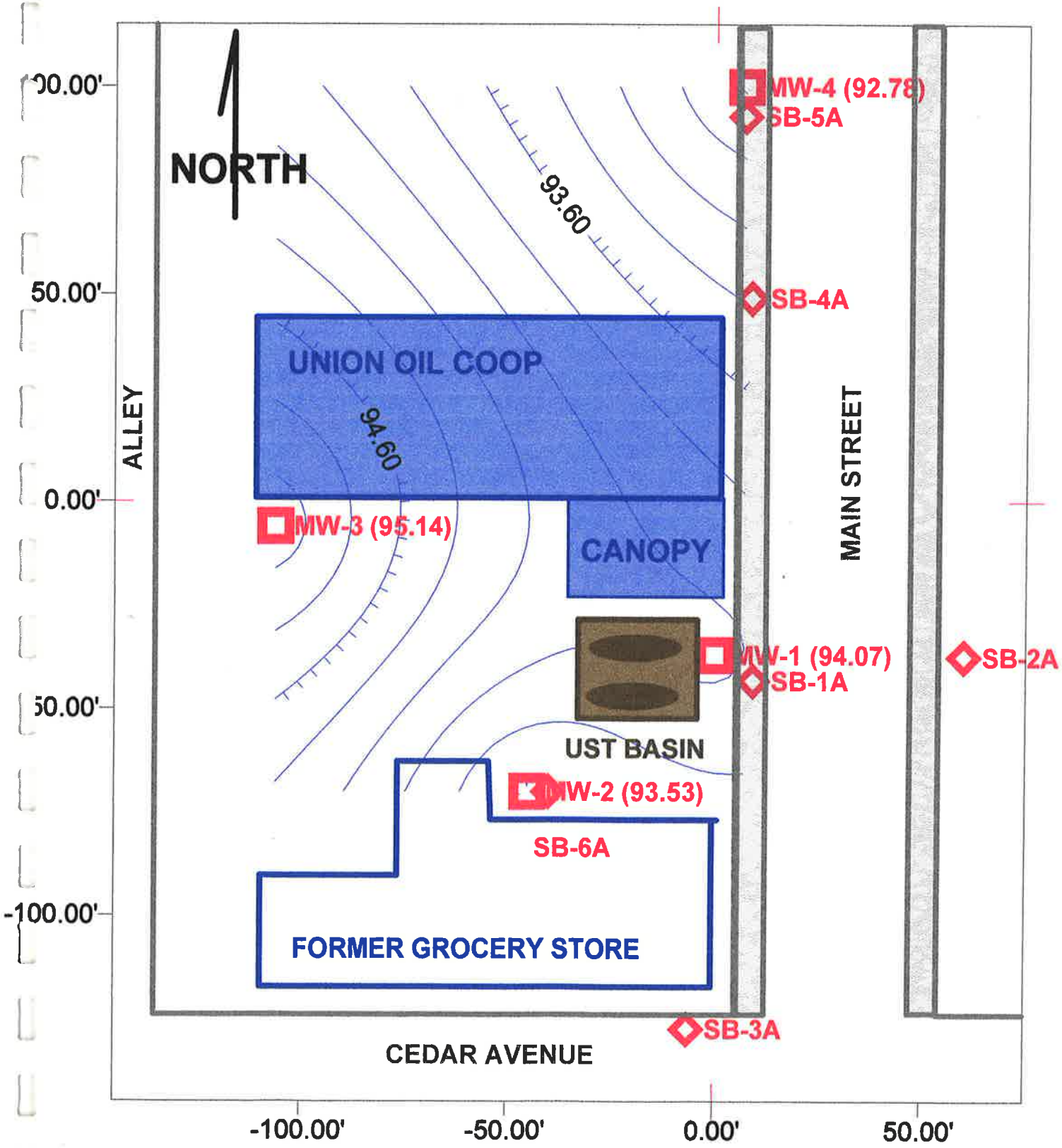
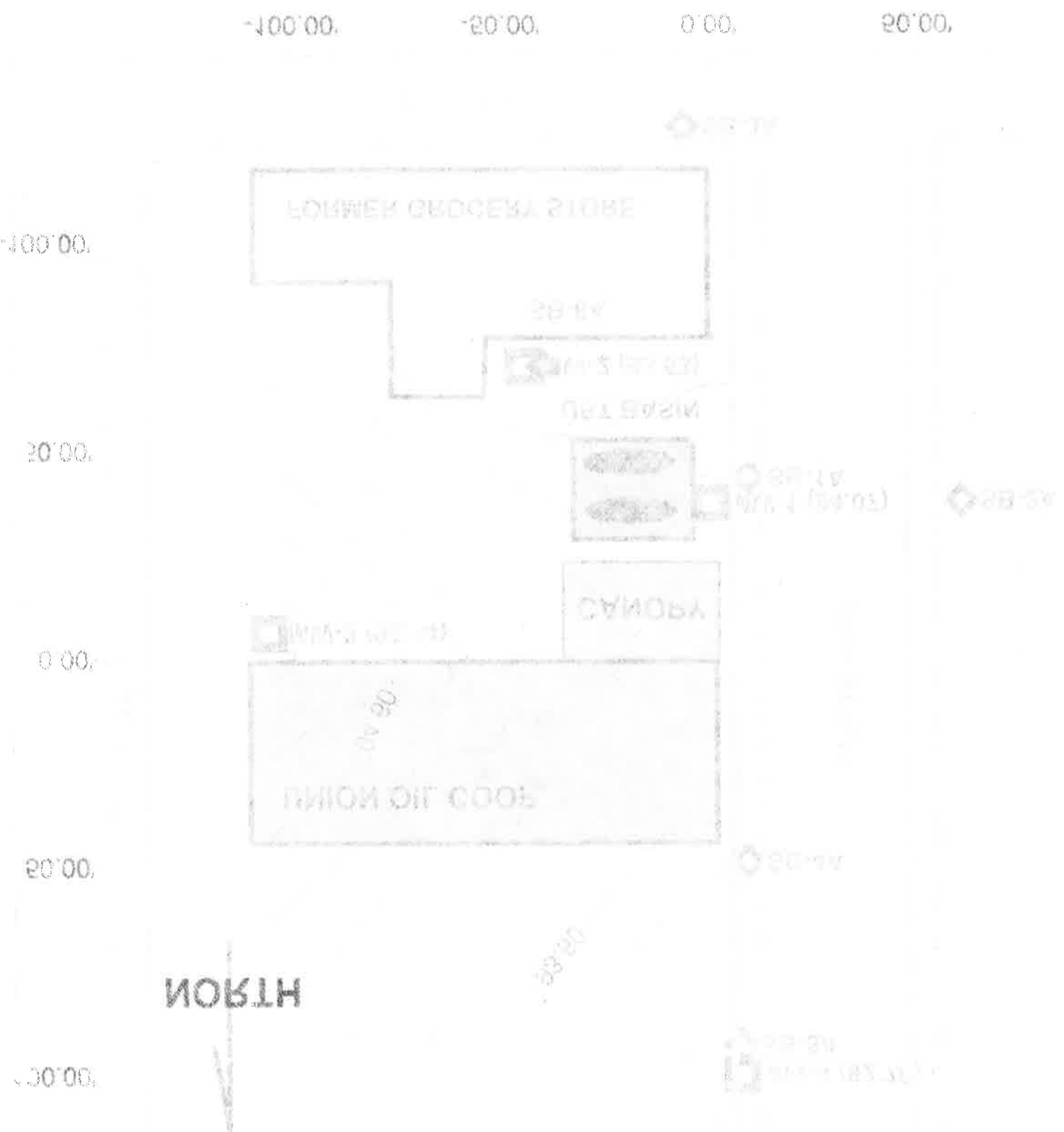


FIGURE 5c GW CONTOUR MAP - 5/8/95

FIGURE 5C GM CONTOUR MAP - 5/8/95



AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

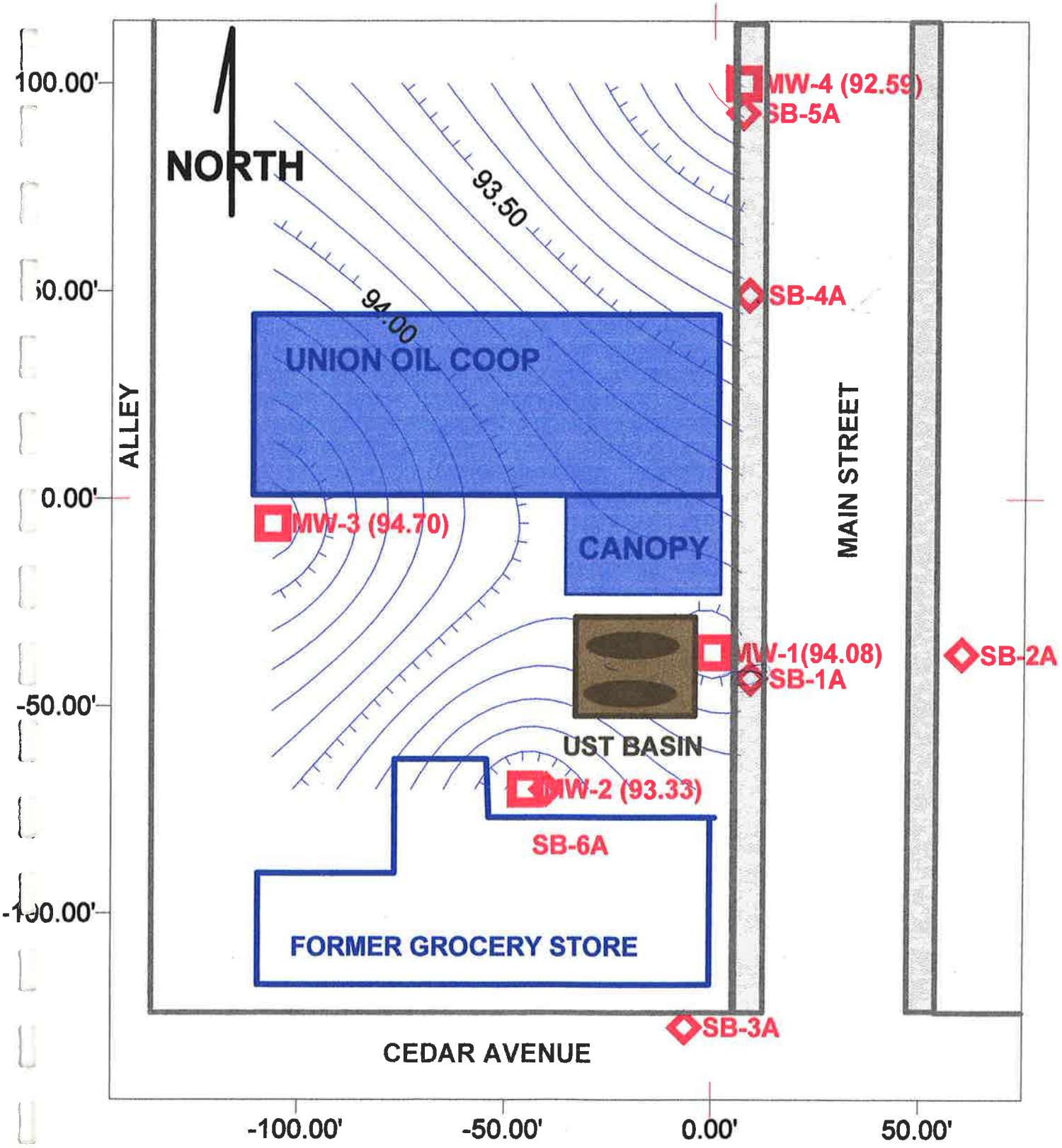
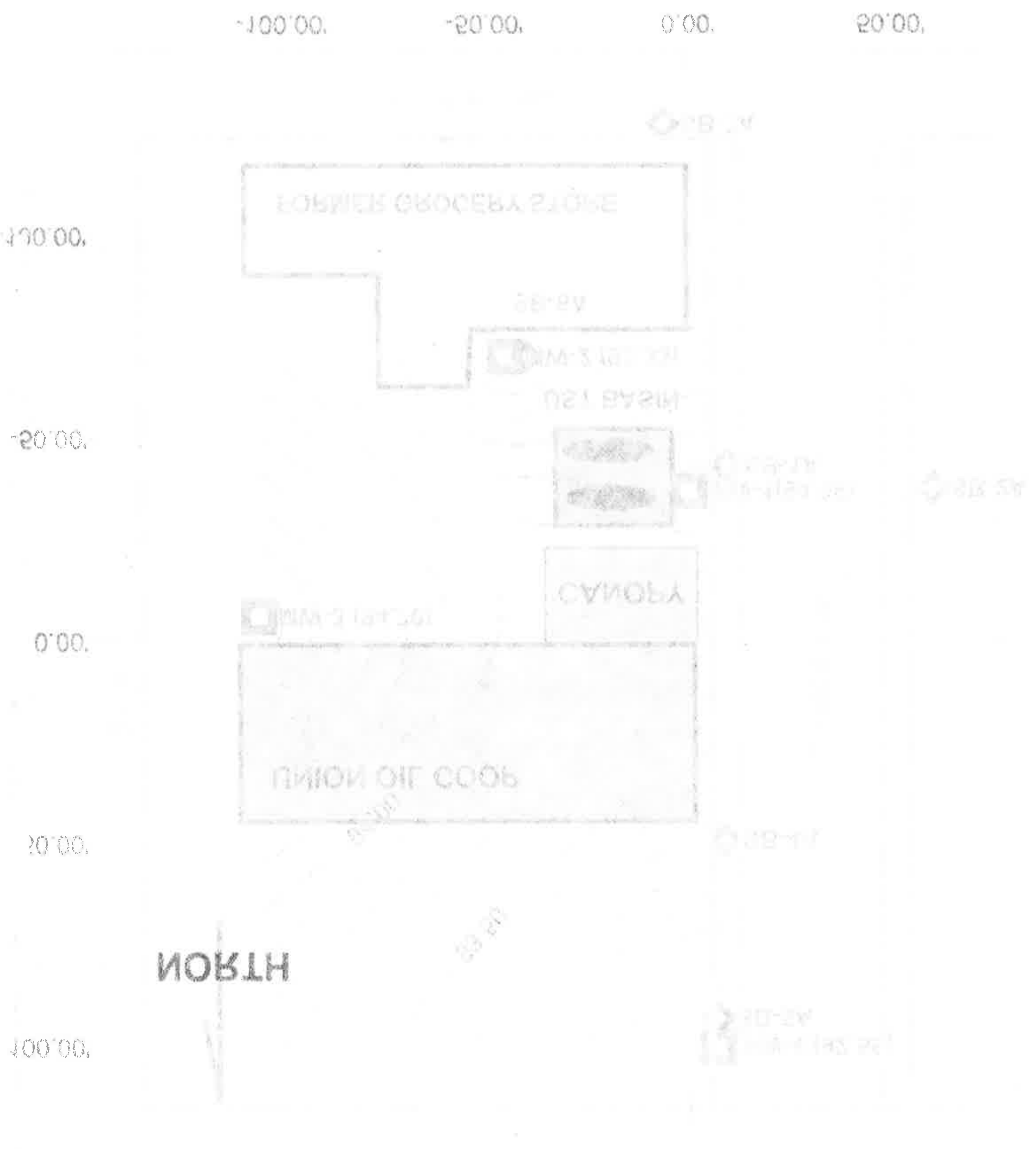


FIGURE 5d GW CONTOUR MAP - 8/22/95

FIGURE 5A GW CONTOUR MAP - 8/22/95



AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

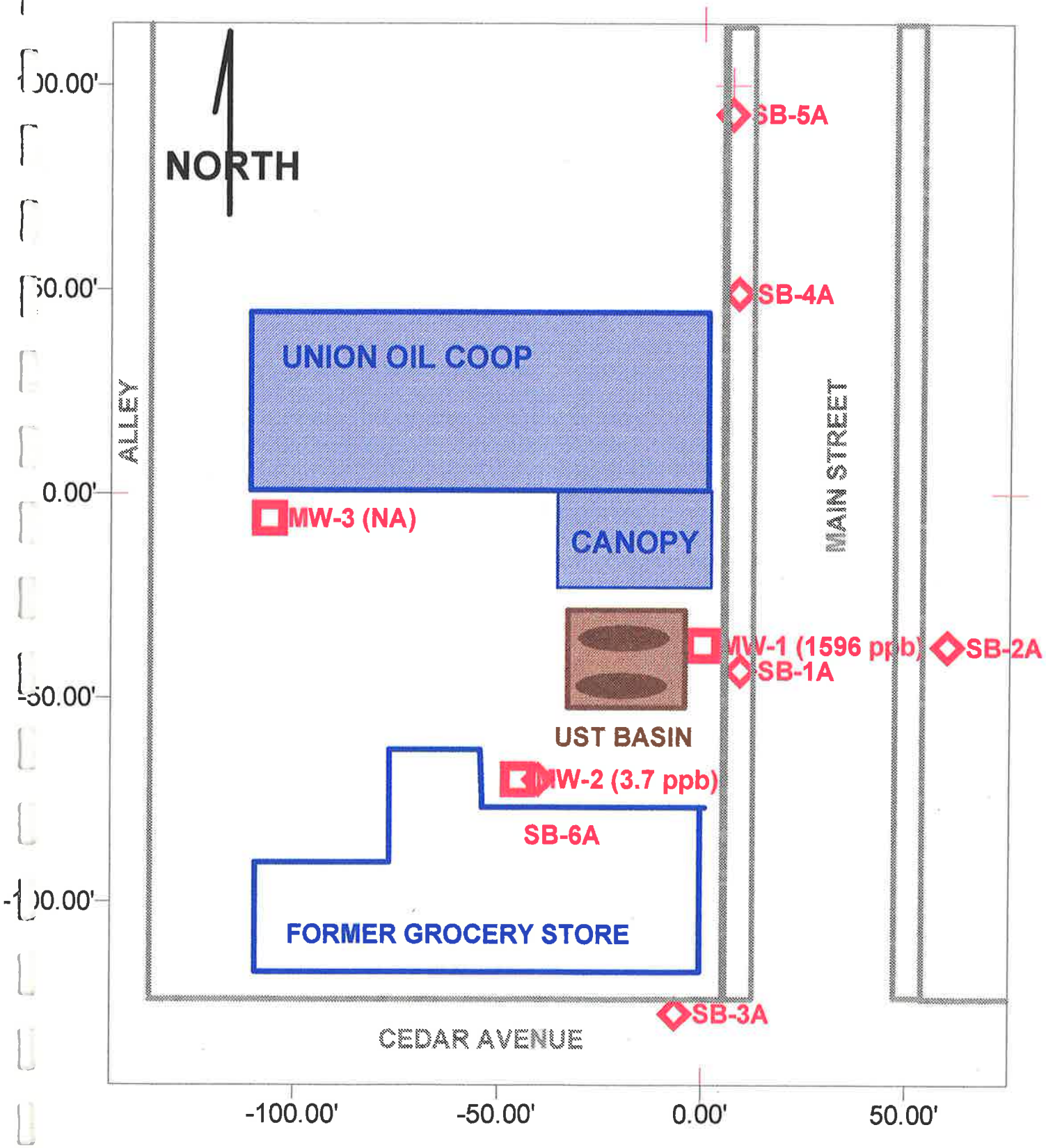


FIGURE 6 GW BENZENE CONCENTRATION MAP - 3/23/94

AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

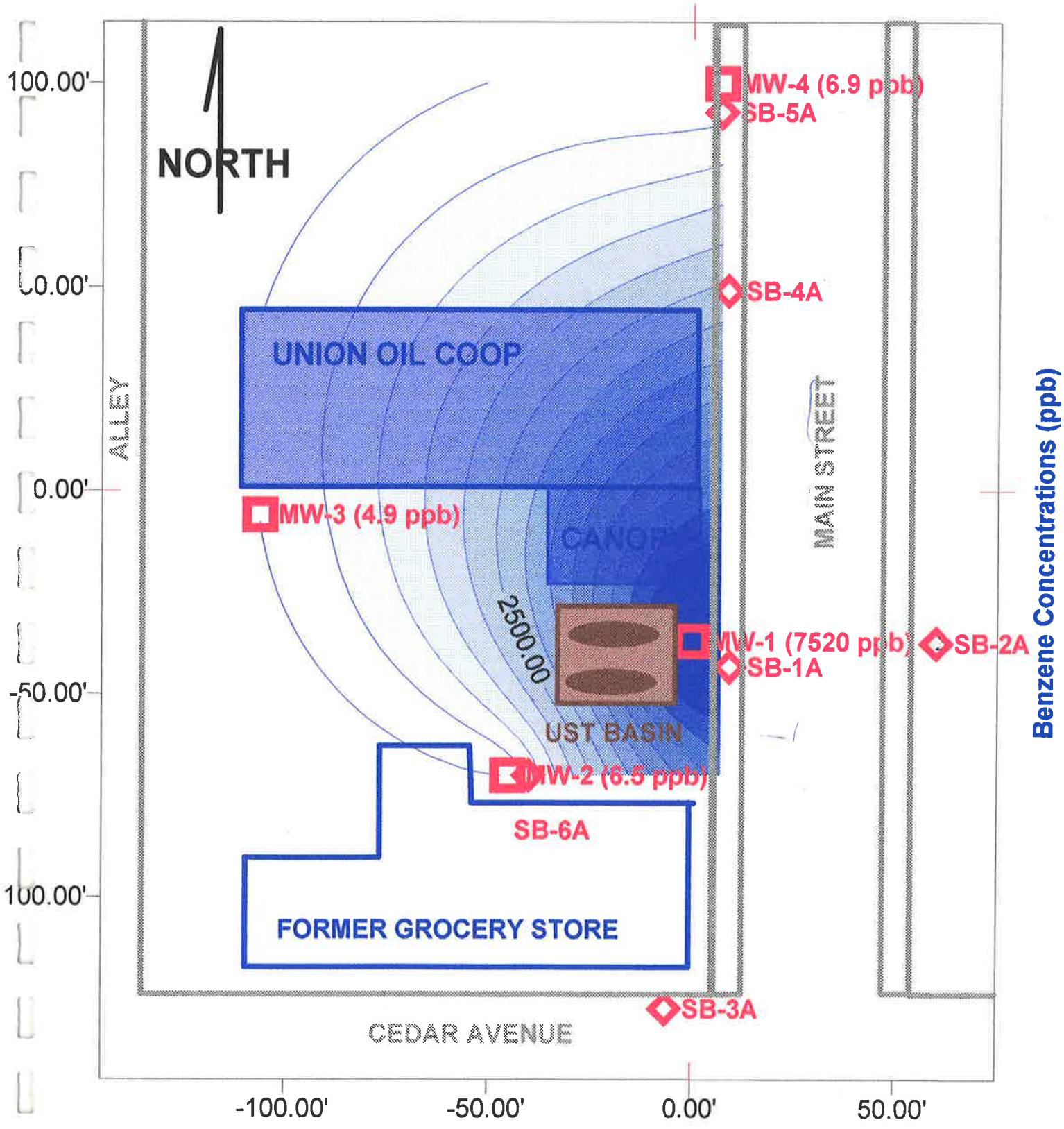


FIGURE 6b GW BENZENE CONCENTRATION MAP - 11/11/94

AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

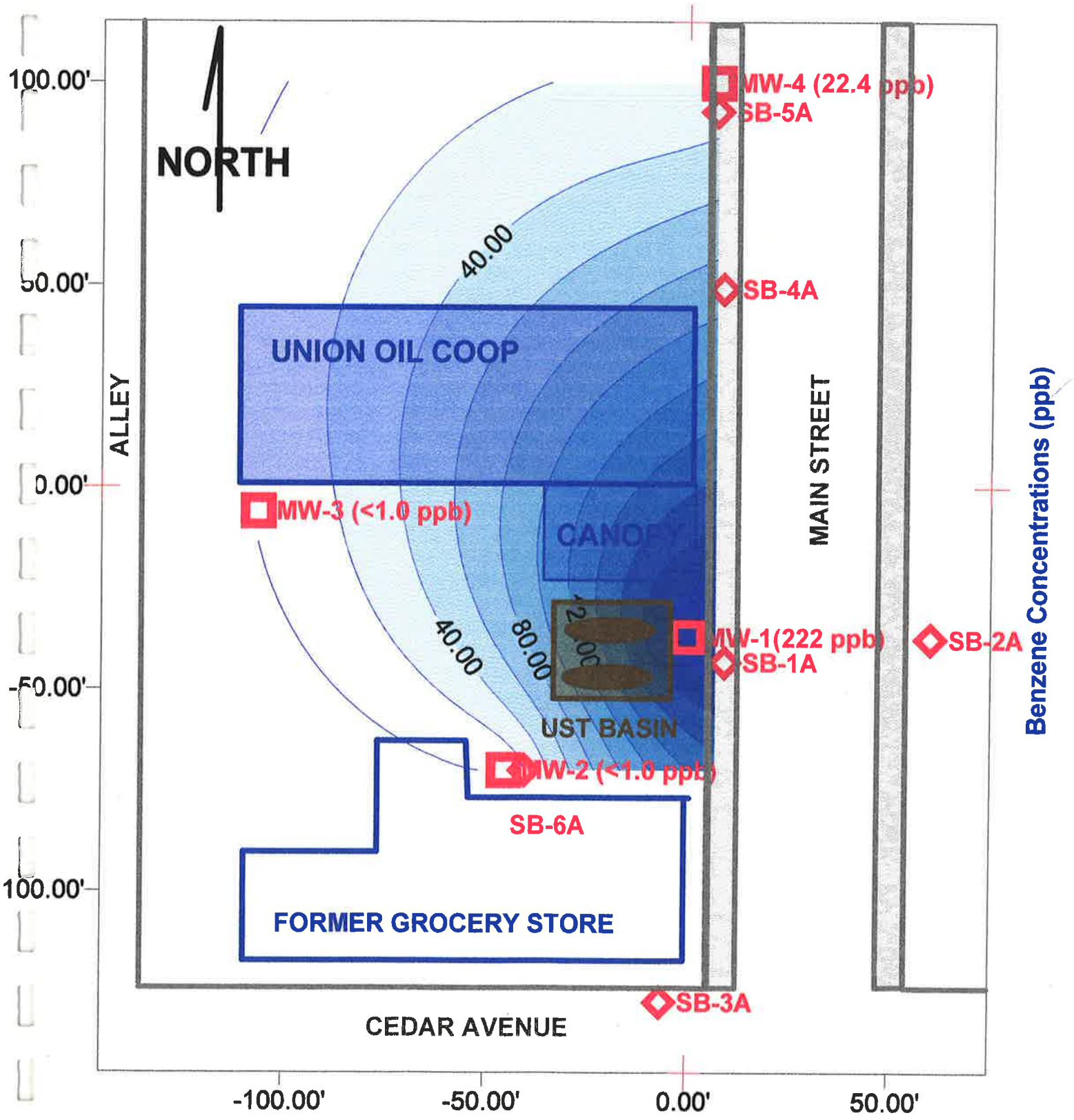
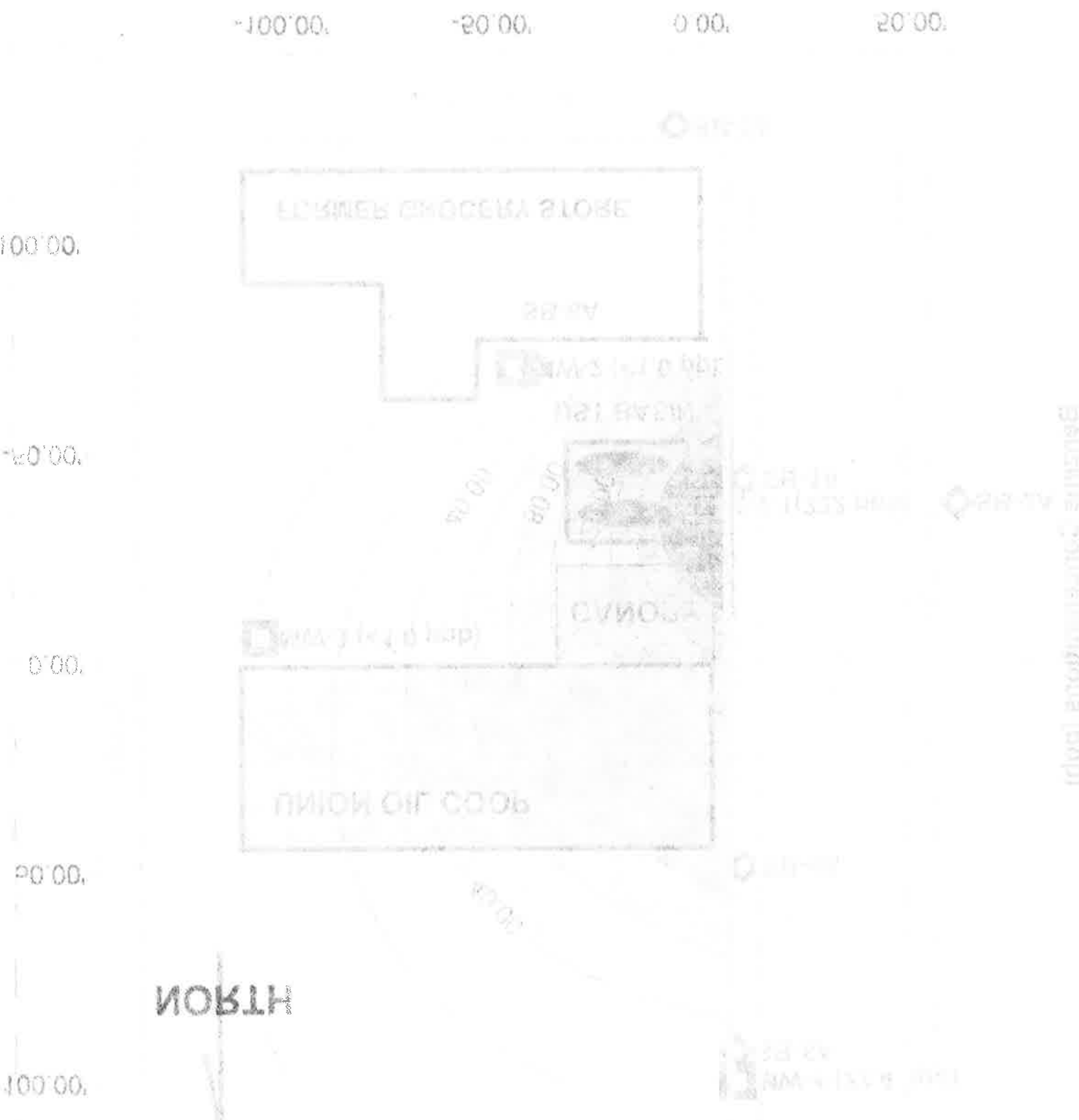


FIGURE 6a GW BENZENE CONCENTRATION MAP - 8/23/94

FIGURE 6a GW BENZENE CONCENTRATION MAP - 8/23/94



AGASSIZ ENVIRONMENTAL SYSTEMS, INC

AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

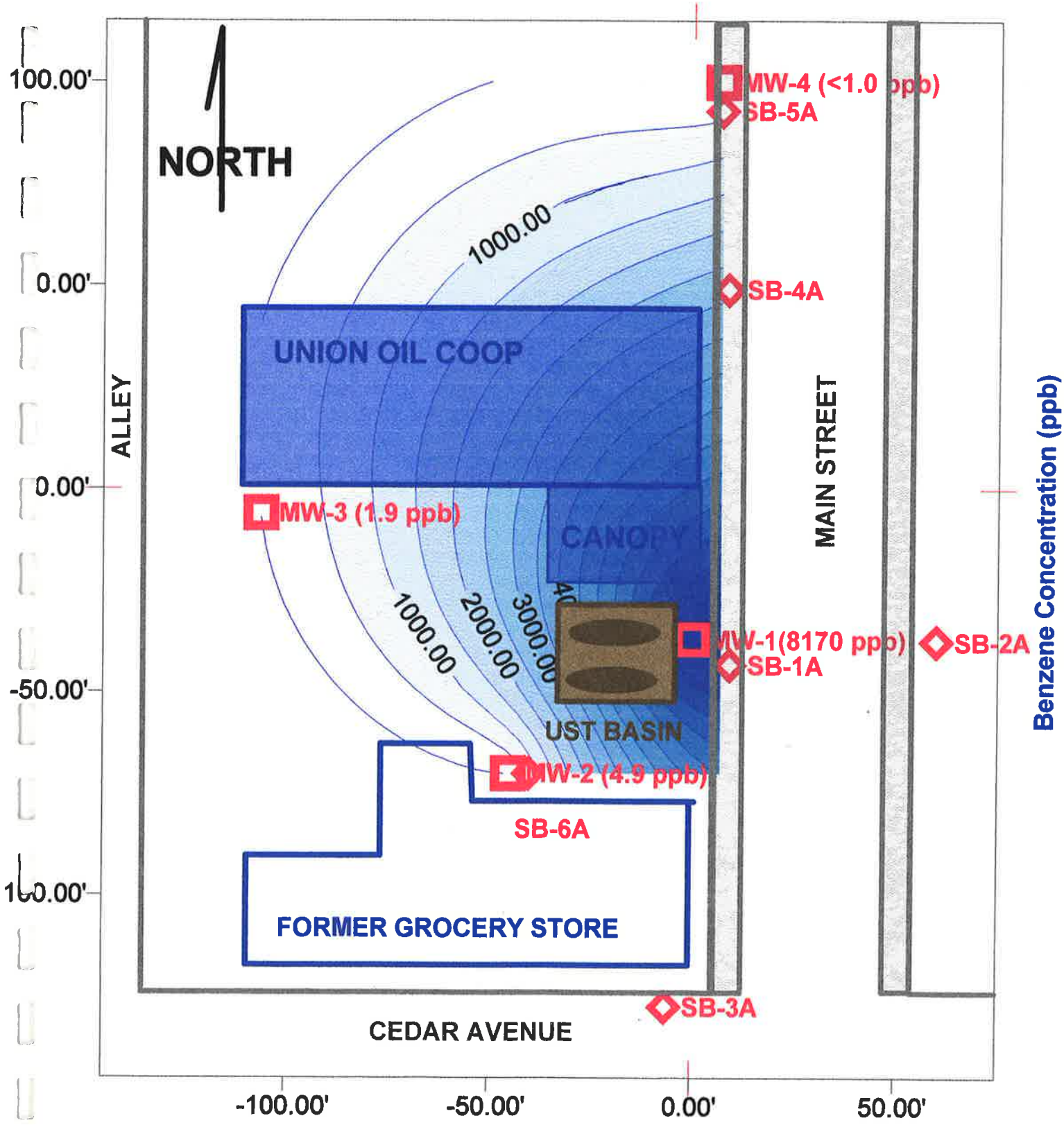
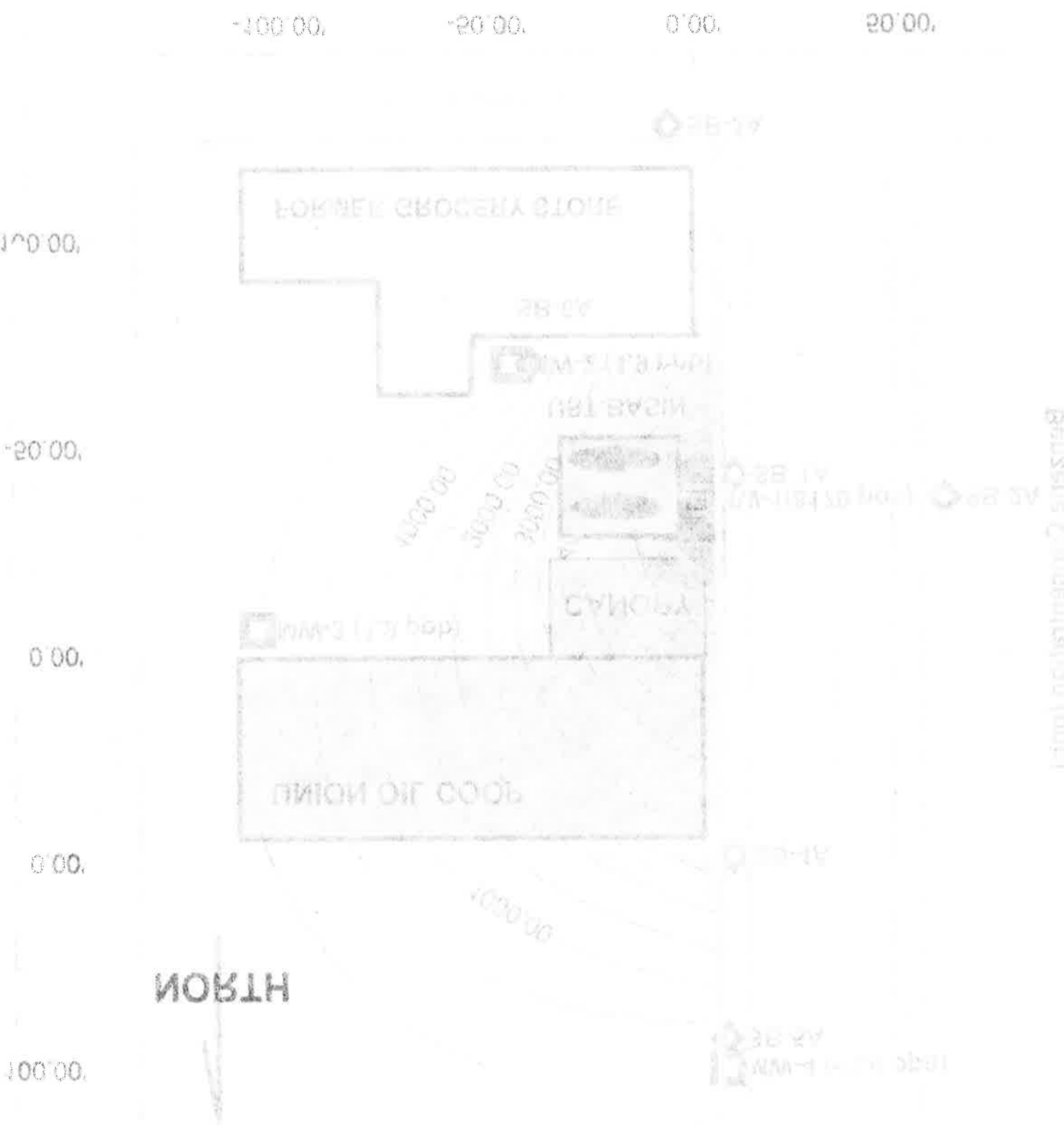


FIGURE 6c GW BENZENE CONCENTRATION MAP - 2/8/95

FIGURE 6c GM BENZENE CONCENTRATION MAP - 2/8/95



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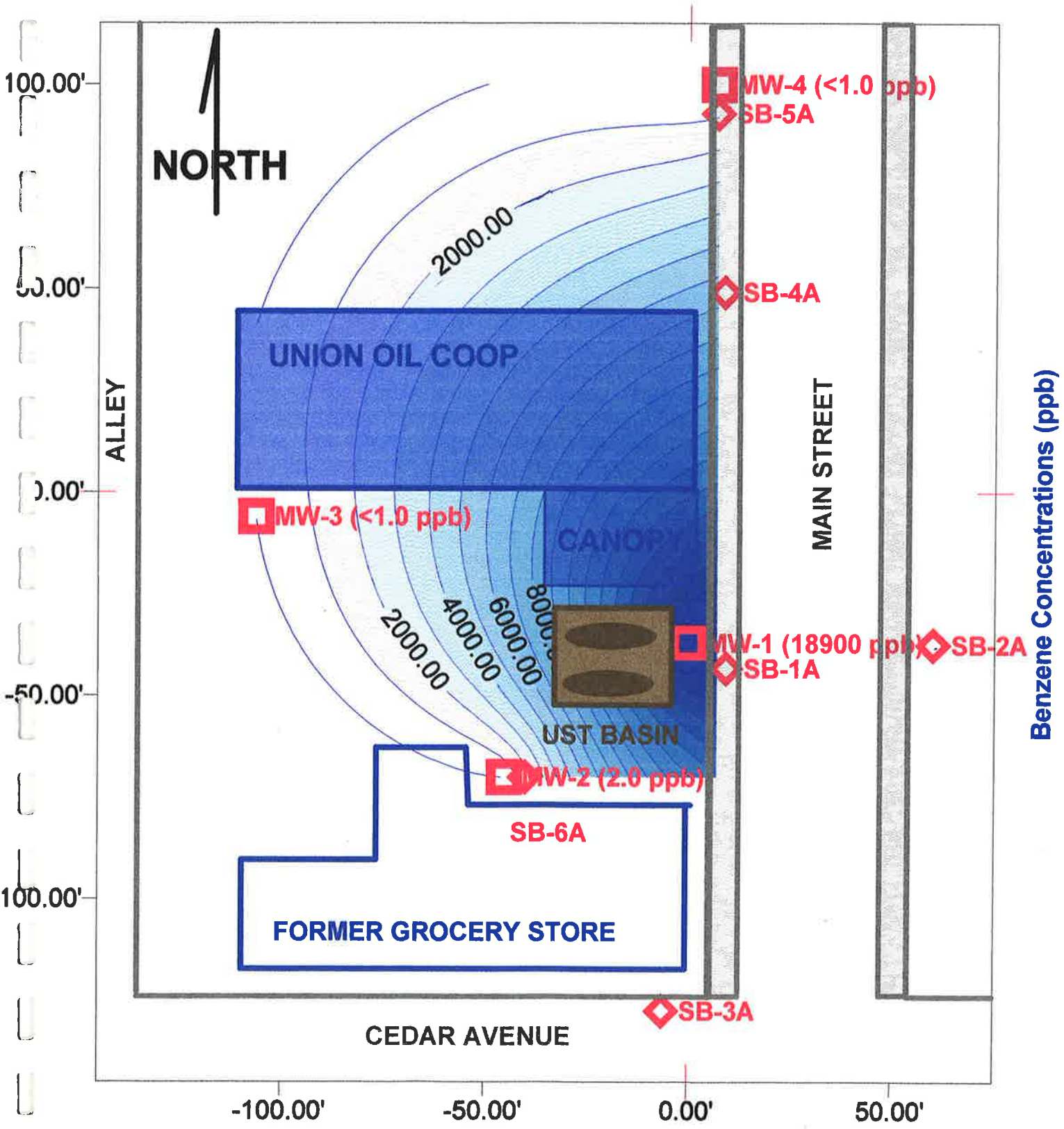
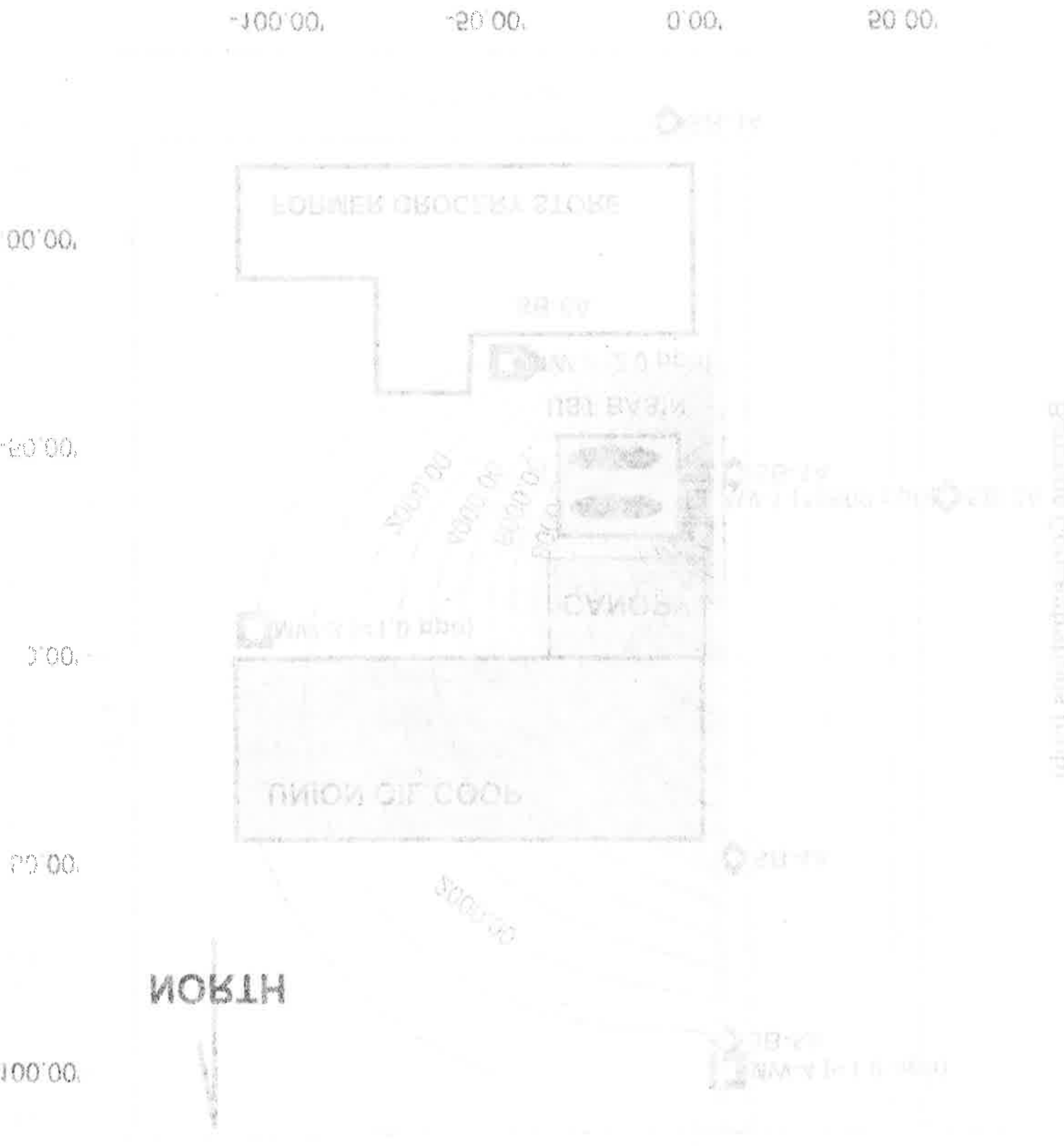


FIGURE 6d GW BENZENE CONCENTRATION MAP - 5/8/95

FIGURE 6d GW BENZENE CONCENTRATION MAP - 5/8/95



AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

AGASSIZ ENVIRONMENTAL SYSTEMS, INC.

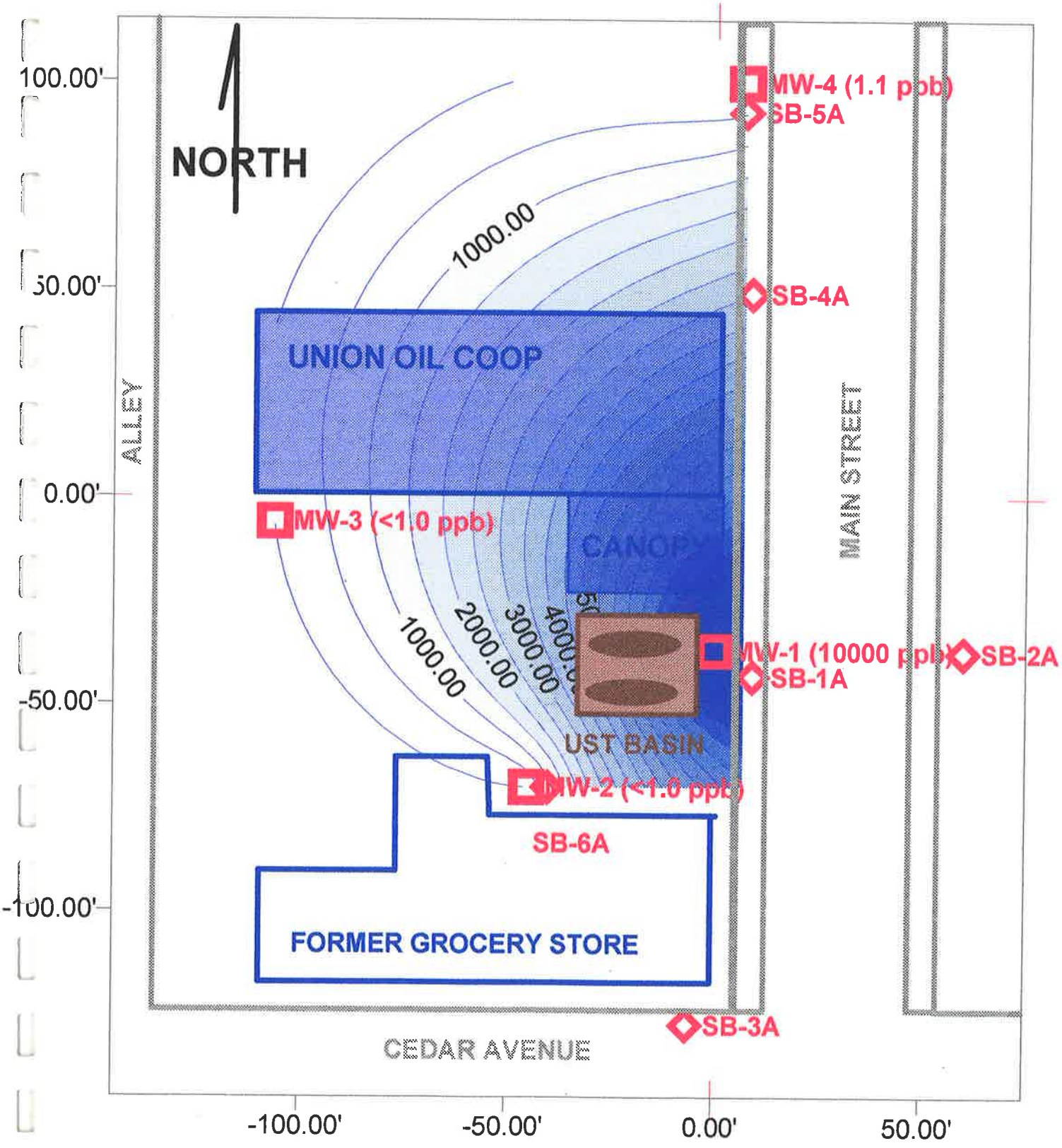


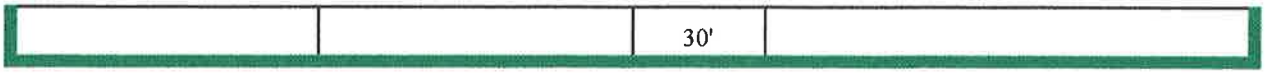
FIGURE 6e GW BENZENE CONCENTRATION MAP - 11/11/94

Appendix A
Geologic Logs/Well Construction Diagrams

AGASSIZ ENVIRONMENTAL SYSTEMS, INC. - SOIL BORING LOG # SB-1a			
DEPTH: 15' WATER LEVEL: 9' DRILLER: JL GEOLOG:CG DATE:3/24/94 PROJECT #: 4002			
SAMPLE TYPE/#	**FID READING (PPM)**	**DEPTH**	**DESCRIPTION**
		0'	8" concrete
		1'	
		2'	Black, moist loam
		3'	
		4'	Gray, silty clay
SV-1a	75	5'	
		6'	Gray, discolored, silty, moist clay
		7'	
SV-1b/SS-1a	6200	8'	WATER; 4" med. sand lense
		9'	
SV-1c	9500	10'	
		11'	Yellow, silty, clay; w/ sand
SV-1d	10	12'	
		13'	Gray, tight, moist clay
		14'	
SV-1e	ND	15'	**EOB**
		16'	
		17'	
		18'	
		19'	
		20'	
		21'	
		22'	
		23'	
		24'	
		25'	
		26'	
		27'	
		28'	
		29'	
		30'	

AGASSIZ ENVIRONMENTAL SYSTEMS, INC. - SOIL BORING LOG # SB-2a			
DEPTH: 15' WATER LEVEL: 9' DRILLER: JL GEOLOG:CG DATE:3/24/94 PROJECT #: 4002			
SAMPLE TYPE/#	**FID READING (PPM)**	**DEPTH**	**DESCRIPTION**
		0'	SIDEWALK; 5" CONCRETE
		1'	1-1 1/2' FROST
		2'	BLACK, MOIST LOAM
		3'	
		4'	YELLOW, MOIST, SILTY CLAY
SV-2a	ND	5'	
		6'	GRAY, SILTY, MOIST CLAY
		7'	
SV-2b	ND	8'	YELLOW, SILTY, MOIST CLAY
		9'	
SV-2c	ND	10'	WATER
		11'	YELLOW, SILTY, MOIST CLAY
		12'	
SV-2d	ND	13'	GRAY, SILTY, MOIST CLAY
		14'	
SV-2e/SS-2a	ND	15'	**EOB**
		16'	
		17'	
		18'	
		19'	
		20'	
		21'	
		22'	
		23'	
		24'	
		25'	
		26'	
		27'	
		28'	
		29'	
		30'	

AGASSIZ ENVIRONMENTAL SYSTEMS, INC. - SOIL BORING LOG # SB-3a			
DEPTH: 15' WATER LEVEL: 9' DRILLER: JL GEOLOG:CG DATE:3/25/94 PROJECT #: 4002			
SAMPLE TYPE/#	**FID READING (PPM)**	**DEPTH**	**DESCRIPTION**
		0'	2" TAR, 6" CONCRETE
		1'	
SV-3a	ND	2'	BLACK, MOIST LOAM
		3'	
		4'	YELLOW, SILTY CLAY; W/ SAND LENSE
SV-3b	ND	5'	
		6'	
SV-3c	ND	7'	YELLOW/GRAY, MOIST CLAY
		8'	
		9'	WATER; COARSE GRAVEL LENSE TO 12'
SV-3d	ND	10'	
		11'	
		12'	
SV-3e	ND	13'	GRAY, SILTY, MOIST CLAY
		14'	
SV-3f	ND	15'	**EOB**
		16'	
		17'	
		18'	
		19'	
		20'	
		21'	
		22'	
		23'	
		24'	
		25'	
		26'	
		27'	
		28'	
		29'	


30'

AGASSIZ ENVIRONMENTAL SYSTEMS, INC. - SOIL BORING LOG # SB-4a			
DEPTH: 15' WATER LEVEL: 8' DRILLER: JL GEOLOG:CG DATE:3/25/94 PROJECT #: 4002			
SAMPLE TYPE/#	**FID READING (PPM)**	**DEPTH**	**DESCRIPTION**
		0'	CONCRETE SIDEWALK
		1'	
		2'	BLACK, MOIST LOAM
		3'	
		4'	YELLOW, SILTY, MOIST CLAY
SV-4a	ND	5'	
		6'	
SV-4b/SS-4a	1240	7'	GRAY, DISCOLORED CLAY
		8'	WATER; LENSE FROM 7'-8'
		9'	
SV-4c	25	10'	
		11'	YELLOW, SILTY CLAY; W/ SAND LENSES
		12'	
SV-4d	ND	13'	GRAY, TIGHT CLAY
		14'	
SV-4e/SS-4b	ND	15'	**EOB**
		16'	
		17'	
		18'	
		19'	
		20'	
		21'	
		22'	
		23'	
		24'	
		25'	
		26'	
		27'	
		28'	
		29'	
		30'	

AGASSIZ ENVIRONMENTAL SYSTEMS, INC. - SOIL BORING LOG # SB-5a			
DEPTH: 15' WATER LEVEL: 10' DRILLER: JL GEOLOG:CG DATE:4/20/94 PROJECT #: 4002			
SAMPLE TYPE/#	**FID READING (PPM)**	**DEPTH**	**DESCRIPTION**
		0'	6" CONCRETE SIDEWALK
		1'	6" GRAVEL
		2'	BLACK, MOIST LOAM
SV-5a	ND	3'	
		4'	YELLOW, SILTY, MOIST CLAY
SV-5b	ND	5'	
		6'	
SV-5c	ND	7'	
		8'	YELLOW, SILTY CLAY; SATYRATED W/ SAND LENSES
		9'	
SV-5d	ND	10'	WATER
		11'	
SV-5e		12'	
	ND	13'	GRAY, TIGHT, MOIST CLAY
		14'	
SV-5f	ND	15'	**EOB**
		16'	
		17'	
		18'	
		19'	
		20'	
		21'	
		22'	
		23'	
		24'	
		25'	
		26'	
		27'	
		28'	
		29'	
		30'	

AGASSIZ ENVIRONMENTAL SYSTEMS, INC. - SOIL BORING LOG # SB-6

DEPTH: 5' WATER LEVEL: NA DRILLER: JL GEOLOG:CG DATE:8/16/94 PROJECT #: 4002

SAMPLE TYPE/#	FID READING (PPM)	DEPTH	DESCRIPTION
		0'	BLACK LOAM
		1'	
		2'	
		3'	
		4'	
		5'	YELLOW, MOIST CLAY
		6'	**EOB-OBSTRUCTION**
		7'	
		8'	
		9'	
		10'	
		11'	
		12'	
		13'	
		14'	
		15'	
		16'	
		17'	
		18'	
		19'	
		20'	
		21'	
		22'	
		23'	
		24'	
		25'	
		26'	
		27'	
		28'	
		29'	
		30'	

AGASSIZ ENVIRONMENTAL SYSTEMS, INC. - SOIL BORING LOG # SB-7

DEPTH: 19' WATER LEVEL: 7' DRILLER: JL GEOLOG:CG DATE:8/16/94 PROJECT #: 4002

SAMPLE TYPE/#	FID READING (PPM)	DEPTH	DESCRIPTION
		0'	BLACK LOAM
		1'	
		2'	
SV-7a	ND	3'	
		4'	
SV-7b	ND	5'	
		6'	YELLOW, SOFT, MOIST CLAY
		7'	
SV-7c	220	8'	GRAY/BLUE, DISCOLORED, SOFT, MOIST CLAY
		9'	
SV-7d	115	10'	
		11'	
		12'	
SV-7e	35	13'	GRAY/BROWN, SOFT, MOIST CLAY
		14'	
SV-7f	10	15'	
		16'	
SV-7g	ND	17'	
		18'	
SV-7h	ND	19'	**EOB**

CONVERTED INTO MW-2

AGASSIZ ENVIRONMENTAL SYSTEMS, INC. - SOIL BORING LOG # SB-8

DEPTH: 19' WATER LEVEL: 7' DRILLER: JL GEOLOG:CG DATE:8/16/94 PROJECT #: 4002

SAMPLE TYPE/#	FID READING (PPM)	DEPTH	DESCRIPTION
		0'	6" GRAVEL
		1'	BLACK, RICH, MOIST LOAM
SV-8a	ND	2'	
		3'	
		4'	
SV-8b	ND	5'	
		6'	
SV-8c	65	7'	WATER; GRAY/BLUE, DISCOLORED, MOIST, SOFT CLAY
		8'	
		9'	
SV-7d	55	10'	
		11'	
SV-8e	25	12'	
		13'	GRAY/BROWN, SOFT, MOIST CLAY
		14'	
SV-8f	15	15'	
		16'	
SV-8g	ND	17'	
		18'	
SV-8h	ND	19'	**EOB**

CONVERTED INTO MW-3

AGASSIZ ENVIRONMENTAL SYSTEMS, INC. - SOIL BORING LOG # SB-9

DEPTH: 19' WATER LEVEL: 8' DRILLER: JL GEOLOG:CG DATE:8/16/94 PROJECT #: 4002

SAMPLE TYPE/#	FID READING (PPM)	DEPTH	DESCRIPTION
		0'	BLACK LOAM
		1'	
SV-9a	ND	2'	
		3'	YELLOW, SOFT, SILTY CLAY
		4'	
SV-9b	25	5'	
		6'	
SV-9c	775	7'	
		8'	WATER; BLUE/GRAY, DISCOLORED, SOFT, SILTY, MOIST CLAY
		9'	
SV-9d	220	10'	
		11'	
SV-9e	55	12'	
		13'	GRAY/BROWN, SOFT, SILTY, MOIST CLAY
		14'	
SV-9f	15	15'	
		16'	
SV-9g	5	17'	GRAY, SOFT, SILTY CLAY
		18'	
SV-9h	ND	19'	**EOB**

CONVERTED INTO MW-1

AGASSIZ ENVIRONMENTAL SYSTEMS, INC. - SOIL BORING LOG # SB-10

DEPTH: 19' WATER LEVEL: 9' DRILLER: JL GEOLOG:CG DATE:8/16/94 PROJECT #: 4002

SAMPLE TYPE/#	FID READING (PPM)	DEPTH	DESCRIPTION
		0'	5" CONCRETE
		1'	6" GRAVEL
SV-10a	ND	2'	YELLOW/BROWN, SOFT, MOIST CLAY
		3'	
		4'	
SV-10b	ND	5'	
		6'	
SV-10c	ND	7'	
		8'	YELLOW, SOFT, MOIST CLAY
		9'	WATER
SV-10d	ND	10'	
		11'	
		12'	
SV-10e	ND	13'	
		14'	
SV-10f	ND	15'	
		16'	
SV-10g	ND	17'	GRAY, STIFF, MOIST CLAY
		18'	
SV-10h	ND	19'	**EOB**

CONVERTED INTO MW-4
