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MEMORANDUM

TO: Glen Schmiesing, Bill Ashton (Hercules)

JOB NO: 18539.001

cc: J. Tucker, Ciba

FROM: Bob O'Neill

DATE: April 12, 2001

SUBJECT: Evaluation of Leakage from Glens Falls Feeder Canal Adjacent to Ciba Site, Glens Falls, New York

1.0 INTRODUCTION

This technical memorandum presents an evaluation of leakage from the Glens Falls Feeder Canal (canal) in the vicinity of the Ciba Site. The evaluation is based on hydraulic monitoring conducted during the draining of the canal in November 1999, reconnaissance of the canal after it was drained, and observations made during the implementation of Corrective Measures (CM) at the site. It was anticipated that some of the activities planned as part of CM Construction at the site would allow observations and/or expose features that potentially relate to the leakage. The preparation of this memorandum was postponed until these observations were complete.

The objectives of this evaluation are as follows:

- Evaluate the condition of canal with regard to the integrity of the canal walls and floor, leakage out of or into the canal, and the amount of sediment and debris within the canal.

- Qualitatively evaluate the degree to which the canal is in hydraulic communication with the groundwater system (overburden and bedrock water-bearing zones), the Sliver Quarry, and the Cement Company Pond, to the extent feasible with the existing monitoring well network.

- Evaluate the characteristics and configuration of the outlet from the Sliver Quarry through which water exits to flow underneath the canal to the Site. Some, and possibly all, of this water eventually arrives in a stormwater sewer manhole located east of the North Lagoon Area. This sewer leads to Weir Brook stormwater sewer system.

A work permit was obtained from the New York State Canal Corporation (NYSCC) prior to conducting the field activities. The Glens Falls Lehigh Cement Company (GFLCC) was also contacted for permission to conduct field activities on their property, which was granted.

The components of the evaluation are described in the sections below, including methods and procedures, observations, and findings. Section 2.0 describes the hydraulic evaluation. Section 3.0 discusses the reconnaissance of the canal. Section 4.0 provides a discussion of passages beneath the canal. Section 5.0 provides conclusions and recommendations based on the evaluations described herein.

2.0 HYDRAULIC EVALUATION

Hydraulic data (i.e., water level and flow data) were collected from various locations in the vicinity of the Ciba Site just prior to, during, and after the draining of the canal for the winter in November 1999. Based on conversations with NYSCC personnel, the diversion of water to the canal from the Hudson River at the Feeder Dam was closed at approximately 1400 hours on November 18, 1999. The gate allowing flow from the canal into the Weir Brook culvert (see Drawing 18539-001) was opened on November 19, 1999 at approximately 0740 hours.

Table 1 lists the locations where water level measurements were made during the investigation. Measurements were made manually using an electronic water level measuring meter, or by use of an automatic data logger, referenced from the water level reference mark established at each location. The locations where observations regarding water flow were made are as follows (refer to Drawing 18539-001 for position of locations):

- Feeder Canal.
- Sluice for stream entering canal, located west of the Sliver Quarry.
- Manhole, located east of North Lagoon Area, that is part of the sewer system leading to Weir Brook. This manhole receives flow from the Sliver Quarry.
- Seeping/upwelling water in the vicinity of the Building 49 foundation slab.
- Stream flowing to Cement Company Pond.
- North Lagoon underdrain discharge (if observable in manhole).

The flow observations included whether flow was present or absent, and a visual estimate of the rate of flow relative to previous observations.

During the morning of November 18, 2000, the day prior to the draining of the canal, automatic data loggers were installed and started at the water level monitoring locations

noted in Table 1. The loggers were set to collect water level data at 15-minute intervals. Also, frequent rounds of manual measurements with the electronic water level meter were made at all the locations listed in Table 1 beginning on the morning of November 18, 1999 and ending on November 20, 1999.

Flow observations were made at approximately the same frequency as the manual water level measurements.

The following subsections describe the observations and findings made during the monitoring period described above. Attachment 1 contains hydrographs (Figures 1 through 35) of the changes in water levels versus time for various locations monitored during this period. Note that the vertical scale varies among the hydrographs to better illustrate water level changes.

Feeder Canal

Figures 1 and 2 are plots of the change in water level versus time during the monitoring period described above. Figure 1 was developed using data collected manually with a water level meter. Figure 2 is data collected with a data logger. The plots indicate that initially the water level in the canal was rising at a slow rate until approximately 1400 on November 18, at which time the level began to steadily decrease. The beginning of this water level decline corresponds with the closing of the water diversion gate from the Hudson River to the canal. The water diversion gate is located upstream of the City of Glens Falls, at the Feeder Dam. At approximately 0745 hours on November 19, the water level in the canal began to drop at a faster rate. This corresponds to the opening of the gate at the sluice chamber that leads to Weir Brook. At approximately 1400 hours on November 19, the water level in the canal stabilized. At this time, the water level in the canal was at or near the bottom of the canal. The floor of the canal, or bottom sediment lying on the canal floor, was exposed through much of the canal. However, a steady flow of water continued in part of the canal near the site following the draining. This flow originated, for the most part, from the stream that enters the canal at the sluice located directly west of the Sliver Quarry (see Drawing 18539-001). Water from this stream, once in the canal, was observed flowing to the east and exiting the canal at the sluice chamber leading to Weir Brook. Based on the manual water level data, the maximum change in water level in the canal during the monitoring period was 1.79 feet.

Sliver Quarry

The Sliver Quarry is a former limestone quarry situated directly north of the canal near the western end of the Ciba Site. The north wall of the canal is positioned only a few feet south of the south wall of the quarry. Thus, only a few feet of rock separate the canal wall and the excavated area of the quarry. Based on measurements taken during this monitoring period, and based on previous observations, the elevation of the water in the Sliver Quarry is typically below that of the canal floor.

Based on a dye tracer study conducted in March 1996, water in the Sliver Quarry was found to flow from the quarry, beneath the canal, and into on-site stormwater sewer pipes. These stormwater sewers lead to a manhole located east of the North Lagoon Area, which is part of the sewer system connecting to Weir Brook culvert. The dye tracer study, and subsequent observations, indicated that water in the Sliver Quarry was exiting through the south wall of the quarry. During periods of relatively low water in the Sliver Quarry (November 18 and December 1, 1999), the outflow area was accessed by wading (see Photographs 21, 22, and 23 in Attachment 2). Debris was observed piled-up against the quarry wall in this area, indicating that at times water flows toward and into the quarry wall at a substantial rate. The debris was cleared from the location to the extent practical by hand. The only potential outlets that were observed in this area are fractures in the rock.

The Sliver Quarry receives storm water drainage from large areas to the north of the site. However, during the monitoring period described in this report, there were no precipitation events and no storm water was observed entering the Sliver Quarry.

On the west side of the sliver quarry, seepage into the quarry from the rock ledge on northwest side of the quarry was observed (see Drawing 18539-001). This may be groundwater discharge, or it may be related to leakage from the sluice and/or culvert for the stream located directly west of the Sliver Quarry.

Figures 3 and 4 are plots of the change in water level in the Sliver Quarry (staff gauge SG-9) versus time collected manually, and collected using a data logger, respectively. These data were collected over the same time period as those described for the canal.

The general pattern and timing of water level change in the Sliver Quarry is similar to that of the canal (see Figure 6). Although the observed magnitude of the change is different, with a maximum change in water level during the monitoring period of 0.53 feet, versus 1.79 feet for the canal, the level in the Sliver Quarry was still declining at the end of the monitoring period. During the period prior to the closing of the water diversion at the Feeder Dam, the water level in the Sliver Quarry was rising slowly, but at a rate slightly greater than the rise observed in the canal over the same period. Following the closing of the water diversion, there was a relatively abrupt decrease in water level (approximately 0.12 feet), followed by an overall gradual decrease in water elevation. Following the opening of the gate to drain the canal (approximately 0745 hours on November 19) the water level in the Sliver Quarry decreased more rapidly.

The correlation between the water level patterns of the Sliver Quarry and the canal during the monitoring period indicates a hydraulic connection between the two. Water in the canal, being at a higher elevation, likely leaks into the Sliver Quarry. The decrease in water level in the Sliver Quarry as the canal is drained indicates that the amount of leakage to the quarry decreases as the water level in the canal is lowered.

Cement Company Pond and Stream

The Cement Company Pond is fed by a stream that enters from the north near the western boundary of the Ciba Site. The stream emanates from near the base of the relatively steep, south-facing embankment on the south side of the canal (see Drawing 18539-001). The pond drains through a pipe that feeds into the Weir Brook piping system.

Figure 5 is a plot of the change in water level versus time in the Cement Company Pond. As described for the Sliver Quarry, the general pattern and timing of water level change in the Cement Company pond is similar to that of the canal (see Figure 6), although the magnitude of the change was less (the maximum change in water level during the monitoring period was 0.41 feet, versus 1.79 feet for the canal).

Observations of the stream that feeds the Cement Company Pond indicate that the width and height of the flow of the stream decreased as the canal was being drained. Photographs A1 and A2 in Attachment 2 were taken of this stream on November 18, 1999, before the opening the gate from the canal to Weir Brook, and November 19, 1999, approximately 3 ½ hours after the gate was opened, respectively. These photographs indicate a substantial decrease in the width of flow in the stream. Although the volumetric flow decreased, the stream continued to flow after the canal was drained.

The changes in volumetric flow in the stream feeding the Cement Company Pond and the water level changes in the Cement Company Pond during the monitoring period indicate a hydraulic connection with the canal. Water in the canal, being at a higher elevation than the stream and pond, likely feeds the stream, and is likely the main source of the stream. Noteworthy is that the stream is adjacent to a portion of the canal that the NYSCC previously attempted to line with a geosynthetic membrane to reduce leakage. As described above, there is a continuous, although reduced, flow in the canal even in the drained condition, due to inflow to the canal from a stream located west of the Sliver Quarry (see Drawing 18539-001). This flow may provide the continued source of water to the stream feeding the Cement Company Pond after the canal is drained.

Groundwater

- Overburden Water-Bearing Zone - Figures 7 through 14 are plots of the change in water level within the overburden wells vs. time during the monitoring period. Of the overburden wells that were monitored, only the two wells that are closest to the canal, MW-OB1 and MW-OB2, appeared to respond directly to changes in the water levels within the canal (see Figure 14). The water levels in both wells changed at times corresponding to changes in the canal water level, although the magnitudes of the changes were less. The magnitude of the response in MW-OB2 was more pronounced, with the maximum change in water level during the monitoring period being 0.36 feet, versus 0.06 feet for MW-OB1. However, the water levels in these wells were continuing to decline at the end of the monitoring period and thus, the full magnitude of the changes were not determined.

- Bedrock Horizon A Water-Bearing Zone - Figures 15 through 20 present plots of the change in water level within the Horizon A wells versus time during the monitoring period. Of the four Horizon A wells that were monitored, the water levels in three appeared to respond directly to changes in canal water level (see Figure 20). In two of these wells, AW-A1 and P-A1, the maximum changes in water level during the monitoring period were 0.9 and 1.2 feet, respectively. These changes are equal to approximately 50 and 67 percent, respectively, of the water level change measured in the canal (1.79 feet). Note that the water levels in these wells were still declining at the end of the monitoring period, and thus the full magnitude of the water level changes in these wells were not determined. P-A1 and AW-A1 are located approximately 45 and 70 feet south of the canal, respectively, and are the closest Horizon A wells to the canal. Well MW-23S, located to the north of the canal, responded to the change in canal water level, but the magnitude (0.15 feet) was less than for AW-A1 and PA-1. However, the water level in MW-23S was still declining at the end of the monitoring period. Measurements of water levels in well MW-36S, located on the Main Plant Site, approximately 430 feet from the canal, did not indicate a response to the change in canal water level.

- Bedrock Horizon B Water-Bearing Zone - Figures 26 through 33 are plots of the changes in water levels within the Horizon B wells versus time during the monitoring period. Based on the data collected during the monitoring period, none of the Horizon B wells that were monitored appeared to respond to the change in water level in the canal (see Figure 25).

- Bedrock Horizon C Water-Bearing Zone - Figures 26 through 33 are plots of the changes in water levels within the Horizon C wells versus time during the monitoring period. Of the six Horizon C wells that were monitored, only AW-C1, the well closest to the canal, appeared to respond directly to changes in the water levels within the canal (see Figure 33). The maximum change in water level in AW-C1 during the monitoring period was 0.6 feet. However, the water level in AW-C1 was still declining at the end of the monitoring period, and thus the full magnitude of the water level change in this well was not determined.

The monitoring data indicate that the canal is hydraulically connected to both overburden and bedrock water-bearing zones. This interconnection is most evident in the wells closest to the canal. The apparent lack of response during the monitoring period in bedrock Horizon B, which is located stratigraphically between A and C, may be a result of the relatively low hydraulic conductivity of the Horizon B wells in the vicinity of the canal (e.g., MW-40B). It is possible that a longer monitoring period may be required to observe a response (if any) in the Horizon B wells near the canal.

Sumps North of Railroad

Two sumps, designated for this evaluation as Sump A and Sump B, were located just north of the railroad in the central portion of the Ciba Site. Sump A was located within the foundation slab of former Building 5. Sump B was located on a concrete pad directly west of former Building 53. Photographs of Sumps A and B are included in Attachment 2 (Photographs A5 and A6, respectively). These sumps were demolished and/or buried in 2000 as part of CM construction at the site. Historically, standing water was typically observed in these sumps, even during dry weather. Further, during the draining of the canal in 1998, it was observed that the water level in these sumps decreased. Accordingly, the sumps were selected for monitoring during this evaluation.

Figures 34 and 35 are plots of the change in water level versus time in Sumps A and B. Both plots indicate relatively consistent water levels from before the canal is drained until at least 8 hours after the opening of the gate to drain the canal. After this time, the water levels in the sumps begin to decline. By the end of the monitoring period, the water levels in Sumps A and B had declined 0.27 and 0.29 feet respectively, and were continuing to decline.

The response observed in these sumps to the draining of the canal indicates that a hydraulic connection between the sumps and the canal existed. The nature of the connection is not known. The delayed response indicates that between the canal and the sumps there is a degree of storage, suggesting that the hydraulic link maybe indirect.

Manhole East of North Lagoon and Old Stone Culvert

Prior to CM Construction activities in 2000, a manhole was located east of the North Lagoon Area that was part of the sewer system leading to Weir Brook (see Drawing 18539-001). This manhole received flow from the pipe that conveyed flow from the Cement Company Pond on the west, and from a pipe that entered the manhole from the north. The dye tracer study described in the section discussing the Sliver Quarry indicated that the water in the pipe from the north, at least in part, originated in the Sliver Quarry. Historic plant drawings indicated that the pipe from the north led to the "Old Stone Culvert" (OSC), a buried structure located near the northern property boundary of the site (see Drawing 18539-001). Excavation work conducted in January 1997, during which a portion of the OSC was exposed, indicated that the OSC was constructed of ungrouted limestone slabs, and that it continued for some distance toward, and possibly under, the canal. This work further confirmed that the OSC was connected by PVC piping to the manhole. However, at the time of the work (January 1997) no flow was observed in the OSC. Noteworthy is that various historic plant drawings indicated that there may be other buried pipes in the area that potentially may contribute to the flow observed in the manhole. During CM Construction activities in Fall of 2000, the OSC was again exposed. At that time, a sandbag was used to temporarily block most of the flow from entering the PVC pipe at the end of the OSC. Observations at the manhole indicated that the flow from the pipe from the north decreased substantially when the pipe was blocked, indicating that most of the flow to the manhole at that time was from the OSC.

From November 18 through 20, 1999 periodic observations of the flow discharging into the manhole from the pipe entering from the north were made. These observations involved recording changes in the distance from the north side of the manhole that the flow contacted the bottom of the manhole. Since this distance varies with flow rate, these are considered indirect measurements of changes in flow. The observations indicated that the distance that the flow contacted the bottom of the manhole shifted south to north by about one foot (±) by the end of the monitoring period. This indicates that there was some decrease in flow, possibly related to the draining of the canal.

Seeping/Upwelling Water-Building 49 Area

Seepage and upwelling water have been historically observed in the area of the Building 49 foundation slab (see Drawing 18539-001). This slab was buried during CM Construction activities in 2000. Prior to the draining of the canal, flow was observed:

- Upwelling from penetrations through the Building 49 foundation slab.
- Seeping from the bank located directly north of the Building 49 foundation slab.

Additionally, there was standing water in the vicinity of Building 49 slab resulting from these sources of flow.

Water from these areas was observed to flow overland to the south, where it ponded in a depression just north of the railroad. It is suspected that from the ponded area north of the railroad, the water seeped into the ground. South of the ponded area, on the south side of the railroad, seeps were observed (see Drawing 18539-001). These seeps are suspected to be derived from water in the ponded area, via seepage through the railroad embankment.

It was observed that the seepage from the bank to the north of the Building 49 foundation slab stopped within approximately one hour of the opening of the gate that allows water from the canal to drain to Weir Brook. The level of ponded water in the area of the Building 49 slab decreased steadily during canal draining, such that by the end of the monitoring period, the water level in the slab penetrations was below the bottom of the slab and no upwelling was observed. Also, the seepage areas south of the railroad were no longer flowing. These observations are consistent with similar observations made during the draining of the canal in November 1998.

The decrease and/or stoppage of these flows coincident with the draining of the canal indicate they are in hydraulic connection with the canal.

North Lagoon Underdrain Discharge

The underdrains located between the North Lagoon and North Waste Pile formerly discharged to the industrial sewer at the base of a manhole located east of the North Lagoon. The manhole was decommissioned in 2000 as part of CM construction. Because

the water level in the manhole is typically near the base, flow discharging from the underdrains was usually observable from the top of the manhole. During the draining of the canal, there was no change in the level of water in the manhole, and no observable changes in the rate of discharge from the underdrains. However, unless the changes in discharge were substantial, it is unlikely that the changes would have been readily identifiable using the type of observations made for this evaluation.

3.0 CANAL RECONNAISSANCE

On December 1, 1999, approximately two weeks after the canal was drained, a reconnaissance of the canal was conducted to evaluate and record the condition of the canal with regard to the integrity of the canal walls and floor, leakage out of or into the canal, and the amount of sediment and debris in the canal. During this reconnaissance, photographs were taken of portions of the canal, and of features related to the canal. These photographs are provided in Attachment 2. The location and direction of the photographs are depicted on Drawing 18539-001. Provided below is a summary of the findings of the reconnaissance.

Along much of the area observed, the walls of the canal show substantial deterioration. The outer concrete portion of the canal wall has degraded such that the limestone blocks, that were apparently the original walls of the canal, are exposed. There appear to be several generations of local concrete repairs on the canal wall in various places. Along the south wall of the canal, adjacent to the Ciba Site, an approximately 1,700-foot long segment of the south wall was repaired by driving steel sheet piles north of the old canal wall, and filling the volume between the sheet piling and south wall with concrete. Based on records provided by the NYSCC, this repair was completed in 1988. Along one portion of this repaired section, approximately 250 feet east of the gate to Weir Brook, it appears that tie-backs were placed, apparently to stabilize the sheet piles (see Photograph 25 in Attachment 2). The floor of the canal was not readily observable due to overlying sediment and debris, or due the presence of liners in the canal (see below).

Sinkholes in the soil were noted directly behind the northern canal walls at a few locations, which is an indication of potential leakage (See Photograph 19 and 26). Sinkholes were less evident behind the southern wall. One sinkhole was observed behind the southern wall on November 19, 1999 at a location a few feet beyond the western end of the sheet pile repair work, directly across from the Sliver Quarry. Observations showed a large void extending partly beneath the canal towpath to the south (see Photograph A3 and A4). This void was filled the same day by personnel from the NYSCC. Thus, although sinkholes are not as evident on the south side, it is not known whether sinks, when present, are routinely filled by the NYSCC in order to maintain the towpath for recreation.

There are two sections of the canal near the Ciba Site where the NYSCC installed a geosynthetic liner along the walls and floor of the canal to address leakage. Both liners have holes and tears. One section of liner begins near the northwest corner of the MPS and extends westward approximately 325 feet. The stream that feeds the Cement Company Pond emanates from the base of the steep bank to the south of the canal adjacent to this

lined section. The second section of liner is adjacent to the Pretreatment Plant. Observations to the south of the canal in this area indicate leakage from the canal.

Review of records obtained from the NYSCC indicates that in 1940, a new floor was installed in the canal in the vicinity of the Ciba Site. According to the records, installation of the new floor extended from just west of the Sliver Quarry to approximately 100 feet east of the gate to Weir Brook, a length of approximately 1,100 feet.

Based on discussions with the Glens Falls Lehigh Cement Company (GFLCC), a portion of the canal located just upstream of the Ciba Site, adjacent to the GFLCC property, washed out in July 1998. The washout caused some flooding on the GFLCC property. The washed-out section was repaired by the NYSCC. Provided in Attachment 3 is a drawing on which a representative of the GFLCC plotted the location of the washout.

4.0 PASSAGES BENEATH CANAL

Thus far, two culverts have been identified on the Ciba Site that currently, or previously, conveyed water from the north side of the canal, and possible from the canal itself, to the site. Both culverts were buried prior to CM Construction at the site. The first is known as the Old Stone Culvert (OSC) (described previously in report). As described previously, the OSC, when exposed, has been observed to convey water, and the water is likely at least in part contributed from the Sliver Quarry. The second was discovered in October 2000, during CM construction activities, at a location approximately 100 feet east of the OSC. It is oriented in a north-south direction. The second culvert was not conveying water when it was unearthed, but was partly filled with sediment, indicating that at times in the past it conveyed water.

Another potential location for a passage beneath the canal is north of former Building 47, to the east of Weir Brook. A plant drawing, entitled "Plant Map, Storm Sewer Lines" (Drawing 051-8711-21008-5GF, Revision 7) dated September 7, 1970 indicates that an "old brook" entered the site storm sewer system at this location (see copy of a portion of drawing in Attachment 4). Alternatively, the "old brook" depicted in this drawing may have been a leakage point from the canal. Noteworthy is that the "old brook" is adjacent to the section of the canal where during the sheet pile repair work in 1988 (see above), additional support for the sheet piles was apparently required, as evidenced by the tie-backs installed (see Photograph 25 in Attachment 2).

Stone culverts passing beneath the canal have been identified at several locations beyond the portions of the canal adjacent to the site. Photographs 1, 2 and 3 in Attachment 2 depict a culvert that was observed during the reconnaissance as an example. The construction of this culvert is similar to those identified on the Ciba Site. As these culverts are apparently common along the length of the canal, it is possible that there are additional buried culverts on the Ciba Site that have not been identified.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The following conclusions are made based on the information collected during this evaluation, and previously existing information:

- The canal is drained by:
  - Closing the water diversion gate at the Feeder Dam, which diverts water from the Hudson River to the canal; and
  - Opening the gate at the sluice chamber that leads to the Weir Brook culvert, which is located at the Ciba Site.

- In the drained condition, the floor of the canal, or bottom sediment lying on the canal floor, is exposed through much of the canal near the Ciba Site. However, a steady flow of water continues in part of the canal near the site following draining. This flow originates, for the most part, from the stream that enters the canal at the sluice located directly west of the Sliver Quarry. Water from this stream, once in the canal, flows to the east and exits the canal at the sluice chamber leading to Weir Brook.

- The Sliver Quarry receives leakage from, and is in direct hydraulic connection with, the canal. It also receives water from stormwater drainage, groundwater discharge, and possibly leakage from the sluice/culvert for the stream located to the west.

- Water exits the Sliver Quarry at a localized area of the south wall of the quarry through fractures in the rock. Water may also exit by other means (e.g., groundwater discharge), but no other outflow areas were observed. The water exiting through the fractures, or a portion of it, travels beneath the canal to the Old Stone Culvert (OSC).

- The stream feeding the Cement Company Pond is derived mostly, and possibly entirely, from water in the canal.

- The canal is hydraulically connected to groundwater in both the overburden and bedrock water-bearing zones. The interconnection is most evident in wells closest to the canal.

- Leakage from the canal is the source of ponded and upwelling water observed near the foundation slab of former Building 49 and the seeps south of the railroad, south of the Building 49 slab.

- The canal is in a state of progressive deterioration in numerous locations adjacent to the site and leakage may be occurring from these areas.

- Sinkholes developing in the soil outside of the canal walls indicate that leakage from the canal may be actively removing adjacent soils.

5.2 RECOMMENDATIONS

It is recommended that measures to divert, intercept, or reduce leakage from the canal prior to it reaching the site continue to be evaluated. Such measures may have the following benefits:

- Decrease the amount of groundwater that is required to be captured and treated at the Ciba Site.

- Decrease in the number/volume of surface seeps and flow in abandoned sewers at the Ciba Site which may be required to be isolated from other site waters for treatment.

- Decrease in the risk that the volume of water contributed to the Ciba Site from the canal will increase with time.

- Potentially decrease the rate at which soil adjacent to the canal walls and floor is removed by water leaking from the canal.

TABLE 1

WATER LEVEL MONITORING LOCATIONS

Wells/Piezometers	Staff Gauges
Overburden Zone	Feeder Canal (SG-5)
MW-OB1	Feeder Canal (SG-5A)[a]
MW-OB2	Silver Quarry (SG-9)[a]
MW-OB5	Cement Company Pond (SG-10)
MW-OB15	Sump A[b]
MW-OB20	Sump B[c]
MW-18	
MW-24	
Horizon A	
AW-A1[a]	
MW-23S	
MW-36S	
P-A1	
Horizon B	
MW-10B	
MW-20D	
MW-23D	
MW-36D	
MW-40B	
Horizon C	
AW-C1[a]	
AW-C9	
AW-C10	
MW-17C	
MW-20C	
MW-36C	

a Locations to monitor with automatic data loggers prior to and during draining of canal.
b Sump located in foundation slab of former Building 5.
c Sump located on concrete pad west of former Building 53.

ATTACHMENT 1

HYDROGRAPHS
(FIGURES 1 THROUGH 35)

18539.001

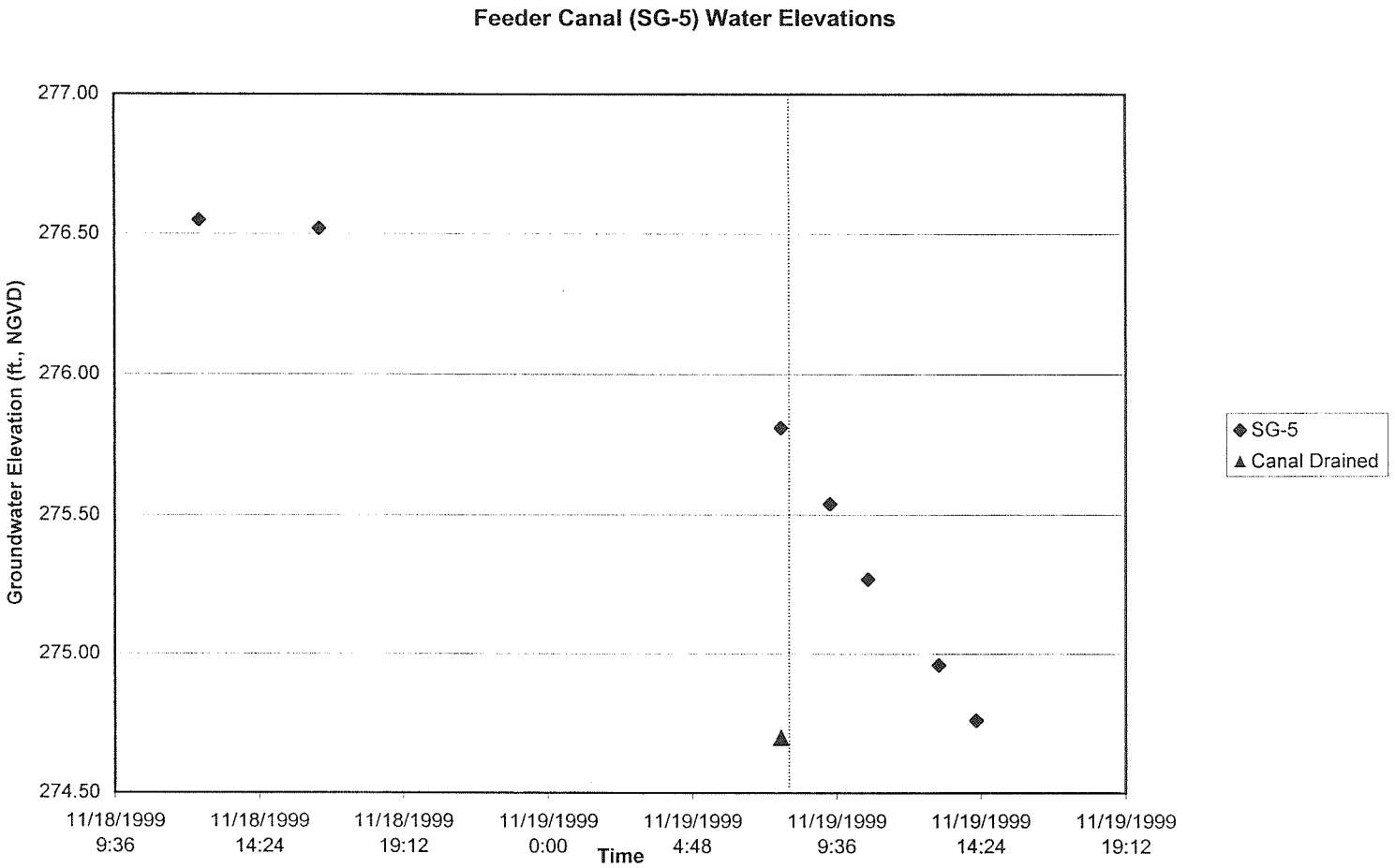


FIGURE 1

HYDROGRAPH
FEEDER CANAL (SG-5)

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

18539.001

FEEDER CANAL: Change in Water Level (Automatic Data Logger)

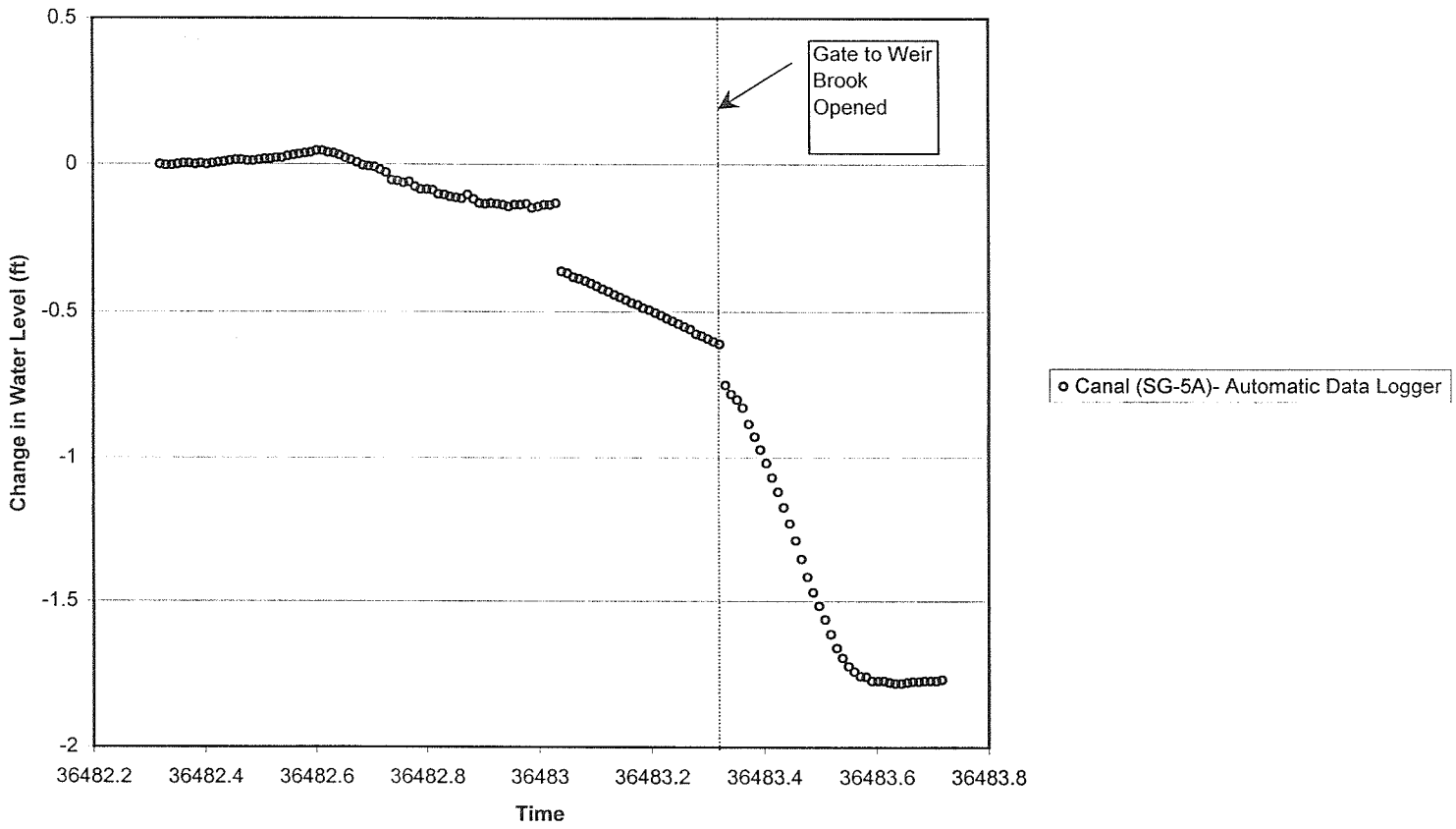


FIGURE 2

CHANGE IN WATER LEVEL CANAL (FROM DATA LOGGER)

HERCULES INCORPORATED

CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

18539.001

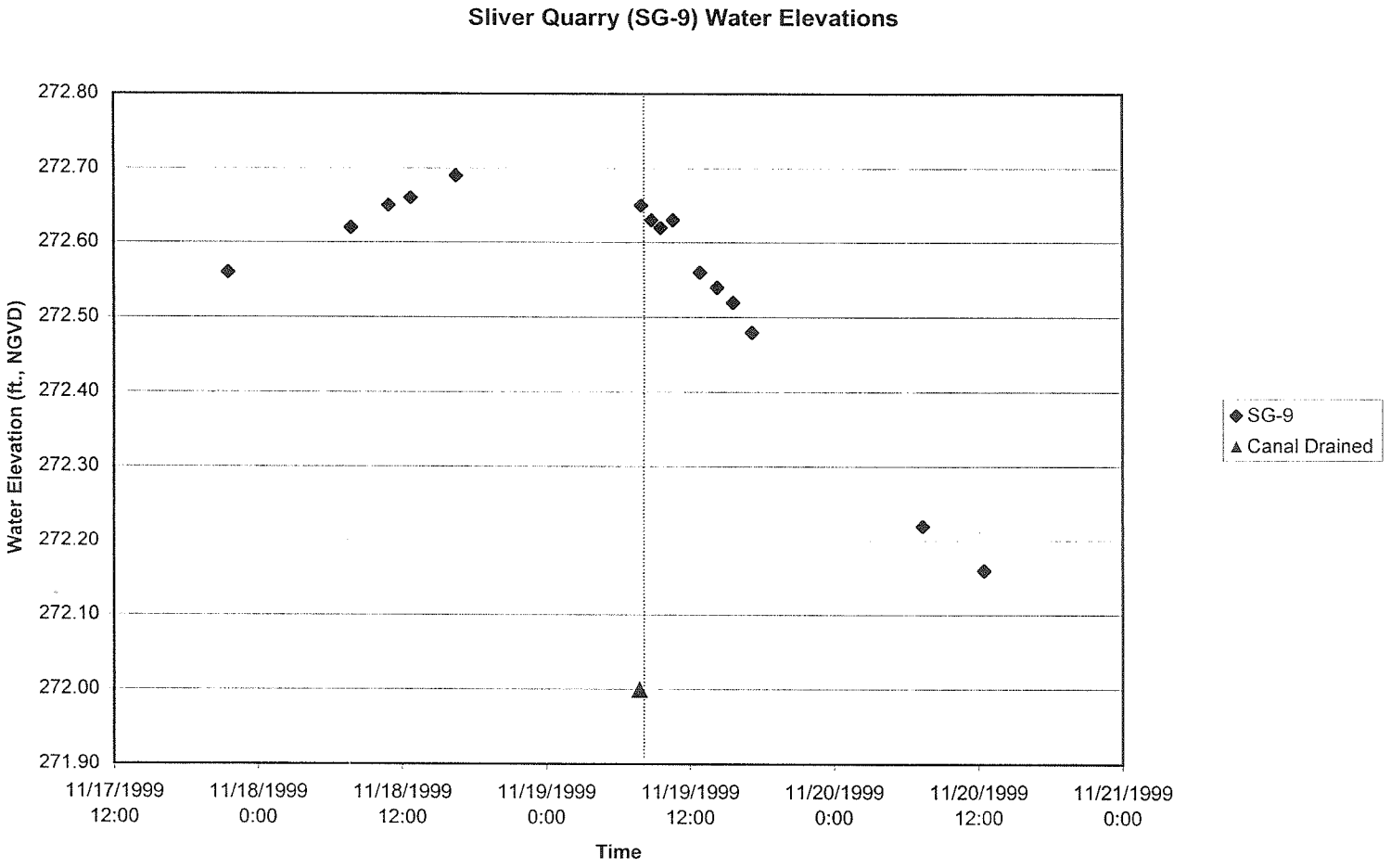


FIGURE 3

HYDROGRAPH
SLIVER QUARRY (SG-9)

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

SLIVER QUARRY: Change in Water Level (Automatic Data Logger)

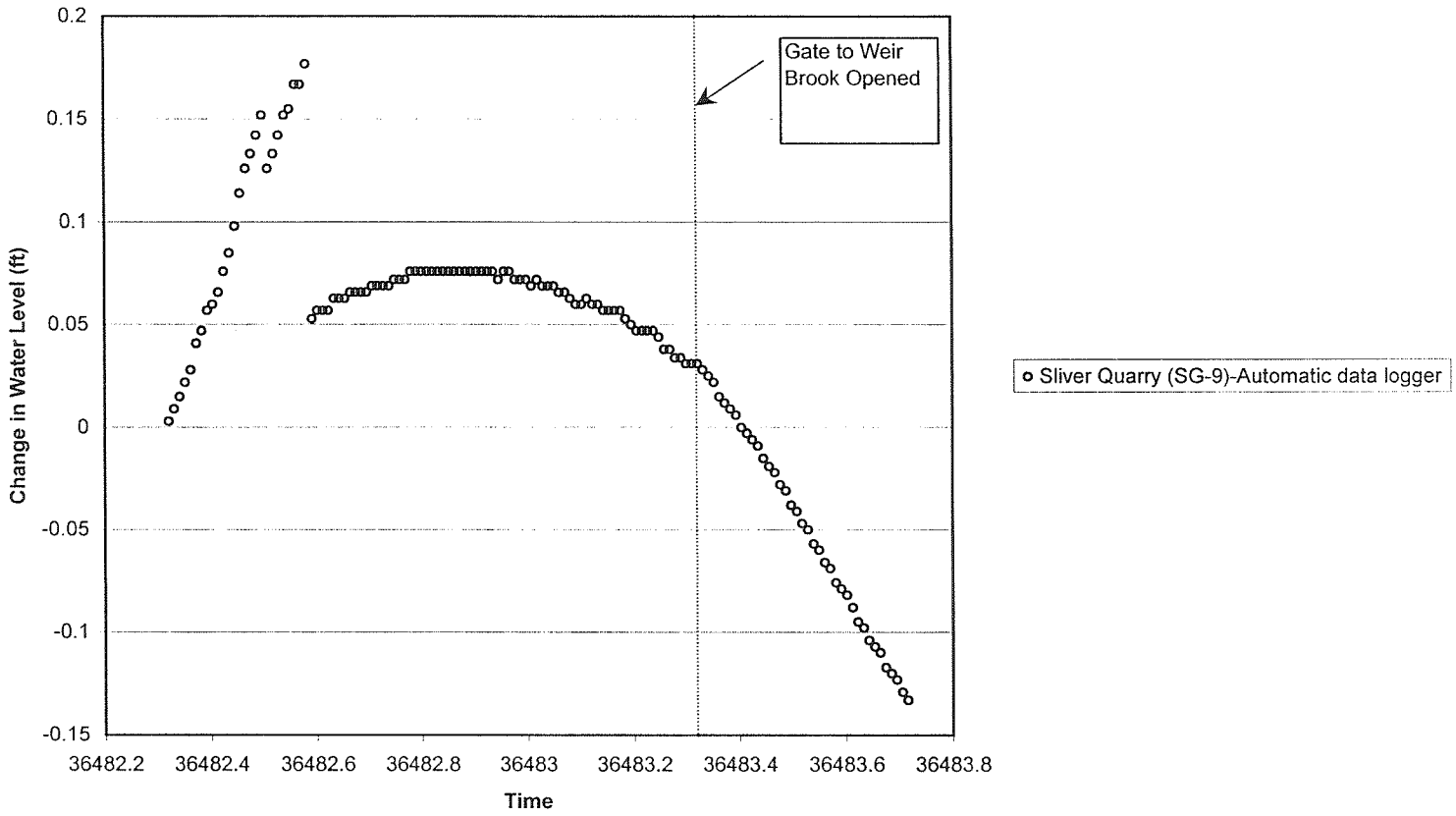


FIGURE 4

CHANGE IN WATER LEVEL
SLIVER QUARRY (FROM DATA LOGGER)

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

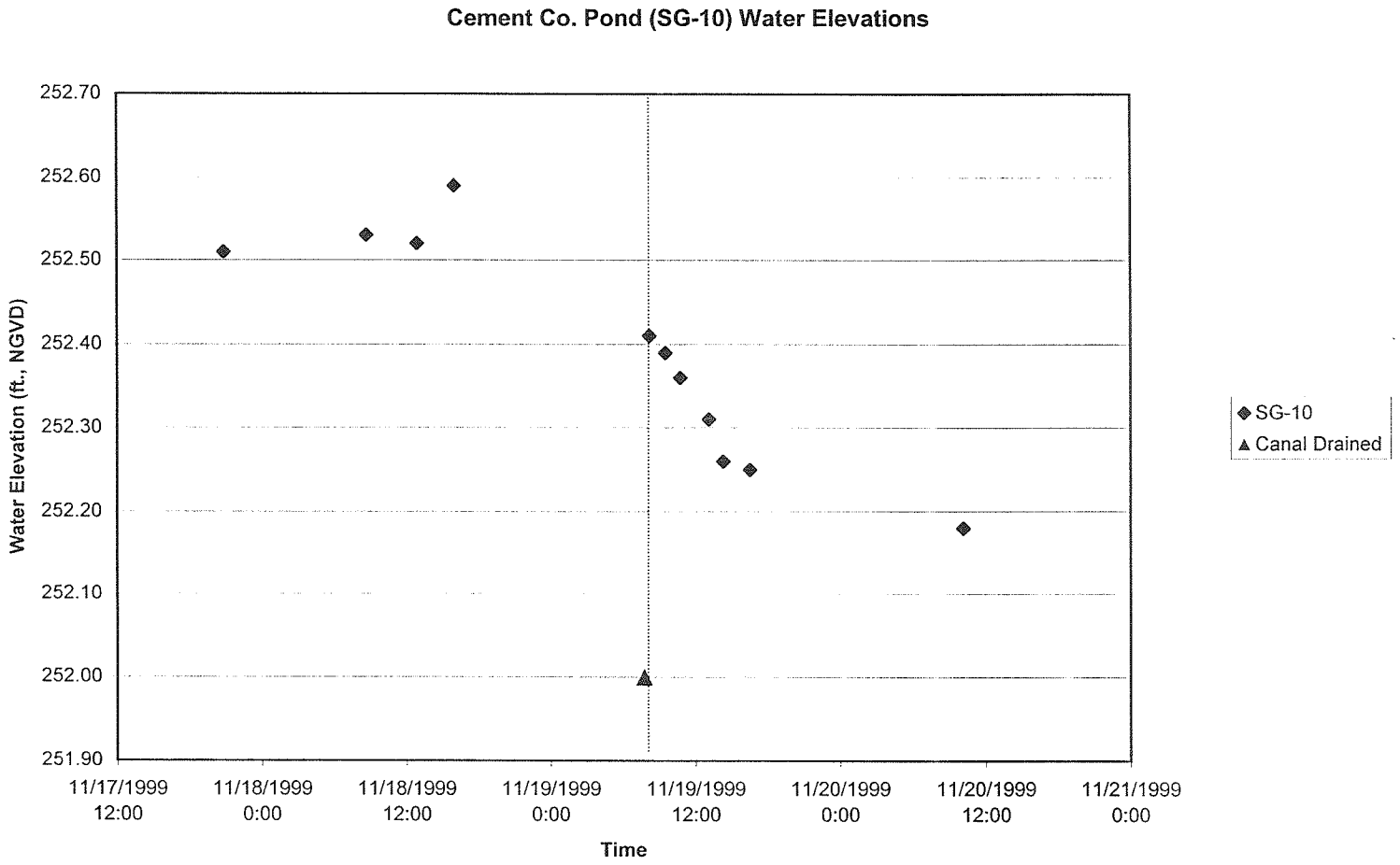


FIGURE 5

HYDROGRAPH
CEMENT COMPANY POND (SG-10)

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

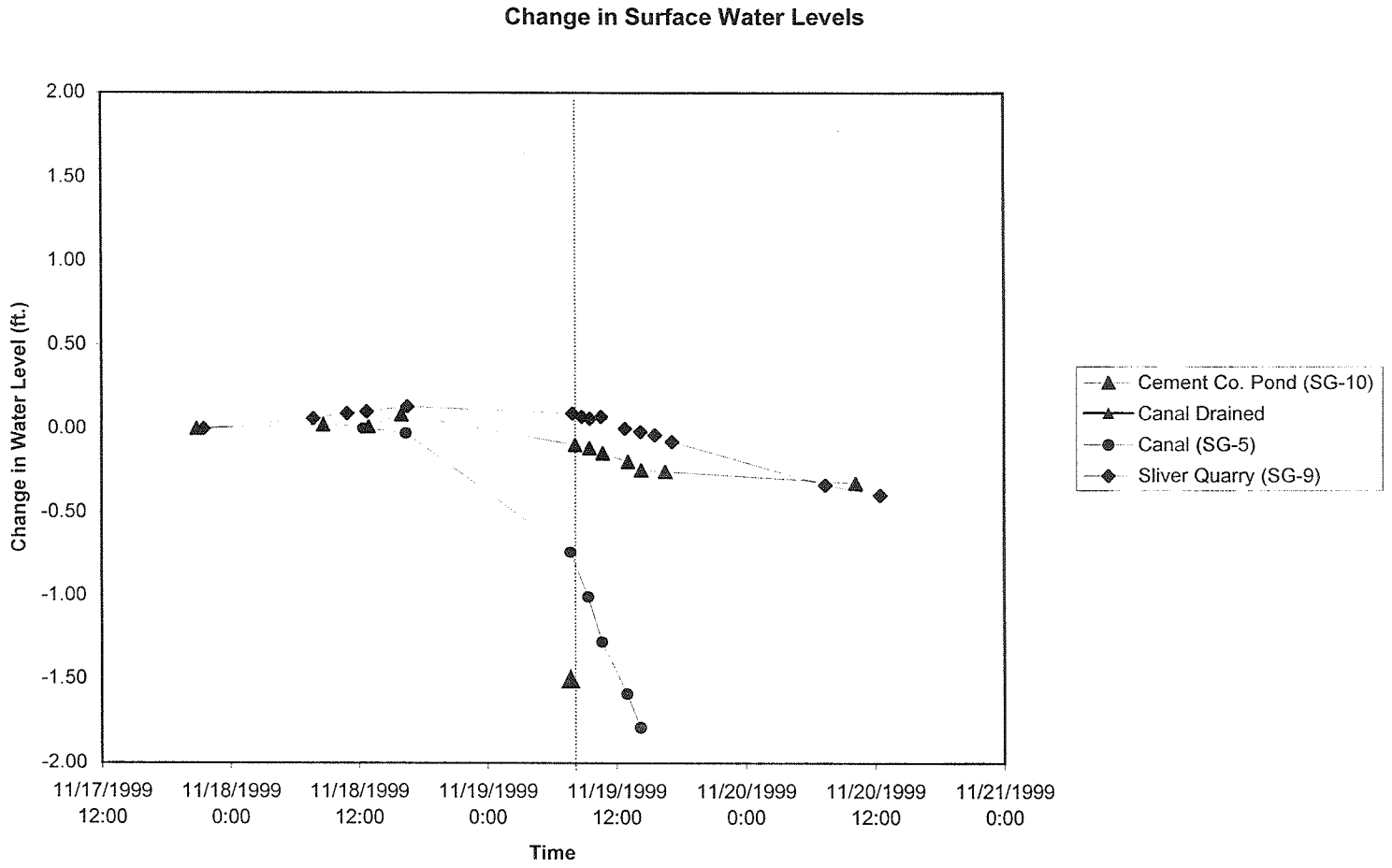


FIGURE 6

CHANGE IN WATER LEVELS SURFACE WATER STAFF GAUGES

HERCULES INCORPORATED

CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

18539.001

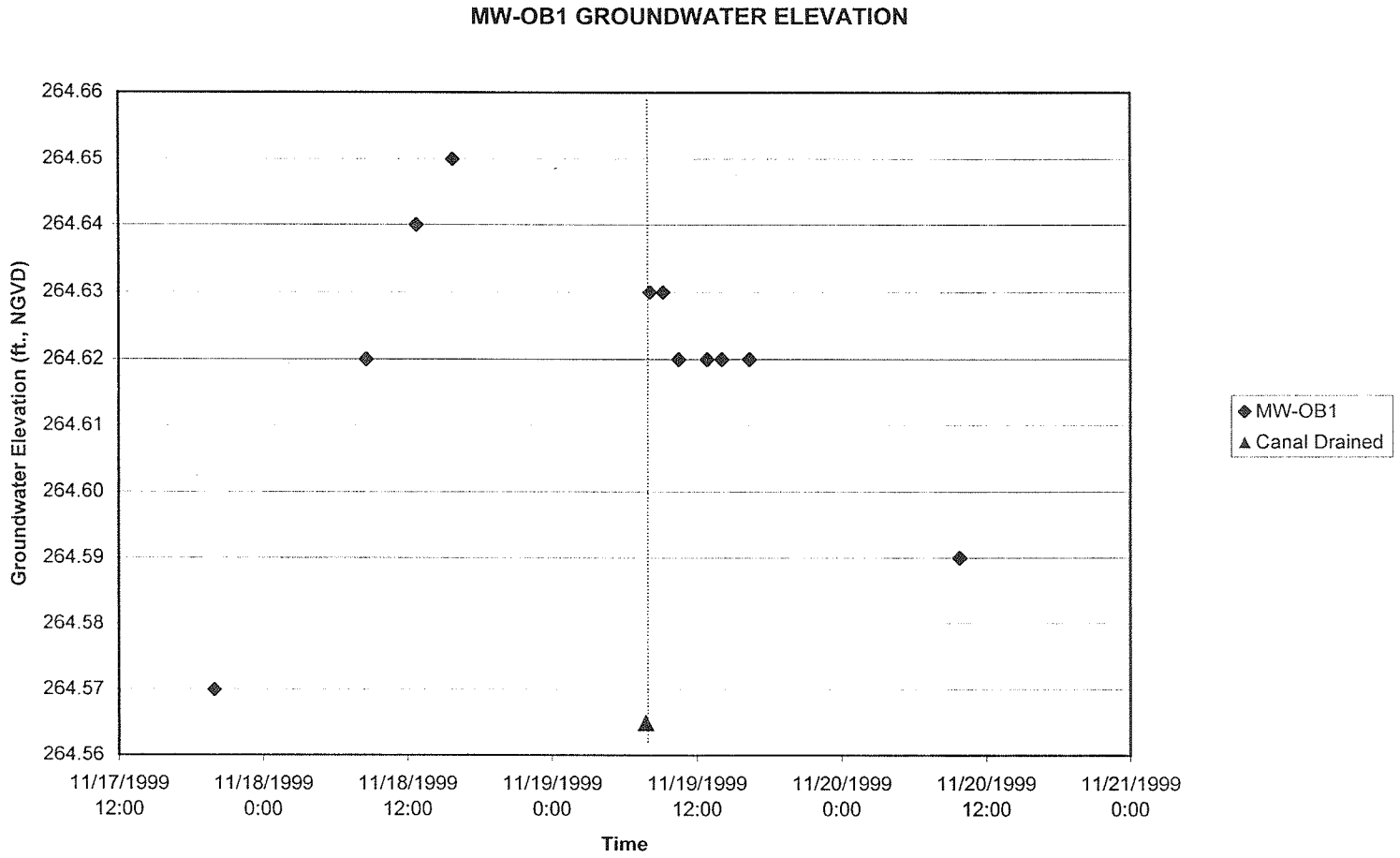


FIGURE 7

HYDROGRAPH
MW-OB1

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

18539.001

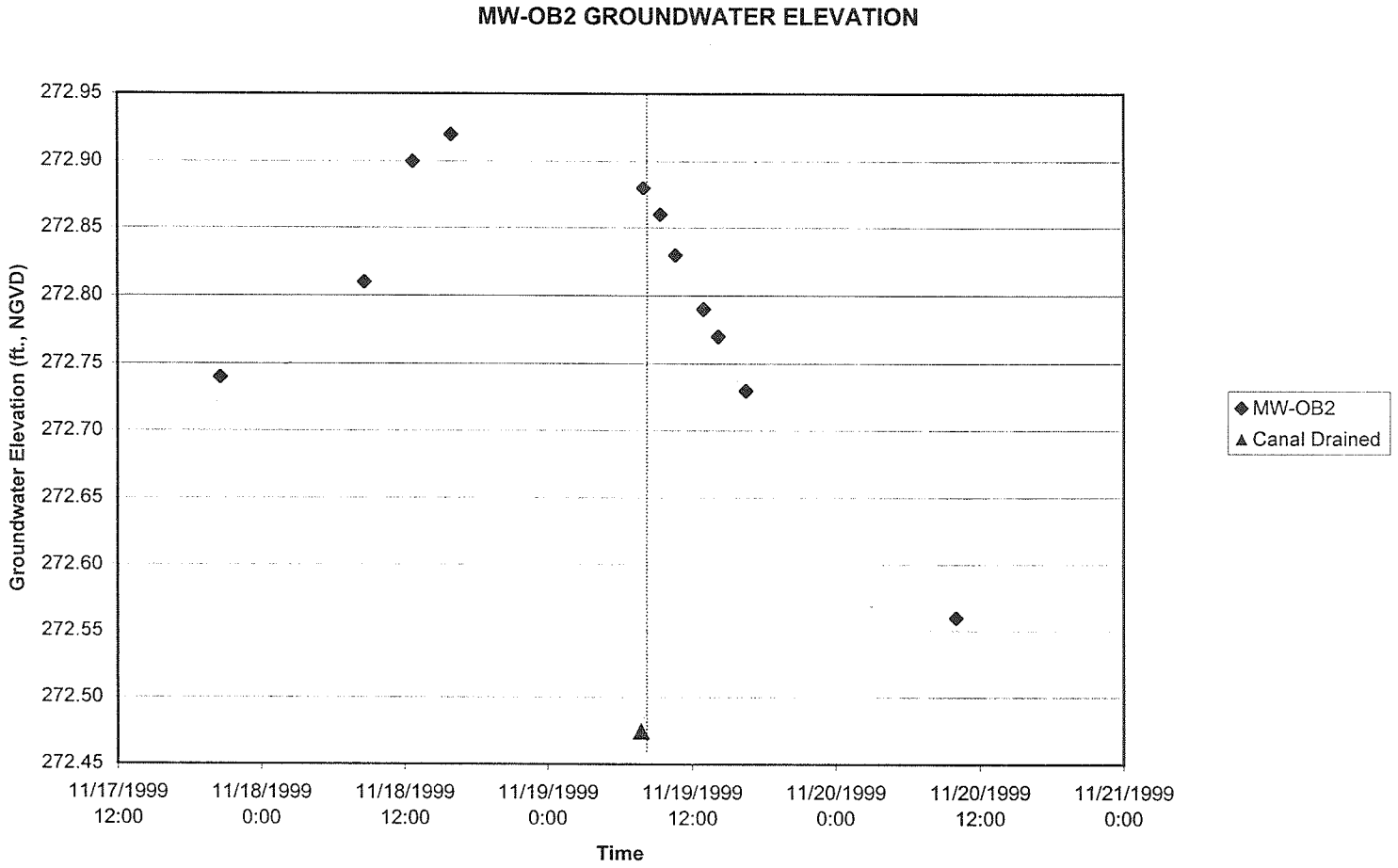


FIGURE 8

HYDROGRAPH MW-OB2

HERCULES INCORPORATED

CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

18539.001

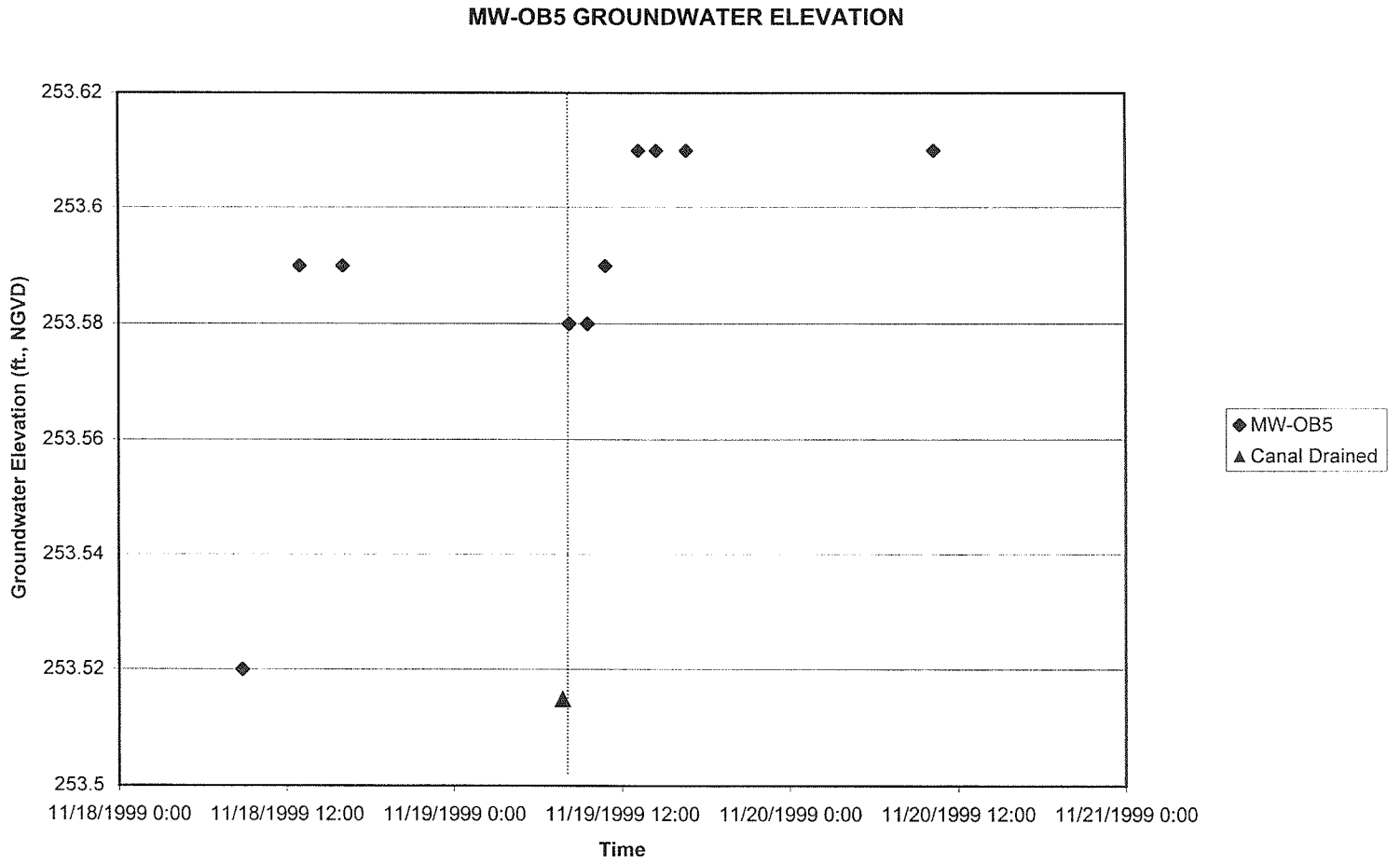


FIGURE 9

HYDROGRAPH
MW-OB5

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

18539.001

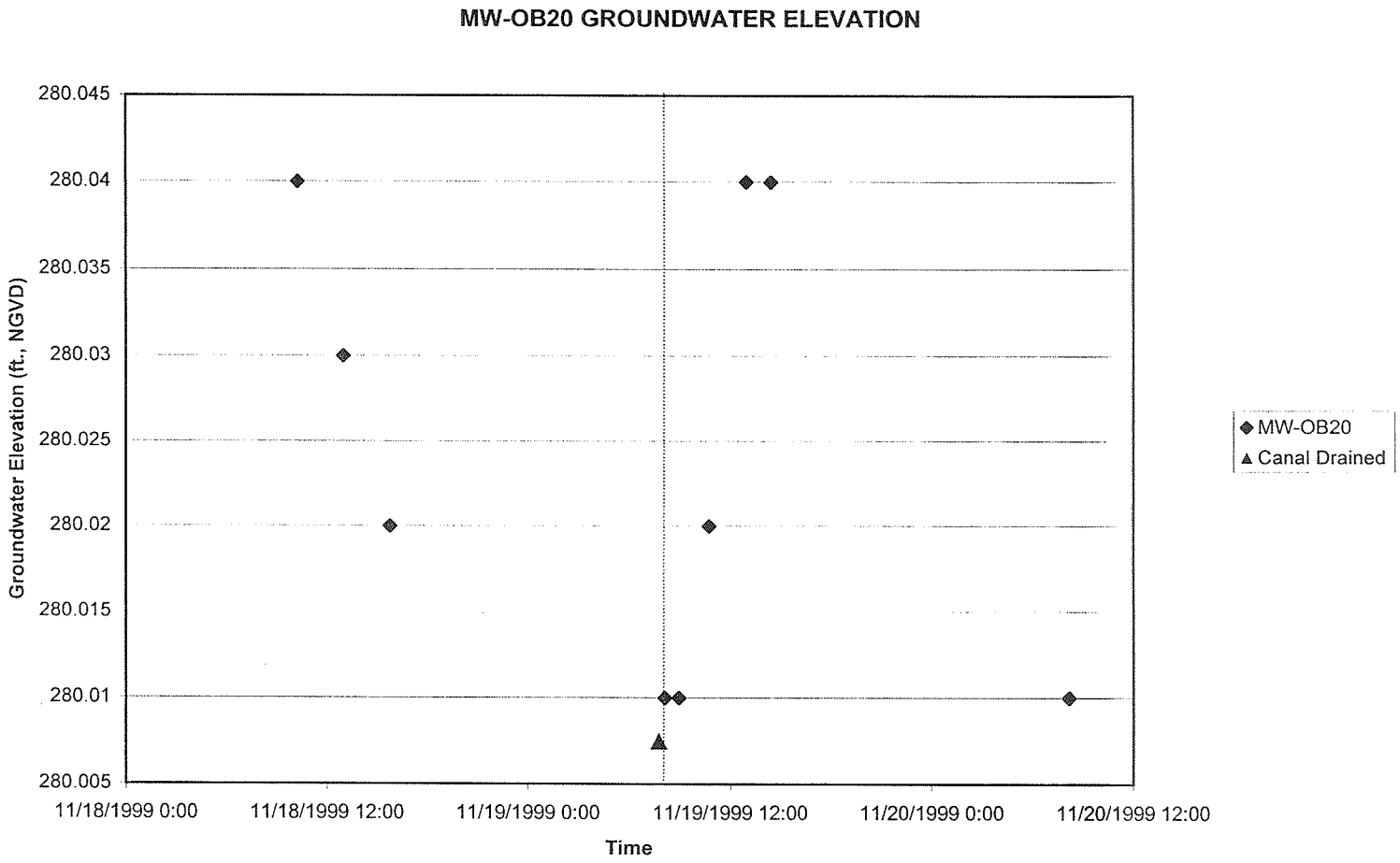


FIGURE 11

HYDROGRAPH
MW-OB20

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

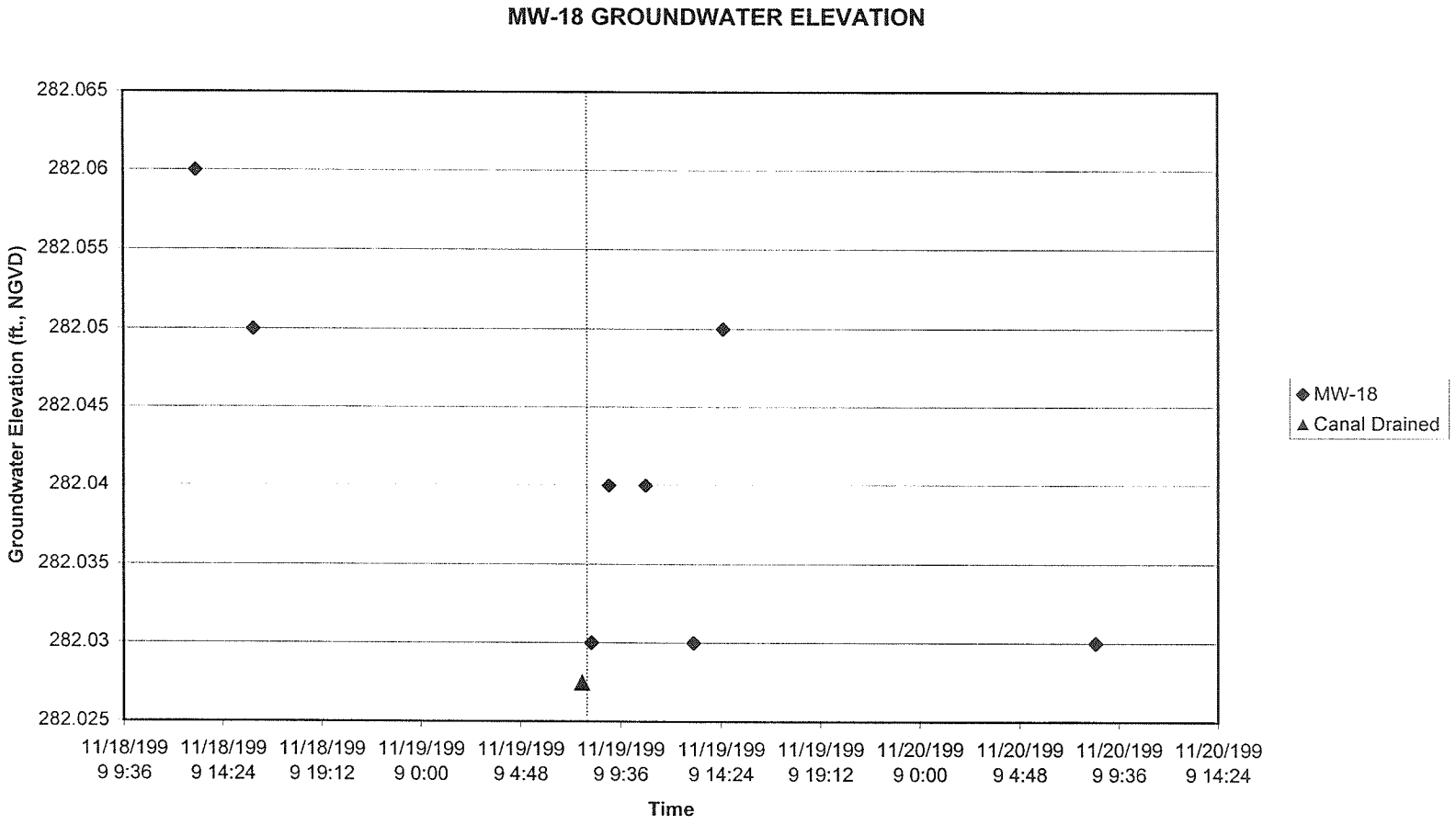


FIGURE 12

HYDROGRAPH
MW-18

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

18539.001

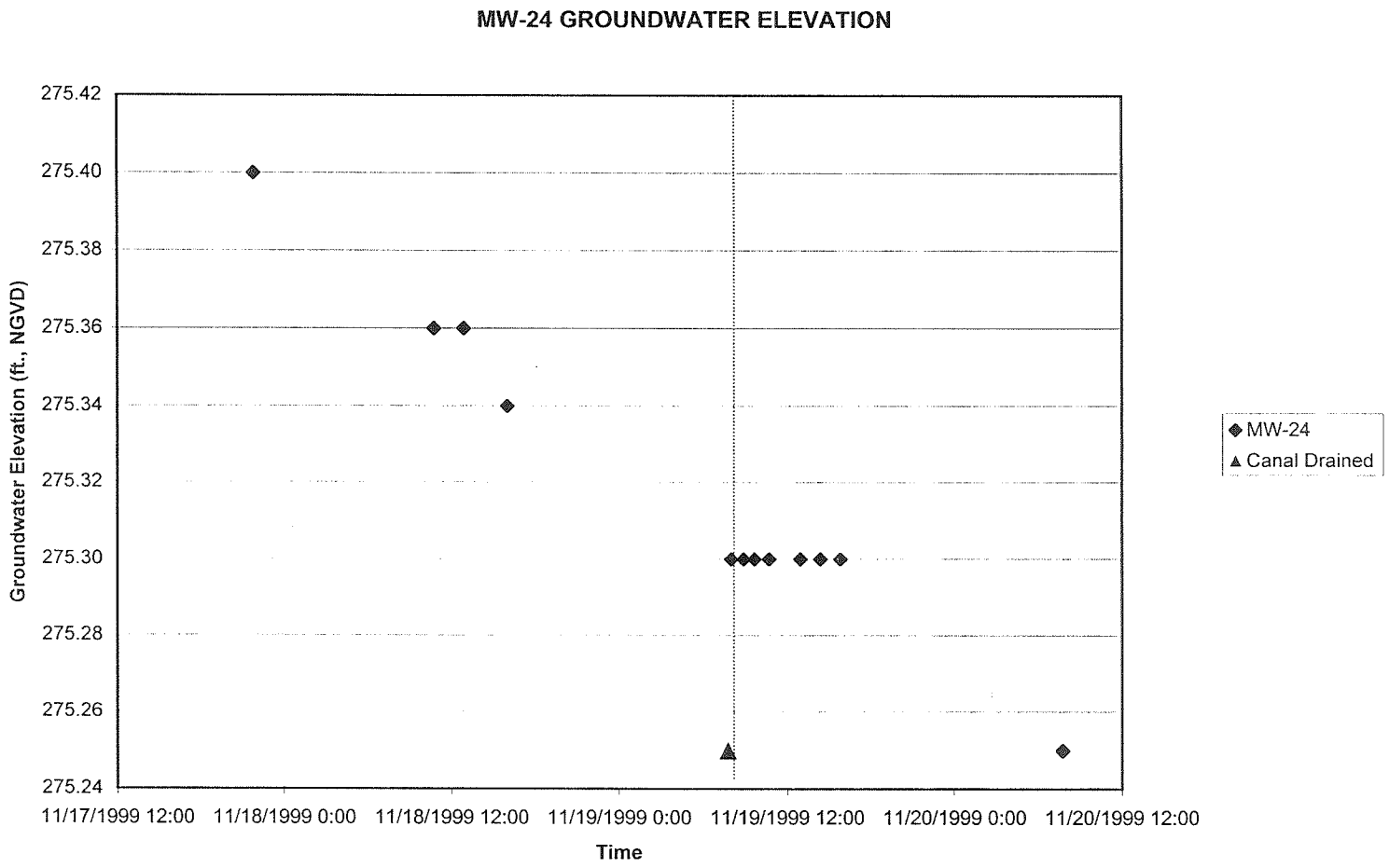


FIGURE 13

HYDROGRAPH
MW-24

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

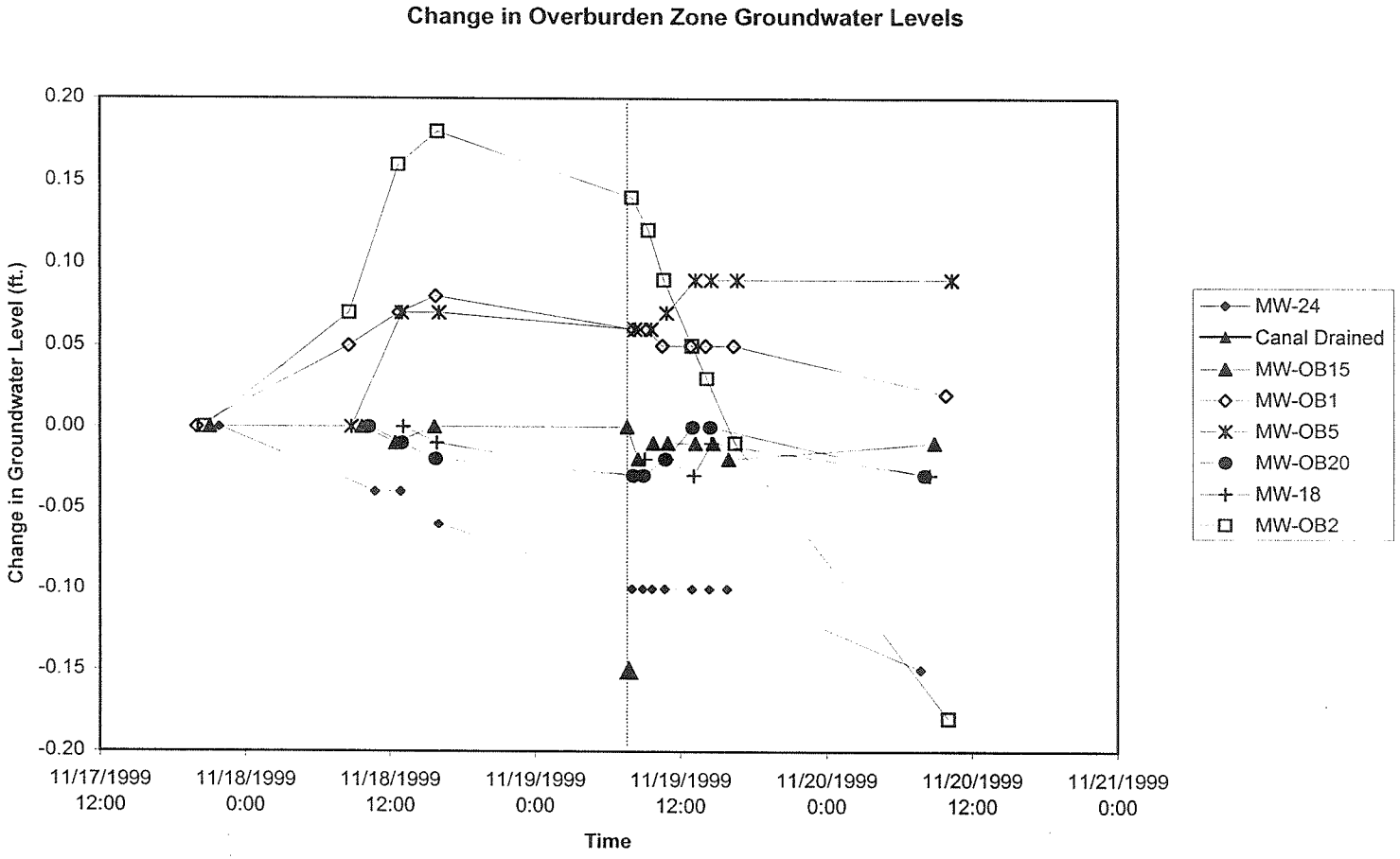


FIGURE 14

CHANGE IN WATER LEVELS OVERBURDEN WELLS

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

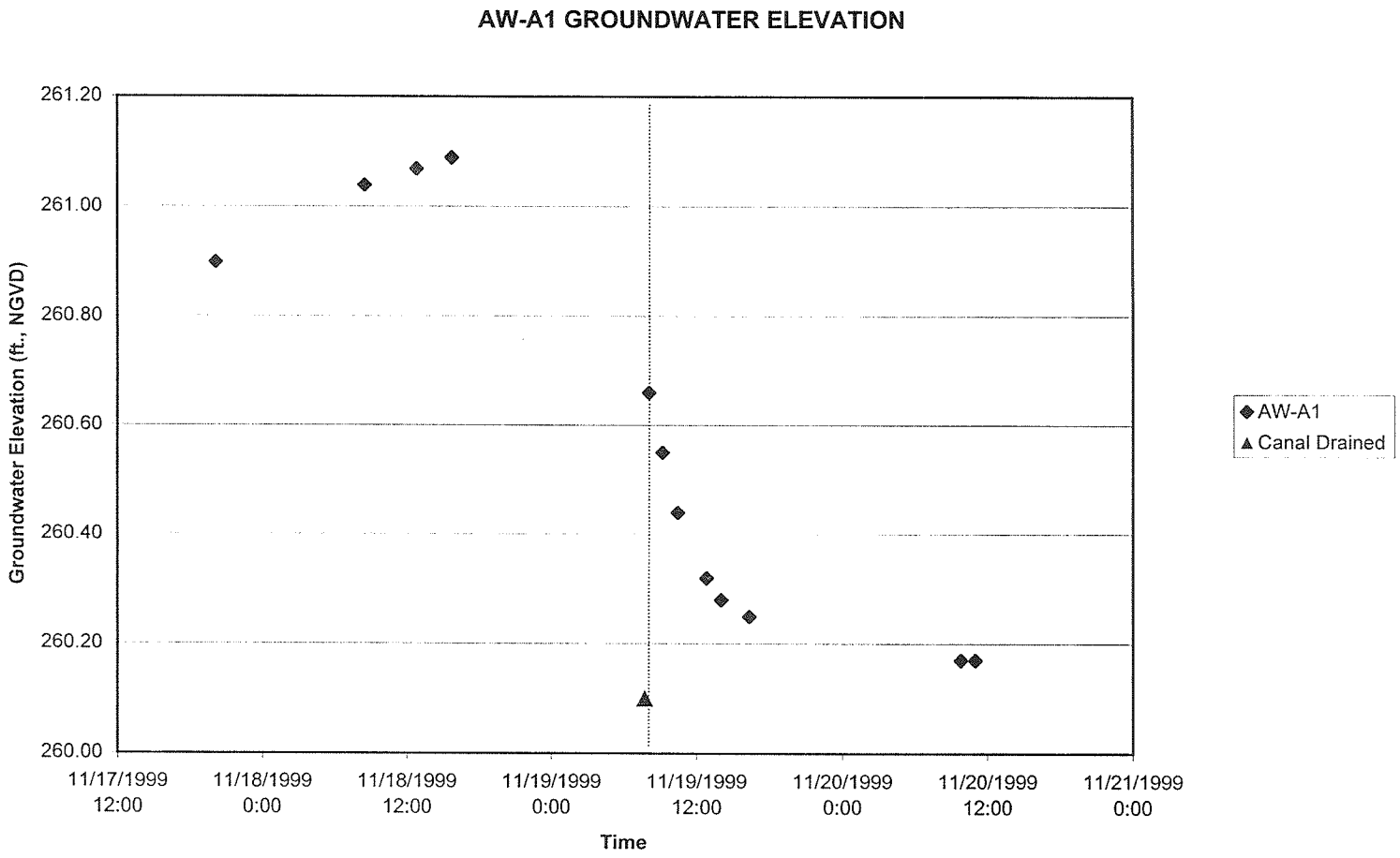


FIGURE 15

HYDROGRAPH
AW-A1

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

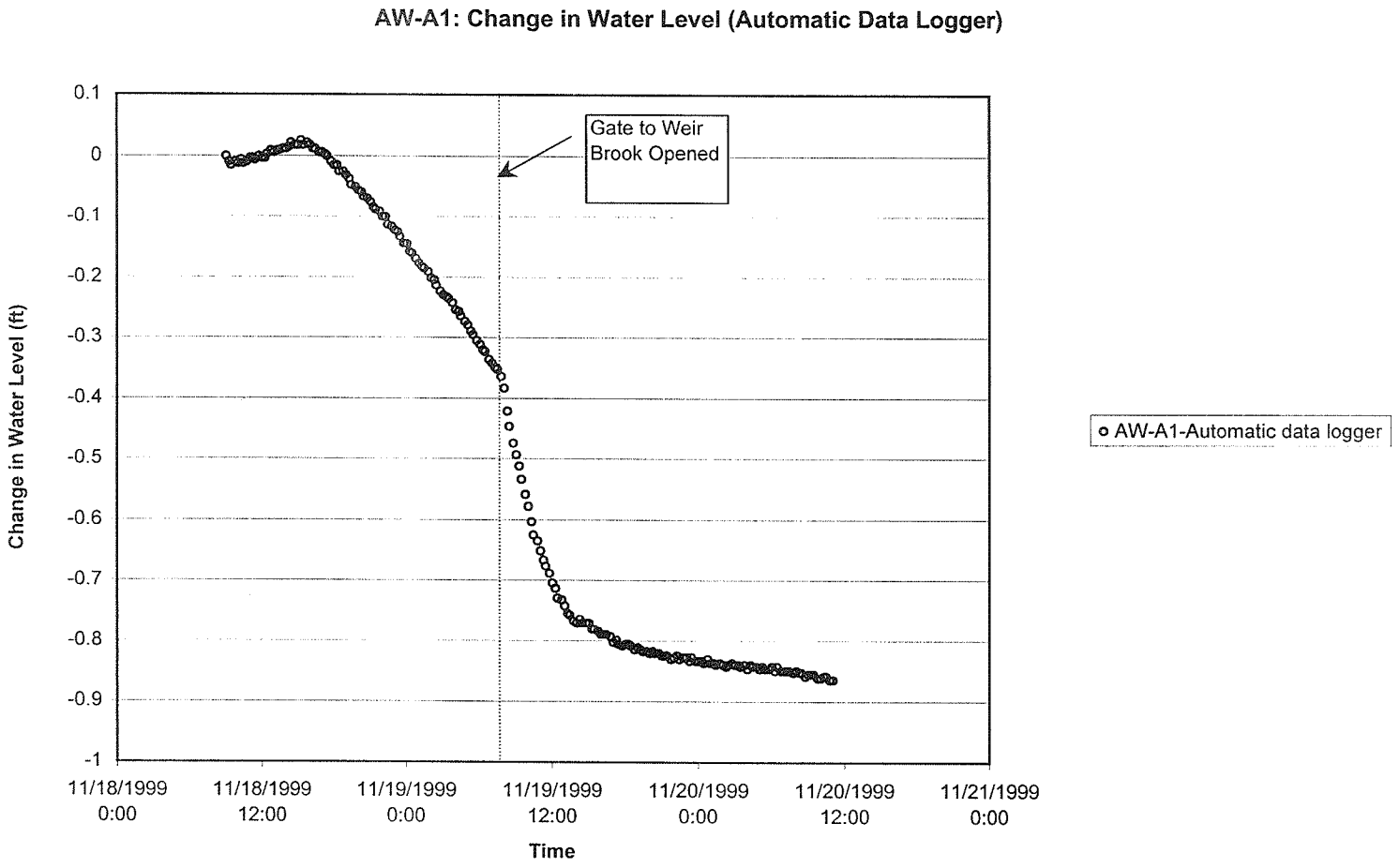


FIGURE 16

CHANGE IN WATER LEVEL AW-A1 (FROM DATA LOGGER)

HERCULES INCORPORATED

CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

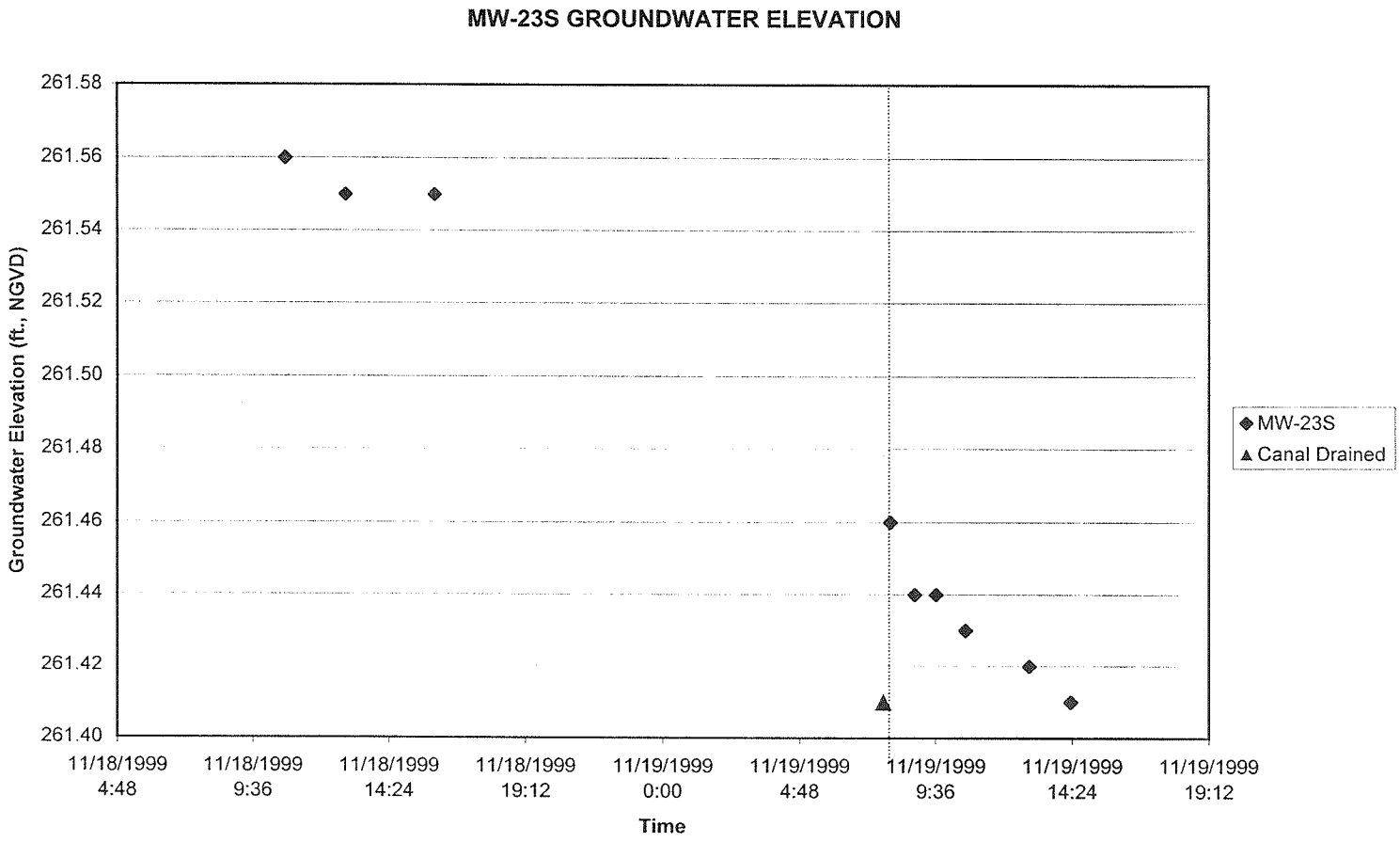


FIGURE 17

HYDROGRAPH
MW-23S

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

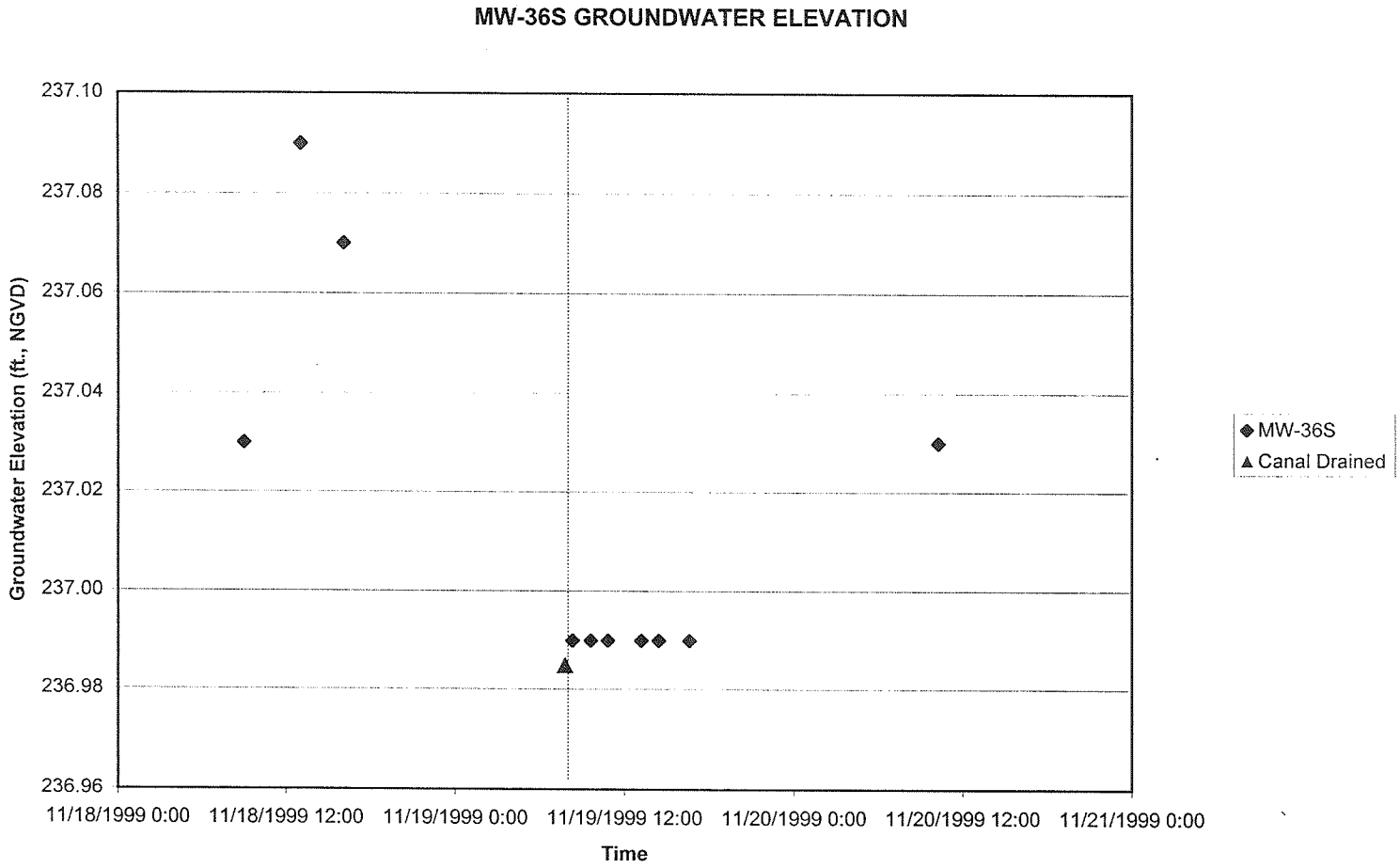


FIGURE 18

HYDROGRAPH
MW-36S

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

18539.001

P-A1 GROUNDWATER ELEVATION

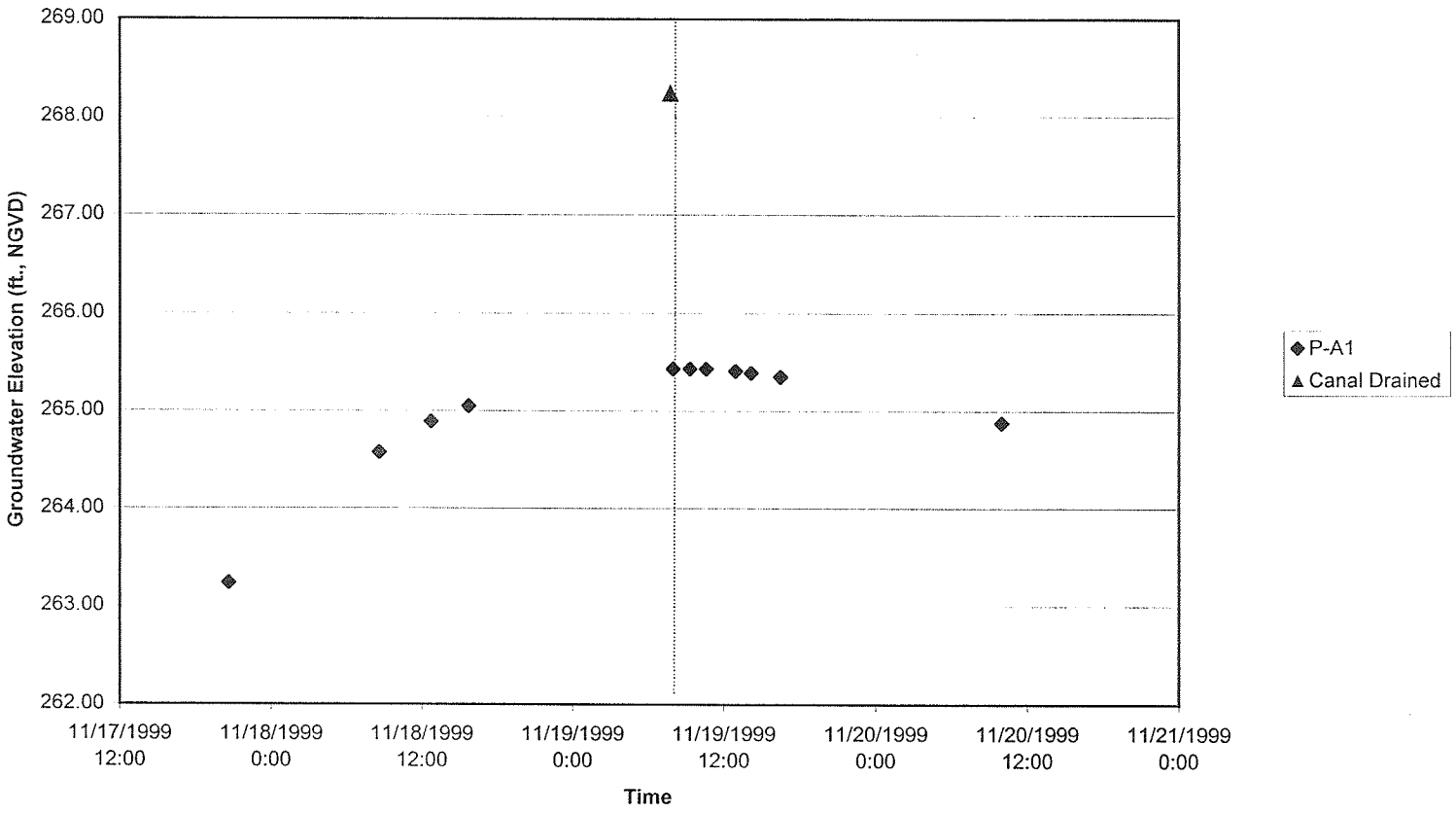


FIGURE 19

HYDROGRAPH
P-A1

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

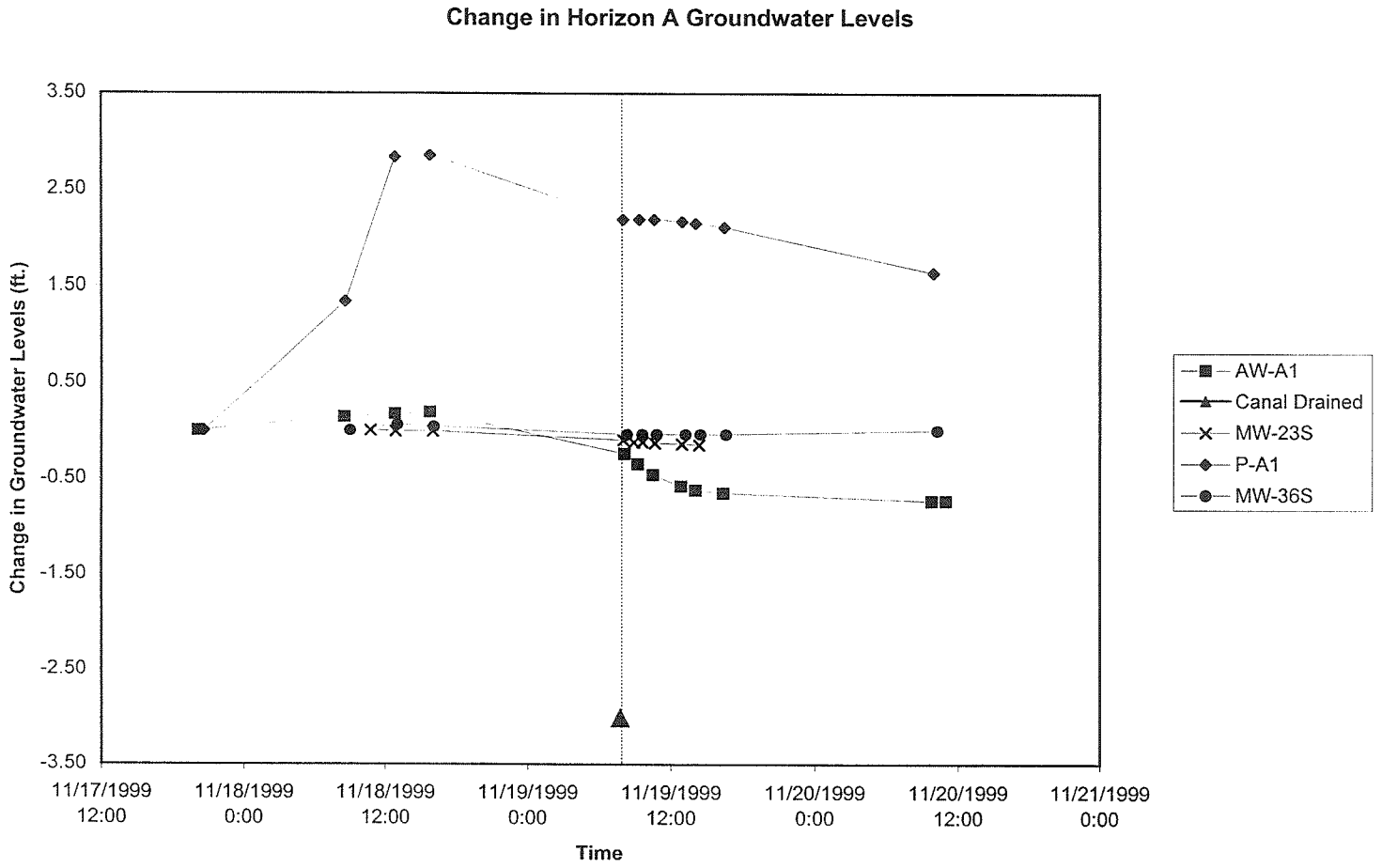


FIGURE 20

WATER LEVEL CHANGE HORIZON A WELLS

HERCULES INCORPORATED

CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

18539.001

MW-10B GROUNDWATER ELEVATION

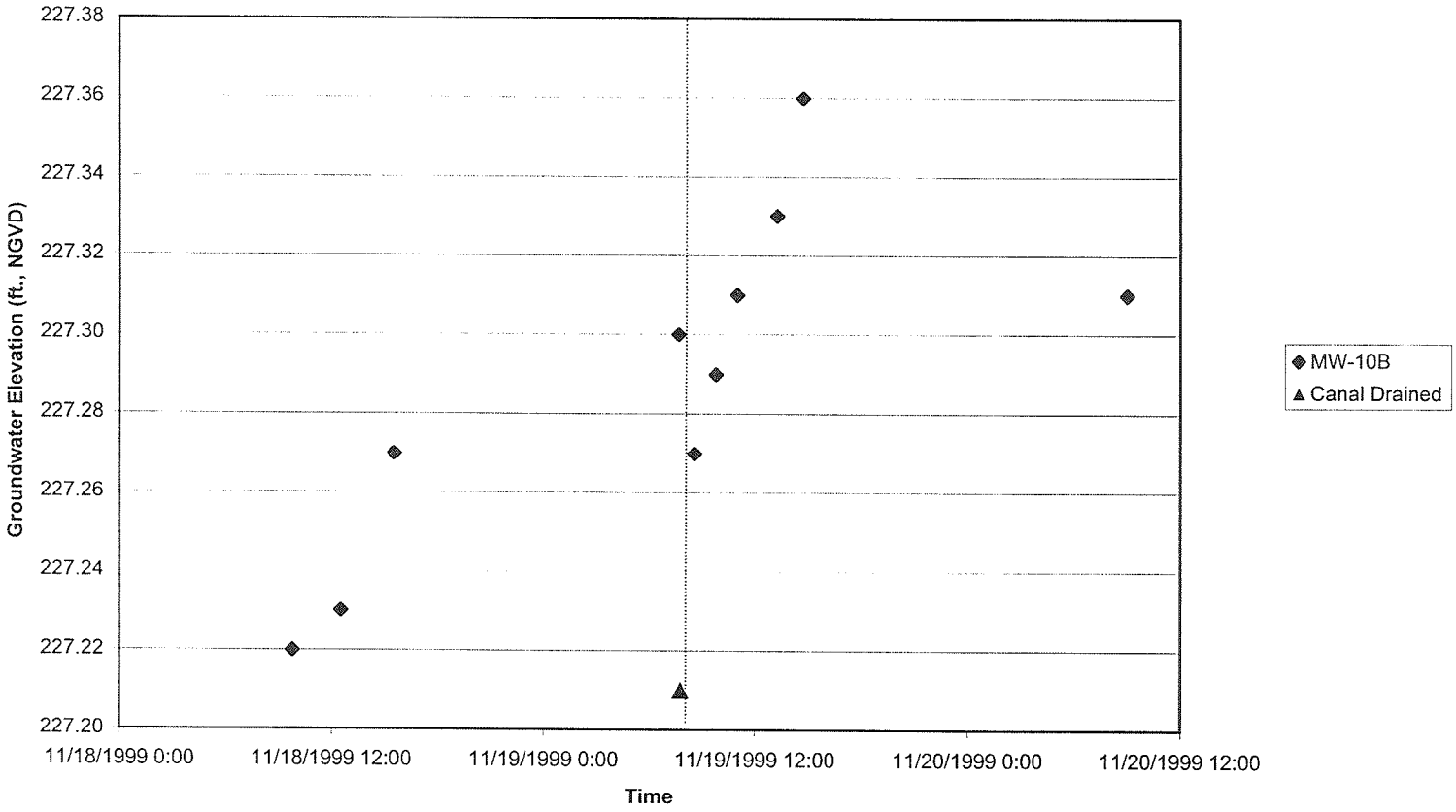


FIGURE 21

HYDROGRAPH
MW-10B

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

18539.001

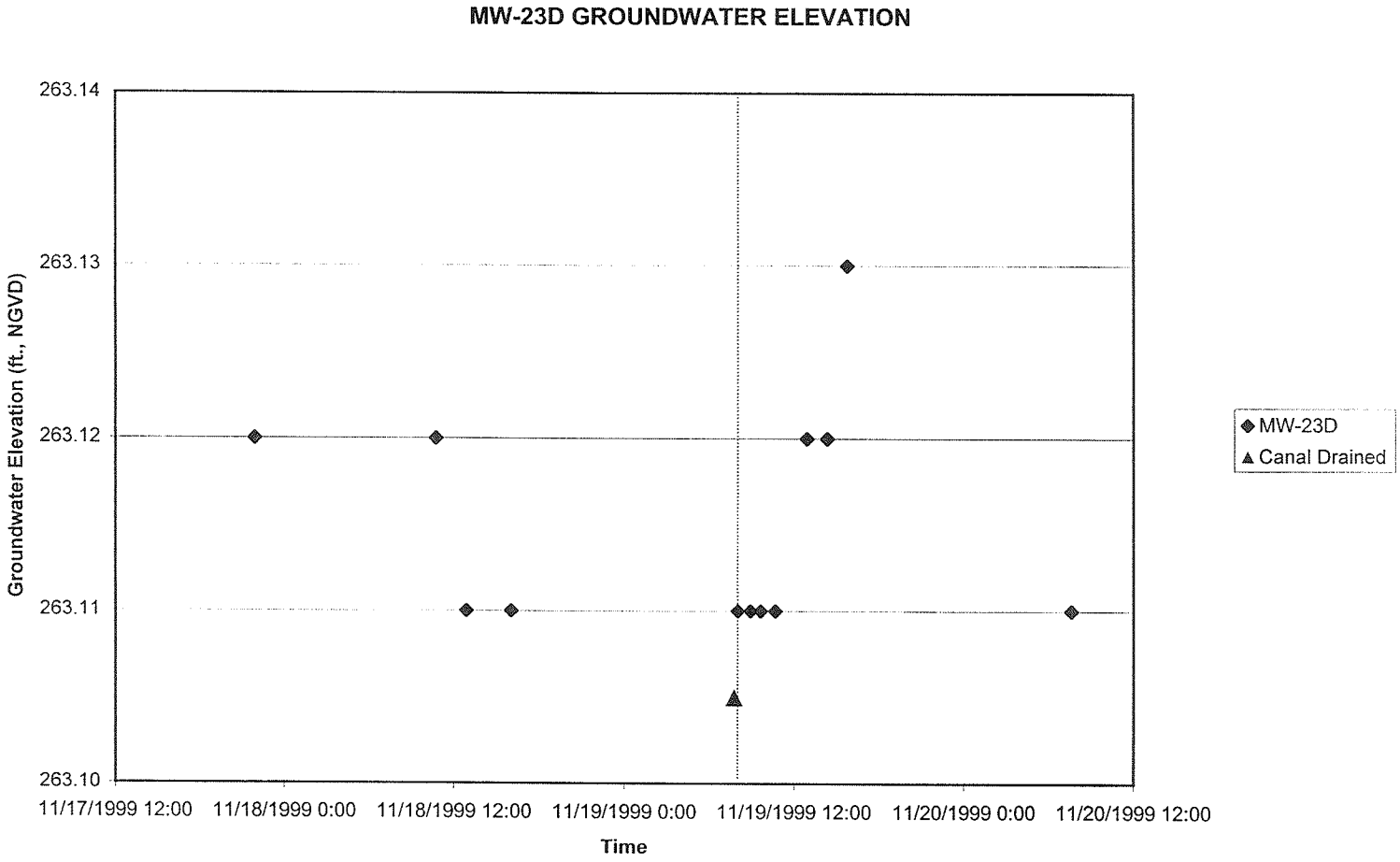


FIGURE 22

HYDROGRAPH
MW-23D

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

18539.001

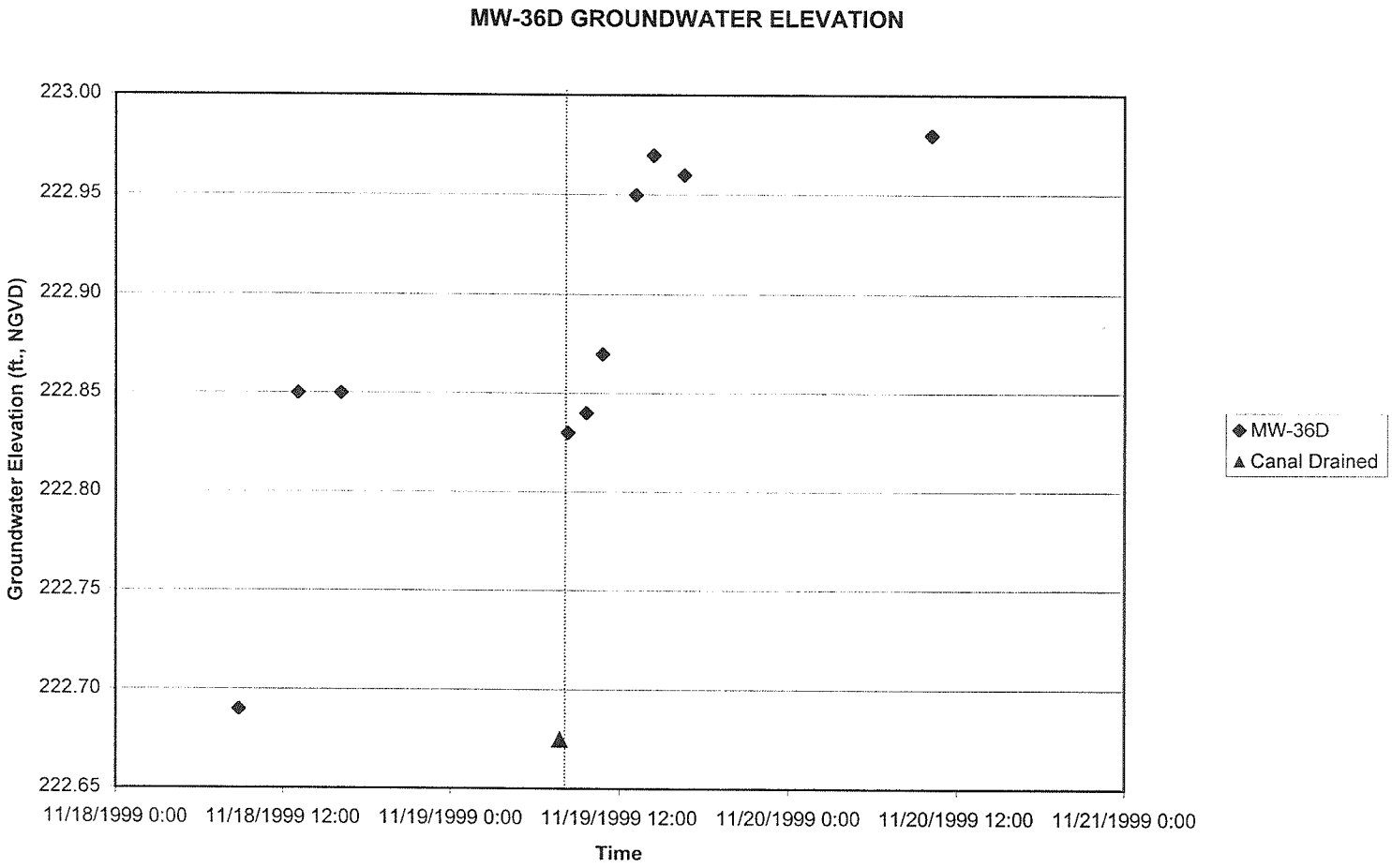


FIGURE 23

HYDROGRAPH
MW-36D

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

18539.001

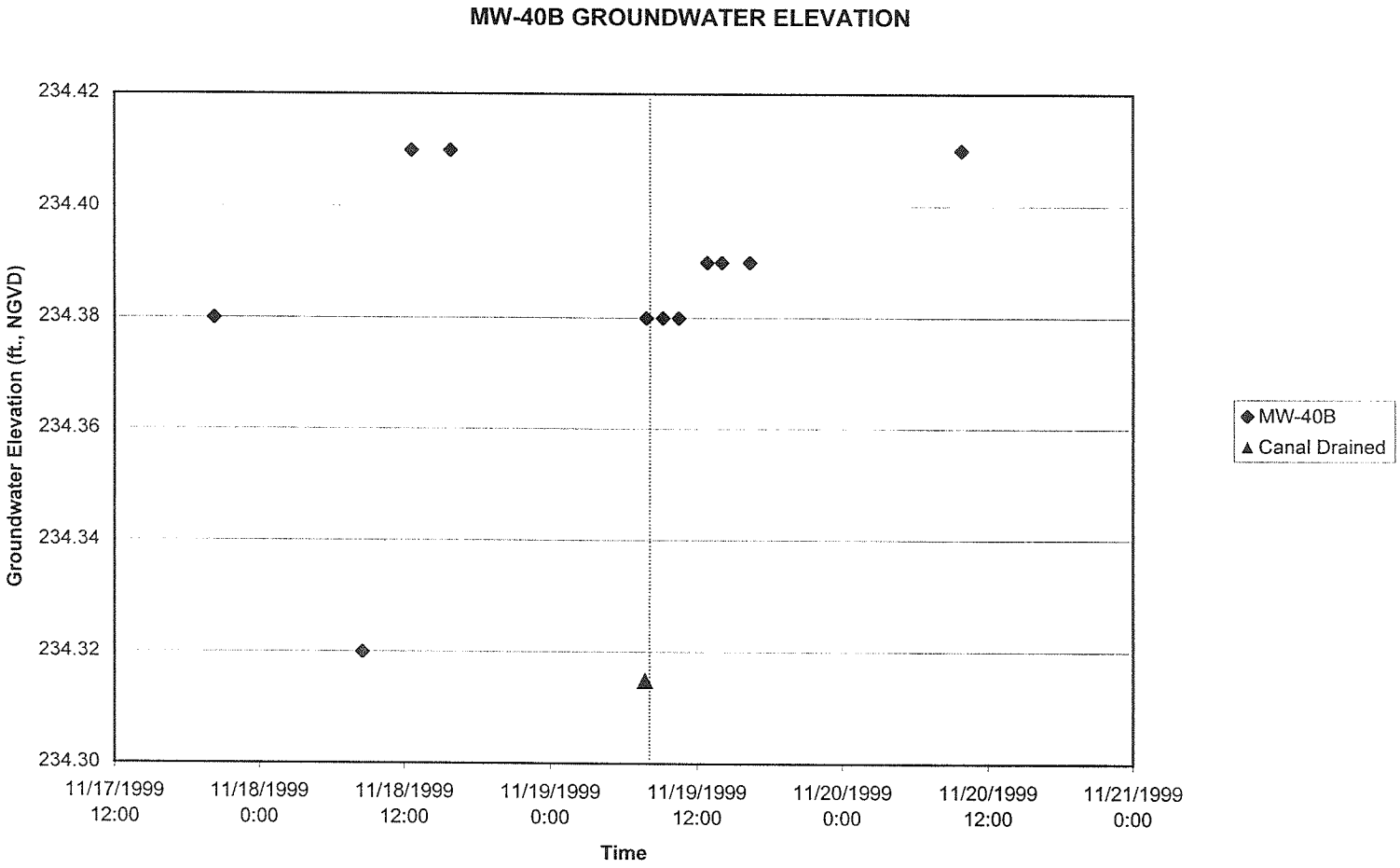


FIGURE 24

HYDROGRAPH
MW-40B

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

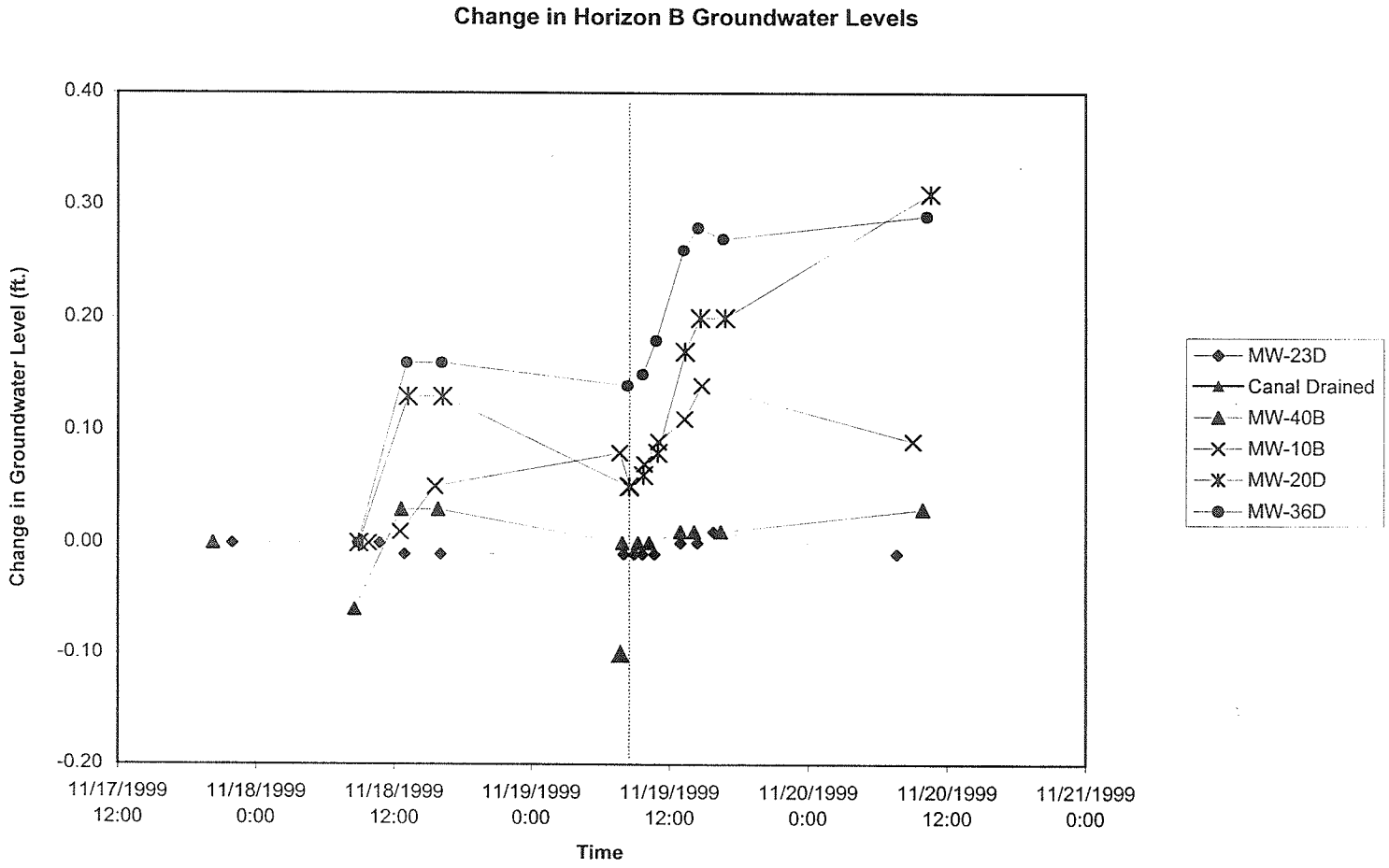


FIGURE 25

CHANGE IN WATER LEVELS
HORIZON B WELLS

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

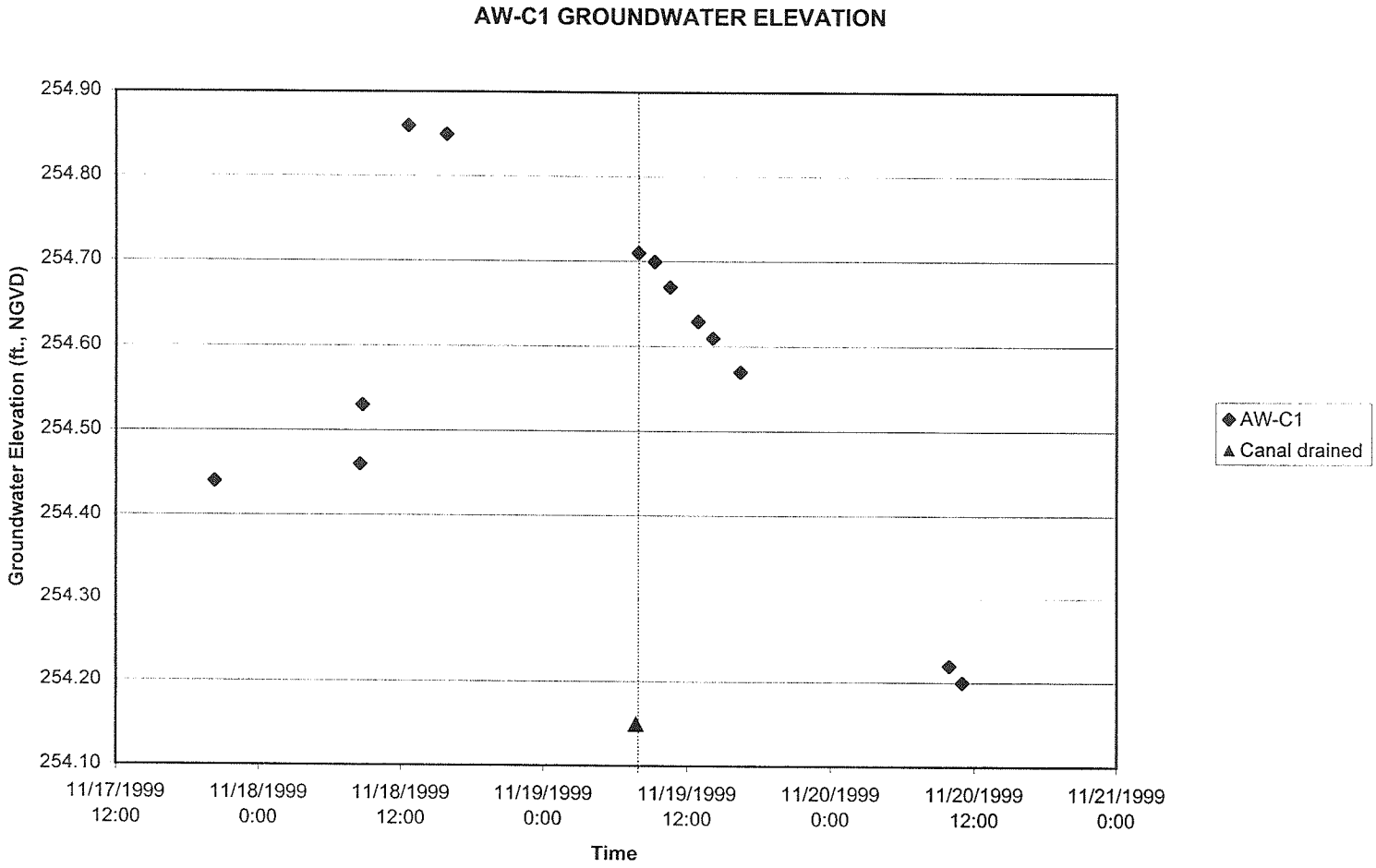


FIGURE 26

HYDROGRAPH
AW-C1

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

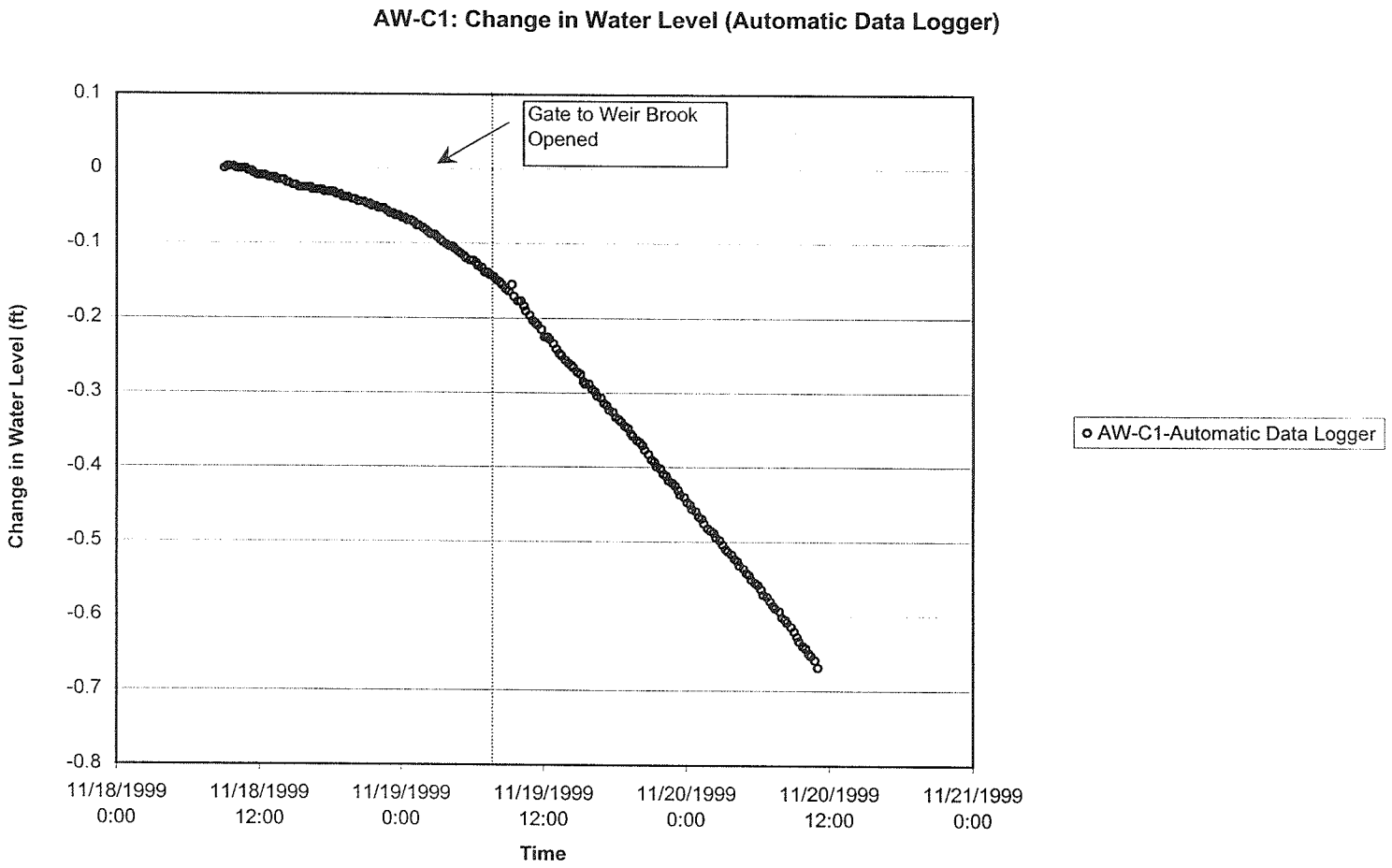


FIGURE 27

CHANGE IN WATER LEVEL AW-C1 (FROM DATA LOGGER)

HERCULES INCORPORATED

CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

18539.001

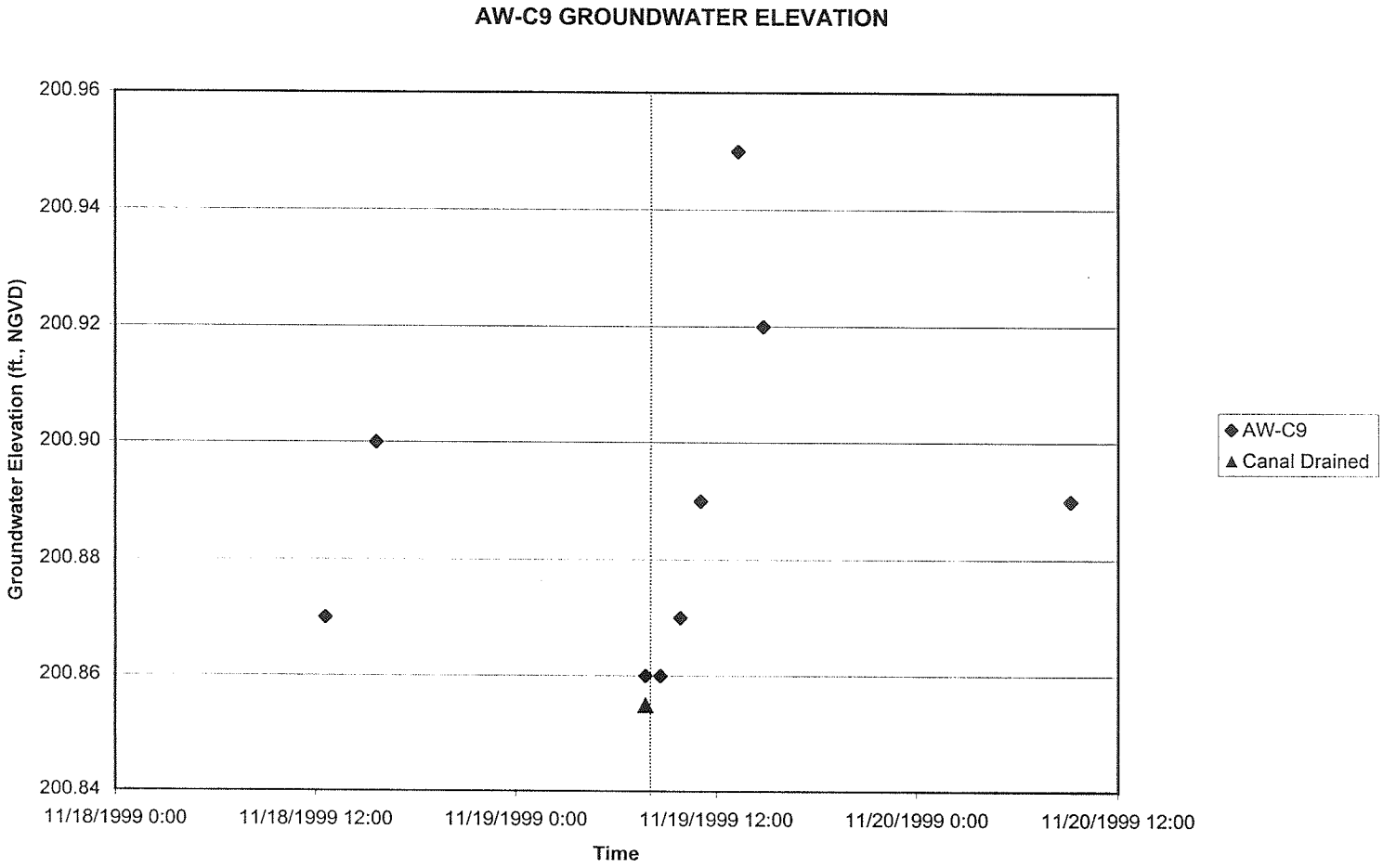


FIGURE 28

HYDROGRAPH
AW-C9

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

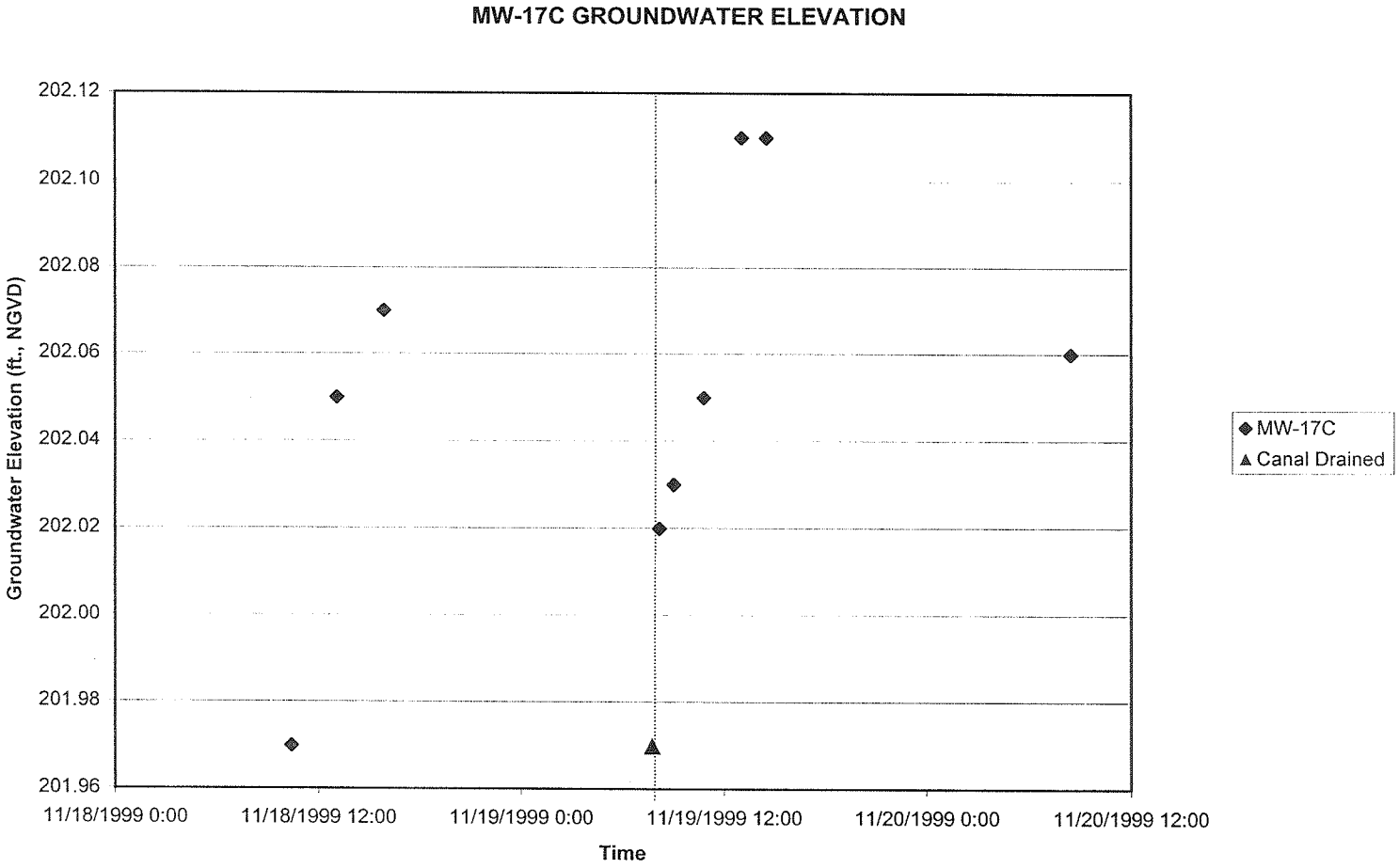


FIGURE 30

HYDROGRAPH
MW-17C

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

18539.001

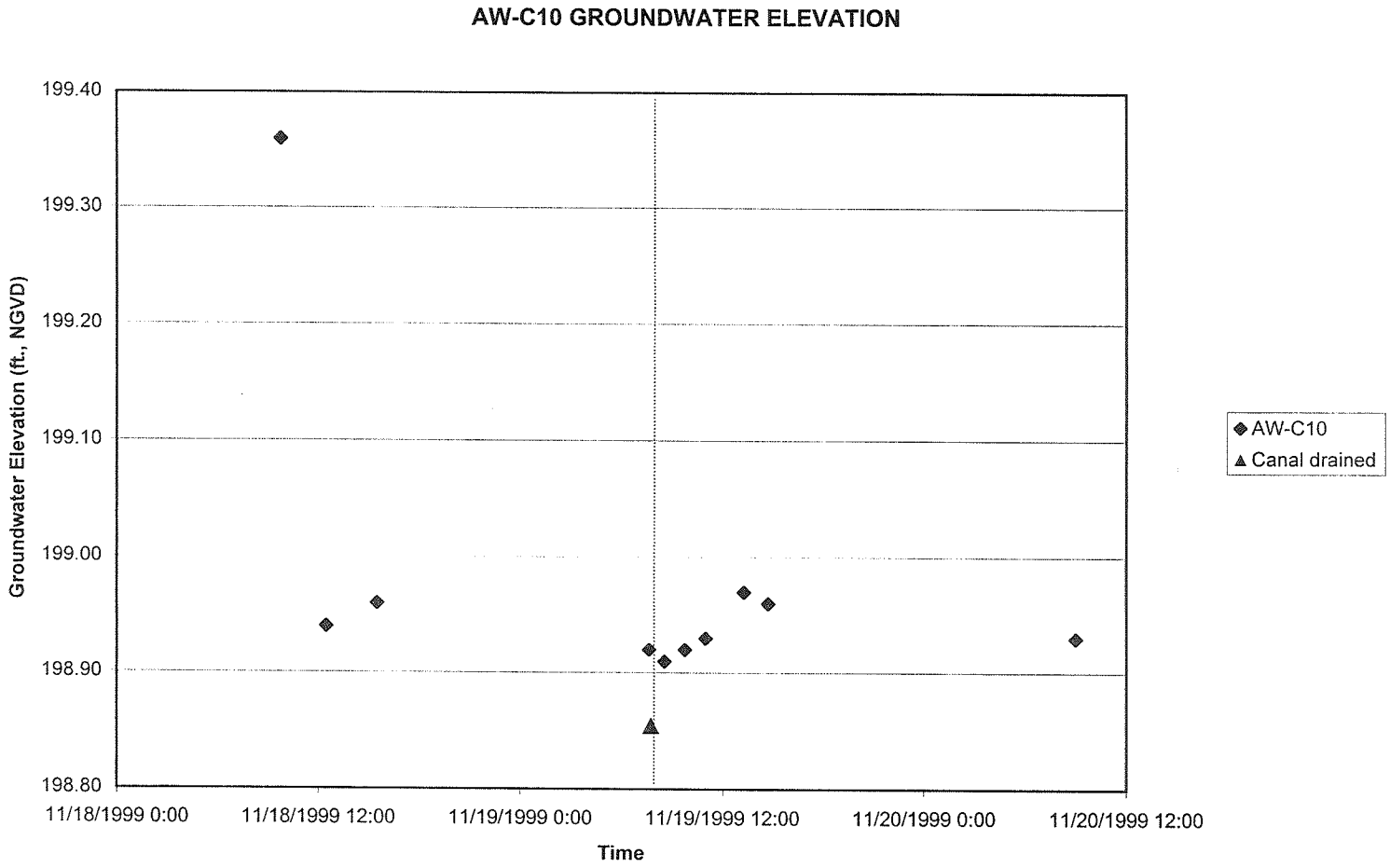


FIGURE 29

HYDROGRAPH
AW-C10

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

MW-20C GROUNDWATER ELEVATION

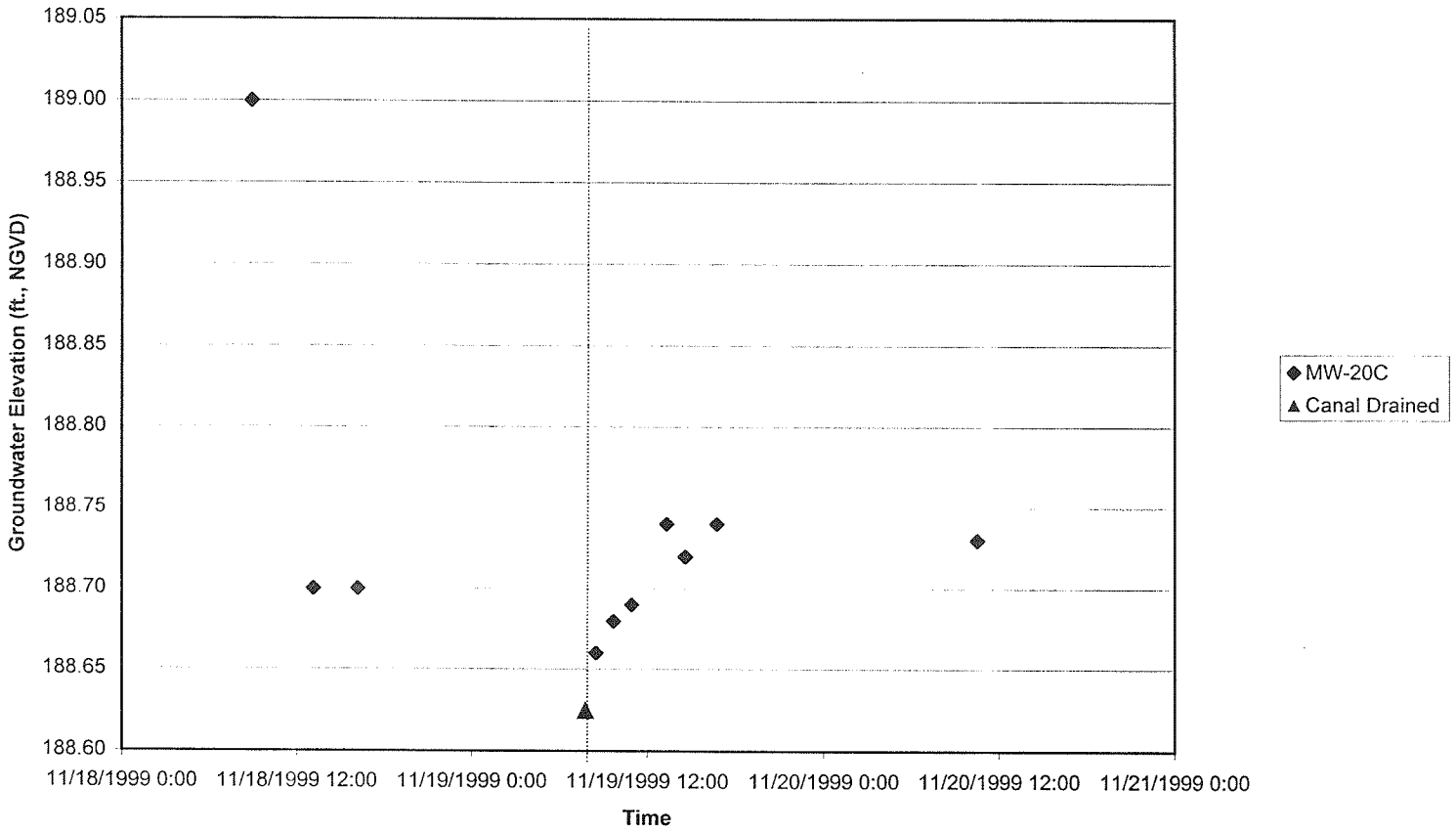


FIGURE 31

HYDROGRAPH
MW-20C

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

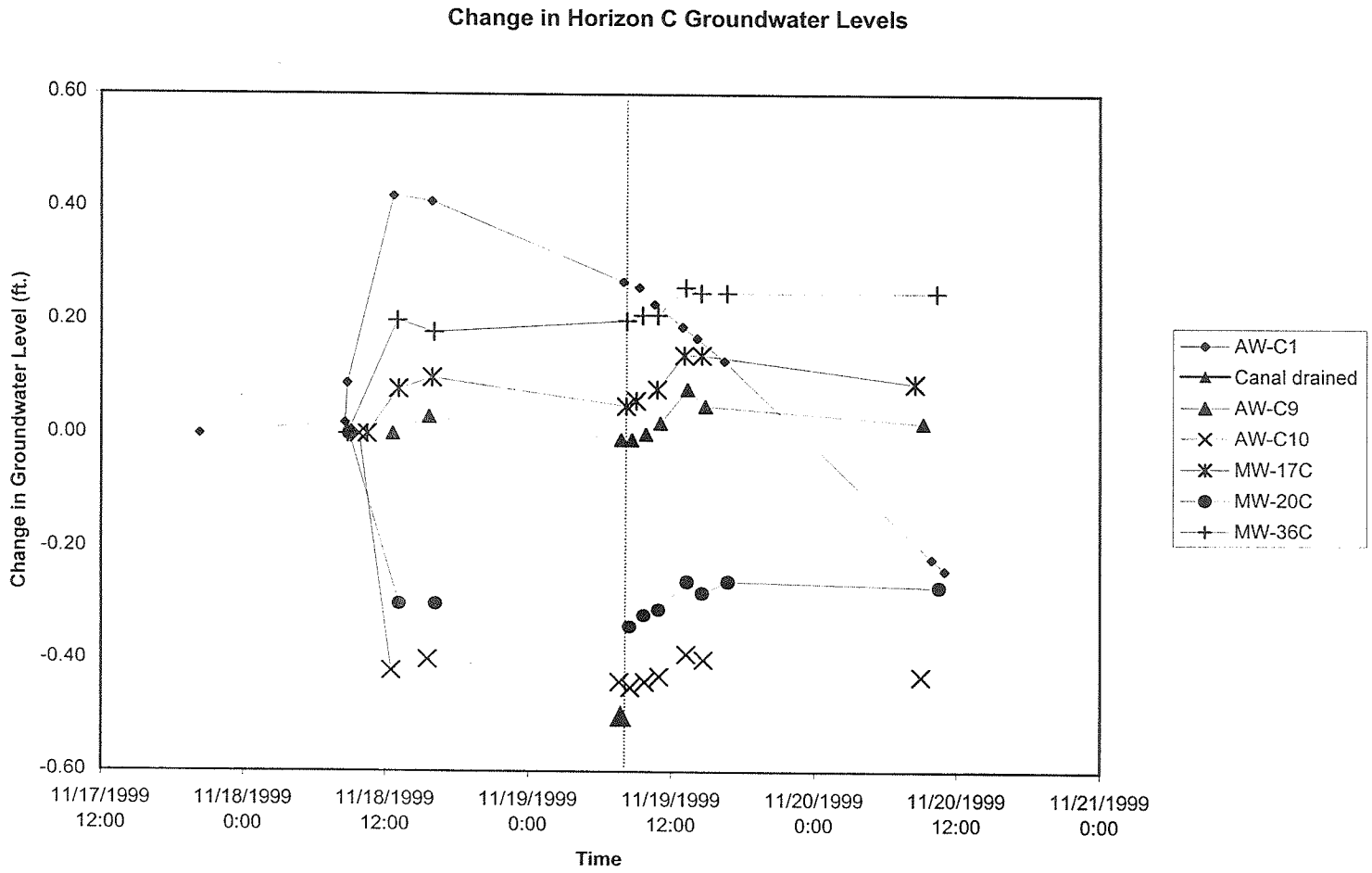


FIGURE 33

CHANGE IN WATER LEVELS HORIZON C WELLS

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

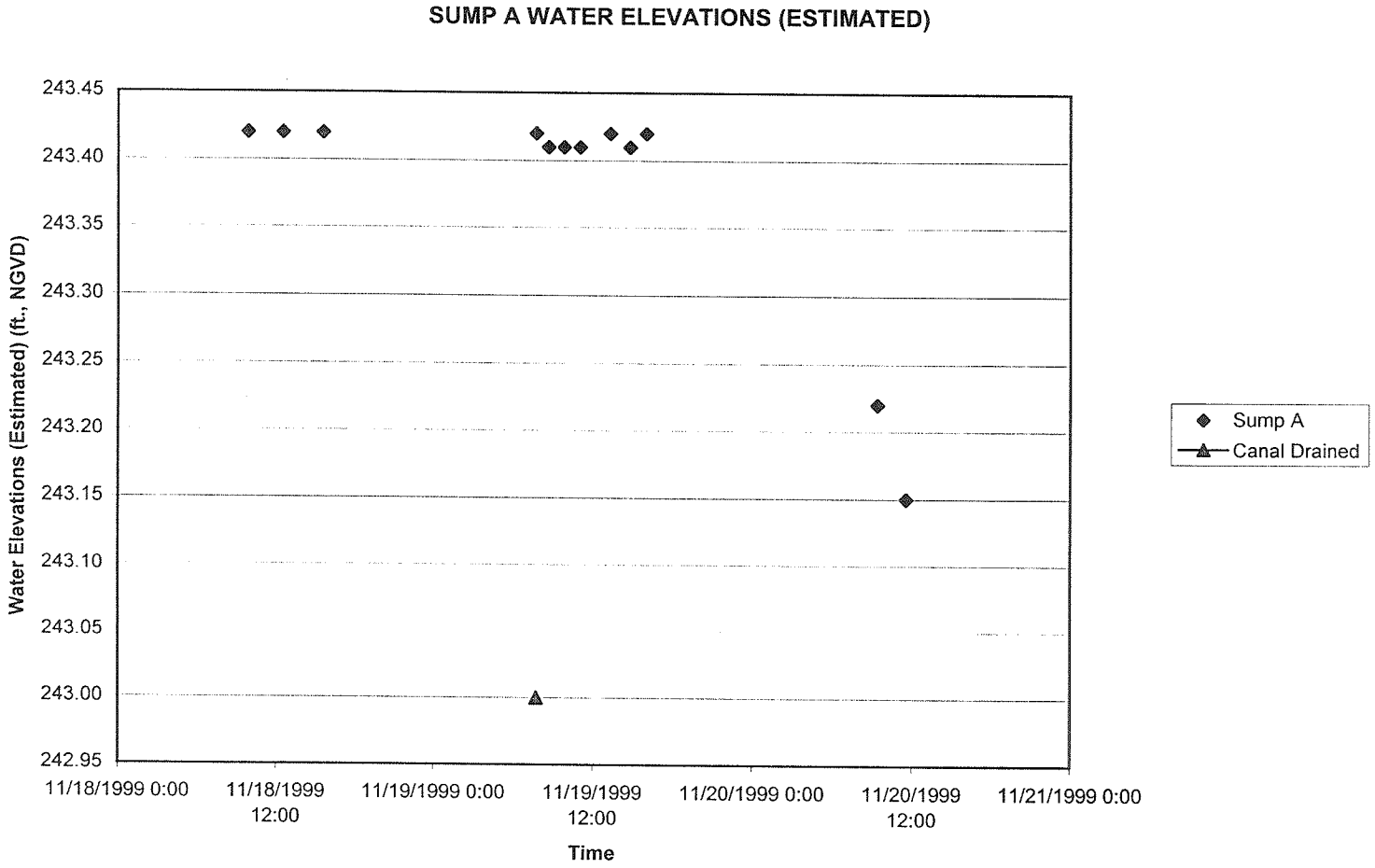


FIGURE 34

HYDROGRAPH
SUMP A

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

SUMP B WATER ELEVATION (ESTIMATED)

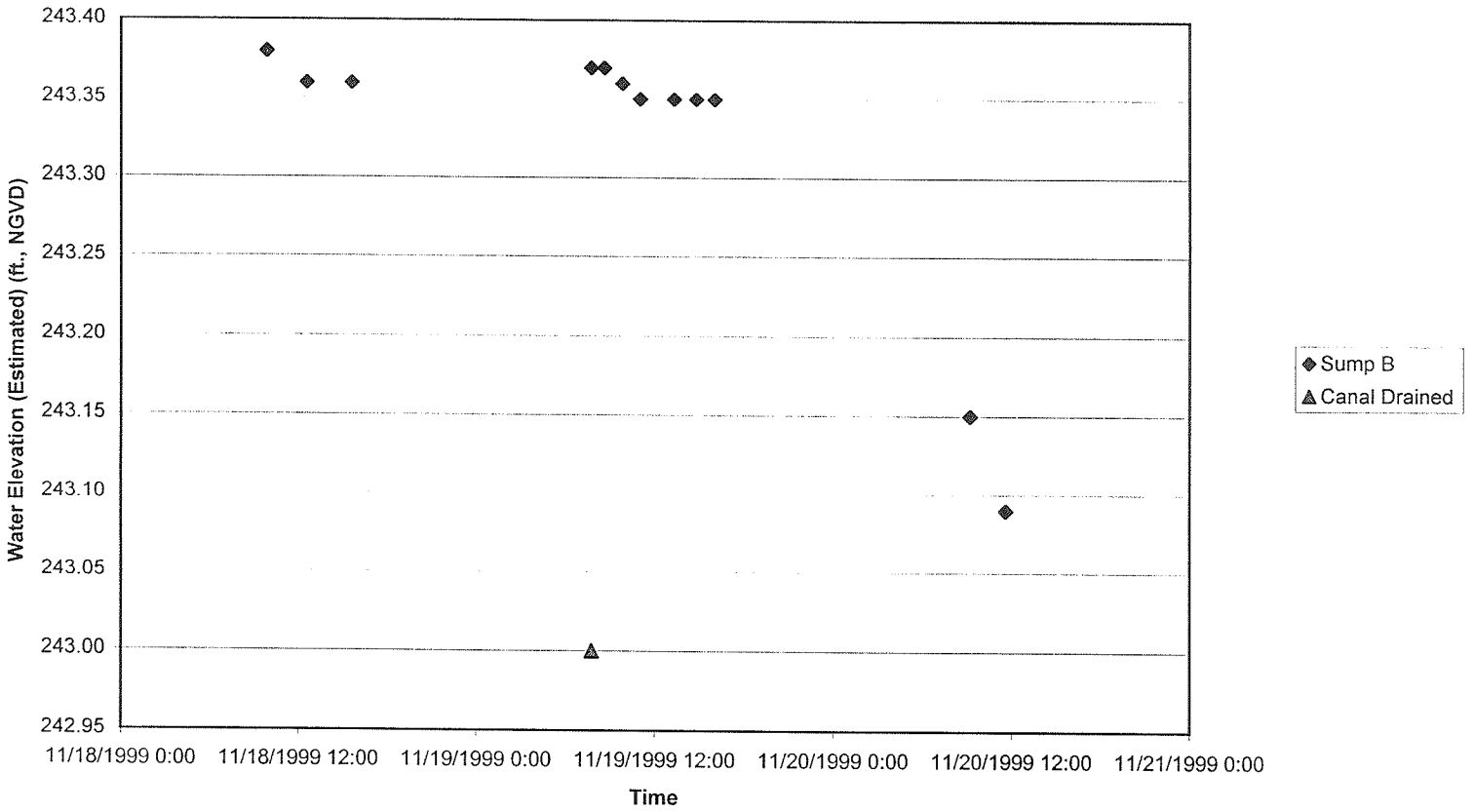


FIGURE 35

HYDROGRAPH
SUMP B

HERCULES INCORPORATED
CIBA SITE, GLENS FALLS, NY

BROWN AND CALDWELL

ATTACHMENT 2

PHOTOGRAPHS

1. Stone culvert under canal by Northeast Lot (looking northeast).

2. Stone culvert under canal by Northeast Lot (looking north).

3. Stone culvert under canal by Northeast Lot (looking north).

4. Canal east of Pretreatment Plant and north of Northeast Lot (looking west).

5. Canal observed from Lower Warren St. (looking west).

6. Deterioration in north wall of canal, opposite from middle of North Lot (looking north).

7. Deterioration in north wall of canal and local repair in wall, opposite west end of North Lot (looking northwest).

8. Deterioration in north wall of canal and local repair in wall, opposite west end of North Lot (looking northwest).

9. Deterioration in north wall of canal opposite intersection of Boulevard and Lower Warren St. (looking northwest).

10. View of canal looking east from approximately 200 feet west of Weir Brook inlet gate. Gate structure is visible.

11. View of canal looking west from approximately 200 feet west of Weir Brook inlet gate.

12. North wall of canal adjacent to Sliver Quarry (looking northwest).

13. North wall of canal adjacent to Sliver Quarry (looking northwest).

14. North wall of canal adjacent to Sliver Quarry (looking northwest).

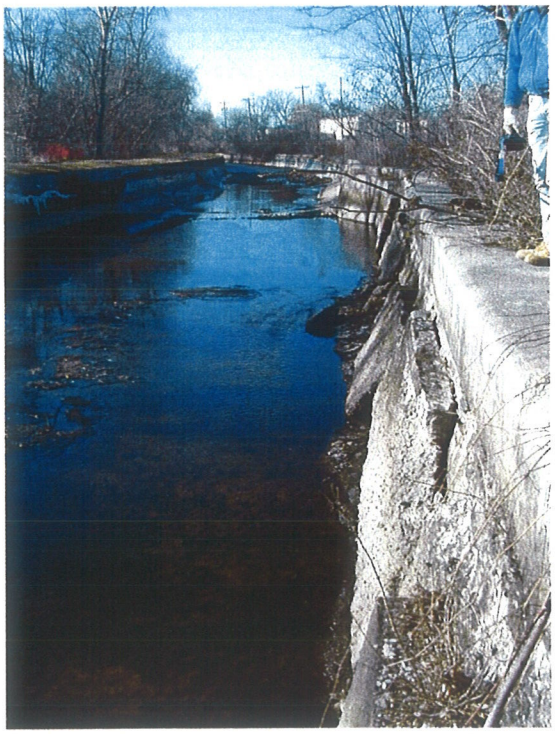
15. North wall of canal adjacent to Sliver Quarry (looking northwest).

16. Sluice for stream entering canal from north (looking north). Sluice is directly west of Sliver Quarry.

17. Stream flowing into north side of Cement Co. Pond (looking southwest). Stream emanates from base of slope.

18. View of canal to east from canal wall near west end of Sliver Quarry (near sluice).

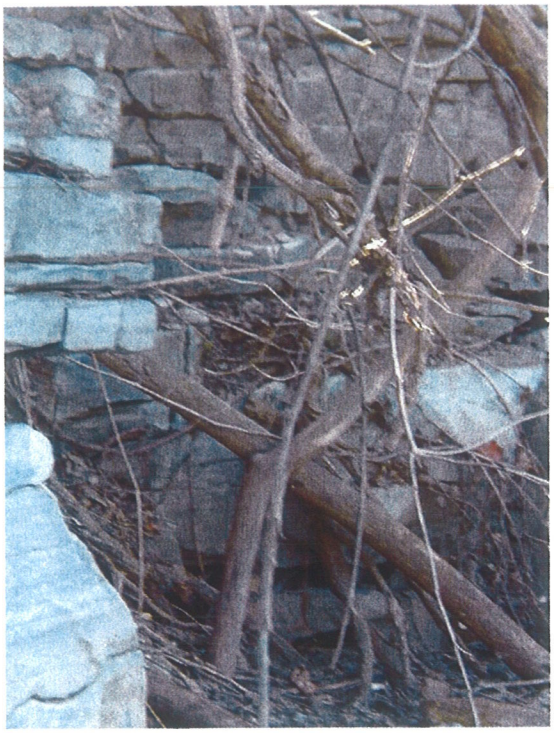
19. Sinkhole/washout in soil behind north wall of canal, approximately 15 feet east of sluice into canal (looking down to northeast).



20. North wall of canal adjacent to Sliver Quarry (looking west).

21. Rock cove in south wall of Sliver Quarry by flow outlet area.

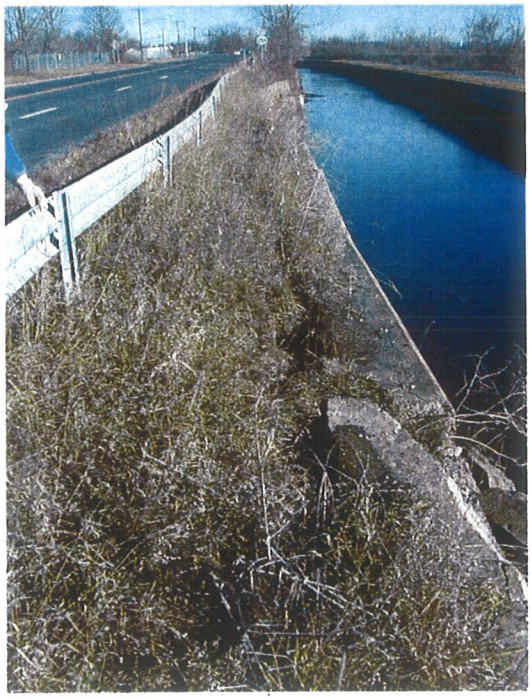
22. Rock cove in south wall of Sliver Quarry by flow outlet area.



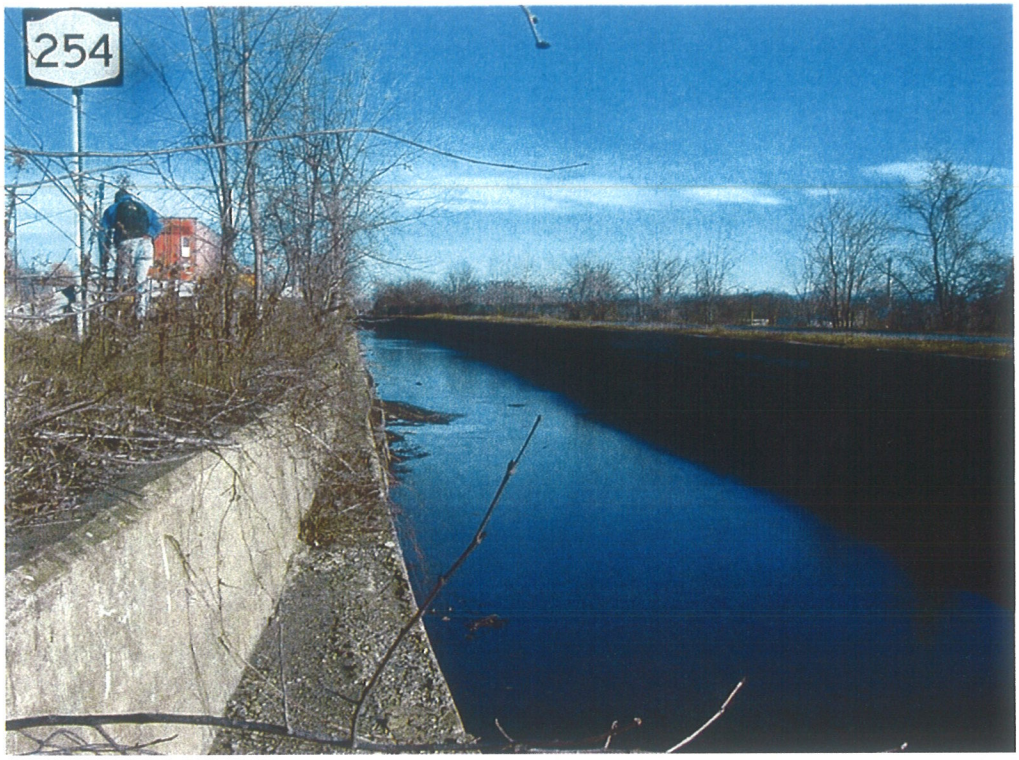
23. Rock cove in south wall of Sliver Quarry by flow outlet area.

24. Gate from canal to Weir Brook (looking southeast).

25. Repair to south wall of canal with tie-backs east of Weir Brook gate (looking southeast).



26. Sinkhole/washout behind north wall of canal, opposite from southwest corner of North Lot (looking east).



27. Canal viewed toward east from opposite west end of North Lot.

A1. Stream feeding Cement Company Pond (looking north) on 11/18/99, prior to opening of gate from canal to Weir Brook.

A2. Stream feeding Cement Company Pond (looking north) on 11/19/99 at approximately 1115 hours, approximately 3.5 hours after the opening of the gate from canal to Weir Brook.

A3. Sinkhole between south wall of canal and towpath observed on 11/19/99 (looking east). Sinkhole is located on opposite side of the canal from the Sliver Quarry and a few feet west of the western end of the sheetpile repair work in the canal.

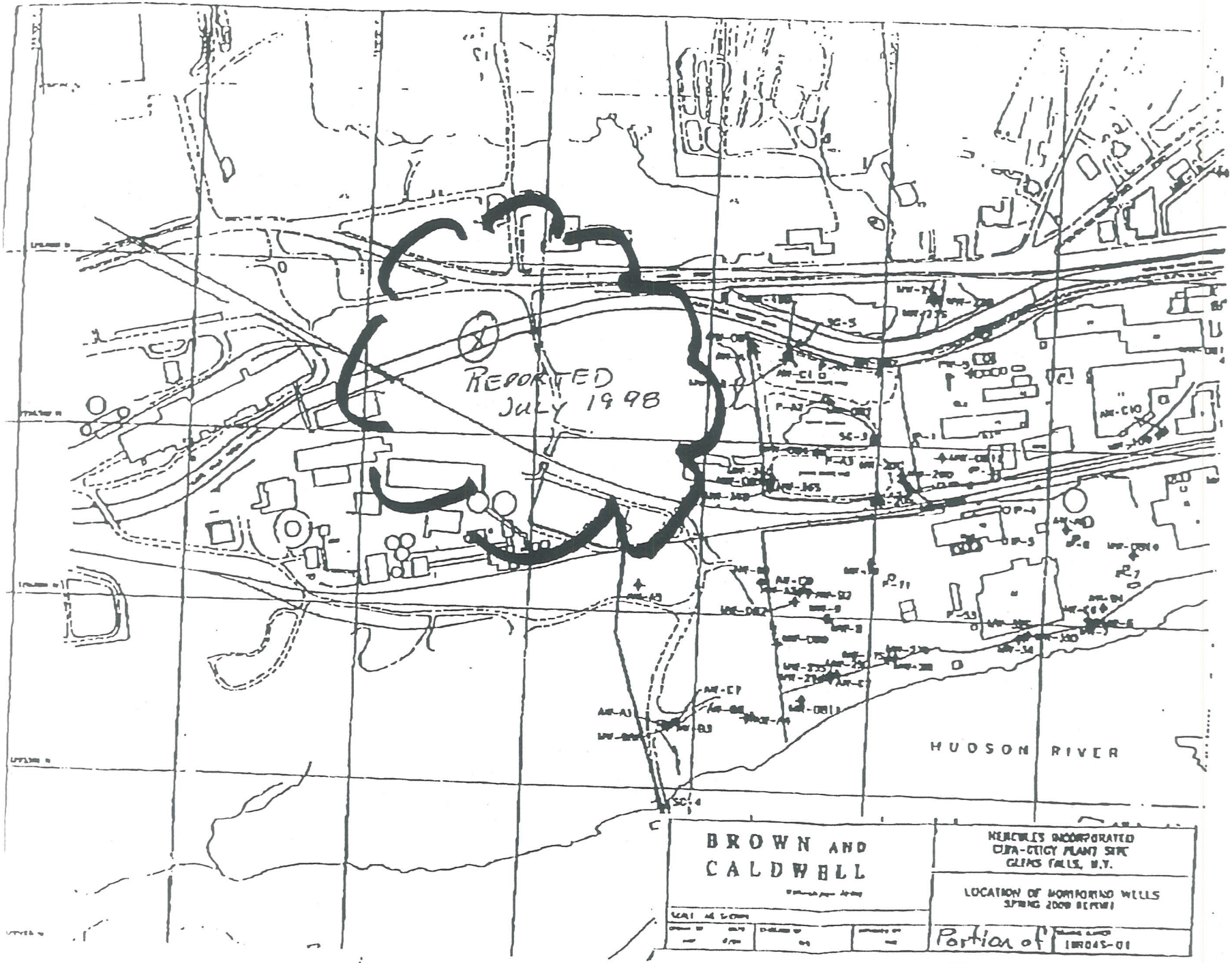
A4. Close-up of sinkhole in photograph A3.

A5. Sump within foundation slab of former Building 5, designated as "Sump A".

A6. Sump in concrete pad located directly west of former Building 53, designated as "Sump B".

ATTACHMENT 3

LOCATION OF CANAL WASHOUT ADJACENT TO GLENS FALLS LEHIGH CEMENT CO. (GFLCC) PROPERTY (AS PLOTTED BY GFLCC)

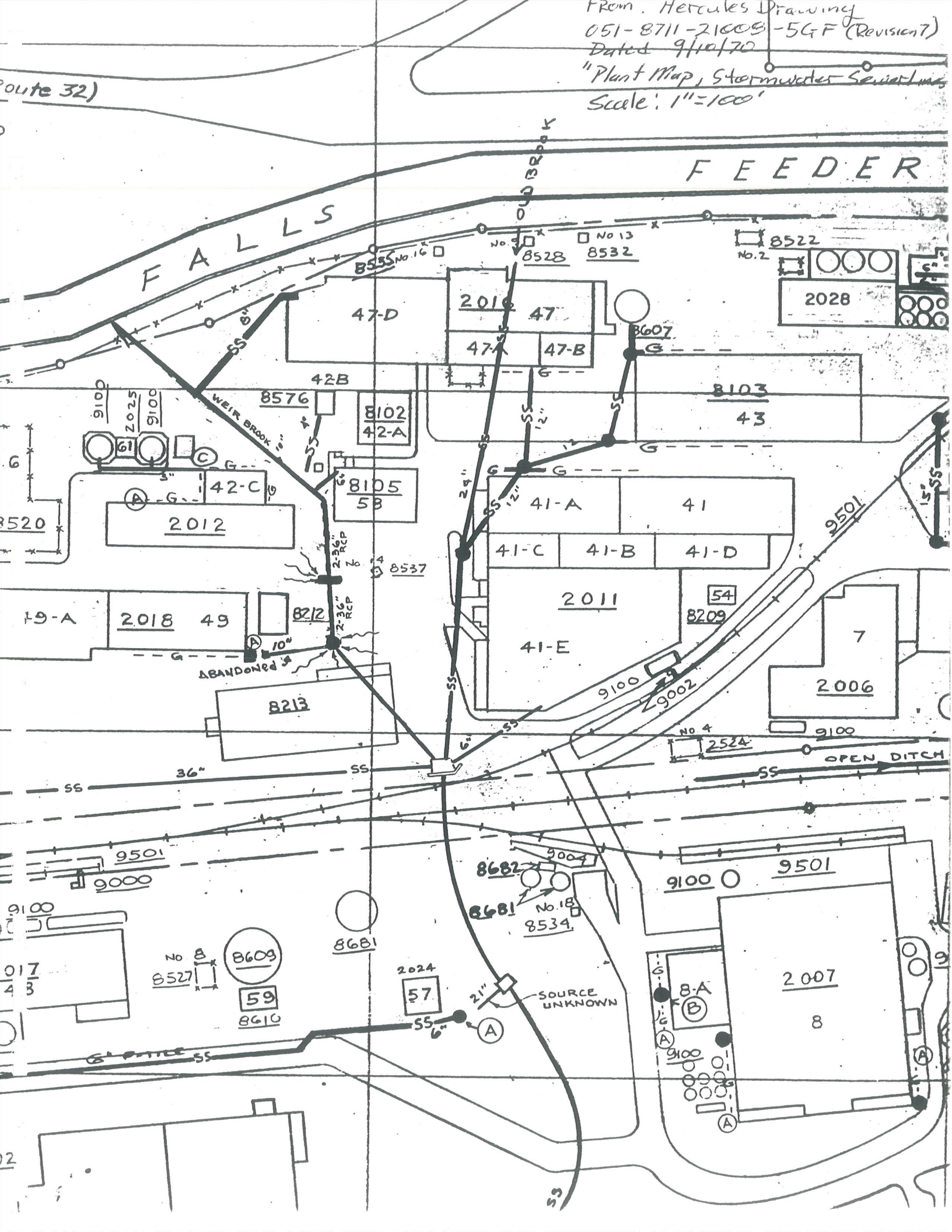


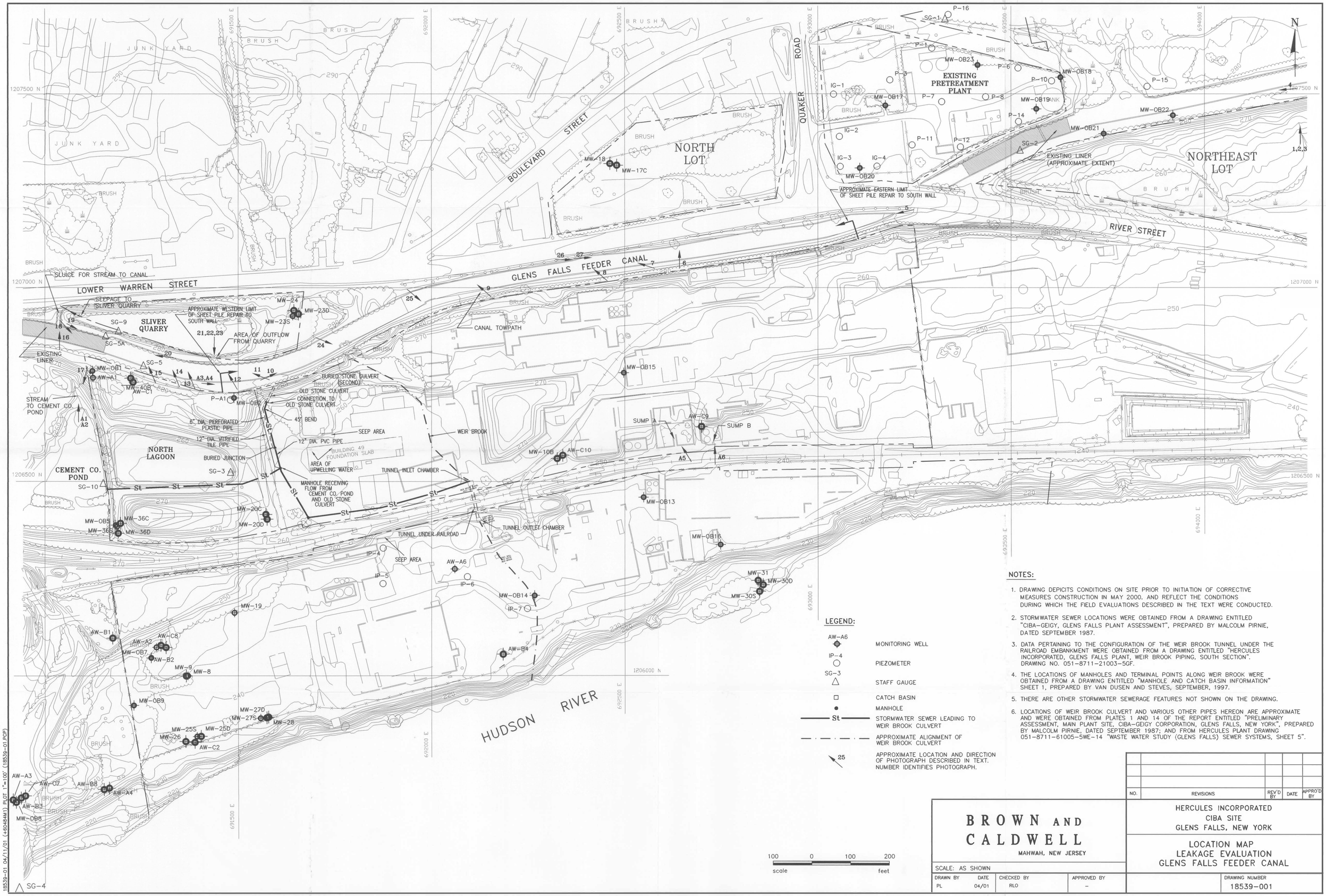
LOCATION OF WASHOUT IN FEEDER CANAL

ATTACHMENT 4

PORTION OF
"PLANT MAP, STORMWATER SEWER LINES"
HERCULES DRAWING 051-8711-21008-5GF (REVISION 7)
DATED SEPTEMBER 10, 1970

From: Hercules Drawing
051-8711-21609-5GF (Revision 7)
Dated 9/10/70
"Plant Map, Stormwater Sewer Lines"
Scale: 1"=100'





LEGEND:

- AW-A6 — MONITORING WELL
- IP-4 — PIEZOMETER
- SG-3 — STAFF GAUGE
- CATCH BASIN
- MANHOLE
- St — STORMWATER SEWER LEADING TO WEIR BROOK CULVERT
- APPROXIMATE ALIGNMENT OF WEIR BROOK CULVERT
- 25 — APPROXIMATE LOCATION AND DIRECTION OF PHOTOGRAPH DESCRIBED IN TEXT. NUMBER IDENTIFIES PHOTOGRAPH.

NOTES:

1. DRAWING DEPICITS CONDITIONS ON SITE PRIOR TO INITIATION OF CORRECTIVE MEASURES CONSTRUCTION IN MAY 2000. AND REFLECT THE CONDITIONS DURING WHICH THE FIELD EVALUATIONS DESCRIBED IN THE TEXT WERE CONDUCTED.
2. STORMWATER SEWER LOCATIONS WERE OBTAINED FROM A DRAWING ENTITLED "CIBA–GEIGY, GLENS FALLS PLANT ASSESSMENT", PREPARED BY MALCOLM PIRNIE, DATED SEPTEMBER 1987.
3. DATA PERTAINING TO THE CONFIGURATION OF THE WEIR BROOK TUNNEL UNDER THE RAILROAD EMBANKMENT WERE OBTAINED FROM A DRAWING ENTITLED "HERCULES INCORPORATED, GLENS FALLS PLANT, WEIR BROOK PIPING, SOUTH SECTION". DRAWING NO. 051–8711–21003–5GF.
4. THE LOCATIONS OF MANHOLES AND TERMINAL POINTS ALONG WEIR BROOK WERE OBTAINED FROM A DRAWING ENTITLED "MANHOLE AND CATCH BASIN INFORMATION" SHEET 1, PREPARED BY VAN DUSEN AND STEVES, SEPTEMBER, 1997.
5. THERE ARE OTHER STORMWATER SEWERAGE FEATURES NOT SHOWN ON THE DRAWING.
6. LOCATIONS OF WEIR BROOK CULVERT AND VARIOUS OTHER PIPES HEREON ARE APPROXIMATE AND WERE OBTAINED FROM PLATES 1 AND 14 OF THE REPORT ENTITLED "PRELIMINARY ASSESSMENT, MAIN PLANT SITE, CIBA–GEIGY CORPORATION, GLENS FALLS, NEW YORK", PREPARED BY MALCOLM PIRNIE, DATED SEPTEMBER 1987; AND FROM HERCULES PLANT DRAWING 051–8711–61005–5WE–14 "WASTE WATER STUDY (GLENS FALLS) SEWER SYSTEMS, SHEET 5".

100 0 100 200
scale feet

NO.	REVISIONS	REV'D BY	DATE	APPRO'D BY

BROWN AND CALDWELL
MAHWAH, NEW JERSEY

HERCULES INCORPORATED
CIBA SITE
GLENS FALLS, NEW YORK

LOCATION MAP
LEAKAGE EVALUATION
GLENS FALLS FEEDER CANAL

SCALE: AS SHOWN			
DRAWN BY	DATE	CHECKED BY	APPROVED BY
PL	04/01	RLO	–

DRAWING NUMBER 18539–001

18539–01 04/11/01 (460484H1) PLOT 1"=100' (18539–01.PCP)