FINAL REPORT
SERVICE WATER INTAKE STRUCTURE
SETTLEMENT EFFECTS AND RELATED WORK

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 PURPOSE AND SCOPE OF REPORT

The purpose of this report is to describe events concerning the settlement of the West Embankment and its effect on the Service Water Pumphouse, the Intake Structure, and the incoming services to the Pumphouse after grouting of the Intake Structure cracks in January 1978 as described in Report No. 2.[1] This report mainly provides data which have been obtained between January 1978 and June 1979. Settlement monitoring data of the Pumphouse and the Intake Structure which were presented in Report No. 2 are updated in this report. The information presented in this report is listed as follows:

a. Presentation of monitoring data on the settlement/rebound of the structures and West Embankment Fill surface.

b. Piezometric readings indicating groundwater levels within the West Embankment.

c. Discussion of the settlement effects on the structures and the incoming services.

d. Description and conclusion of underwater inspection of the Intake Structure.

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(1) Service Water Intake Structure, Settlement Effects and Related Work, June 28, 1978.

2.0 BRIEF HISTORY

A descripton of the Service Water Pumphouse and the Service Water Intake Structure along with the sequence of various construction events are presented in detail in Report No. 2.

Briefly, the Service Water Pumphouse and Service Water Intake Structure are located on the west side of the Service Water Pond. The Pumphouse rests at Elevation 386 ft on approximately 30 feet of West Embankment fill materials as shown on Figures 1 and 2 of Report No. 2. The Intake Structure, which provides the Pumphouse with access to the Service Water Pond, is founded at Elevation 367 ft. and rests on 15 feet of fill at the west end and on natural soil at the east end.

A settlement monitoring program was started on January 13, 1977 for the Pumphouse and Intake Structure after the Pumphouse base slab was completed. The settlement measurement made on August 15, 1977 indicated that settlement of the Pumphouse and Intake Structure exceeded the settlement estimate for that stage of construction. Subsequently, on August 29, 1977 cracks were discovered in the Intake Structure.

The embankment fill was completed in October 1977 and preloading of the Pumphouse was carried out during the period October 20 through December 4, 1977. The purpose of the preload was to accelerate the settlement so that no additional significant settlement would occur after the cracks were repaired.

Cracks in the Intake Structure having widths over 0.012 inch were grouted between December 15, 1977 and January 18, 1978 as described in Section 8.0 of Report No. 2. Monticello Reservoir was filled to

Elevation 425 ft during the period December 2, 1977 through February 9, 1978 and the Service Water Pond was filled to Elevation 425 ft during the period from February 23, through March 7, 1978.

As shown in Figure 1, the Pumphouse settled an average of 12.5 inches and the Pumphouse end of the Intake Structure settled about 10 inches before the grouting of the cracks in the Intake Structure and the subsequent filling of the Service Water Pond. The settlement resulted due to the weight of 80 feet of West Embankment fill placed on the underlying saprolitic soils.

After grouting of the Intake Structure cracks, the Pumphouse and the Intake Structure experienced minimal additional settlement during the filling of the Service Water Pond, and an upward rebound movement following completion of the filling of the Pond. These rebound movements range from 0.2 to less than 1.0 inch and are discussed in the section on Monitoring Data.

3.0 MONITORING METHODS

Movements of the structures and the West Embankment fill along with the change of the groundwater level are being monitored. The different monitoring systems are listed as follows:

a. The Pumphouse movement is monitored at the four corners of the pump room floor of the Pumphouse. The Pumphouse movement has been monitored since January 1977.

b. The Intake Structure movement has been monitored since February 1978 by the use of three masts affixed on the roof of the structure and projecting above the Pond surface. Prior to that time, when the Intake Structure was not submerged by the Service Water Pond, movements were monitored at several points along the base slab as described in Report No. 2.

c. The duct bank movement relative to the Pumphouse has been recorded since December 1978 by measuring the movement joint width above and below the duct banks in the Pumphouse west wall.

d. The groundwater level in the West Embankment fill is monitored in eight piezometers installed in August 1978.

e. The vertical movement of the West Embankment crest is monitored at seven settlement monuments installed in September 1978.

4.0 MONITORING DATA

4.1 SERVICE WATER PUMPHOUSE

As described in Report No. 2, the Service Water Pumphouse experienced an average of 0.19 inch of settlement during the filling of the Service Water Pond in February and March 1978. After the filling was completed, the Pumphouse began to rebound, experiencing an average upward movement of 0.68 inch through July 18, 1979, resulting in a net upward movement of 0.49 inch. The Pumphouse monitoring data is provided in Table 1, (Updated Table 3 of Report No. 2) and is shown in Figure 1 (Updated Figure 9 of Report No. 2) and Figure 2.

It is anticipated that the Pumphouse will continue to rebound until the groundwater level in the West Embankment stabilizes (see Section 4.3). As described in Report No. 2, it is anticipated that the total net rebound will not exceed about one inch from the elevation of the structure prior to the filling of the Service Water Pond.

4.2 SERVICE WATER INTAKE STRUCTURE

During the filling of the Service Water Pond, the measured settlement of the Service Water Intake Structure because of the weight of water was:

East End (MM-1):	0.52 inch
Middle (MM-2):	0.42 inch
West End (MM-3):	0.22 inch.

After the filling was completed, the Intake Structure began to rebound, similar to the Pumphouse, experiencing the following upward movements through July 18, 1979:

East End (MM-1): 0.57 inch
Middle (MM-2): 0.97 inch
West End (MM-3): 0.83 inch.

The resulting net upward movement is:

East End (MM-1): 0.05 inch
Middle (MM-2): 0.55 inch
West End (MM-3): 0.61 inch.

The Intake Structure monitoring data is provided in Table 2, (Updated Table 10 of Report No. 2) and is shown in Figure 3.

As with the Pumphouse, it is anticipated that the Intake Structure will continue to rebound until the groundwater level in the West Embankment stabilizes. As described in Report No. 2, it is expected that the net rebound will not exceed about two inches.

4.3 WEST EMBANKMENT PIEZOMETRIC LEVELS

Eight well-point piezometers were installed in the West Embankment in August 1978, to monitor groundwater levels. The piezometers are located as shown on Figure 4. The piezometer readings are tabulated in Table 3 and are shown on Figures 4 and 5. The data indicate a gradual rise in groundwater level towards the level of the Service Water Pond and Monticello Reservoir. Initially, the data showed the groundwater level increasing in elevation with greater distance from the Service Water Pond, indicating that the fill is probably being saturated by a gradual rising of the groundwater from within the natural ground beneath the West Embankment fill in response to the filling of Monticello Reservoir and the Service Water Pond. This is also indicated at the two locations where piezometers are installed at two levels. In both of these cases, the lower level piezometer shows a higher piezometric level, indicating an upward gradient in

the groundwater flow. The more recent data also shows high groundwater levels near the Pond, indicating that saturation of the West Embankment directly from the Pond has also progressed to a noticeable degree.

4.4 WEST EMBANKMENT CREST SETTLEMENT MONUMENTS

Seven crest settlement monuments were installed in the West Embankment in September 1978. Each monument is located adjacent to a piezometer with the same identification number. The piezometer locations are shown on Figure 4. The monuments consist of six-inch diameter concrete-filled steel pipe, embedded approximately six feet below the surface of the West Embankment fill in a 12-inch diameter concrete-filled hole, as shown in Figure 6. A brass plate is attached to the top of each monument with a three-foot long rod embedded in the concrete within the pipe.

Data obtained from the monuments are presented in Table 4. The data indicate that the embankment surface generally experienced up to 0.08 inch of settlement during the first six weeks after installation of the monuments. During this time, the Pumphouse was essentially stationary. It is possible that during this period the monuments were settling slightly due to "seating," or that continuing compression of the upper portion of the fill above the groundwater level was greater than the simultaneous expansion of the soil below the groundwater level because of buoyancy effects. After that time the monuments generally show upward movement, with the net rebound through July 1979, ranging from 0.05 to 0.67 inch. During this time, the Pumphouse experienced about 0.15 inch of rebound.

Monument WE-8 indicated a settlement of 0.43 inch during the first five months of monitoring, followed by 0.25 inch of rebound during the next four months. The initial settlement is atypical and was probably because of poor seating of the monument during installation. It is believed that the monument is now seated and is correctly reflecting the rebound which is occurring.

5.0 ANALYSIS AND INSPECTION OF STRUCTURES

5.1 SERVICE WATER PUMPHOUSE

Since Report No. 2 was presented, survey monitoring of the Pumphouse has continued (refer to Section 4.0). During this period, the rebound movement of the structure has been about 0.22 inch with little or no rotational effects, therefore, requiring no structural evaluation. No visual observations of the structure have been reported that warrant investigation or evaluation.

5.2 SERVICE WATER INTAKE STRUCTURE

5.2.1 Structural Evaluation

Subsequent to Report No. 2, survey monitoring of the Intake Structure masts has continued (See Table 2 and Section 4.0). From the time when the Intake Structure cracks were grouted in January 1978, the differential movement between the middle (Mast MM-2) and ends (Masts MM-1 and MM-3) has been calculated from Table 2. The relative movement between the middle and ends of the tunnel has been consistent but very small. During the initial filling of the Pond, from February 23 to March 7, 1978, relative movement indicated a very small bending in the long direction of the tunnel inducing compression in the top and tension in the bottom of the structure. This occurred during the period when the overall mast survey indicated that some initial downward settlement of the tunnel was taking place. After completion of Pond filling operations, the relative movement between the middle and ends of the tunnel indicated a reversal of bending with a gradual increase of tension in the top, and compression in the bottom. During this period, the mast survey indicated an overall rebound of the tunnel. Although for both these bending effects, the calculated stresses were small, it was apparent that the bending effects during the rebound period

were greater than during the downward settlement period during Pond filling. These results are consistent with the predictions in Report No. 2 that change in stress conditions would be small following grouting of the tunnel cracks. It is predicted that until the groundwater level in the area of the Pumphouse and Intake Structure stabilizes and all rebound has virtually ceased (see discussion in Section 4.0 of this report), some small change in stress will continue to occur. Confirmation that stress changes in the tunnel from January 1978 until June 1979 had no significant structural effect is supported by the underwater inspection made in June 1979 and presented in Section 5.2.2 of this report.

5.2.2 UNDERWATER INSPECTION

A detailed underwater inspection of the Intake Structure throughout its length on all four internal surfaces was made during the period from June 7 through June 13, 1979. A very fine film of deposits was removed from the surface of the walls, roof, and floor before final inspection. The diver was provided with prequalified gauge wires of 0.014, 0.031, and 0.048 inch diameter with which to measure the width of any crack found. The diver's inspection report is attached as Appendix A and identifies four hairline cracks. All of the four cracks discovered were hairline and significantly less in width than the smallest gauge of 0.014 inch. It is not possible to determine for certain whether these are cracks existing from the time of grouting which were considered too small for grouting within the parameters described in Report No. 2, or whether they are cracks of a more recent origin. If the latter case is true, the location of the cracks is consistent with the differential movement evaluation described in Section 5.2.1 of this report which indicated some small additional tension stress from bending in the longitudinal direction of the structure. The strain in the longitudinal rebar bridging these hairline cracks will not add significant additional strain to that calculated in Report No. 2 for the cracking that occurred

before grouting in January 1978. The results of this inspection support the calculation results which indicated that the intake structure movement had very little stress effects. The diver reported no unusual observations.

5.3 ELECTRICAL DUCT BANKS

Details of the electrical duct banks at the west wall of the Pumphouse are shown on Figures 19 and 20 of Report No. 2. These reinforced concrete duct banks penetrate the wall and are surrounded by a Servicised Closed Cell Plastic foam filler (See Figure 19 of Report No. 2), which is a flexible movement joint.

Downward movement of the duct banks relative to the Pumphouse has been taking place since their construction was completed in June 1978. The movement observations were made since December 1978 by surveying on a regular basis the thickness of the flexible joint above and beneath the duct banks at the inside face of the Pumphouse west wall. The accumulative total maximum relative movement downward is recorded as 0.841 inch in June 1979 and no appreciable movement had occurred since March 1979.

Compressibility tests were conducted on the Servicised Closed Cell Plastic foam to determine the flexibility of the joint foam after its compression from duct settlement. Tests were conducted on samples having the same thickness as that placed around the duct bank in the wall openings. These tests showed that the spring modulus of the compressed filler was 0.19×10^5 lb/cu ft, which is much softer than the modulus of subgrade reaction of west embankment soil surrounding the duct banks (lower bound value of 1.5×10^5 lb/cu ft).

It was concluded from these tests that an additional one inch of relative downward movement of the duct banks would be necessary

before substantial stiffening of the foam filler would approach the soil stiffness. Since the filler stiffness is less than the soil stiffness, no concentrated reaction on the duct banks occurs at the Pumphouse wall entry. No further significant relative settlement of the duct banks in the future is anticipated. It is concluded that the original duct banks design assumptions will remain valid and the duct banks will remain well within their ultimate strength capacity when subjected to the design surcharge loads for the embankment.

5.4 SERVICE WATER PUMP DISCHARGE LINES

The two 30-inch discharge lines were laid and backfilled in April 1978. The details of the system as it enters the pumphouse is described in Section 9.2 of Report No. 2. The actual connections of the lines to the pumps were made in October 1978, at which time some misalignment between the pump and the 30-inch lines was found. To correct this misalignment it was necessary to re-excavate around the 30-inch lines close to the Pumphouse south wall. The re-backfill operation was carefully supervised for good compaction and alignment. The non-conformance findings and remedial disposition are documented in accordance with standing quality control procedures.

Differential movement of the West Embankment soil and the Pumphouse since October 1978 can be obtained by comparing embankment monument movements at WE-12, WE-12A, and WE-13 (See Table 4 and Figure 3) with Pumphouse movement for survey points 'B' and 'C' (See Figure 1). The maximum differential that can be estimated from this comparison is around 0.4 inch of embankment movement upward relative to the Pumphouse. Some further small differential is expected in the upward direction until the groundwater level stabilizes in the immediate area. The dresser couplings provided in the 30-inch lines adjacent to the Pumphouse wall, as described in Report No. 2, have a capacity for a 6 inch differential and, therefore, are more than adequate to absorb any anticipated differential movement.

5.5 CIRCULATING WATER BY-PASS LINE

The 36-inch by-pass line (designated non-nuclear safety class) between the Pumphouse and Monticello Reservoir was connected in February 1978 and its details are described in Section 9.2 of Report No. 2.

Because the 36-inch line is cast directly into the northwest corner of the Pumphouse, movement of the pipe at entry into the wall is monitored using survey point 'D' (See Figure 1) on the Pumphouse itself. Survey data of point 'D' since February 1978 indicate a net upward movement of the pipe and structure of around 0.6 inch, including about 0.17 inch since September 1978. Comparing this with the monument data readings in the West Embankment on the north side of the Pumphouse (see Table 4 and Figure 3), there appears to have been very little differential movement between the embankment fill and the pipe entry into the structure since September 1978. The dresser couplings provided in the by-pass line close to the Pumphouse will allow a total of 6 inches differential which will adequately absorb the differential movement. After the groundwater level has essentially stabilized, relative movement will cease to be measurable.

6.0 CONCLUSIONS

a. Prior to filling the Service Water Pond, it was expected that the net movement of the Service Water Pumphouse due to the filling would not be more than about one inch upward or downward. Following the filling of the Service Water Pond, the Pumphouse movement was downward (actual average downward movement was 0.19 inch) followed by an upward movement which is gradually tapering off; the average upward movement from March to August 197[illegible] was about 0.53 inch and the average upward movement from August 1978 to July 1979 was about 0.15 inch.

b. Prior to filling the Service Water Pond, it was expected that the net movement of the Service Water Intake Structure due to the filling would not exceed two inches up or down. Following the filling of the Service Water Pond, the Intake Structure movement was downward (downward movement was between 0.22 to 0.52 inch) followed by an upward movement which is gradually tapering off; the actual upward movement was between 0.47 and 0.67 inch from March to August 1978 and between 0.10 to 0.30 inch from August 1978 to July 1979.

c. It is anticipated that the groundwater level in the West Embankment will continue to rise, at a gradually decreasing rate, for the next 6 to 12 months, or perhaps longer. Additional increases after that time will be very small, with the groundwater level probably stabilizing near the lower level of the daily fluctuations in the Service Water Pond and Monticello Reservoir.

d. It is anticipated that rebound of the structures will continue for several more months, at a gradually decreasing rate, until the groundwater level in the West Embankment has essentially stabilized.

e. The electrical duct banks, 30-inch discharge lines, and 36-inch circulating water by-pass line have experienced less than one inch differential movement with respect to the Pumphouse. These movements are easily accommodated either by the flexible foam movement joint in the Pumphouse wall around the electrical duct banks or by the flexible connections used in the discharge lines and in the circulating water by-pass line.

f. Underwater investigation of the Intake Structure does not indicate any crack which would add any significant additional strain in the longitudinal reinforcement or that would require grouting within parameters described in Report 2.

g. Applicant shall monitor the Service Water Pumphouse and Intake Structure for settlement twice a year during the operating life of the Plant, unless a lesser frequency can be shown to be adequate.

TABLES

TABLE 1
(SHEET 1 OF 3)
SUMMARY OF SERVICE WATER PUMPHOUSE SETTLEMENT READINGS
(UPDATED TABLE 3 OF REPORT NO. 2)

DATE	APPROXIMATE FILL ELEVATION	CONCRETE ELEVATION	MEASURED SETTLEMENT (inches) A	B	C	D
6/07/78	435	459	11.988	11.352	12.336	13.128
6/14/78	435	459	12.036	11.412	12.408	13.188
6/21/78	435	459	12.000	11.304	12.324	13.104
6/28/78	435	459	12.024	11.412	12.444	13.164
7/05/78	435	459	11.976	11.424	12.408	13.104
7/12/78	435	459	11.964	11.340	12.360	13.092
7/19/78	435	459	11.976	11.364	12.336	13.044
7/26/78	435	459	12.048	11.412	12.396	13.104
8/02/78	435	459	12.048	11.388	12.372	13.080
8/09/78	435	459	11.916	11.316	12.312	13.008
8/16/78	435	459	11.976	11.376	12.372	13.068
8/23/78	435	459	11.964	11.256	12.240	13.056
8/28/78	435	459	11.964	11.376	12.360	13.068
8/30/78	435	459	11.940	11.376	12.324	13.032
8/31/78	435	459	11.916	11.328	12.300	13.020
9/05/78	435	459	11.988	11.364	12.360	13.092
9/07/78	435	459	12.000	11.340	12.336	13.068
9/11/78	435	459	11.880	11.268	12.288	12.996
9/14/78	435	459	11.940	11.304	12.288	13.056
9/18/78	435	459	11.928	11.328	12.300	13.020
9/19/78	435	459	11.916	11.316	12.312	13.008
9/21/78	435	459	11.940	11.340	12.312	13.056
9/27/78	435	459	11.964	11.304	12.276	13.068
10/04/78	435	459	11.976	11.376	12.360	13.080
10/11/78	435	459	11.952	11.376	12.360	13.080

TABLE 1
(SHEET 2 OF 3)
SUMMARY OF SERVICE WATER PUMPHOUSE SETTLEMENT READINGS
(UPDATED TABLE 3 OF REPORT NO. 2)

DATE	APPROXIMATE FILL ELEVATION	CONCRETE ELEVATION	MEASURED SETTLEMENT (inches) A	B	C	D
10/18/78	435	459	11.964	11.376	12.336	13.014
10/25/78	435	459	11.952	11.352	12.348	13.068
11/01/78	435	459	11.928	11.292	12.276	13.056
11/08/78	435	459	11.892	11.340	12.324	13.080
11/15/78	435	459	11.916	11.304	12.324	13.128
11/22/78	435	459	11.892	11.328	12.324	13.008
11/29/78	435	459	11.892	11.304	12.312	13.032
12/06/78	435	459	11.976	11.364	12.384	13.176
12/13/78	435	459	11.940	11.424	12.432	13.068
12/20/78	435	459	11.940	11.376	12.396	13.092
12/27/78 (1)	435	459	-	-	-	-
01/03/79	435	459	11.856	11.400	12.396	13.068
01/10/79	435	459	11.940	11.436	12.432	13.068
01/17/79	435	459	11.868	11.388	12.384	13.044
01/24/79	435	459	11.964	11.388	12.384	13.128
01/31/79	435	459	11.916	11.376	12.376	13.128
02/08/79	435	459	11.868	11.376	12.396	13.116
02/14/79	435	459	11.940	11.460	12.408	13.116
02/21/79	435	459	11.928	11.412	12.420	13.080
02/28/79	435	459	11.928	11.412	12.384	13.080
03/06/79	435	459	12.000	11.460	12.468	13.152
03/14/79	435	459	11.940	11.376	12.372	13.092
03/21/79	435	459	11.904	11.352	12.336	13.080
03/27/79	435	459	11.964	11.388	12.372	13.116
04/04/79	435	459	11.856	11.280	12.300	13.020
04/11/79	435	459	11.868	11.244	12.240	13.020

NOTE: (1) Settlement points removed by construction activities between 12/20/78 and 12/27/78. New points installed on 12/28/78. Cummulative settlement after that date is added to settlement on 12/20/78.

TABLE 1
(SHEET 3 OF 3)
SUMMARY OF SERVICE WATER PUMPHOUSE SETTLEMENT READINGS
(UPDATED TABLE 3 OF REPORT NO. 2)

DATE	APPROXIMATE FILL ELEVATION	CONCRETE ELEVATION	MEASURED SETTLEMENT (inches) A	B	C	D
04/18/79	435	459	11.820	11.196	12.216	12.984
04/25/79	435	459	11.844	11.268	12.288	12.996
05/02/79	435	459	11.760	11.160	12.144	12.912
05/09/79	435	459	11.880	11.328	12.300	13.056
05/16/79	435	459	11.796	11.208	12.204	12.936
05/23/79	435	459	11.820	11.268	12.288	12.984
05/30/79	435	459	11.784	11.184	12.180	12.924
06/05/79	435	459	11.736	11.136	12.168	12.888
06/13/79	435	459	11.808	11.208	12.228	12.960
06/20/79	435	459	11.760	11.124	12.120	12.900
06/27/79	435	459	11.736	11.172	12.180	12.900
07/04/79	435	459	11.748	11.160	12.180	12.900
07/11/79	435	459	11.772	11.184	12.180	12.924
07/18/79	435	459	11.736	11.160	12.180	12.876

TABLE 2
SHEET 1 OF 2
SETTLEMENT READINGS
SERVICE WATER INTAKE STRUCTURE MASTS
(UPDATED TABLE 10 OF REPORT NO. 2)

Date	Elevation of Service Water Pond	Settlement (inches) Mast No. 1	Mast No. 2	Mast No. 3
6/07/78	424.1	-0.02	-0.19	-0.29
6/14/78	423.8	0.01	-0.17	-0.24
6/21/78	422.6	-0.08	-0.25	-0.28
6/28/78	422.4	0.00	-0.17	-0.24
7/05/78	424.6	-0.05	-0.20	-0.30
7/12/78	422.6	-0.08	-0.24	-0.34
7/19/78	423.0	-0.01	-0.25	-0.31
7/26/78	422.4	0.01	-0.25	-0.28
8/02/78	422.6	0.01	-0.23	-0.28
8/09/78	422.7	-0.10	-0.34	-0.38
8/16/78	421.9	-0.08	-0.31	-0.37
8/23/78	421.0	-0.08	-0.35	-0.34
8/28/78	422.8	-0.05	-0.31	-0.31
8/30/78	422.8	-0.08	-0.37	-0.35
8/31/78	422.2	-0.12	-0.36	-0.35
9/05/78	421.9	-0.06	-0.32	-0.30
9/07/78	421.7	-0.06	-0.32	-0.30
9/11/78	421.6	-0.12	-0.40	-0.38
9/14/78	421.4	-0.10	-0.38	-0.34
9/18/78	421.2	-0.12	-0.38	-0.37
9/19/78	421.1	-0.07	-0.35	-0.37
9/21/78	421.0	-0.11	-0.37	-0.32
9/27/78	420.9	-0.07	-0.35	-0.31
10/04/78	420.9	-0.08	-0.37	-0.34
10/11/78	420.9	-0.05	-0.37	-0.35
10/18/78	420.6	-0.12	-0.38	-0.32
10/25/78	420.5	-0.10	-0.38	-0.37
11/01/78	420.7	-0.06	-0.38	-0.36
11/08/78	421.7	-0.15	-0.44	-0.41
11/15/78	420.2	-0.17	-0.46	-0.40
11/22/78	420.2	-0.11	-0.42	-0.42
11/29/78	419.2	-0.14	-0.46	-0.43
12/06/78	420.9	-0.12	-0.41	-0.35
12/13/78	419.1	-0.12	-0.43	-0.35
12/20/78	420.2	-0.10	-0.41	-0.37
12/27/78	420.1	-0.19	-0.48	-0.41
01/03/79	420.2	-0.22	-0.50	-0.47
01/10/79	420.2	-0.12	-0.44	-0.37
01/17/79	420.2	-0.19	-0.56	-0.46
01/24/79	420.6	-0.10	-0.46	-0.41
01/31/79	420.6	-0.12	-0.43	-0.40

1237 182

TABLE 2
SHEET 2 OF 2
SETTLEMENT READINGS
SERVICE WATER INTAKE STRUCTURE MASTS
(UPDATED TABLE 10 OF REPORT NO. 2)

Date	Elevation of Service Water Pond	Settlement (inches) Mast No. 1	Mast No. 2	Mast No. 3
02/08/79	420.7	-0.20	-0.49	-0.43
02/14/79	421.4	-0.18	-0.47	-0.41
02/21/79	422.9	-0.13	-0.52	-0.40
02/28/79	424.8	-0.17	-0.47	-0.41
03/06/79	424.6	-0.07	-0.35	-0.30
03/14/79	424.8	-0.11	-0.44	-0.41
03/21/79	424.6	-0.11	-0.44	-0.40
03/27/79	424.1	-0.08	-0.44	-0.35
04/04/79	425.2	-0.16	-0.50	-0.41
04/11/79	424.9	-0.16	-0.50	-0.44
04/18/79	424.9	-0.20	-0.54	-0.48
04/25/79	424.8	-0.16	-0.52	-0.46
05/02/79	424.9	-0.13	-0.54	-0.53
05/09/79	423.2	-0.16	-0.49	-0.41
05/16/79	423.4	-0.18	-0.58	-0.49
05/23/79	422.6	-0.17	-0.55	-0.50
05/30/79	423.8	-0.13	-0.56	-0.50
06/05/79	422.6	-0.18	-0.62	-0.53
06/13/79	423.6	-0.22	-0.60	-0.50
06/20/79	423.1	-0.23	-0.65	-0.54
06/27/79	423.6	-0.22	-0.65	-0.55
07/04/79	422.5	-0.20	-0.64	-0.56
07/11/79	423.8	-0.20	-0.62	-0.50
07/18/79	421.6	-0.22	-0.66	-0.59

NOTE: Elevation of Service Water Pond is given only at time of elevation measurements on masts. Water level can fluctuate from elevation 418.0 to 425.0

1237 183

TABLE 3
WEST EMBANKMENT PIEZOMETER DATA

PIEZOMETER NUMBER	WE-8	WE-9	WE-9A	WE-10	WE-11	WE-12	WE-12A	WE-13
TIP ELEVATION:	377.3	371.3	383.1	406.6	411.4	375.2	385.1	402.3
DATE	ELEVATION OF WATER LEVEL							
8/17/78	Dry	405.9	403.3	-	-	398.8	-	Dry
8/18/78	378.6	405.9	403.0	408.0	412.8	408.8	386.4	Dry
8/21/78	381.4	407.6	402.5	414.3	418.7	409.2	386.5	Dry
8/23/78	383.7	406.6	402.4	413.8	418.8	409.6	387.2	Dry
8/25/78	385.8	406.8	402.4	414.6	419.1	409.7	387.7	Dry
8/28/78	386.8	407.0	402.2	414.4	419.0	409.9	389.5	Dry
8/30/78	386.9	407.1	402.2	414.4	419.0	410.0	388.8	Dry
9/01/78	387.2	406.9	402.1	414.9	418.7	410.0	389.0	Dry
9/06/78	288.0	407.0	402.0	415.1	418.7	410.1	389.8	Dry
9/08/78	388.4	407.0	402.0	415.3	418.8	410.5	390.1	Dry
9/14/78	389.0	406.7	401.7	414.6	418.4	410.4	390.6	Dry
9/21/78	390.0	406.8	401.7	415.6	418.3	410.6	391.2	Dry
9/28/78	391.9	407.3	402.1	416.0	418.3	410.7	391.8	Dry
10/06/78	392.2	407.5	402.2	413.9	418.2	414.4	392.5	Dry
10/12/78	393.0	407.5	402.1	416.3	418.1	411.1	392.9	Dry
10/19/78	394.0	407.6	402.0	416.4	418.0	411.2	393.3	Dry
10/26/78	390.0	407.8	402.3	416.0	417.9	411.0	393.6	Dry
11/06/78	396.2	407.9	402.5	416.5	417.6	411.3	394.5	Dry
12/05/78	399.2	408.7	402.6	416.9	417.4	412.1	396.3	Dry
1/05/79	402.0	408.2	402.2	417.3	417.0	411.7	397.5	Dry
1/30/79	404.6	409.6	403.2	417.5	418.5	412.9	399.5	404.0
3/07/79	407.0	411.1	404.6	418.2	418.7	415.1	401.9	Dry
4/04/79	408.0	411.6	405.0	417.7	419.0	415.0	402.5	Dry
5/01/79	410.8	412.1	406.3	418.1	419.4	416.8	404.8	Dry
6/02/79	411.7	412.0	406.9	417.9	419.5	416.7	406.3	Dry
7/02/79	413.3	413.0	409.1	418.3	420.0	417.8	407.7	Dry

1237 184

TABLE 4

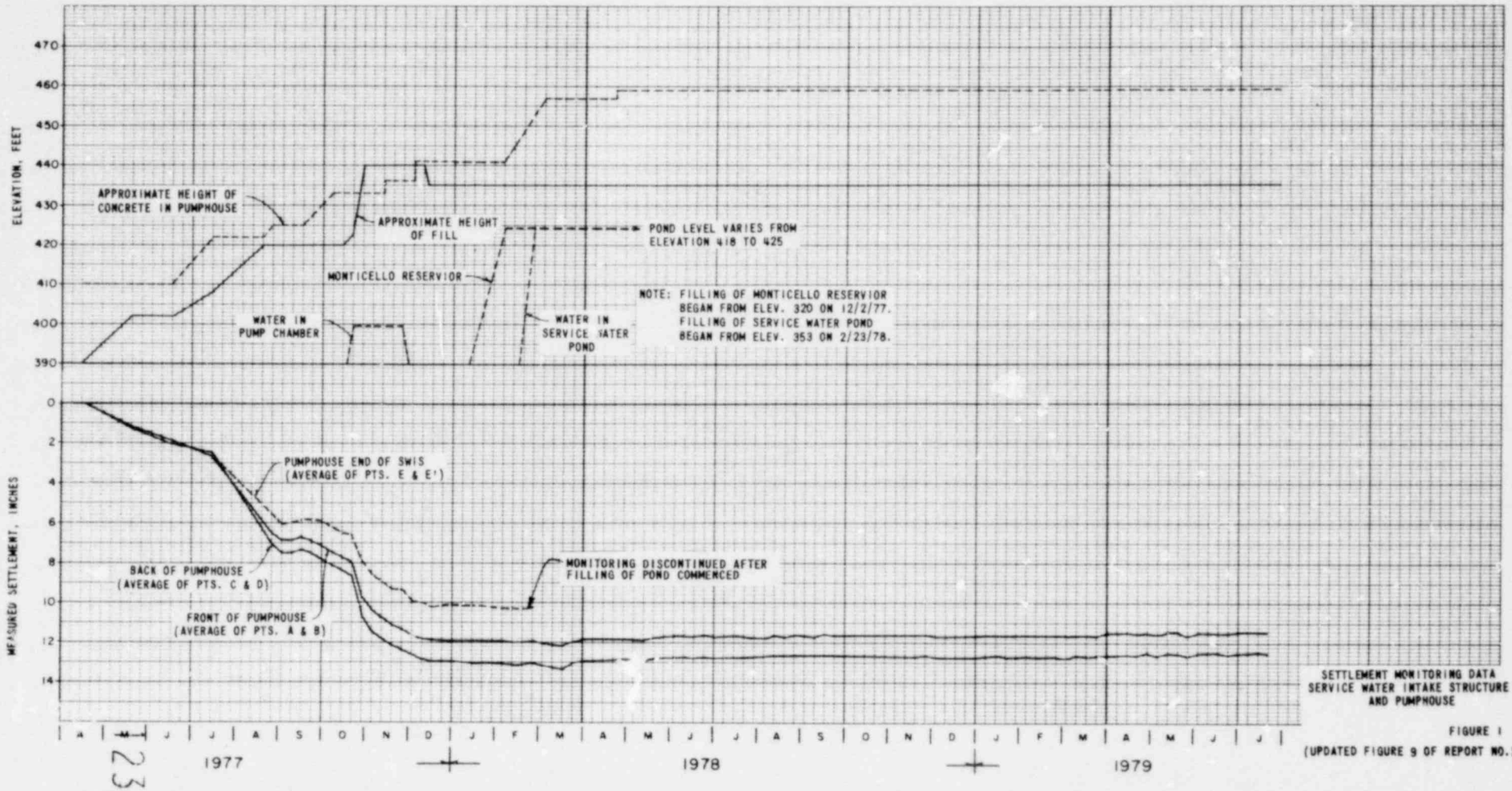
WEST EMBANKMENT SETTLEMENT MONUMENT DATA

DATE	MEASURED SETTLEMENT (inches)(1)						
	WE-8	WE-9	WE-10	WE-11	WE-12	WE-12A	WE-13
9/27/78	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11/01/78	0.28	0.02	-0.04	0.07	0.08	0.07	0.02
11/08/78	0.22	0.06	0.02	0.07	0.07	0.07	0.04
12/06/78	0.28	0.02	-0.01	0.04	-0.06	-0.10	-0.05
1/03/79	0.29	0.02	-0.05	0.00	-0.19	-0.30	-0.13
1/30/79	0.36	-0.04	-0.02	0.05	-0.19	-0.22	-0.07
3/06/79	0.43	-0.04	0.02	0.08	-0.25	-0.22	-0.23
4/04/79	0.30	-0.19	-0.12	0.00	-0.41	-0.36	-0.48
5/02/79	0.24	1.02(2)	-0.19	-0.04	-0.54	-0.49	-0.61
6/05/79	0.19	1.02	-0.20	-0.02	-0.61	-0.60	-0.61
7/04/79	0.18	1.04	-0.19	-0.05	-0.67	-0.66	-0.62

1237 185

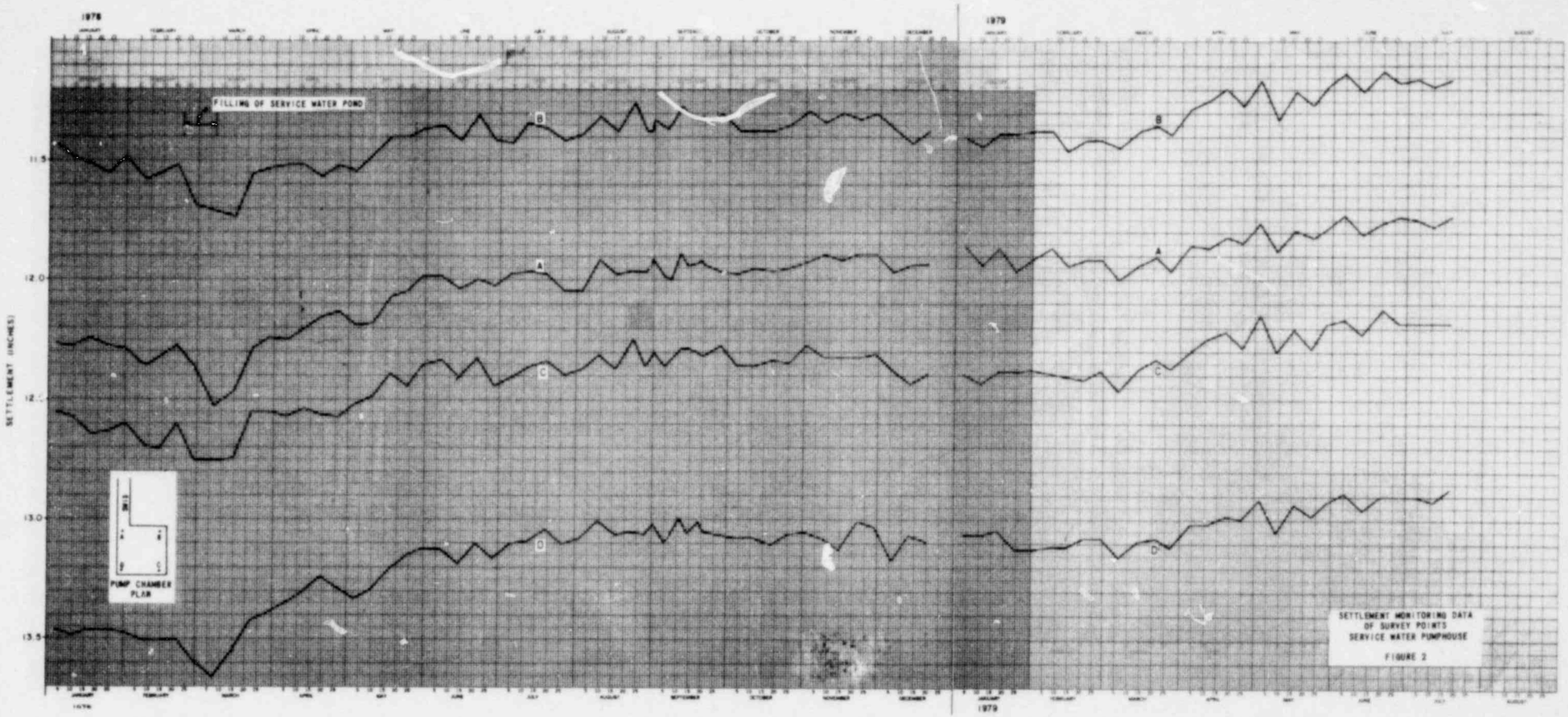
NOTE: (1) Negative readings signify heave as opposed to settlement
(2) Disturbed by utility pole placement

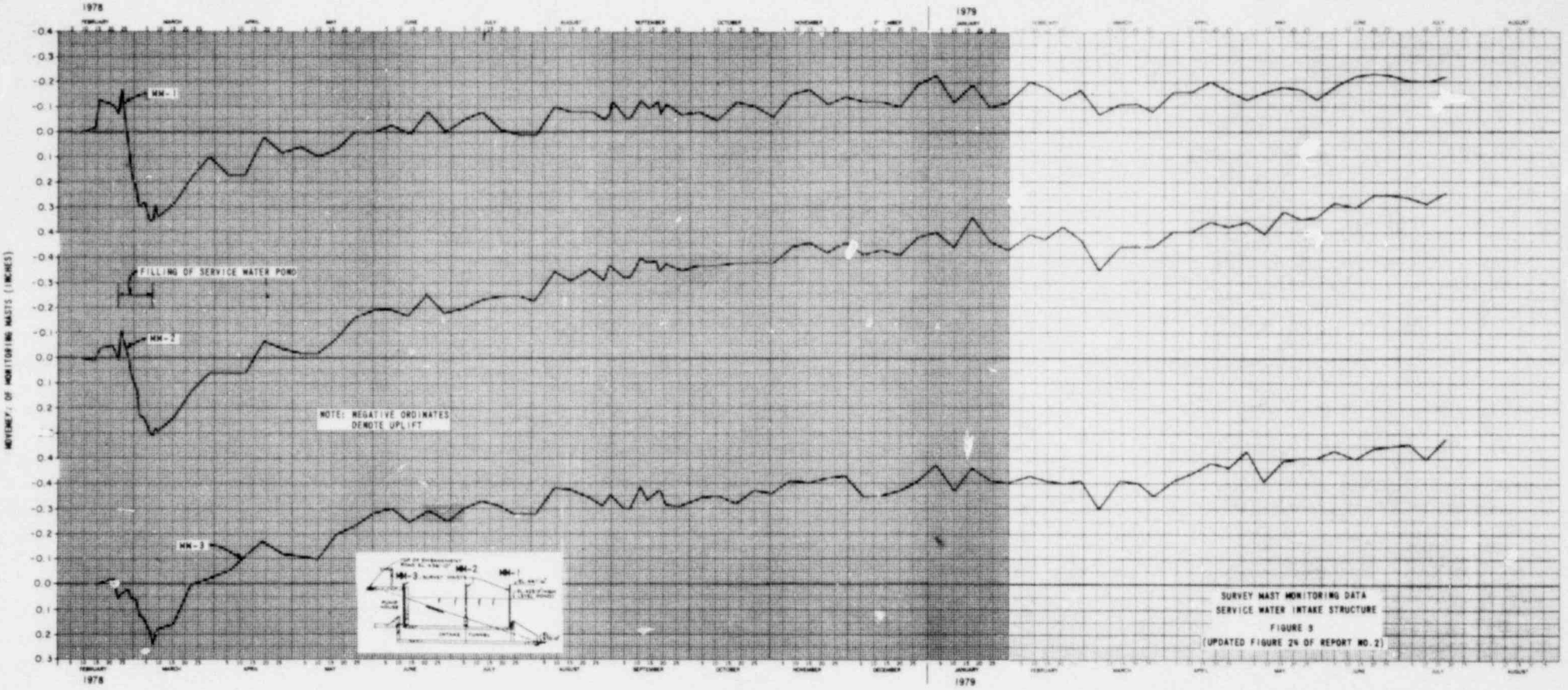
FIGURES

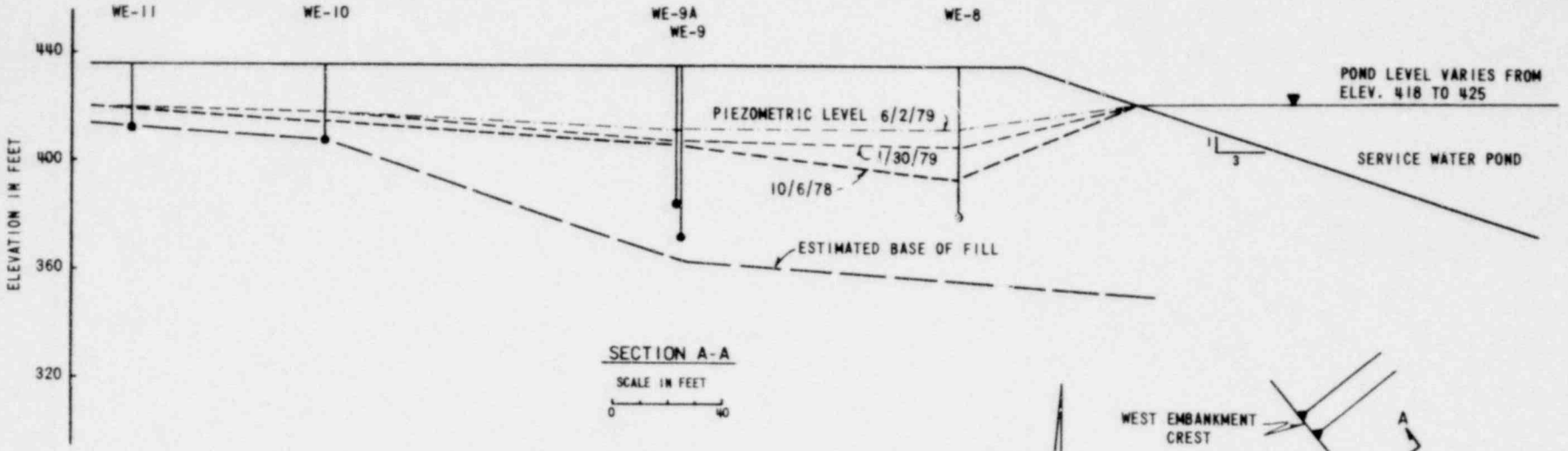


SETTLEMENT MONITORING DATA
SERVICE WATER INTAKE STRUCTURE
AND PUMPHOUSE

FIGURE 1
(UPDATED FIGURE 9 OF REPORT NO. 2)


1978
1979
FILLING OF SERVICE WATER POND
SETTLEMENT (INCHES)
11.5
12.0
12.5
13.0
13.5
A
B
C
D
PUMP CHAMBER PLAN
SETTLEMENT MONITORING DATA OF SURVEY POINTS SERVICE WATER PUMPHOUSE
FIGURE 2

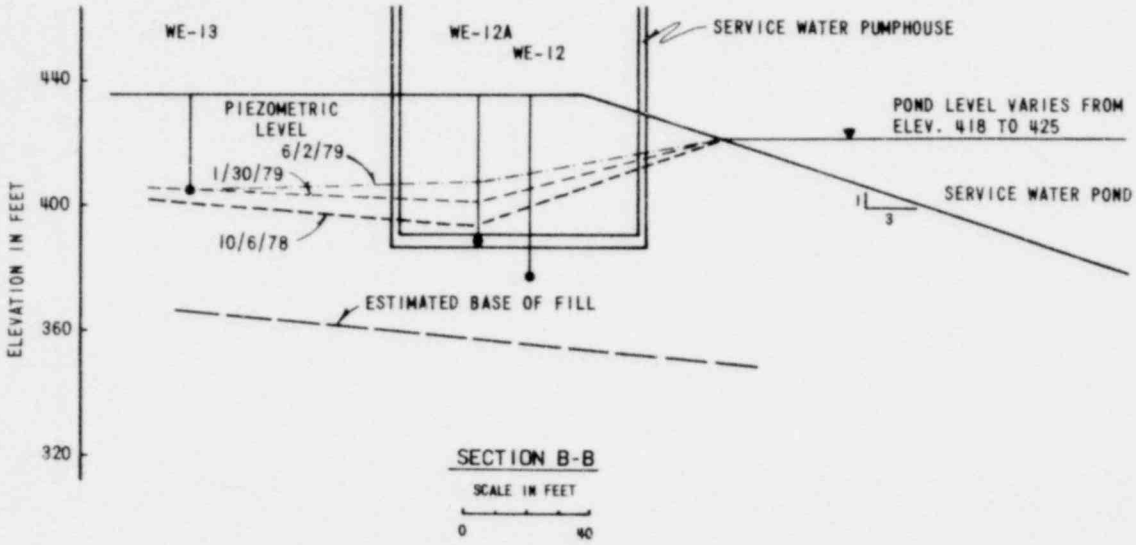

1978
1979
MOVEMENT OF MONITORING MASTS (INCHES)
MM-1
MM-2
MM-3
FILLING OF SERVICE WATER POND
NOTE: NEGATIVE ORDINATES DENOTE UPLIFT
SURVEY MAST MONITORING DATA
SERVICE WATER INTAKE STRUCTURE
FIGURE 3
(UPDATED FIGURE 24 OF REPORT NO. 2)



SECTION A-A

SCALE IN FEET

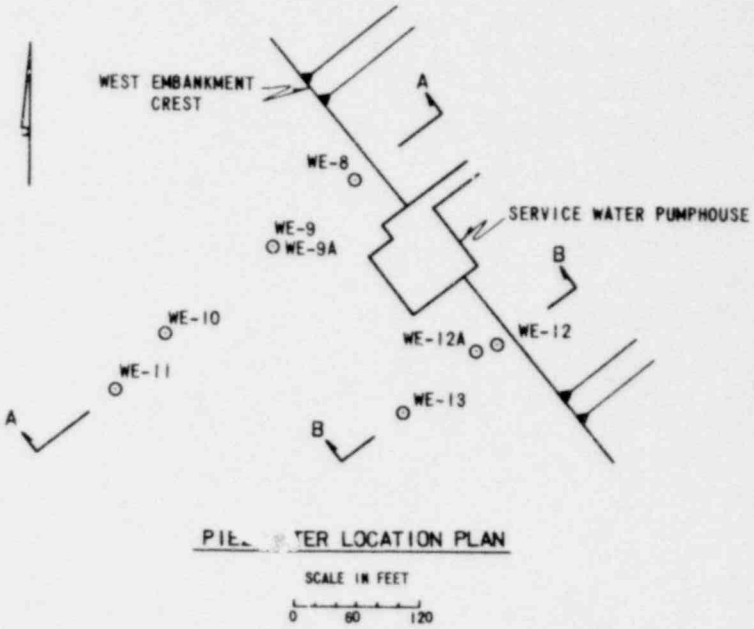
0 40



SECTION B-B

SCALE IN FEET

0 40



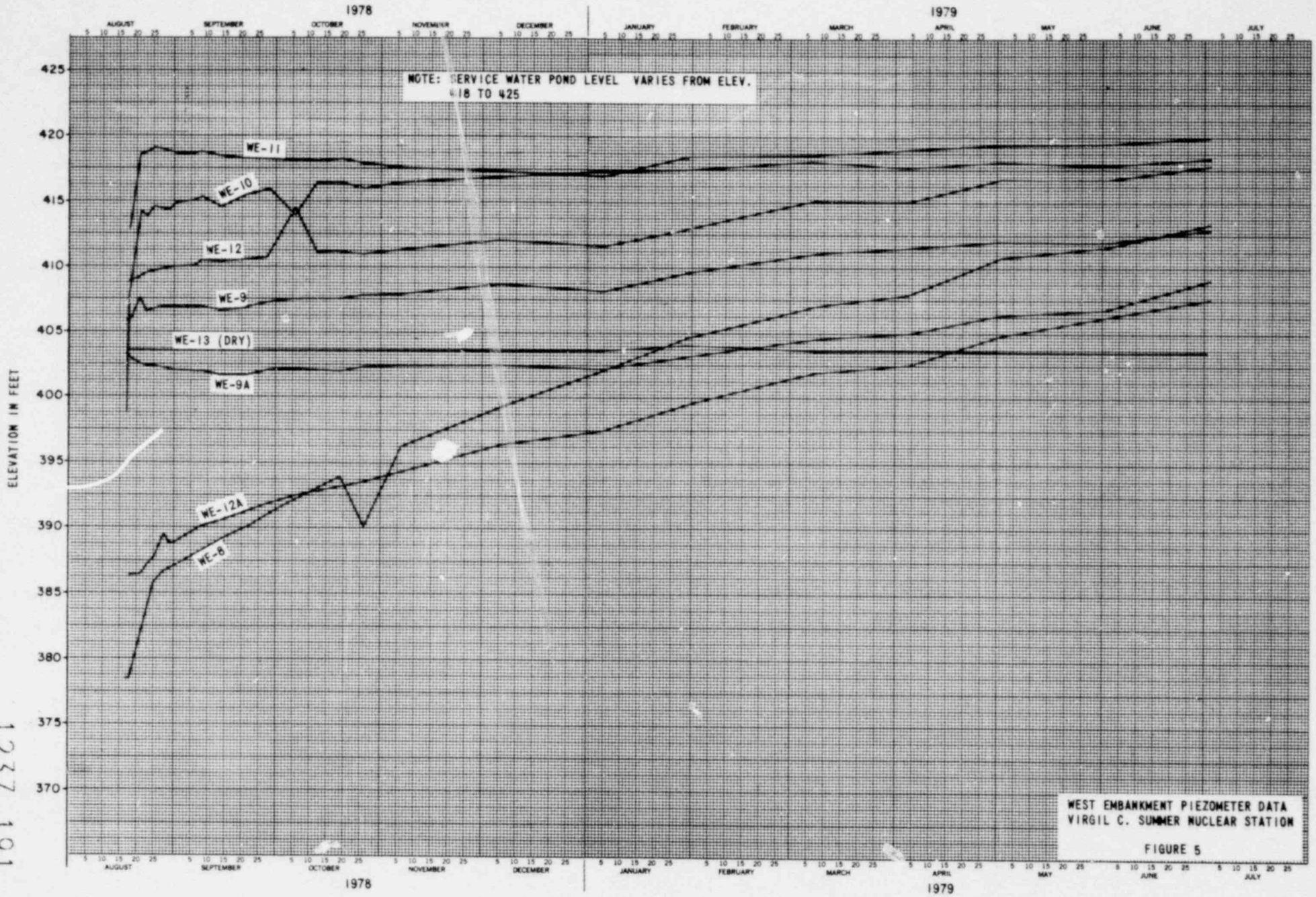
PIEZOMETER LOCATION PLAN

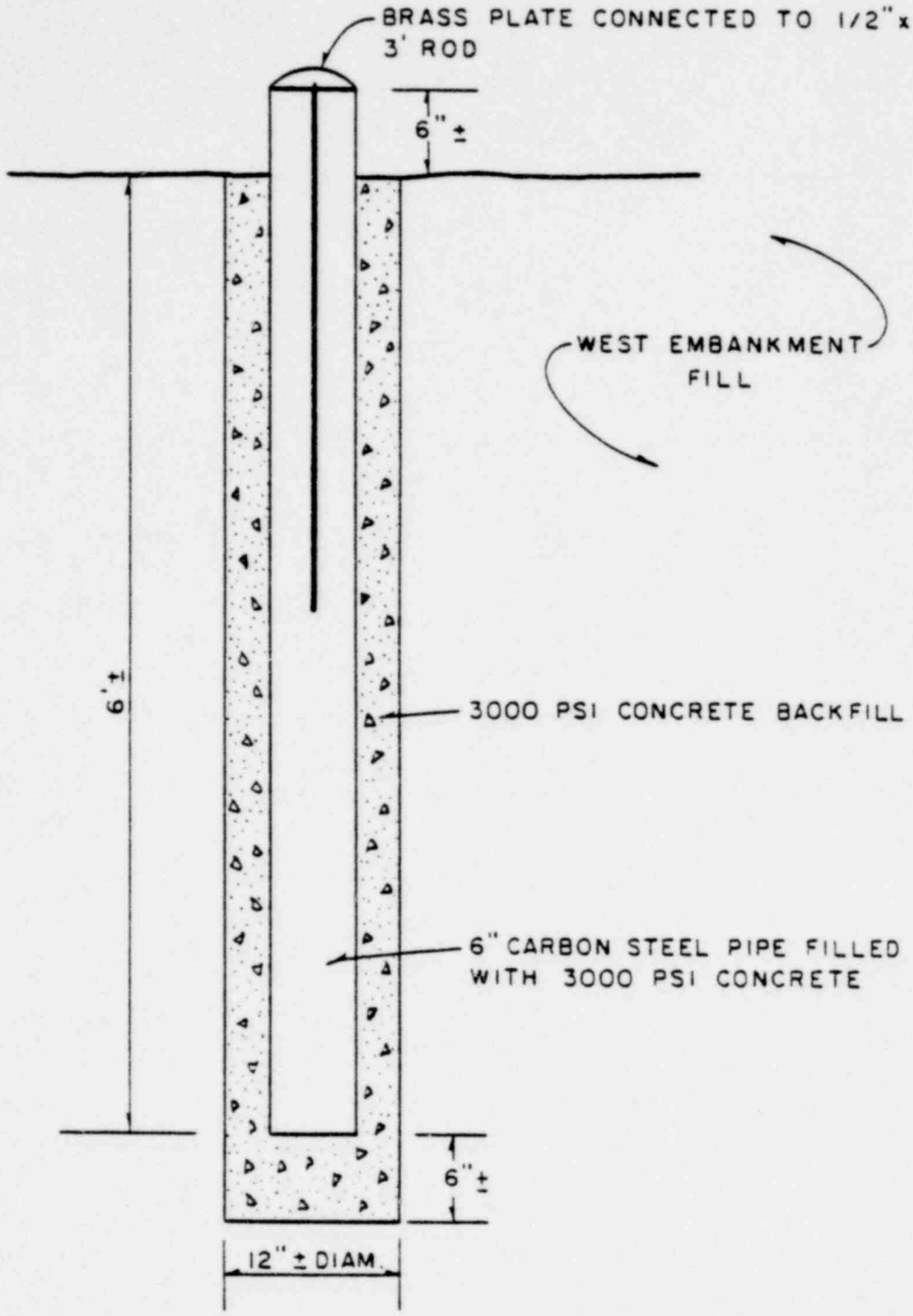
SCALE IN FEET

0 60 120

PIEZOMETER LOCATION PLAN AND PROFILES

FIGURE 4


1978
1979
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
NOTE: SERVICE WATER POND LEVEL VARIES FROM ELEV. 418 TO 425
WE-11
WE-10
WE-12
WE-9
WE-13 (DRY)
WE-9A
WE-12A
WE-8
ELEVATION IN FEET
425
420
415
410
405
400
395
390
385
380
375
370
WEST EMBANKMENT PIEZOMETER DATA
VIRGIL C. SUMMER NUCLEAR STATION
FIGURE 5

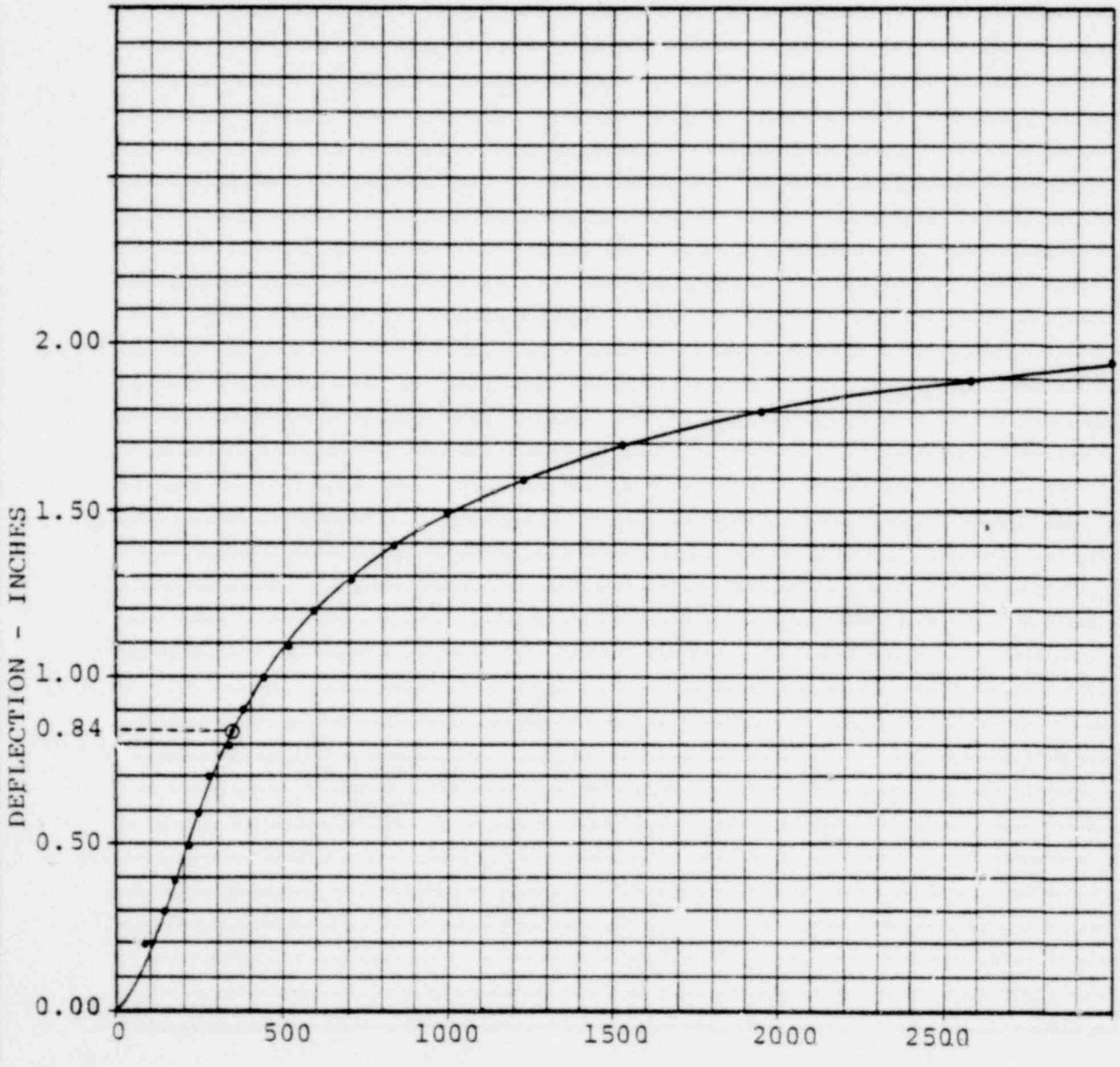


1237 192

WEST EMBANKMENT
SETTLEMENT MONUMENT

FIGURE 6

UNCONFINED COMPRESSION TEST				
Project	Virgil C. Summer Nuclear Station			
Boring No. N/A	Sample No. N/A	Depth N/A	Ft.	
Description	Servicise Closed Cell Foam Blocks 6.1" x 6.2" x 2.3"			
Moisture Content N/A %		Dry Density N/A	pcf	
Liquid Limit N/A %	Plastic Limit N/A %			



⊙ 0.841 inches recorded maximum accumulative "squeeze up" as of June 1979

LOAD VS. DEFLECTION CURVE
SERVICISE CLOSED CELL
PLASTIC FOAM BLOCKS

FIGURE 7

JOB No 71 C 72

WGA RP - 2

APPENDIX A

SALMONS DREDGING CORPORATION
MARINE CONTRACTORS AND ENGINEERS

SUBMARINE PIPE LINES AND CABLES
SHIP SALVAGE OPERATIONS, DIVING, PIERS, DOCKS AND BRIDGES
FACILITIES AVAILABLE AT OUR TERMINALS FOR VESSELS OF ALL TONNAGE
CHERRY HILL LANE ON SHIPYARD RIVER

TELEPHONE A. C. 803
722-3813

P. O. BOX 42. ZIP 29402
CHARLESTON, SOUTH CAROLINA

June 15,1979.

DIVERS REPORT
V.C. SUMMER NUCLEAR PLANT - JENKINSVILLE, S.C.

June 7,- 13th,1979

As the divers were making their suvey of the service water intake tunnel they found at Station y-47'-0', F. section 3 feet up from A section, a 3/4" hole. Also at station Y-47'-6" F. section, 5 feet up from A.section another 3/4" hole. These holes are plugged with wooden plugs. We were told at the job site that these holes were used to force grout into a crack found before flooding.

In the service water pump house at elevation 400, at the corner of the wier wall where it joins the south wall, there was a hairline crack less than .015". This crack ran all the way around and terminated at the corner of the north wall and wier wall at the top, elevation 400.

Note: This crack is on the south, east and north walls only and is a horizontal crack.

Robert L. Barry

Robert L. Barry, Master Diver
SALMONS DREDGING CORPORATION

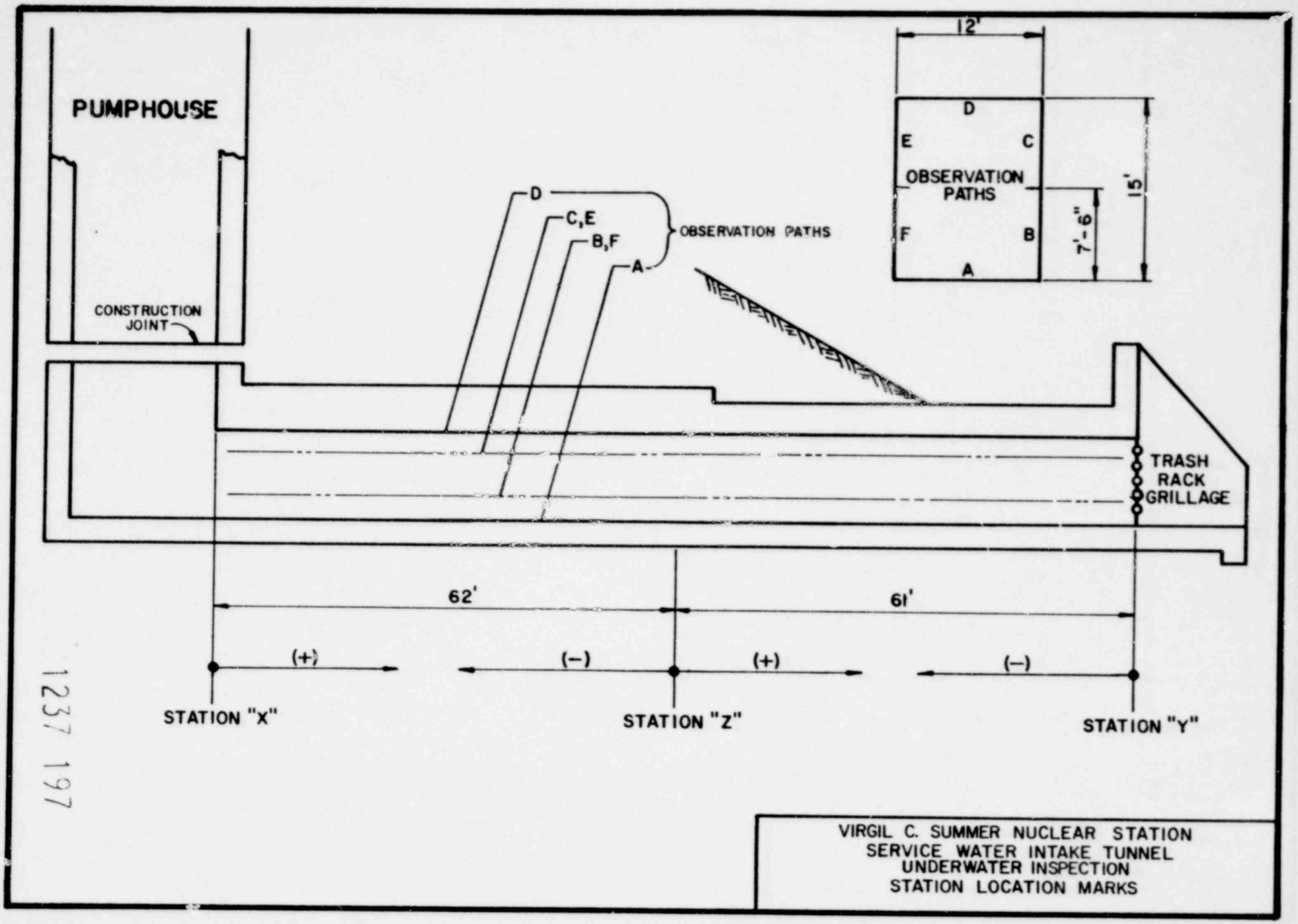
1237 195

TABLE A-1

VIRGIL C. SUMMER NUCLEAR STATION
SERVICE WATER INTAKE TUNNEL
UNDERWATER INSPECTION

Crack Identification Number	Observation Path	Station Identification	Distance From Station	Width of Crack			Remarks
				None	Less Than 0.015"	0.015" to 0.080"	
1	A	Y		✓			A hairline crack that starts at the corner of Station (D) and (C) and runs down vertically 4'-0" and ends.
	B	Y		✓			
	C	Y	-50'-6"		✓		
	D	Y		✓			
	E	Y		✓			
	F	Y		✓			
2	A	Z		✓			A hairline crack that starts at Station "Z" -15'-0", 5'-0" up from (A) and ends 3'-0" down from (D) at Station "Z" -17'-0".
	B	Z		✓			
	C	Z		✓			
	D	Z		✓			
	E	Z	-17'-0"		✓		
	F	Z	-15'-0"		✓		
3	A	X		✓			A hairline crack that starts 4'-0" down from (D) at Station "X" +32'-0" and ends 3'-6" from (D) at Station "X" +31'-8".
	B	X		✓			
	C	X		✓			
	D	X		✓			
	E	X	+32'-0"		✓		
	F	X		✓			
4	A	X		✓			A hairline crack that starts at (C) - (D) Station "X" +55'-0" and ends 3'-6" above (A) Station "X" +55'-0".
	B	X	+55'-0"		✓		
	C	X	+55'-0"		✓		
	D	X		✓			
	E	X		✓			
	F	X		✓			

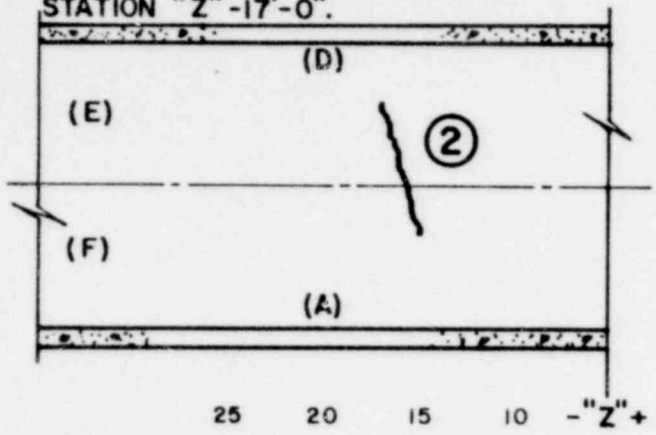
Survey began June 7 and ended June 15, 1979.



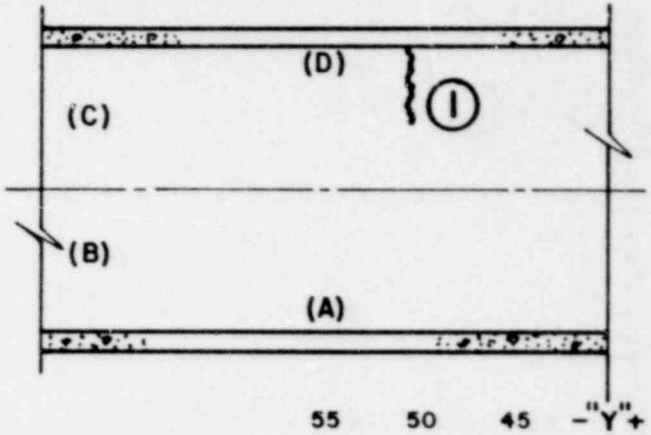
1237 197

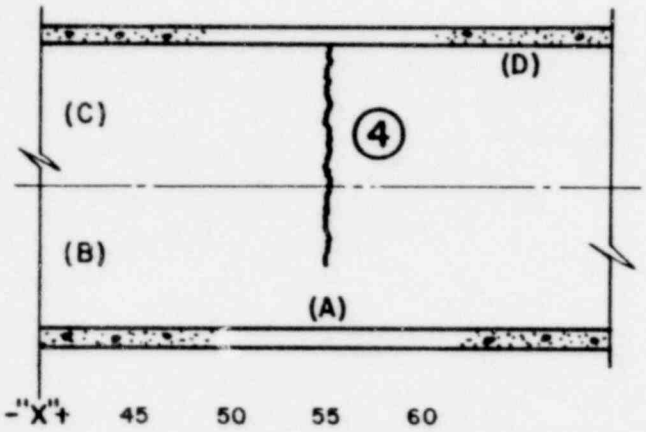
VIRGIL C. SUMMER NUCLEAR STATION
SERVICE WATER INTAKE TUNNEL
UNDERWATER INSPECTION
STATION LOCATION MARKS

A HAIRLINE CRACK THAT STARTS AT STATION "Z"-15'-0",5'-0" UP FROM (A) AND ENDS 3'-0" DOWN FROM (D) AT STATION "Z"-17'-0".

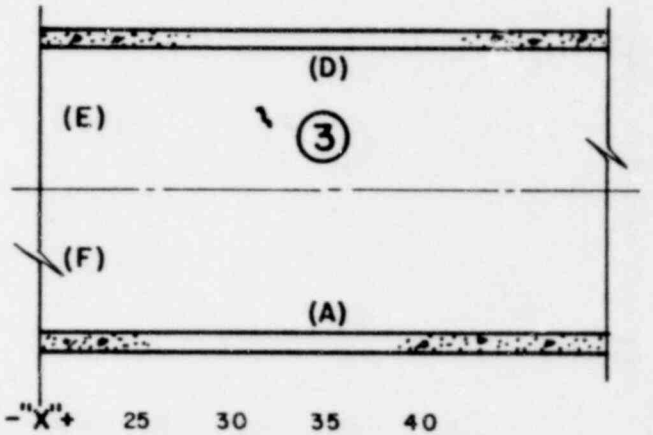


A HAIRLINE CRACK THAT STARTS AT THE CORNER C-D & RUNS VERTICAL DOWN 4'-0" AT STA. "Y"-50'-0".





A HAIRLINE CRACK THAT STARTS AT THE CORNER C-D AT STA. "X"+55'-0" AND ENDS 3'-6" ABOVE (A) AT STA. "X" +55'-0".



A HAIRLINE CRACK THAT STARTS 4'-0" DOWN FROM (D) AT STA. "X"+32'-0" AND ENDS 3'-6" FROM (D) AT STA. "X" +31'-8".

VIRGIL C. SUMMER NUCLEAR STATION
SERVICE WATER INTAKE TUNNEL
UNDERWATER INSPECTION
CRACK LOCATIONS

1237 198