50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. NSF/RA-780336	2.	3. Recipient's Accession No.

4. Title and Subtitle
Engineering Profile of Latham Water District, Albany, New York, Seismic Vulnerability, Behavior and Design of Underground Piping System, Technical Memorandum No. 2

5. Report Date
April 1978

6.

7. Author(s)
L.R.-L. Wang, W.T. Lavery

8. Performing Organization Rept. No.
Technical Memor. #2

9. Performing Organization Name and Address
Rensselaer Polytechnic Institute
Department of Civil Engineering
Troy, New York 12181

10. Project/Task/Work Unit No.
SVBDUPS Project

11. Contract(C) or Grant(G) No.
(C)
(G) ENV7614884

12. Sponsoring Organization Name and Address
Applied Science and Research Applications (ASRA)
National Science Foundation
1800 G Street, N.W.
Washington, DC 20550

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

This technical memorandum describes the engineering data need for the seismic vulnerability evaluation of Latham Water District, Albany, New York. These data include: structural information of the water distribution system; soil conditions in the District; and geological environment within the District. The main body of this report consists of tables on well information, driller's logs, water distribution maps, and schematics. The research reported in this memorandum is part of a project whose overall aims are to develop a systematic way of assessing the adequacy and vulnerability of water/sewer distribution systems subjected to seismic loads and to develop future design methodologies.

17. Document Analysis a. Descriptors

Water distribution
Water supply
Seismology
Seismic detection
Water pipelines
Soil structure
Soil properties
Subsurface investigations

b. Identifiers/Open-Ended Terms

Seismic vulnerability

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
NTIS	20. Security Class (This Page)	22. Price

34

A03 - A01

(See ANSI-Z39.18) *See Instructions on Reverse*

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

Seismic Vulnerability, Behavior and Design of Underground Piping System

Engineering Profile of

Latham Water District
Albany, New York

by

Leon Ru-Liang Wang

Warren T. Lavery

Sponsored by National Science Foundation

Research Applied to National Needs (RANN)

Grant No. ENV76-14884

Technical Memorandum (SVBDUPS Project) No. 2

April 1978

Department of Civil Engineering
Rensselaer Polytechnic Institute
Troy, New York 12181

ACKNOWLEDGEMENT

This is the second in a series of Technical Memoranda under the general title of 'Seismic Vulnerability, Behavior and Design of Underground Piping Systems' (SVBDUPS). A technical memorandum is written with somewhat limited objective and scope as compared to a technical report.

The research has been sponsored by the Earthquake Engineering Program of NSF-RANN under grant No. ENV76-14884 and Dr. S.C. Liu is the Program Manager of this Project in which Dr. Leon Ru-Liang Wang is the Principal Investigator. The overall aims of this research are to develop a systematic way of assessing the adequacy and vulnerability of water/sewer distribution systems subjected to seismic loads and to develop future design methodologies.

Most of the figures in this Memorandum have been prepared by Mr. F. Peter Tolcser, a graduate student in the Department of Civil Engineering at R.P.I. His work is greatly appreciated. The discussions by Dr. Michael O'Rourke is very helpful.

Appreciation also goes to the Advisory Panel which consists of Mr. Holly A. Cornell, Board Chairman of CH2M Hill, Inc., Corvallis, Oregon; Mr. Warren T. Lavery, Superintendent of Latham Water District, Latham, N.Y.; Dr. Richard Parmelee, Professor of Civil Engineering, Northwestern University and Drs. Jose Roesset and Robert Whitman, Professors of Civil Engineering, M.I.T., for their constructive comments and suggestions.

The typing and proofreading of this report by Mrs. Jo Ann Grega and Mrs. Betty Alix are also appreciated.

Please note that although the project is sponsored by the National Science Foundation, any opinions, findings and conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the view of National Science Foundation.

Introduction

The purpose of this technical memorandum is to describe the engineering data needed for the seismic vulnerability evaluation of Latham Water District, Albany, New York. Note that the seismic risk analysis of Latham has been studied[2], the engineering data needed for the seismic vulnerability evaluation of the system are as follows:

. Structural information of the water distribution system;

. Soil conditions in the District

. Geological environment with the District.

These engineering profile data will be described separately in the following sections.

Structural Information of the Water Distribution System[3]

Latham Water District is in the Town of Colonie, which is north of the City of Albany and west of Troy in the State of New York. The water distribution system covers most of the Town of Colonie, with a total area of approximately 50 square miles (130 square kilo-meters). The system has two intakes, one from The Mohawk River and the other from The Stony Creek Reservoir. There are two water treatment plants, one for each of the two intakes (Fig. 1).

The Latham water distribution system consists of water pipes with sizes varying from 6 inches (15.24 cm) to 30 inches (76.2 cm) in diameter. The location of the pipes with a diameter of 10 inches (25.4 cm) and above are shown in Fig. 1. The buried depth of these pipes are generally 5 ft from the ground surface regardless of pipe sizes. Backfills is natural soil.

Most of these pipes are cast iron pipes with exceptions of a 30 inch (76.2 cm) and two 24 inch (61 cm) mains near the north boundary of the town which are pre-stressed concrete pipes. The typical buried pipe trench and joint details are shown in Figs. 2 and 3 respectively and correspond to AWWA

Standards[4].

The junction details are sometimes very complex. Some junction details are given in the Appendix. At some locations, pipes cross in plan but are separated in elevation. These crossing pipes are considered as independent pipes.

Soil Conditions

The soil in the Latham Water District was deposited by the glacier of the pleistocene geologic age. The major types of soil are till and outwash. Till is a non-homogeneous mixture, ranging in size from clay to boulders. It is material dropped by the glacier, usually at the borders of the glacier. Outwash is deposited by glacial streams or is settled out of standing water of a glacial age. Outwash exhibits a layering pattern and noticeable gradations in size.

From Reference 1, well information for the Latham Water District area is given in Table 1 and Fig. 4. The details of driller's logs for those borings owned by the Latham Water District are given in Table 2.

From Table 1, the depths of soil layer to bed rock (in feet) in the district are presented and contours of the soil depth are plotted in Fig. 5. From this figure, one can see that in the Latham Water District Area, the bed rock forms a valley near the center of the district.

Geological Conditions

The Latham Water District has shale as bedrock as shown in Fig. 6. These deposits were formed during the Ordivician geologic age. The three primary rock formations are the Normanskill shale, the Snake Hill formation, and the Indian Ladder formation. The depth of these formations ranges between 400 and 3000 ft. On the whole, they are very dense and quite impervious, and as a result do not have good water bearing characteristics.

From Fig. 5, one finds that in the Latham Water District the maximum depth of soil to bed rock is 305 ft (93 m) and the minimum depth is 8 ft (25 m) with a mean value of 86.85 ft (26.5 m) and a standard deviation 71.54 ft (21.8 m).

Notes of the Latham Water District

1) Depth of pipe: Top of pipe is typically 4-5 ft below ground surface.
2) Usually, when a large pipe crosses a smaller (usually older) one, the larger diameter pipe goes under the smaller pipe.
3) Connections are all cast iron.
4) Bedding type 1 or 2 is used (Spec. C150-76, page 9, Table 50.2)[4]; it is tamped when settlement is to be considered.
5) Almost all cast iron pipes are 18/40 strength. (Higher strength pipes are used for high rise buildings, in high pressure systems, or in fire districts. They are not used in the Latham Water District).
6) The pressure in the pipes of the Latham Water District varies from 40 to 110 psi.[3]

References

1. Arnow, T.
The Ground-Water Resources of Albany County, New York
Bulletin GW-20, Department of Conservation
State of New York, 1949

2. O'Rourke M.J. and Solla E.
Seismic Risk Analysis of Latham
Technical Report (SVBDUPS Project) No. 3, Dept. of Civil Engineering
Rensselaer Polytechnic Institute, Troy, NY, May 1977

3. Latham Water District
Standard Specifications for Water Distribution Systems
Town of Colonie, New York 1974

4. American Water Work Association
AWWA Standards

TABLE 1
WELL INFORMATION WITHIN LATHAM WATER DISTRICT

Well No.	Location	Elevation (ft)	Depth to Ground Water Table (ft)	Depth to Bedrock (ft)	Geologic Subdivision	Detailed Boring Data
4	F-5	320	15	-	Pleistocene Gravel	Yes*
7	F-4	320	8	-	Pleistocene Sand	
8	F-5	310	22	-	..	
9	F-6	380	-	84	Snake Hill Formation	
10	F-6	380	-	81	Snake Hill Formation	
11	F-6	310	10	38	Pleistocene Sand	
13	G-4	320	4	-	..	
14	G-6	300	10	-	..	
15	G-6	295	10	-	..	
17	G-7	310	4	-	..	
18	H-5	300	7	-	..	
19	G-6	295	8	-	..	
20	G-7	300	6	-	Pleistocene Quicksand	
21	G-9	380	-	50	Snake Hill Formation	
23	H-7	295	8	-	Pleistocene Gravel	Yes*
24	G-8	310	-	80	..	
25	H-6	250	5	-	Pleistocene Sand	
26	H-7	295	10	-	..	

TABLE 1
WELL INFORMATION WITHIN LATHAM WATER DISTRICT
(continued)

Well No.	Location	Elevation (ft)	Depth to Ground Water Table (ft)	Depth to Bedrock (ft)	Geologic Subdivision	Detailed Boring Data
27	I-8	220	15	-	..	
28	I-8	220	15	-	..	
62	I-4	220	17	-	..	
64	I-4	285	16	-	..	
67	I-4	290	12	-	..	
68	H-5	280	3	-	..	
72	J-5	200	3	-	..	
199	I-5	250	3	-	..	
214	J-8	200	-	214	Snake Hill Formation	
230	I-10	220	36	64	..	
240	G-10	280	20	56	..	
241	G-11	100	8	30	..	
252	F-12	25	-	39	..	
253	D-10	320	22	-	Pleistocene Till	
254	D-10	320	28	-	..	
256	C-10	360	16	18	Normanskill Shale	Yes*
257	A-10	240	25	30	..	
259	C-9	350	11	22	..	
260	C-9	200	32	8	..	
261	E-5	300	8	-	Pleistocene Gravel	

TABLE 1

WELL INFORMATION WITHIN LATHAM WATER DISTRICT

(continued)

Well No.	Location	Elevation	Depth to Ground Water Table (ft)	Depth to Bedrock (ft)	Geologic Subdivision	Detailed Boring Data
265	F-7	300	29	-	..	Yes*
266	F-7	300	0	305	..	*
267	E-7	280	12	164	Pleistocene Sand	Yes*
268	F-7	285	0	48	Pleistocene Gravel	Yes*
269	F-2	340	14	73	Pleistocene Sand	Yes*
270	F-3	330	7	38	..	*
271	G-8	320	40	127	..	Yes*
272	H-6	290	24	218	..	Yes*
273	D-7	210	28	173	Pleistocene Gravel	Yes*
274	D-6	200	-	94	..	*
311	F-10	300	80	113	Snake Hill Formation	
314	H-10	280	25	58	..	
320	C-11	260	-	80	Normanskill Shale	
351	G-11	50	6	40	Snake Hill Formation	

*Wells Owned by the Latham Water District

TABLE 2

Driller's Logs of Latham Water District Owned Wells

(Altitudes are approximate elevations above mean sea level, as taken from the topographic map)

Well #4; dug well; altitude 320 feet.

	Thickness (feet)	Depth (feet)
Sand	1	1
Hardpan	4	5
Clay, blue	10	15
Quicksand	1	16
Clay, blue	8	24
Gravel	1	25

Well #23; drilled by Van Nouhuys in 1923; altitude 295 feet.

Clay and quicksand	19	19
Hardpan	2	21
Gravel	4	25

Well #256; drilled by Hall and Co., Inc., in 1935; altitude 260 feet.

Cemented gravel and hardpan	18	18
Bluestone (Normanskill shale)	32	50
Sandstone (Normanskill shale)	33	83

Well #265; drilled by Layne-New York Co., Inc., in 1930; altitude 300 feet.

Sandy clay	10	10
Fine sand and blue clay	43	53
Hard packed sand	72	125
Tough blue clay and coarse sand and gravel	51	221
Boulders	24	245
Hardpan	1	246

Well #267; drilled by Layne-New York Co., Inc., in 1932; altitude 280 feet.

Top soil	10	10
Sand	65	75
Blue clay	75	150
Sand	15	165

TABLE 2 (continued)

Well #268; drilled by Layne-New York Co., Inc., in 1932; altitude 285 feet.	Thickness (feet)	Depth (feet)
Yellow clay	7	7
Blue clay	33	40
Dark gravel	10	50
Well #269; drilled by Layne-New York Co., Inc., in 1934; altitude 340 feet.		
Yellow sand.	12	12
Blue clay	2	14
Yellow sandy clay	11	25
Gray sand	10	35
Brown clay.	2	37
Gray fine sand.	13	50
Gray coarse sand.	23	73
Schenectady formation at	-	73
Well #271; drilled by Layne-New York Co., Inc., in 1941; altitude 320 feet.		
Brown sand.	14	14
Shale and boulders.	6	20
Fine brown and gray sand.	10	30
Fine brown sand and some gravel	19	49
Sandy blue clay	10	59
Black gravel and sand	5	64
Black gravel, some clay, and sand	19	83
Black gravel, more sand	7	90
Black shale and boulders.	25	115
Hard sand and shale	5	120
Black hard rock	3	123
Soft blue clay	4	127
Black hard rock (Snake Hill formation)	20	147
Well #272; drilled by Layne-New York Co., Inc., in 1942; altitude 290 feet.		
Top soil	1	1
Fine brown sand	9	10
Fine brown sand and streaks of hardpan.	27	37
Blue clay	16	53
Fine sand and clay.	46	99
Tough blue clay	6	105
Fine sand and clay.	43	148
Blue clay	55	203
Sand, shale, clay, and boulders	15	218
Blue rock (Snake Hill formation).	11	229

TABLE 2 (continued)

Well #273; drilled by Layne-New York Co., Inc., in 1942;
altitude 210 feet

	Thickness (feet)	Depth (feet)
Sandy clay	6	6
Fine sand	8	14
Blue clay	99	113
Coarse black sand, gravel, and clay	7	120
Gravel and boulders	2	122
Coarse black sand and heavy gravel	23	145
Coarse gravel	13	158
Boulders and gravel, hard streaks	15	173
Snake Hill formation	2	175

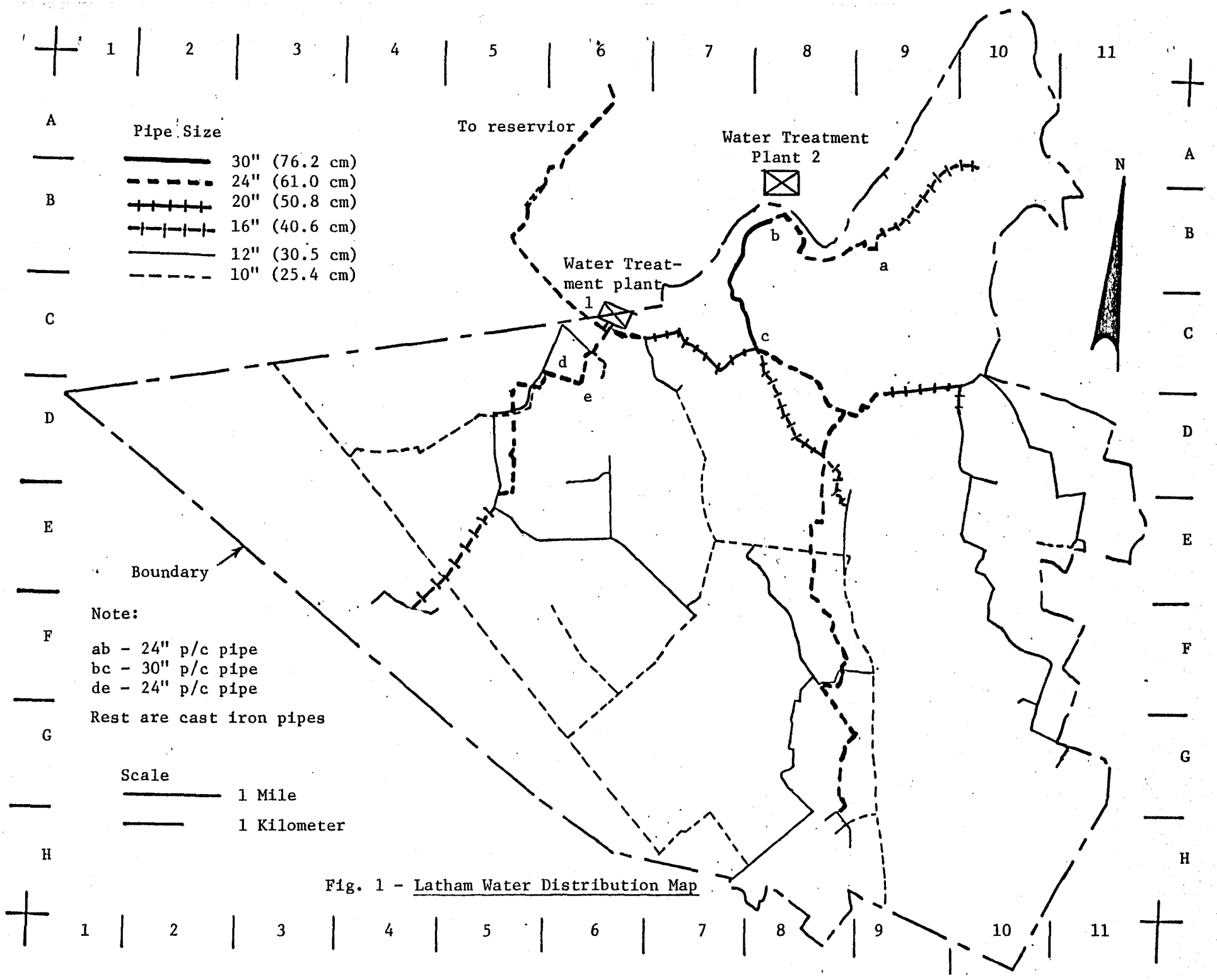
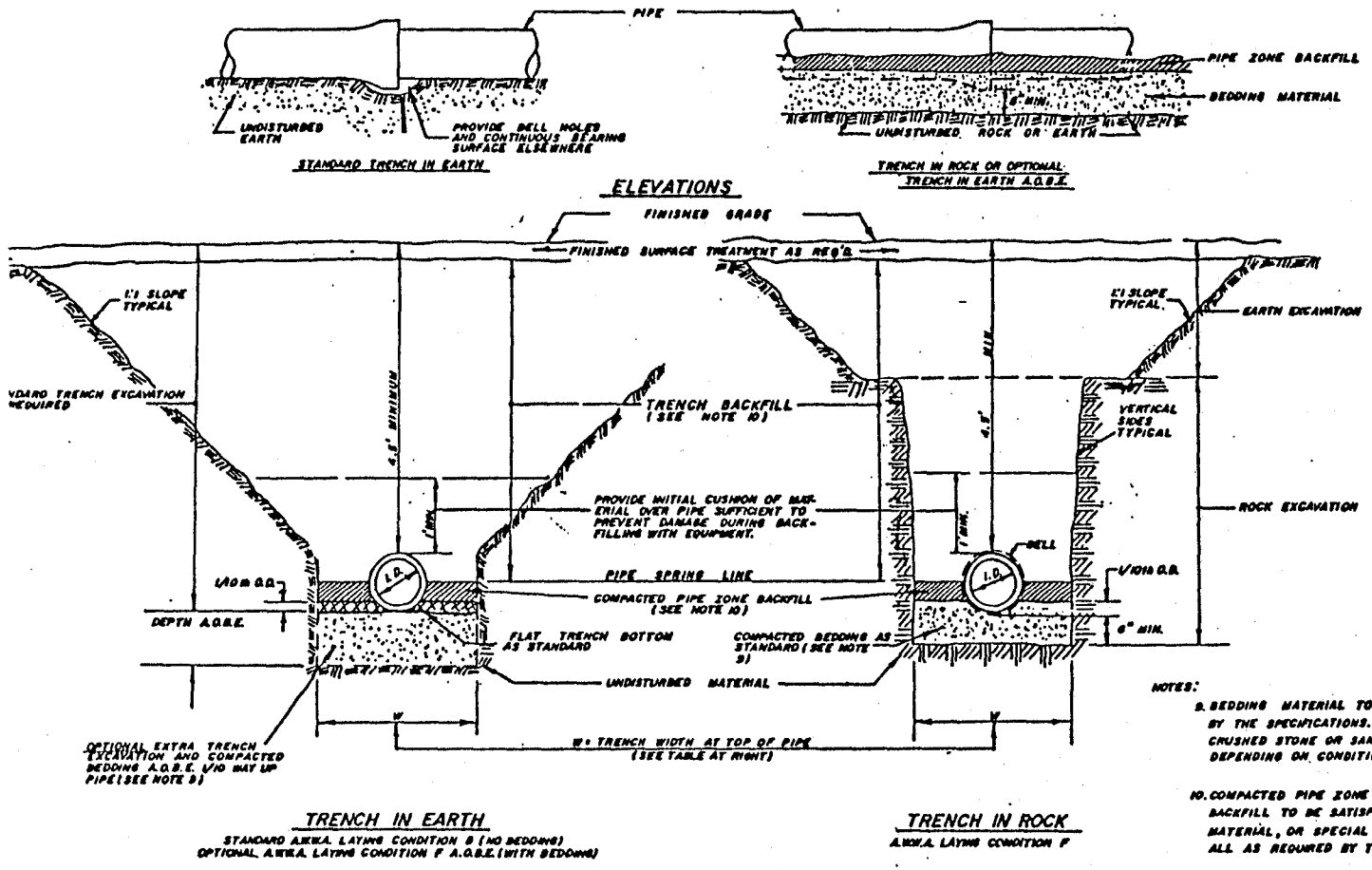


Fig. 1 - Latham Water Distribution Map

TYPICAL CONCRETE THRUST BLOCK DETAILS

NO SCALE



NOTES:

9. BEDDING MATERIAL TO BE AS REQUIRED BY THE SPECIFICATIONS. VARIOUS SIZES OF CRUSHED STONE OR SAND SHALL BE USED DEPENDING ON CONDITIONS.

10. COMPACTED PIPE ZONE BACKFILL AND TRENCH BACKFILL TO BE SATISFACTORY EXCAVATED MATERIAL, OR SPECIAL TRENCH BACKFILL, ALL AS REQUIRED BY THE SPECIFICATIONS.

Fig. 2 - **TYPICAL TRENCH DETAILS**

NO SCALE

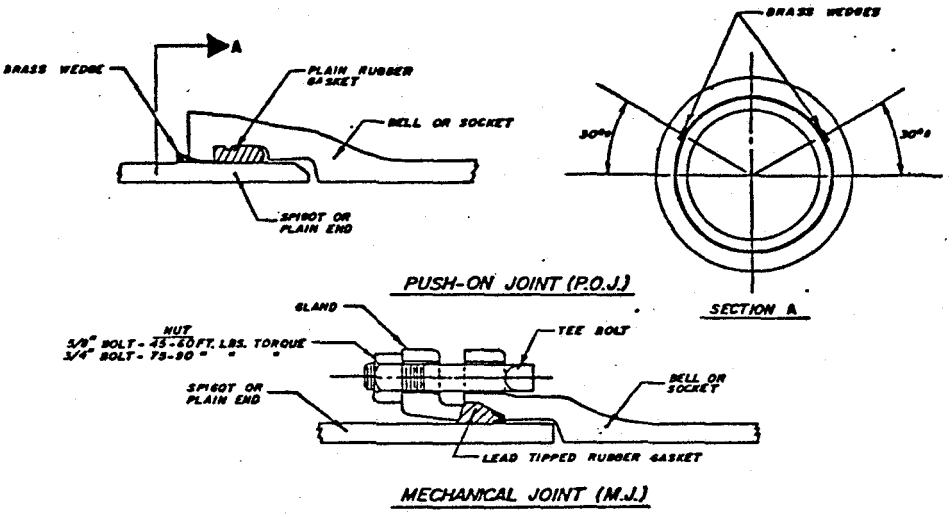


Fig. 3 - TYPICAL JOINT DETAILS
NO SCALE

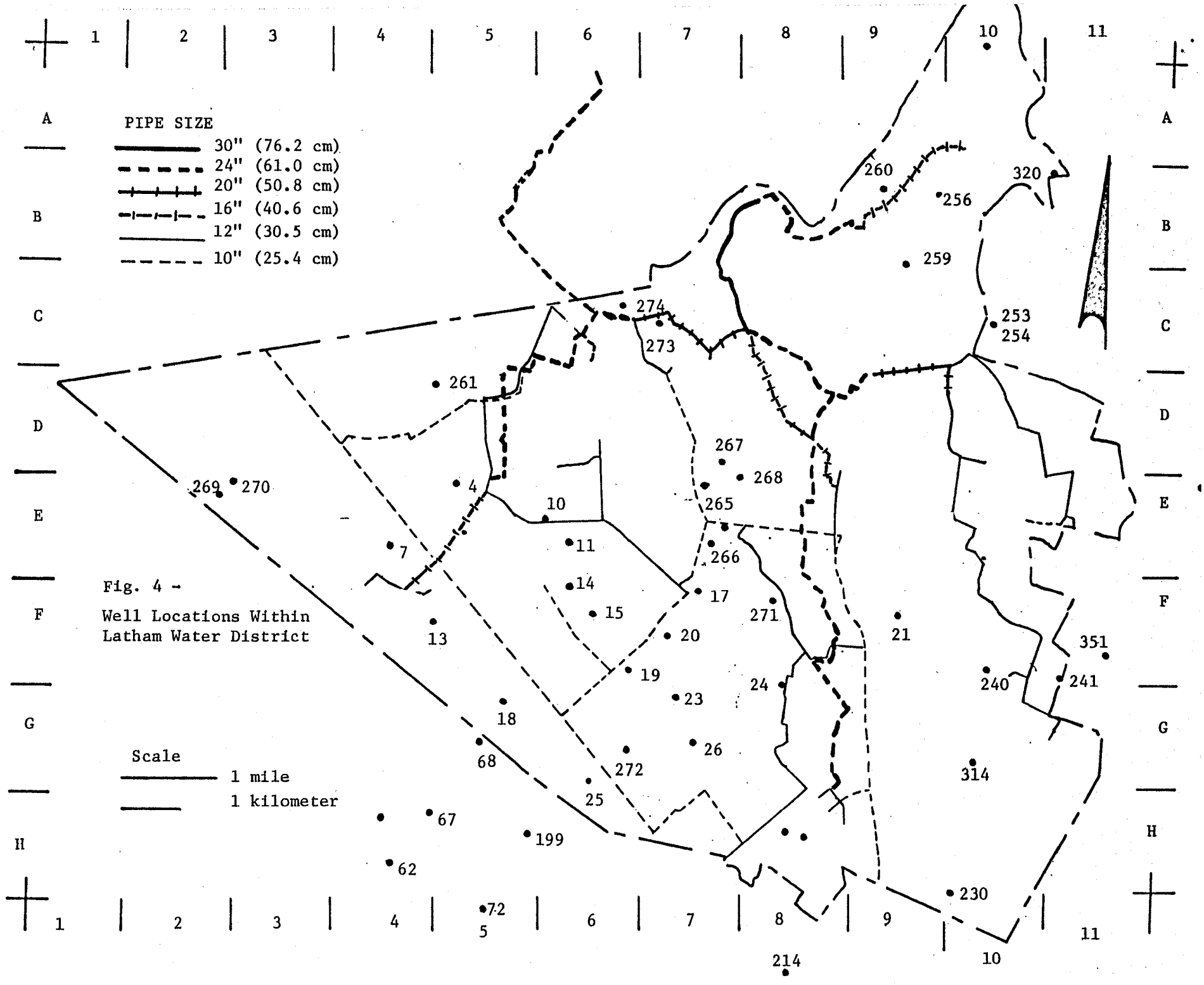
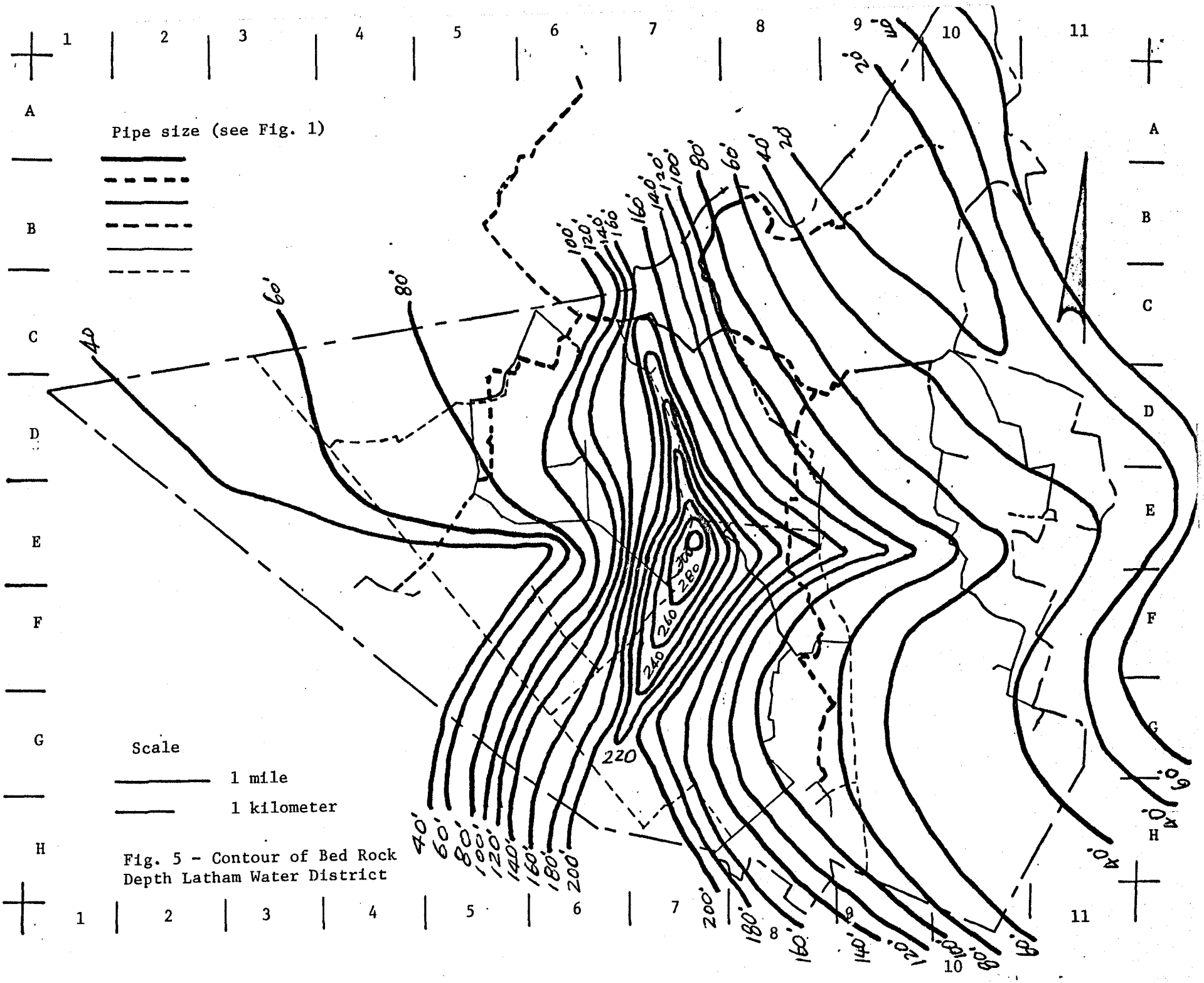


Fig. 4 - Well Locations Within Latham Water District


Pipe size (see Fig. 1)
Scale
1 mile
1 kilometer
Fig. 5 - Contour of Bed Rock Depth Latham Water District

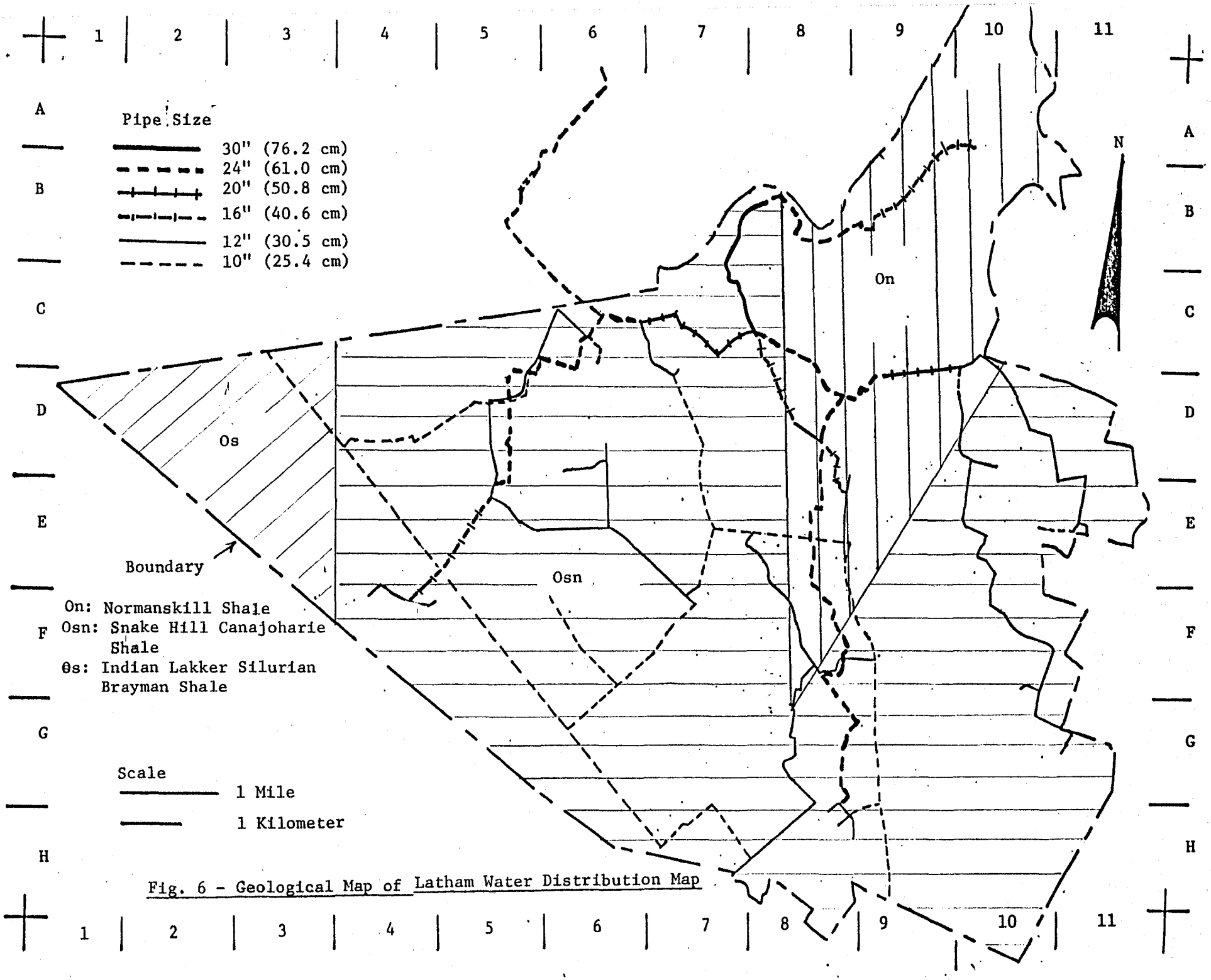
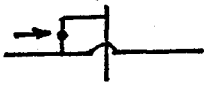
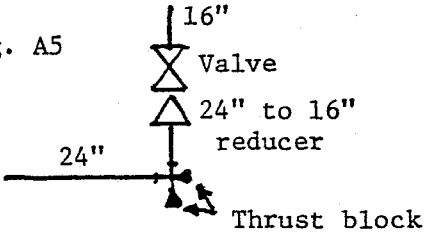
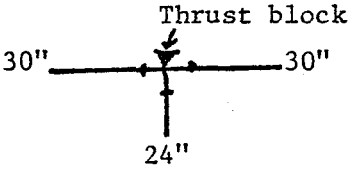


Fig. 6 - Geological Map of Latham Water Distribution Map

APPENDIX

Joint/Junction Details of Latham Water District

The location of some complex joints/junctions of Latham Water District are given in Fig. A1. The details of these joints/junctions are described in the following and subsequent figures.

Location	Description	Notes
C-6	24", 12" pipes cross Rte. 7	See Fig. A2
E-5	16" crosses 10" on Rte. 5	16" under 10", not connected.
E-5	12",16", 24" pipes intersect	See Fig. A3
E-8	24" crosses 10", 10" crosses 12"	1) 24" under 10", no connection Tie in Valve 
F-8	24" runs parallel to 12", crosses	24" crosses under 12", See Fig. A4
C-10	20",16",12" intersect	See Fig. A5 
B-9	24" crosses Route 87, reduces to 16"	
D-8	20" to 16", 24" crosses 16"	See Fig. A6
B-8	30" prestressed concrete pipe has 24" coming off	
C-8	30" to 24"; 24" to 16"	See Fig. A7
E-8	Connection details	See Fig. A8

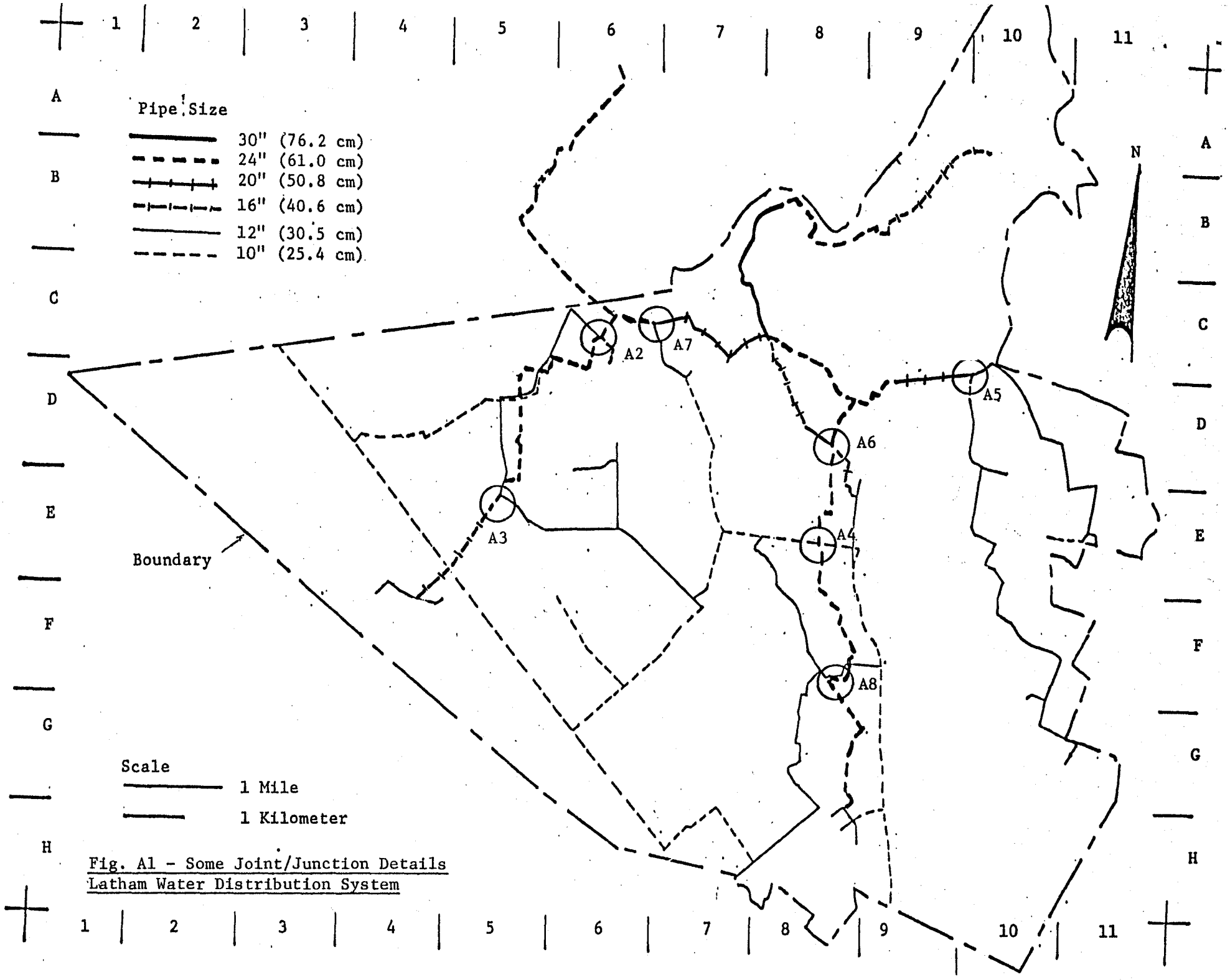


Fig. A1 - Some Joint/Junction Details
Latham Water Distribution System

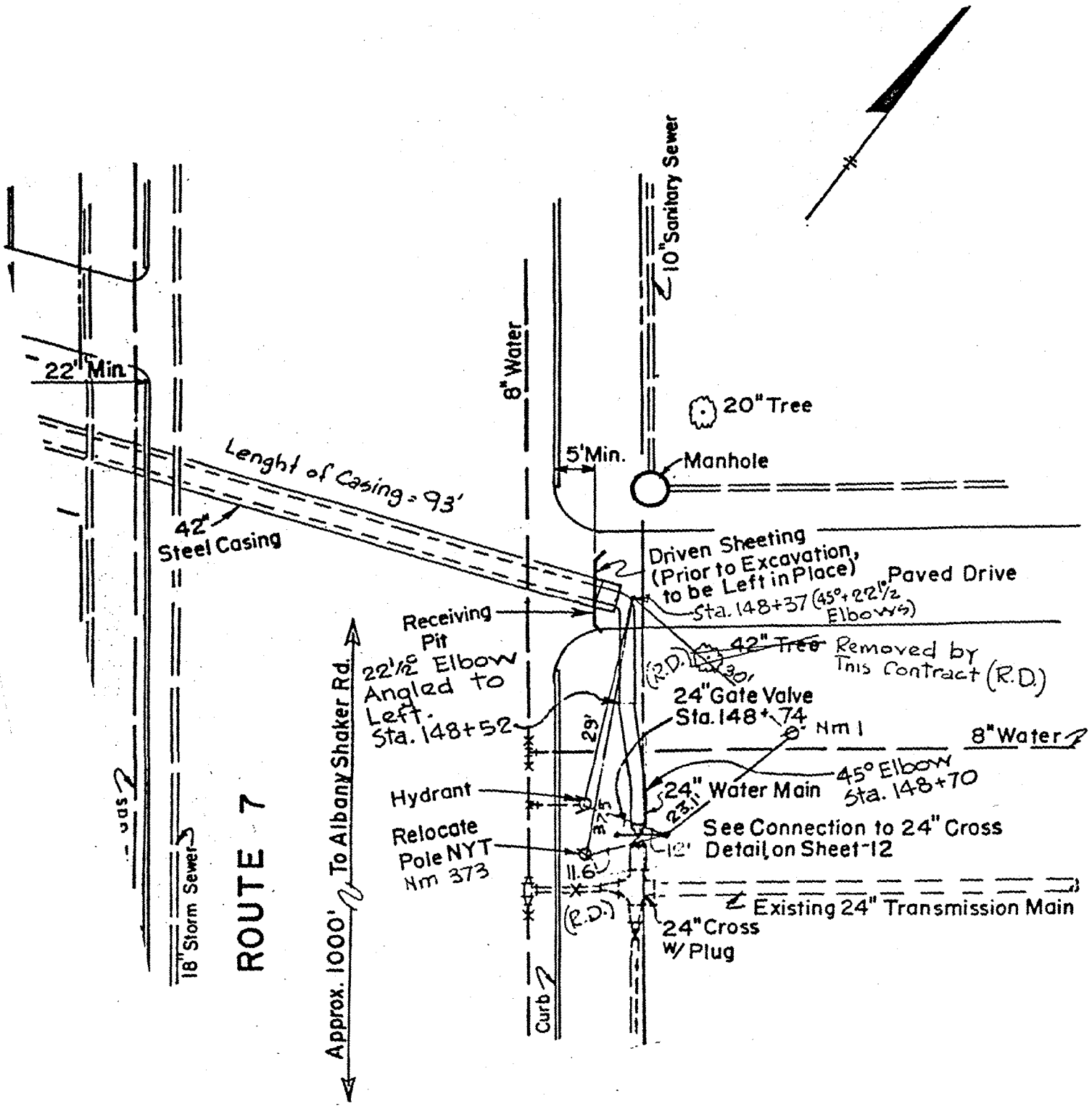

22' Min.
Lenght of Casing = 93'
42" Steel Casing
8" Water
10" Sanitary Sewer
20" Tree
5' Min.
Manhole
Driven Sheeting (Prior to Excavation, to be Left in Place)
Paved Drive
Sta. 148+37 (45° + 22½° Elbows)
Receiving Pit
22½° Elbow Angled to Left. Sta. 148+52
42" Tree Removed by This Contract (R.D.)
(R.D.)
30'
24" Gate Valve Sta. 148+74
Nm 1
8" Water
45° Elbow Sta. 148+70
29'
Hydrant
24" Water Main
23.1'
37.5'
See Connection to 24" Cross Detail on Sheet-12
Relocate Pole NYT Nm 373
11.6'
(R.D.)
Existing 24" Transmission Main
24" Cross W/ Plug
Curb
Approx. 1000' To Albany Shaker Rd.
ROUTE 7
18" Storm Sewer
Gas

Fig. A2

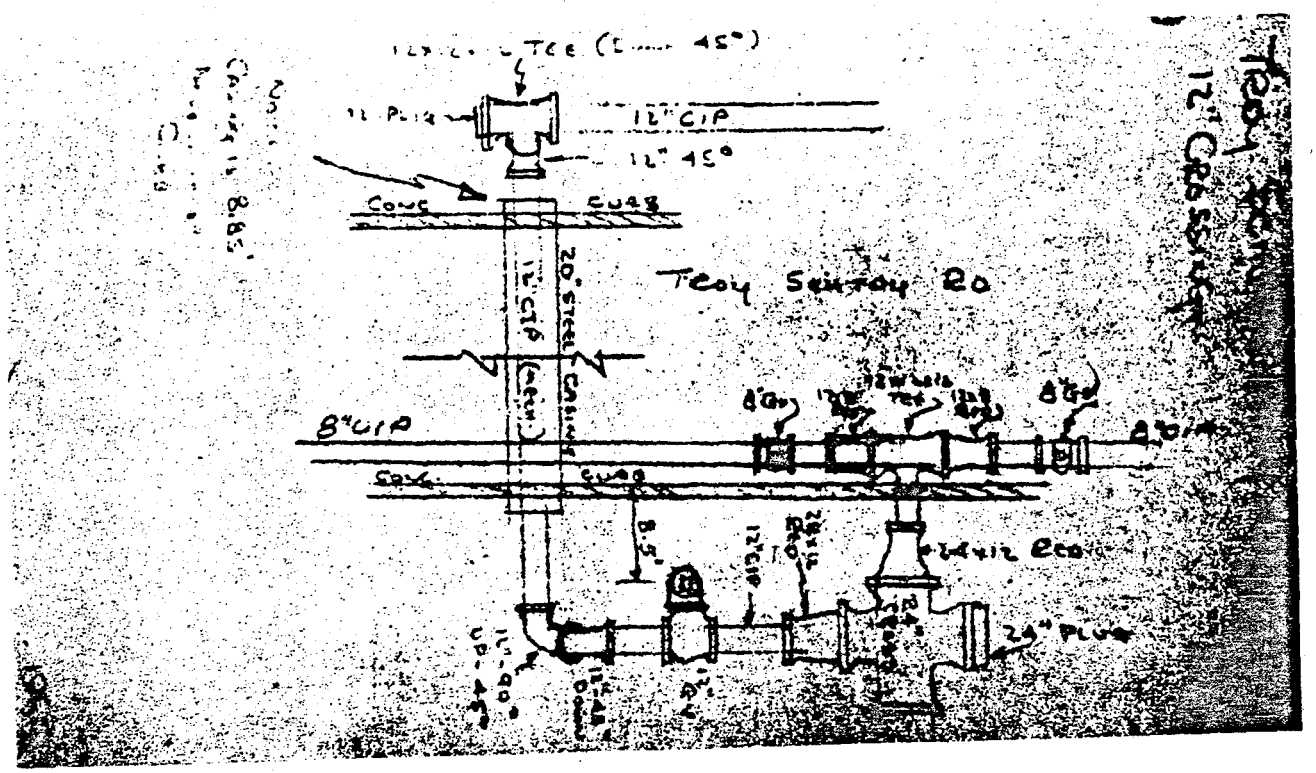
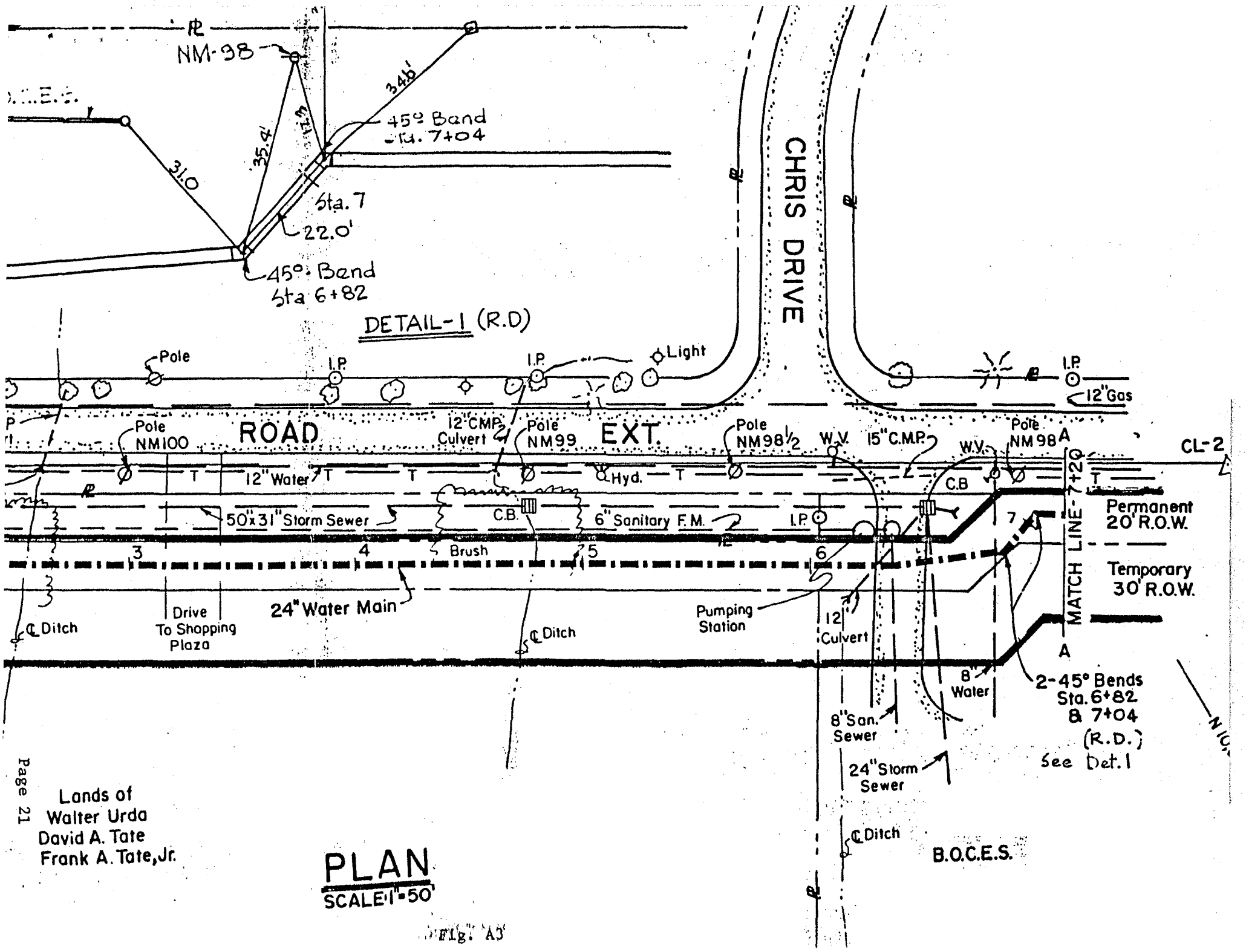


Fig. A2

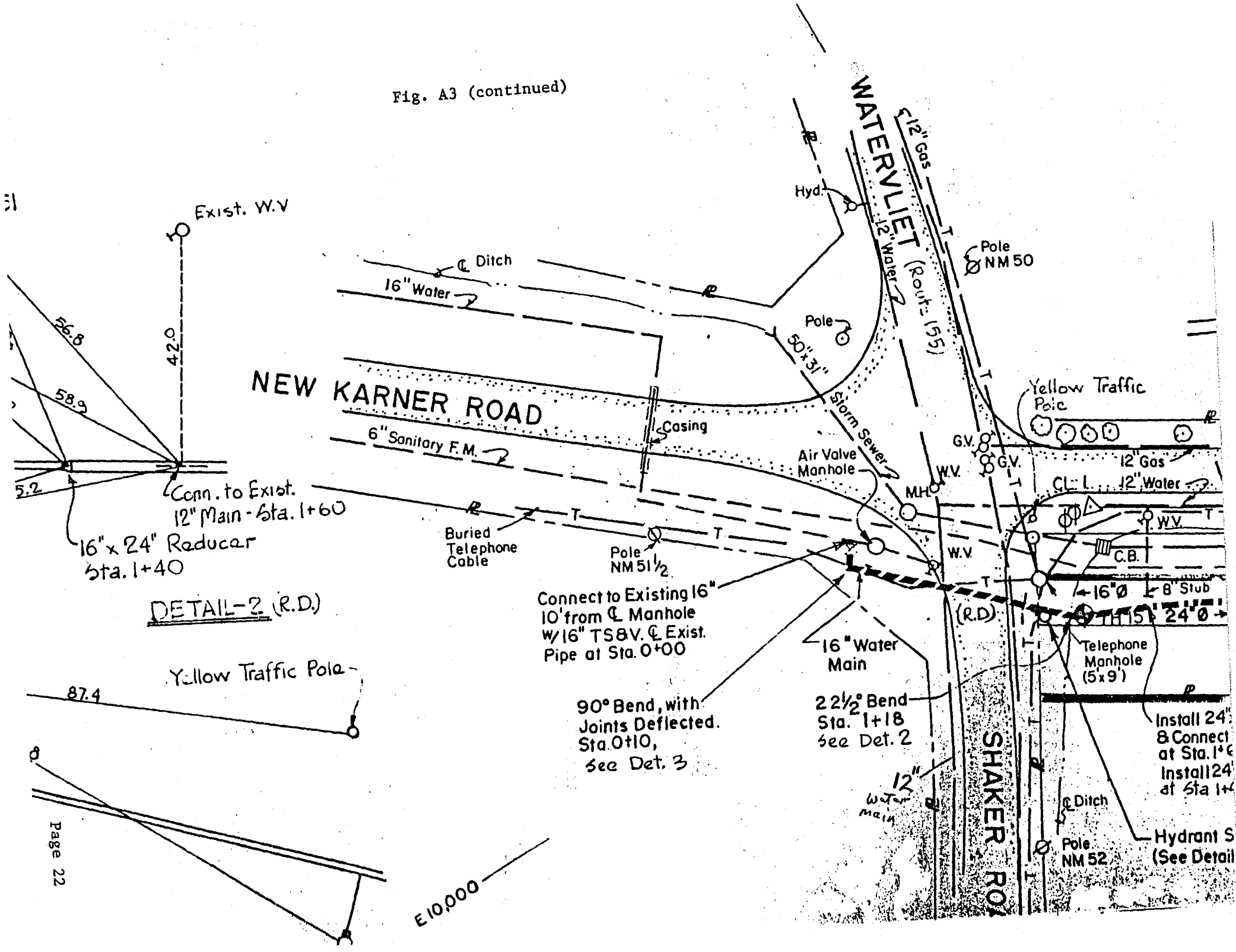
(Continued)

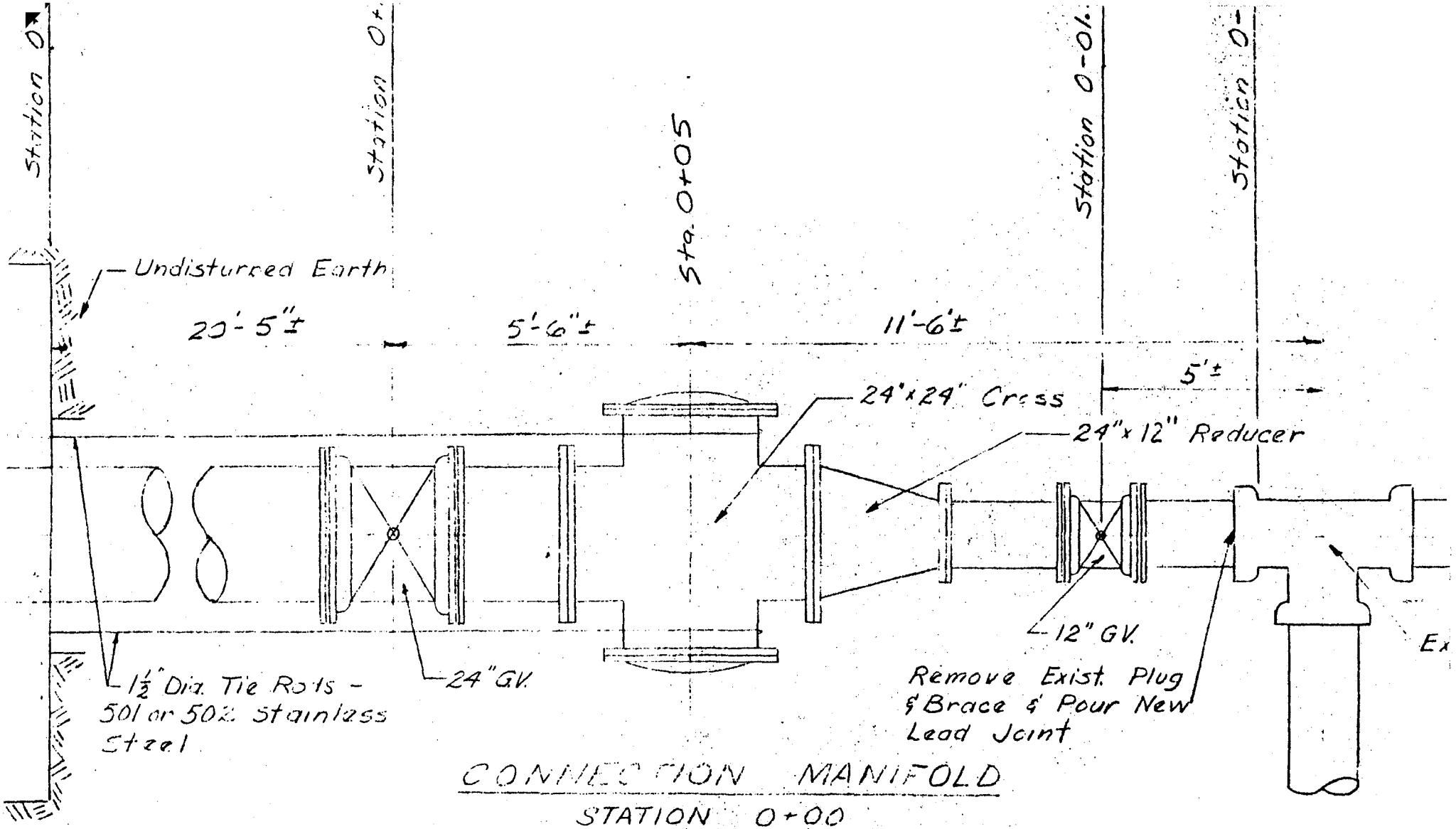


Page 21

Fig. A3

Fig. A3 (continued)





CONNECTION MANIFOLD

STATION 0+00

No Scale

Note: Deflect Joints to Offset Pipeline Around Power Pole See Sheet No. 2

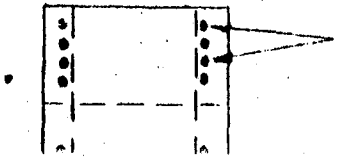
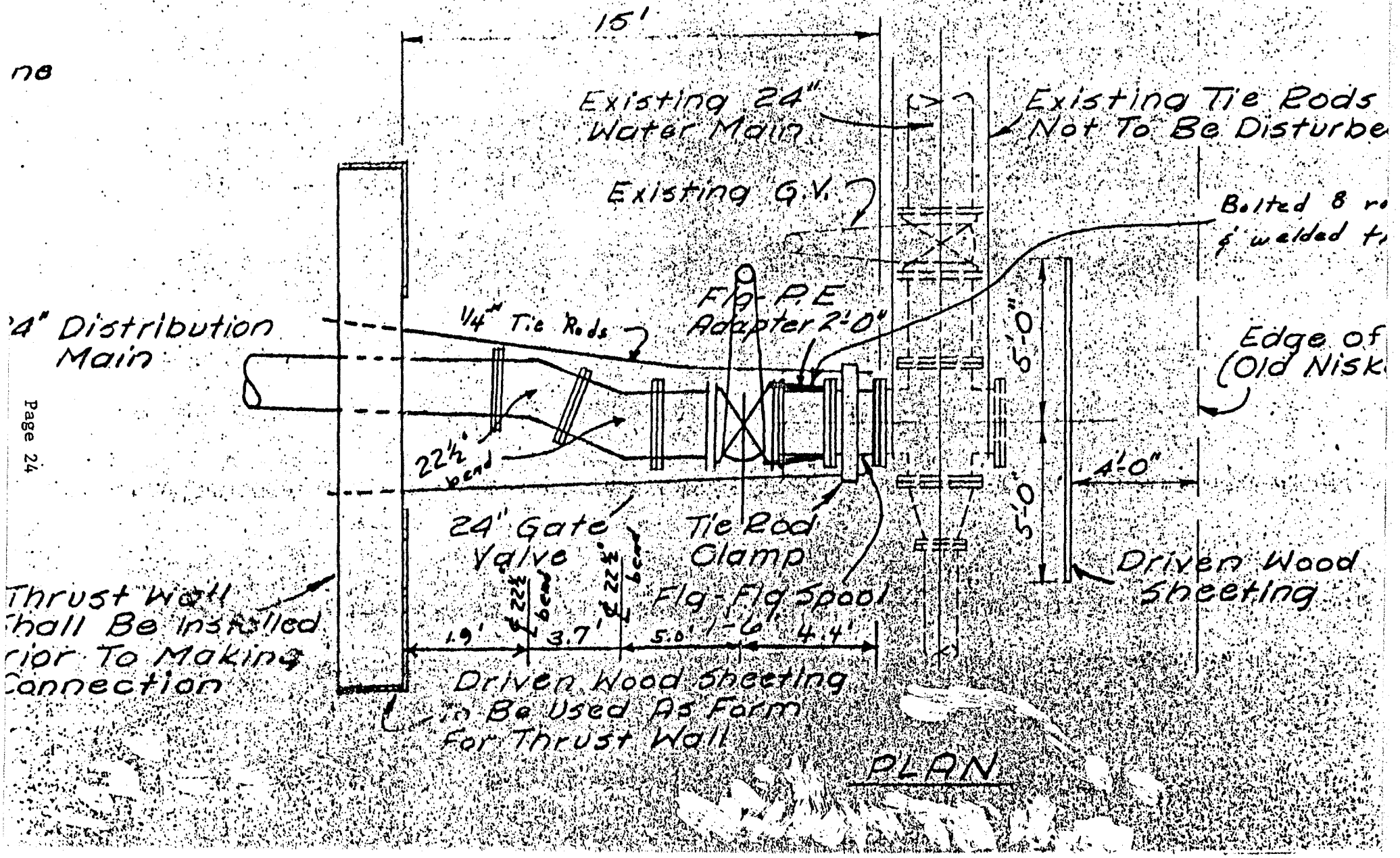


Fig. A4

Fig. A4 (continued)



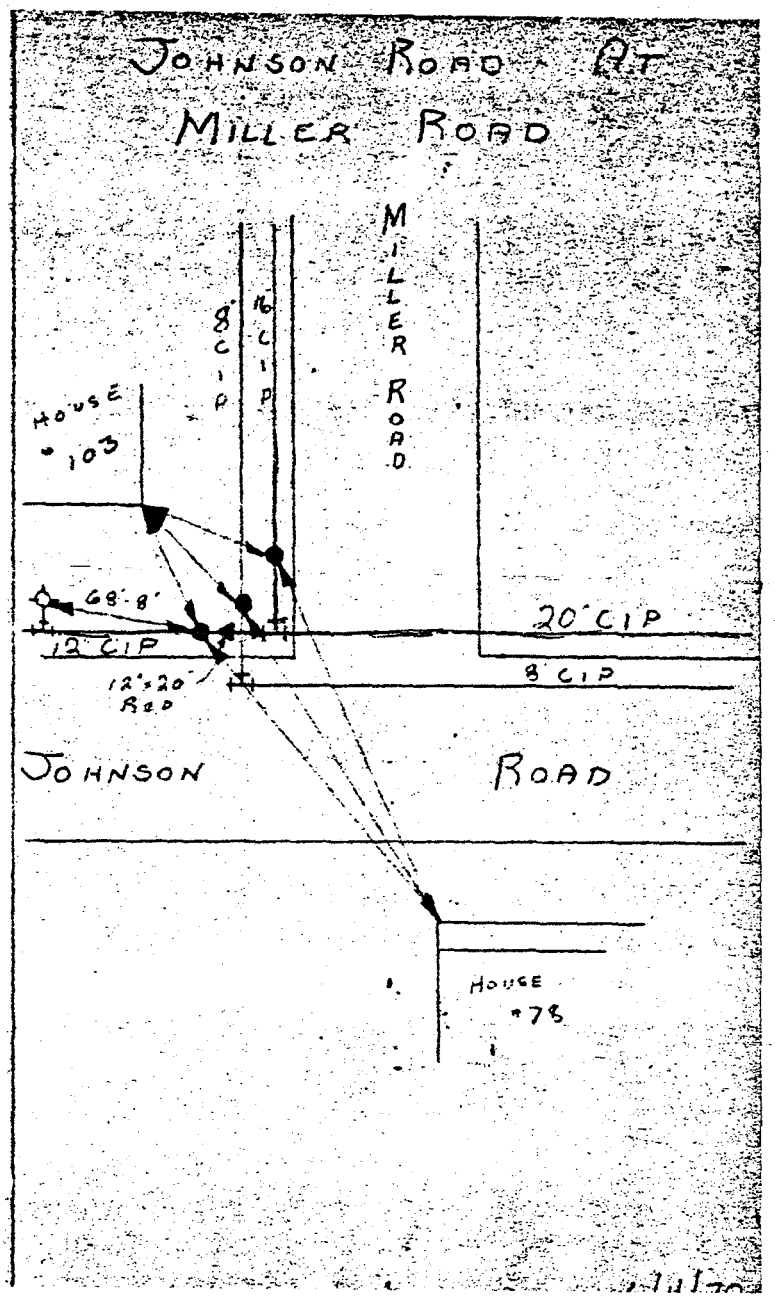

JOHNSON ROAD AT
MILLER ROAD
MILLER ROAD
8" CIP
16" CIP
HOUSE #103
68'-8"
12" CIP
20" CIP
8" CIP
12"x20" RED
JOHNSON ROAD
HOUSE #78

Fig. A5

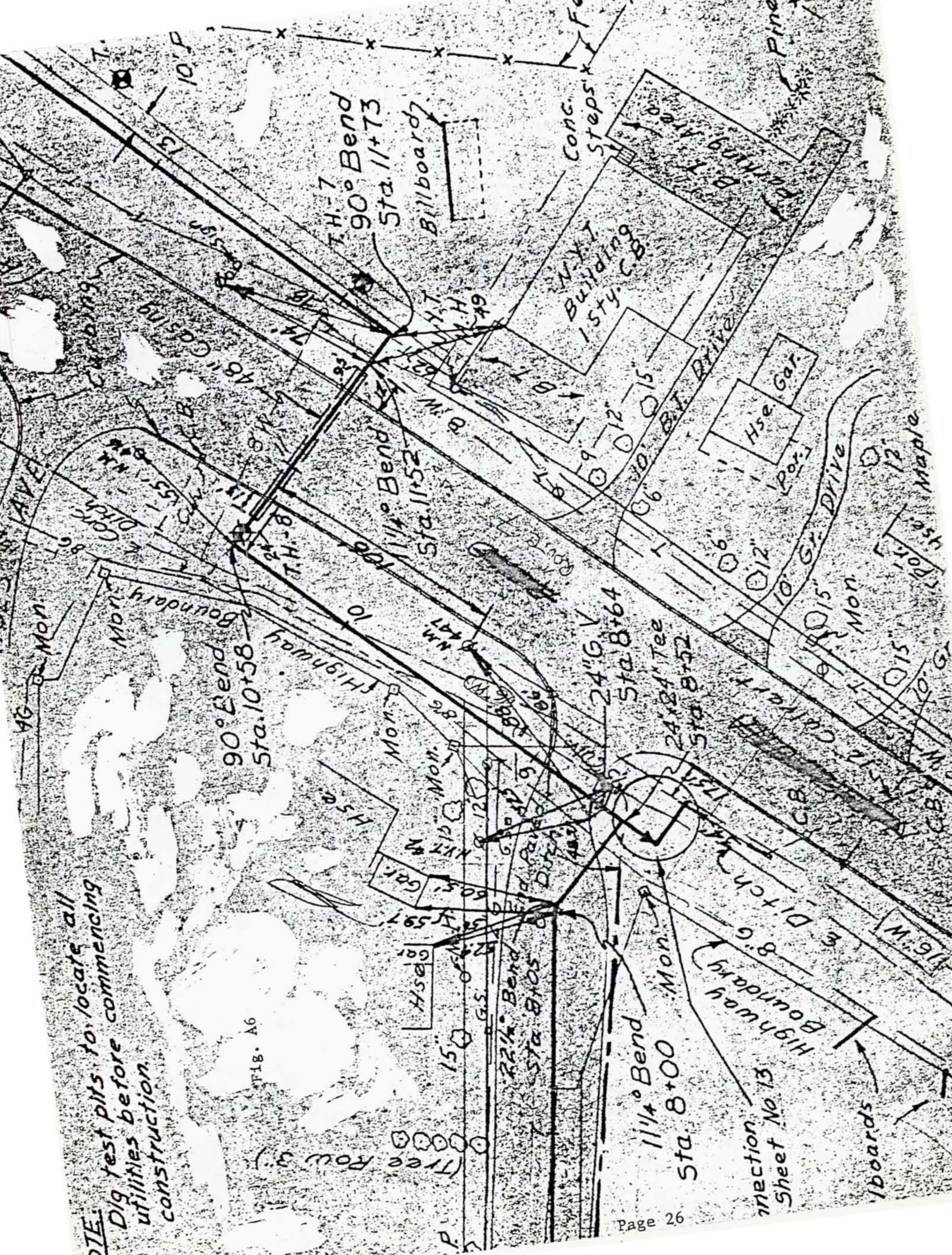

NOTE: Dig test pits to locate all utilities before commencing construction
T.H.-7
90° Bend
Sta. 11+73
Billboard
Conc. Steps
N.Y.T. Building 1 Sty. C.B.
B.T. Drive
Hse
Gar.
Gr. Drive
Maple
11¼° Bend
Sta. 11+52
T.H.-8
48" Casing
90° Bend
Sta. 10+58
Highway Boundary
Mon.
24" G.V.
Sta. 8+64
24"x24" Tee
Sta. 8+52
22½° Bend
Sta. 8+05
11¼° Bend
Sta. 8+00
Ditch
Culvert
Tree Row 3
Sheet No. 13

Fig. A6

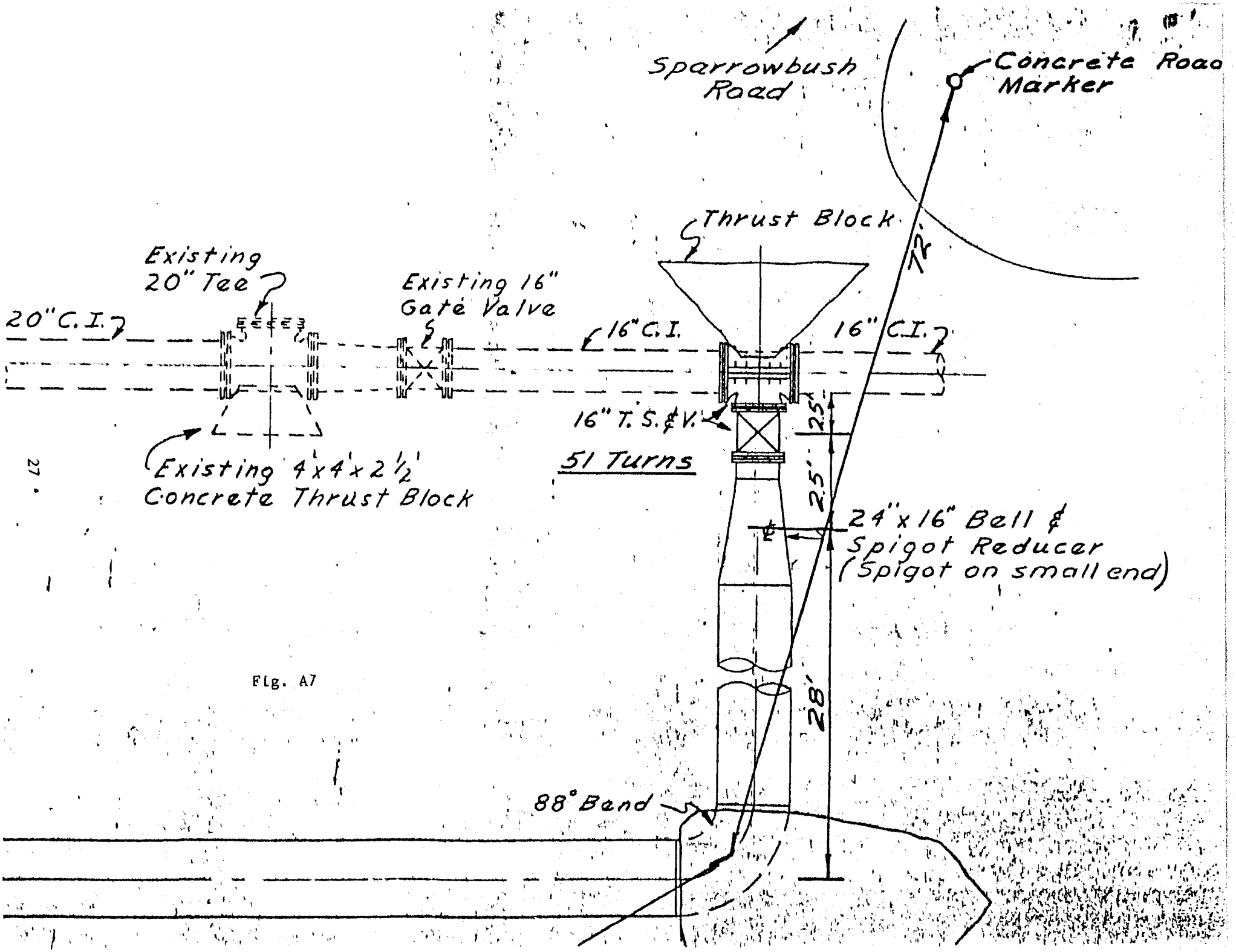

Sparrowbush Road
Concrete Road Marker
Thrust Block
12'
Existing 20" Tee
Existing 16" Gate Valve
20" C.I.
16" C.I.
16" C.I.
16" T. S. & V.
51 Turns
Existing 4'x4'x2½' Concrete Thrust Block
2.5'
25'
24" x 16" Bell & Spigot Reducer (Spigot on small end)
28'
88° Bend

Fig. A7

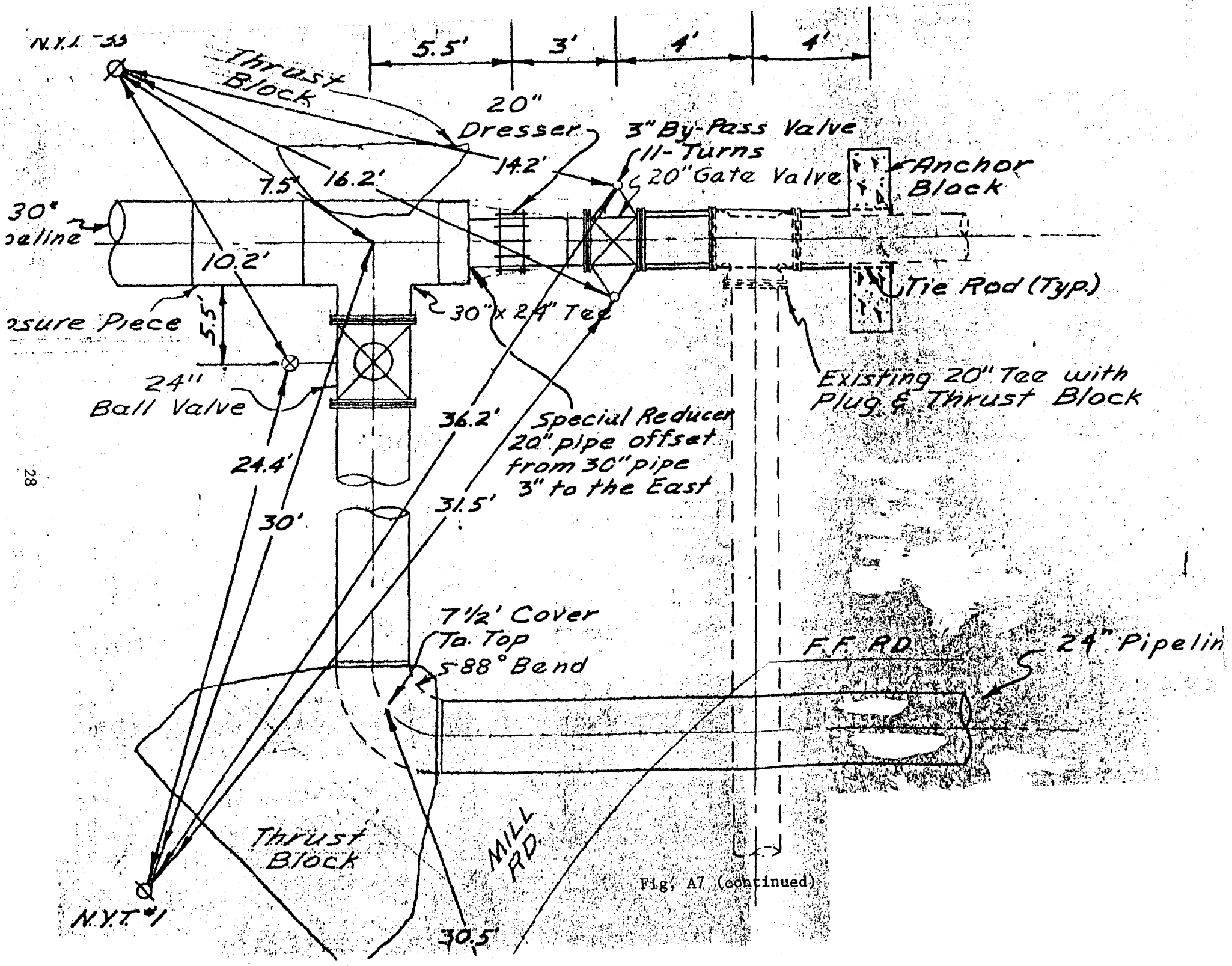
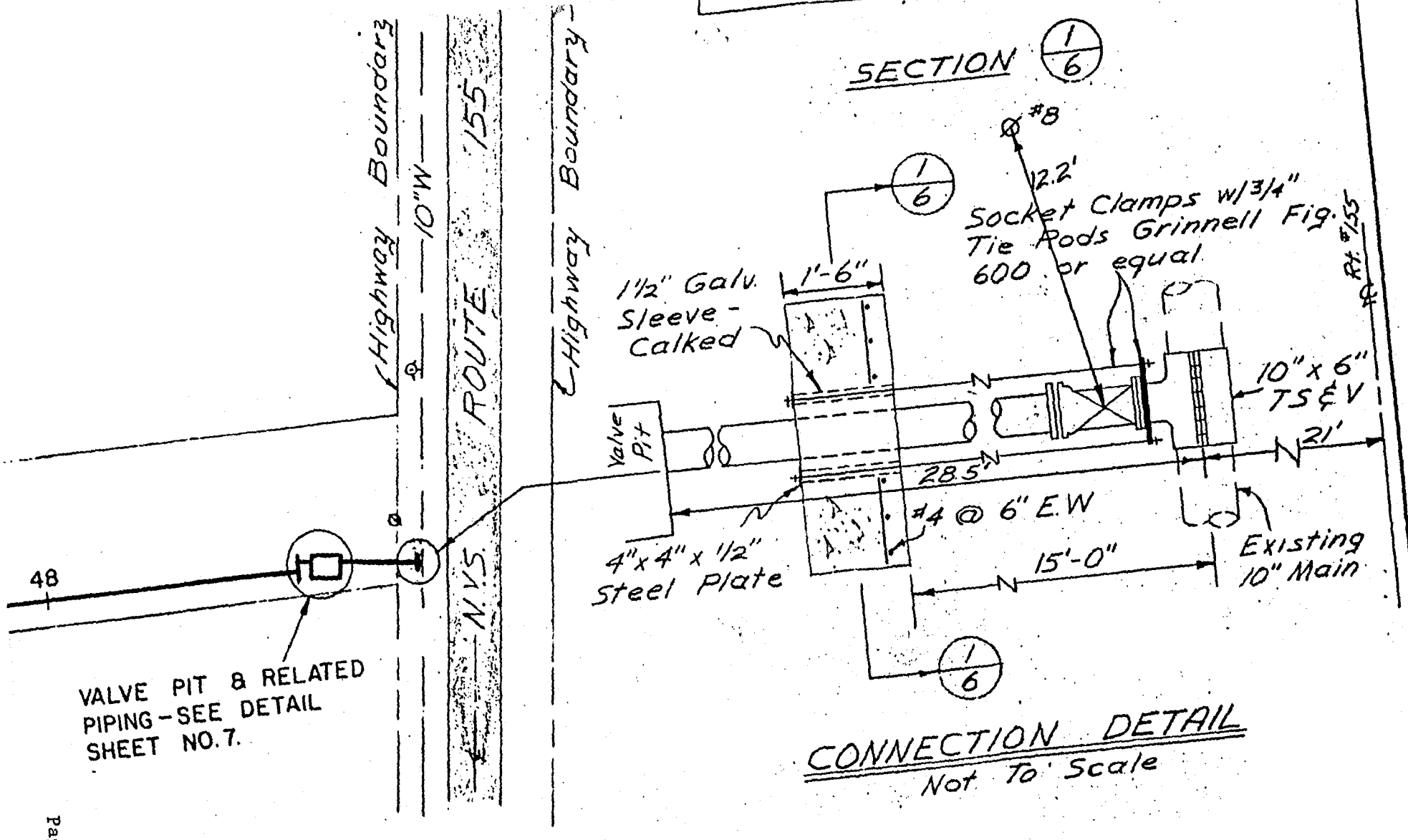


Fig. A7 (continued)



GRAPHIC SCALES

5 0 5 10ft.

50 0 50 100ft.

Fig. A8

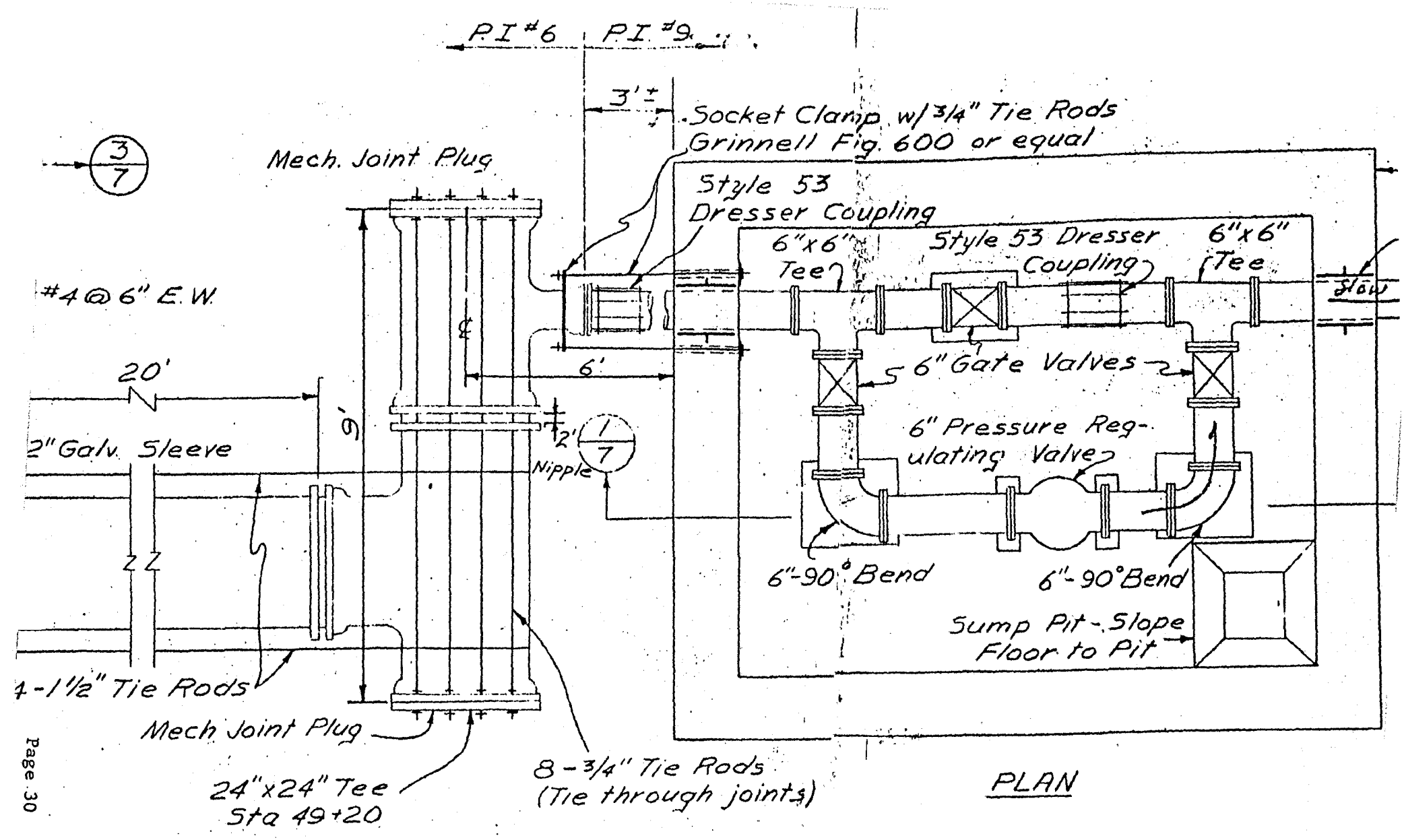


Fig. A8 (continued)