THESIS

ADDITION TO

EAST LANSING

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SUPPLEMENTARY
MATERIAL
IN BACK OF BOOK

Proposed Addition To The City of East Lansing.

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PROPOSED ADDITION TO THE CITY OF EAST LANSING.

Introduction.

The land which we are going to plat is located north of the East Lansing City limits. It is roughly rectangular in shape and bounded on the south by Pine Lake Avenue and on the west by Abbot Street. (See description on plat) This is known as the Burcham property hence the name of the plat,- "Burcham's Addition".

This tract of land is exceptionally difficult to handle i.e.,contour and layout, in comparison to other property in the neighborhood. This is due not only to the fact that most of the area is wooded and partly covered with swamp growth but also to the fact that there is a high ridge running semi-circular around part of the area. This can be very readily seen by consulting the accompanying topographic map. On the concave side of this semicircle lies a large swamp. The area of the plat is approximately sixty-five acres.

General Statement.

This technical problem will be handled by dividing it into three divisions:

1. The survey which will consist of;

A. Primary traverse.

B. Secondary traverse.

C. A system of bench marks.

D. Crosssection elevations.

2. The plat layout consisting of:

A. Dividing plat into blocks and streets.

B. Dividing plat into building lots.

3. Designing of storm sewerage:

A. Dividing into separate areas tributary to each street.

B. Establishing preliminary courses of sewerages

C. Computing grades and establishing elevations at manholes.

D. Computing sizes of sewers.

E. Revise elevations, grades, and sizes if necessary.

THE SURVEY.

The first step of the survey was to close a point of beginning. This was taken as the southeast corner of the property which also happened to be the corner of four townships. This point consists of a concrete monument with an iron plug in the top. This monument also lies on the center line of Abbot Street and Pine Lake avenue. The transit was set up over this point,(Ac on the map of the plat). Another monument at B' was located 2640 feet due north of A. This was the quarter corner in the west line of Section 7. The line AB' is the one to which all bearings of the survey are referred. After having placed a flag at B' and establishing the line by sighting on B' with the transit and clamping the lower motion, the telescope was lowered and the point B was located on the same straight line. A stake was driven at B. Another flag was then placed at B and the line AB was measured with a steel tape, sighting in each time on the two flag poles. The distance

AB was measured 1500 feet. Readings were taken about every three hundred feet for back sights. The transit was then moved to B, set up and line on A. Plate at 0. and an angle of 90° turned off in a counter clockwise direction and the upper motion was clamped. The cross hairs on the line BA. It was not possible to see point C from B but this point was reached by making several intermediate set ups and prolonging the line by taking back sights with the telescope inverted and fore sights with the telescope direct. The line CD was run due south in a similar manner a distance of 1505.'2. The line DA was measured to be 1814.'8. From D a line was run N30° 0'W to the point of beginning at A. The traverse failed to close by one foot in ~~xxxxxx~~ departure and .4 of a foot in latitude. The total distance around the traverse being 6652.'8. The error of closure being therefore $\frac{1}{\sqrt{\frac{1^2+.4^2}{6652.8}}} = \frac{1}{6150}$, which is allowable for this type of work.

All angles were read to the nearest minute and distances to the nearest tenth of a foot.

The next step in the work was to run a set of bench mark levels.(see complete set of level notes at end of discussion)

The instrument used for leveling was very accurate having a slow micrometer screw for the final adjustment. A Philadelphia rod was used. The following method of differential leveling is tak-

ing from the Elementary Surveying by Breed and Hosmer:

Differential leveling is the name given to the process of finding the difference in elevation of any two given points. When the points are far apart the instrument is set up and a rod-reading is taken on the first point. This is called a backsight or plus sight and is usually written B.S. or S. Next the rod is taken to some well-defined point which will not change in elevation the top of a hydrant,etc., and held upon it and a reading taken. This is called a foresight or minus sight written F.S. or -S. The difference between the two readings gives the difference in elevation between this new point and the first point. This second point is called a turning point and is written T.P. The level is next set up in a new position and a backsight taken on the same turning point. A new turning point further ahead is then selected and a foresight taken upon it.

This process is continued until a foresight is taken on the last point. The elevation of the last point above the first is equal to the sum of all the backsights minus the sum of all the foresights. If the result is negative, i.e., if the sum of the foresights is the greater, then the last point is below the first. One form of notes of fieldwork is shown on page 87 Fig.43.

Eight bench marks were established around the plat at intervals of about 1000 feet. Elevations were taken at each 100ft. station on the primary traverse line. Numerous interior

points were located by the crossection method. For this purpose the line AB was lettered every 100feet(see fig.) up to P and the line CD was numbered every 100 feet beginning with 1 at C and 2 at a point 100 feet east etc. By following this system the locating of any point is easily known. This plan was mostly used in the eastern portion of the area where the land was free from trees and underbrush.

After having run the levels around the traverse a check was taken on the hydrant (B.M.1) and it was found that the error was .04 feet which is allowable.

The next step was to run a stadia and transit traverse around the semicircular ridge and thru the woods. This traverse was started at the points of beginning of the primary traverse.(The method of such a traverse is explained Art. 151 of Higher Surveying)

Wherever possible a direct reading was taken on the rod for elevation i.e., the telescope was leveled and the rod read without taking a verticle angle.(See notes) Checks were taken on established bench marks wherever possible and finally checked on Station A12 within .2 ft for elevation.

The notes were plotted as shown in Art. 162 and 163 in Higher Surveying. We checked within 10ft for lati-

tude and 15 ft for departure when the noted were plotted.

In locating the streets in this plat , the aim was to extend the older streets of the city wherever possible. This was not possible in every case. M.A.C. Street could not go straight thru because there were permanent buildings in the way fronting on Pine Lake Avenue. This fact necessitated the three short streets, Cherry St., Race St., and South ave. Park St. is an continuation of the street of the same name farther south.

The frontage of the lots vary from 40 to 60 feet. Some of the larger lots in the south west corner were already laid out and it was not deemed necessary to change them. It will be noticed that the irregularity caused by the fact that the line DA does not run due west is all taken up in the lots fronting on Pine Lake Avenue.

Sewerage Design.

After completing the topographic map of the proposed addition a street layout was decided upon. In putting in the streets, which is explained above, the idea of continuing the streets south of Pine Lake Ave. was adherred to as much as possible. The pipe lines were drawn in by following the natural courses and slopes of the land. At High, Division, and Charles Sts. the land sloped gradually down to

Pine Lake Ave., permitting a line to extend clear thru. It was decided not to put in a line on North and Center Aves. because the sewers on the streets running north and south were accessible from the front of the lots.

The swamp area bounded by Grove St., North Ave., Center Ave., and by Charles, by all outward appearances seems to be underlayed by some impervuous material which stops the water from percolating down thru the "hogs back" to the low ground west thereof, thus forming the swamp by the water draining from the higher ground in the north and east section of the plat. It seems that an attempt to drain the swamp was tried by cutting a ditch thru the ridge at a point about half way between North and Center Sts. (see contour map). There is no question in our minds whatever that the swamp could be tapped for drainage at this point providing the cut is made deep enough, as a matter of fact the difference of elevation between the swamp and the low land west of the ridge is about 10 feet, which would be ample enough for first class drainage; however by running a line down M.A.C. St. directly thru the swamp enabled us to drain that area then west on center Ave. and down Grove St. to the main line on Pine Lake Ave. The area south of Center Ave. between Cherry and Charles Sts. is drained by putting in pipes at the high points in Cherry and Pine Sts. down South Ave. to the main pipe on Charles St. at manhole #12. The portion south of South Ave. is taken care of by bringing the water down Cherry

St. to Pine Lake Ave. to M.H. 13 and then to the main. The elevations of the territory along Abbot and Park Sts. Are about the same, except at the intersection of Center Ave. and Park St. which makes it necessary to put in quite a large pipe, due to the small slope available. The distance being about 1500 feet and the least possible fall must be 1.5 feet in order to connect up with the septic tank, which is about 50 feet from the south-west corner of the plat. The septic tank is approximately 8.5 feet lower than the elevation of Station 4o, thus giving a clearance of about one foot to the tank from Sta. 4o. Upon investigation it was found that in order to drain all of thearea thru a main down Pine Lake Ave. to the present septic tank at the south west corner, a large pipe would be necessary. In as much as the septic tank would be too small to take all the water, it was advisable to divide the area into two sections, that is, the area west of Grove St. to drain into the septic tank and the area east of Grove St. to drain into a main going south from the intersection of Charles and Pine Lake Ave.

Computations for Sewerage Design.

Following the sewerage layout, came the determination of the proper size pipe to use in each street, from manhole to manhold. The size of the pipe depends directly upon the length, slope, intensity and area to be drained.A time of 7 minutes was assumed as the total elapsed time at entrance to section, or concentration of the water at the

first inlet, a coefficient of .3 was used, and the intensity was computed by the formula: $i = \frac{10}{\sqrt{t}}$

where i = intensity of rainfall.
t = total time elapsed at entrance to section.

Sample computation for the size of pipe from M.H.1 to M.H.2 on High St.

$$i = \frac{10}{\sqrt{7}} = 3.78$$

The area to be drained = .75 acres.
Slope = 6 ft. in 1000 ft.
Length of Pipe = 325 ft.
Ci = 1.130
CiA'= Q = .847 c.f.s.

Then from the tables in "American Sewerage Practice" on page 94c the size of the pipe and velocity may be obtained, which in this case were 10" pipe, and 2.2 ft/sec. Then by dividing the length of pipe in feet by the velocity and the result by 60 (to change to minutes) the time of flow in section $= \frac{325}{2.2 \times 60} = 2.5$ min. By adding the total elapsed time at the entrance to section, to the time of flow in the section, the total time to the end of section can be obtained.

7.0 min. 2.5 min. = 9.5 min.

Then by using this value 9.5 min. in the formula :

$$i = \frac{10}{\sqrt{t}} = \frac{10}{\sqrt{9.5}} = 3.26$$

Which is the new intensity for the next calculation to the next M.H. The accompanying table shows the data for each section of pipe thruout the entire area. In a few places the sizes vary somewhat. These figures are purely theoretical, and in installing the sewerage for this particular area the engineer must use his own judgment and choose the different sizes of pipe as nearly uniform as possible, thereby decreasing the cost of construction.

Line No	From MH	To MH	Drainage Area (District)	Actual Area (A) acres	Slope in ft per 100' (S)	Length in ft	Intensity of rain (I)	Coef C	Ci	Q = CiA' (c.f.s.)	Diam. of sewer (in)	Velocity ft/sec.	Total elapsed time at entrance to section (min)	Time of flow in section (min)	Total time to end of section (min)
1	1	2	34	.75	.600	325	3.78	.3	1.130	.847	10	2.2	7.0	2.5	9.5
2	2	3	34+37	1.81	2.600	515	3.26	.3	.978	1.86	10	4.6	9.5	1.1	10.6
3	3	4	34+37+38	2.43	10.00	615	3.22	.3	.966	3.31	14	3.8	10.6	2.9	13.5
4	4	5	34+37+38+40	3.79	10.40	230	2.99	.3	.897	3.40	14	3.9	13.5	1.1	14.6
5	5	6	33	1.75	20.00	325	3.78	.3	1.130	1.98	10	4.2	7.0	1.3	8.3
6	6	7	32-33-36-39	5.00	20.00	510	3.47	.3	1.041	5.20	14	5.6	8.3	1.1	9.4
7	7	8	32-33-36-39	9.70	9.00	665	3.26	.3	.978	8.51	22	5.3	9.4	2.1	11.5
8	8	15	28-Abv. M.H. B	23.40	1.00	365	2.62	.3	.786	21.6	30	6.9	14.6	1.0	15.6
9	9	10	32	1.98	40.00	310	3.78	.3	1.130	2.2	10	5.5	7.0	.9	7.9
10	10	11	32-31-23	6.29	5.00	510	3.56	.3	1.068	6.7	20	3.5	7.9	2.4	10.3
11	11	12	32-31-23-30-½ of 27	9.42	9.50	735	3.42	.3	1.026	9.7	20	4.8	10.3	1.2	11.5
12	17	16	½ of 17	.64	2.00	150	3.78	.3	1.130	.7	10	1.35	7.0	1.6	8.6
13	16	14	" " ½ of 25	1.47	30.00	260	3.41	.3	1.023	1.8	10	4.7	8.6	.9	9.5
14	15	14	24	1.34	30.00	310	3.78	.3	1.130	1.65	8	4.4	7.0	2.4	9.4
15	14	12	½ of 26 - Abv. M.H. 14	3.64	15.00	270	3.33	.3	.999	3.64	14	4.5	9.4	1.0	10.5
16	12	13	½ of 27 - " " 12	14.64	3.90	305	3.08	.3	.924	13.5	27	3.9	11.5	1.3	12.8
17	18	19	½ of 17	1.28	35.00	260	3.78	.3	1.130	1.45	8	4.7	7.0	.3	7.3
18	19	15	½ of 17 - 26	2.63	10.00	530	3.72	.3	1.116	2.93	14	3.6	7.3	2.4	9.7
19	13	Main	Abv. M.H. 13	40.33	4.00	—	3.01	.3	.912	34.0	36	5.2	—	—	15.6
20	33	32	21	1.98	45.00	270	3.78	.3	1.130	2.24	10	5.8	7.0	.8	7.8
21	32	31	21-20-22	5.09	5.00	510	3.60	.3	1.080	5.09	18	3.3	7.8	2.5	10.3
22	31	30	18-71 Acres - Abv. M.H. 31	4.59	3.00	170	3.12	.3	.936	4.3	18	2.6	10.3	1.1	11.4
23	35	30	½ of 17	.33	60.00	130	3.78	.3	1.130	.37	8	3.8	7.0	.6	7.6
24	30	29	18-71 Acres - Abv. M.H. 30	10.00	4.0	210	2.96	.3	.798	7.88	22	3.4	11.4	1.0	12.4
25	34	29	12	2.06	6.0	370	3.78	.3	1.130	2.32	14	2.9	7.0	2.1	9.1
26	29	20	Abv. 29	12.55	3.5	660	2.84	.3	.852	10.9	24	3.5	12.4	3.2	15.6
27	20	21	" M.H. 20	15.69	1.5	225	2.63	.3	.789	14.9	20	6.3	15.6	.6	16.2
28	36	37	.36 Acres of 12	.36	2.2	90	3.78	.3	1.130	.41	8	1.3	7.0	.2	7.2
29	38	37	9	1.71	9.0	310	3.78	.3	1.130	1.93	12	3.1	7.0	.6	7.6
30	37	27	Abv. M.H. 37	2.07	20.0	230	3.62	.3	1.086	2.24	10	4.2	7.6	1.0	8.6
31	26	27	8	1.44	1.0	300	3.78	.3	1.130	1.63	10	1.4	7.0	3.6	10.6
32	27	28	Abv. M.H. 27	5.09	1.0	510	3.07	.3	.921	4.69	22	1.8	10.6	4.7	15.3
33	28	21	17 - Abv. M.H. 28	7.14	1.0	665	2.57	.3	.750	5.42	24	1.9	15.3	5.8	21.1
34	21	22	Abv. M.H. 21	10.04	1.0	230	2.17	.3	.651	6.55	27	2.0	21.1	2.9	29.0
35	23	24	7	72	2.0	330	3.78	.3	1.130	8.15	12	1.1	7.0	5.0	12.0
36	24	23	7-6	1.31	10.0	510	2.99	.3	.897	1.18	12	1.1	12.0	7.7	19.7
37	23	22	7-6-5	2.93	1.0	665	2.25	.3	.675	1.98	15	1.4	19.7	7.9	27.6
38	22	—	To Septic Tank Abv. M.H. 22	14.42	—	—	1.91	.3	.573	8.25	27	—	—	—	27.6

Bench Levels and Crossection Elevations.

Sta.	B.S.	H.I.	F.S.	Elev.
B.M.1	.94	857.44		856.50
B.M.2				
Ao			7.99	849.45
A2			7.2	850.2
A2			5.9	851.5
A3			5.0	852.4
A4			3.0	854.4
A4+55.15			1.33	856.11
B3			5.5	851.9
C3			4.6	852.8
D3			4.2	853.1
E3			4.4	853.0
E2			7.0	850.0
D2			7.0	850.4
C2			7.2	850.3
B2			7.99	849.9
Ao	5.23	854.68	7.99	849.45
Bo			5.1	849.6
Co			4.2	850.5
Do	4.82	855.42	4.08	850.60
Eo			5.0	850.4
Fo			5.1	850.3
Go			5.8	849.6

Sta.	B.S.	H.I.	F.S.	Elev.
Go+52.1			5.64	849.78
B.M.3	7.29	856.37		849.08
H_2O level at bridge			12.02	844.35
Ho			5.9	850.5
Io			5.2	851.2
Jo			5.0	851.4
Ko			5.0	851.4
Lo			6.5	849.9
Lo+67.9	5.08	854.86	6.59	849.78
Mo			5.3	849.6
B.M.4	6.36	854.30	6.92	847.94
H_2O at B.M.4			8.16	846.14
H_2O at Lo+67.9			8.18	846.12
No			4.8	859.5
Oo			3.9	850.4
Po			3.1	851.2
B.M.4	6.57	854.51		847.94
T.P.1	4.39	855.17	3.73	850.78
P1			4.6	850.6
O1			4.9	850.2
N1			4.9	850.2
M1			4.9	850.2
P2			3.9	851.3
p3			5.4	849.8
T.P.2	5.69	856.27	4.59	850.58
O3			6.2	850.1
O2			6.1	850.2

Sta.	B.S.	H.I.	F.S.	Elev.
04			6.6	849.7
P3+50			4.7	851.6
P4			2.3	854.4
T.P.3			1.69	854.58
P4+50			6.8	858.9
P5			3.7	862.0
05			6.7	859.0
04+50			13.3	852.4
04+75			10.7	855.0
05+50			1.2	854.5
B.M.5			1.69	853.83
"	.62	864.45		863.83
P5+50			7.3	857.2
P6	3.26	855.32	12.39	852.06
P7			5.6	849.7
(0+50)7			3.5	851.8
(0+50)(6+50)			4.9	850.4
06+50			1.3	854.0
P7+50			4.0	851.3
P8			0.0	855.3
T.P.4	11.89	865.62	1.59	853.73
P8+50			7.5	858.1
P9			5.0	860.6
P9+50			3.5	862.1
T.P.5	10.77	874.27	2.12	863.50
P10			8.9	865.4
P10+50			5.7	868.6
P11			1.0	873.3
T.P.6	5.96	879.85	.36	873.89

Sta.	B.S.	H.I.	F.S.	Elev.
B.M.6			4.76	875.09
P12			5.1	874.8
P13			4.8	875.1
T.P.7	6.58	882.02	4.41	875.44
P14			4.9	877.1
P15			4.1	877.9
P16			2.2	879.8
T.P.8	6.29	886.09	2.22	879.80
P17			5.1	881.0
P18			5.7	880.4
P19+14.8			5.4	880.7
B.M.7			4.03	882.06
T.P.9	4.82	886.26	4.65	881.44
O18			6.0	880.3
O17			6.8	879.5
O19+14.8			4.7	881.6
N19+14.8			4.1	882.2
N18			5.3	881.0
N17			7.2	879.1
N16			9.6	876.7
M16			11.8	874.5
M17			7.5	878.8
M18			7.3	879.0
M19+14.8			4.6	881.7
T.P.10	1.21	882.91	4.56	881.70
L19+14.8			2.2	880.7
L18			6.4	876.5

Sta.	B.S.	H.I.	F.S.	Elev.
L17			8.0	874.9
L16			11.2	871.7
L15			12.7	870.2
K16			16.2	866.7
K17			12.4	870.5
K18			10.3	872.6
K19+14.8			7.8	875.1
T.P.11	.63	875.98	7.56	875.35
J19+14.8			4.9	871.1
I19+14.8			7.9	868.1
H19+14.8			9.3	866.7
T.P.12			7.98	868.00
T.P.12	4.75	87..75	[illegible]	866.00
J18			3.5	869.2
J17			5.3	867.4
J16			7.1	865.6
J15			9.9	863.8
K15			7.2	865.5
I15			9.8	862.9
I16			8.9	863.8
I17			7.9	864.8
I18			6.4	865.3
T.P.13	3..7	868.81	7..1	865.54
H18			3.3	865.5
H17			4.4	864.4
H16			5.4	863.4
H15			5.2	863.6
G15			6.4	862.4

Sta.	B.S.	H.I.	F.S.	Elev.
G16			6.7	862.1
G17			6.3	862.5
G18			4.7	864.1
G19+14.8			2.7	866.1
F19+14.8			2.5	866.3
F18			3.8	865.0
F17			5.0	863.8
F16			6.2	862.6
F15			7.8	861.0
F14			9.9	858.9
G14			7.9	860.9
E14			9.3	859.5
E15			7.0	861.8
E16			6.5	862.3
E17			6.5	862.3
E18			5.9	662.9
E19+14.8			3.6	865.2
T.P.14	1.30	863.96	6.15	86..66
D19+14.8			.4	863.6
D18			3.2	860.8
D17			4.1	859.9
D16			4.3	859.7
D15			4.7	859.3
D14			6.3	857.7
D13			7.5	856.5
C13			7.4	856.6
C14			7.5	856.5
C15			5.4	858.6
C16			6.3	857.7

Sta.	B.S.	H.I.	F.S.	Elev.
C17			5.7	858.3
C18			3.6	860.4
C19+14.8			.8	862.2
B19+14.8			2.4	861.6
A19+14.8			4.0	860.0
A18			5.9	858.1
B18			5.3	858.7
B17			6.6	857.4
A17			6.8	858.2
A16			7.2	856.8
B16			7.2	856.8
B15			6.7	857.3
B.M.8	1.95	860.86	5.05	858.91
A15			4.3	856.6
A14			4.4	856.5
B14			4.5	856.4
B13			5.1	855.8
A13			4.7	856.2
A12			3.3	857.6
T.P.15	5181	863.85	2.82	858.04
B12			6.9	856.9
C12			6.4	857.4
D12			7.4	856.4
E12			5.6	858.2
F12			3.4	860.4
G12			.8	863.0
F11			1.9	861.9
E11			4.4	859.4
D11			6.3	857.5

Sta.	B.S.	H.I.	F.S.	Elev.
CLL			5.7	858.1
B11			5.7	858.1
A11			5.6	858.2
A10			5.2	858.6
B10			3.5	860.3
C10			3.1	860.7
D10			4.1	859.7
E10			3.6	860.2
F10			3.6	860.2
A9			4.0	859.0
T.P.16	6.72	866.67	3.90	859.95
A8			5.3	861.4
A7			5.0	861.7
A6+65;15			5.1	861.6
B6-65.15			1.0	865.7
A6			5.5	861.2
A5			9.3	857.4
A4 + 55.15			10.7	856.0
TP17	5.47	861.81	10.33	856.34
B.M.1			5.26	856.54

Correct elevation of B.M.1 = 856.50

Error in approx. 6800' of .04'

Description of Bench Marks.

B.M.1. This bench mark was obtained and established by the City Surveyor of the City of East Lansing, Michigan. The location of which is, the hydrant on the corner of Grove St. and Pine Lake Ave. the point on the hydrant is on the ring just below the nut. Elevation =856.50'

B.M.2. Sta. A_0 a concrete monument with a plug in the top at the intersection of Abbot St. and Pine Lake Ave. Elevation =849.45'

B.M.3. Nail in S.E. corner of Bridge on intersection of Abbot St. and Center Ave. at Sta. C_0+62.1. Elevation =849.08'

B.M.4. Gas pipe at the west side of ditch at Sta. N_0. Elevation =847.94'

B.M.5. Lone stump with spikes, 20 feet inside fence at Sta.25+25. Elevation =863.35'

B.M.6. Spike in oak tree 10' inside of fence at Sta. P11. Elevation = 875.09'

B.M.7. Highest point on stone in East end of field near Sta. P18. Elevation =883.06'

B.M.8. Stone in field 150' from Pine Lake Ave Between Sta.A14, and A 15. Elevation = 858.91'

Transit and Stadia Traverse Notes.

Sta. Inst.at	Dist. to	Az.An.	Bearing	V.An.	Dif.in Elev.	Elev.	
A	455	270°6'	S88°30'E	49'	6.5	855.8	HI=5.0'
Inst.at B.	---	----	------	---	---	---	----
B.M.1	82	13°8'		0°30'	.7	856.50	HI=5.1'
1.	130	256°0'		-----	----	----	----
2.	1.9	180°		1°50'	4.1	859.9	
3.	121	15.°30'		0°44'	1.6	857.4	
4.	244	158°30'		0 °1'	.1	855.9	
5.	251	172°00'		2°00'	8.8	865.6	
6.	290	174°00'		1°30'	7.6	863.4	
7.	295	181°00'		1°23'	7.1	863.0	
8.	219	186°00'		2°03'	7.7	863.5	
9.	260	210°00'		°05'	9.4	865.2	
10.	305	202°30'		1°18'	8.1	863.9	
STA.C	421	168°30'	N9°30'W	1°30'	11.0	866.8	
Inst.at C	---	----	-----	---	---	---	H.I.=5.1 ----
1.	91	31°00'		-7°03'	-11.1	855.7	
2.	81	11°30'		-2°33'	- 6.3	863.3	
3.	96	330°30'		-1°24'	- 2.3	864.5	
4.	148	304°00'		-0°41'	- 1.8	865.0	
5.	328	298°00'		0°37'	3.5	870.3	
6.	292	283°00'		0°02'	.2	867.0	
7.	450	274°30'		-0°22'	- 2.9	865.9	
8.	458	256°30'		0°10'	1.3	868.1	
9.	478	247°30'		-0°24'	- 3.3	865.5	
10.	577	247°30'		0°30'	5.1	871.9	
11.	400	245°30'		-0°41'	- 4.7	862.1	

Sta.	Dist.	Az.An.	Bearing	V.An. &F.S.	Dif. in Elev.	Elev.	H.I.
12.	290	256° 30'		0° 20'	1.7	868.5	
13.	237	241° 30'		-1° 04'	-2.4	864.4	
14.	199	240° 30'		-1° 47'	-6.2	860.6	
D	413	177° 29'	N0° 30'W	0° 20'	2.4	869.0	
15.	154	193° 30'		-1° 24'	-3.8	863.0	
16.	97	122° 00'		-7.45'	-12.5	854.5	
17.	72	156° 00'		-3° 01'	-3.8	863.0	
Inst.at D	---	-----	----	-----	----	----	5.3'
1.	252	358°		7.5ft.	-2.3	867.9	
2.	160	358° 30'		7.2ft.	-2.0	867.2	
3.	48	358°		6.2ft.	-1.0	868.2	
4.	70	88°		-12° 47'	-15.1	854.1	
5.	100	85° 30'		- 9° 49'	-16.8	852.4	
6.	153	37°		- 6° 04'	-16.1	853.1	
7.	132	15° 30'		8.7ft.	- 3.5	865.7	
8.	247	8° 30'		9.6ft.	-4.4	864.8	
9.	270	21°		-3° 9'	-14.8	854.4	
10.	145	339° 30'		11.5ft.	- 6.3	862.9	
11.	128	336°		7.7ft	- 2.5	866.7	
12.	25	72°		7.2ft	- 2.0	867.3	
13.	31	351° 30'		5.2ft	- .6	868.6	
14.	59	290°		11.3ft	-6.1	863.1	
15.	150	222° 30'		11.1ft	-5.9	863.3	
16.	178	227° 30'		12.0ft	-6.8	862.4	
17.	157	213°		5.2ft	0.0	869.2	
18.	157	227°		5.2ft	0.0	869.2	

Sta.	Dist.	Az.&n.	Bearing	V.An. &F.S.	Dif.in Elev.	Elev.	H.I.
19.	165	194°		-4°49'	-14.6	854.6	
20.	169	211°30		9.7ft	- 4.5	864.7	
21.	108	211°		4.4ft	.6	870.0	
Sta.E.	300	218°17'	N39°30'E	-5.3ft	- .1	869.1	
Inst.at Sta.E	----	----	------	----	---	---	5.1'
1.	63	326°30'		11.8ft	- 7.0	862.1	
2.	99	321°30'		-5°04'	- 8.9	860.2	
3.	25	321°30'		4.1ft	1.0	870.1	
4.	38	136°		6.7ft	- 1.6	867.5	
5.	104	136°30'		-9°00'	-16.1	853.0	
6.	79	136°30'			-16.1	853.0	
7.	138	163°		-6°46'	-16.1	853.0	
8.	77	333°		4.1ft	1.0	870.1	
9.	79	246°30'		4.7ft	.4	869.5	
10.	95	264°30'		12.5ft	- 7.4	861.7	
11.	182	241°30'		11.3ft	- 6.2	862.9	
12.	174	232°		5.0ft	.1	869.2	
13.	179	184°		- 3°29'	-10.8	858.3	
14.	216	169°		- 4°12'	-15.8	853.3	
15.	280	181°30'		- 1°01'	- 5.0	864.1	
Sta. F.	301	222°50'	N44°00E	0°58'	6.4	875.6	
Inst.at Sta. F.	----	----	-----	----	---	---	5.3'
1.	110	317°30'		-7°41'	-14.6	860.9	
2.	66	326°30'		-8°35'	- 9.7	865.8	

Sta.	Dist.	Az.An.	Bearing	V.An. &F.S.	Dif.in Elev.	Elev.	H.I.
3.	30	2°30'		6.3ft	- 1.0	874.5	
4.	57	88°30'		8.1ft	- 2.8	872.7	
5.	131	100°30'		-7°43'	-17.4	858.1	
6.	157	107°30'		-7°55'	-21.7	853.8	
7.	240	100°		-2°31'	-10.5	865.0	
B.M.5	277	109°30'		-2°00'	- 9.7	865.9	
8.	64	196°		6.8ft	- 1.5	874.0	
9.	106	219°30'		7.3ft	- 2.0	873.5	
10.	162	234°		9.3ft	- 4.0	871.5	
11.	220	245°30'		8.3ft	- 3.0	873.5	
12.	259	249°30'		5.5ft	- 0.2	875.3	
13.	220	266°30'		7.7ft	- 2.4	873.1	
14.	229	288°		-3°09'	-12.6	863.9	
15.	130	296°		-5°39'	-12.7	862.8	
16.	85	313°30'		-8°33'	-12.5	863.0	
17.	106	358°		-6°58'	-12.8	862.7	
18.	108	243°30'		7.0ft	- 1.7	873.8	
19.	170	265°		7.4ft	- 2.1	873.4	
Sta. G.	266	265°17'	N86°30'E	7.9ft	- 2.6	872.9	
Inst. at Sta. G.	---	---	-----	---	---	---	5.4'
Sta.H	237	284°24'	S34°30'E	5.0ft	.4	873.3	
1.	120	327°30'		-5°10'	-10.8	862.1	
2.	102	287°		11.0ft	- 5.6	867.5	
3.	158	290°		10.9ft	- 5.5	867.4	
Inst.at H.	---	---	-------	---	---	---	5.1'

Sta.	Dist.	Az.	Bearing	V.An. &F.S.	Dif.in Elev.	Elev.	H.I.
1.	104	29° 30'		6.9ft	- 1.5	871.8	
2.	112	356° 30'		8.5ft	- 3.0	870.3	
3.	45	33[illegible]° 30'		5.1ft	.3	873.6	
4.	161	304° 30'		2.2ft	3.2	876.5	
5.	123	249°		2.0ft	2.4	875.7	
Sta.I	216	245° 36'	N76° 00'E	1° 15'	4.6	877.9	
Sta.J	171	361° 27'	S 2° 30'W	10.7ft	- 5.3	868.0	
6.	132	66° 30'		-1° 20'	- 3.1	870.2	
Inst.at Sta.I.	----	---	-----	----	----	---	4.9'
B.M.7	410	225° 54'		.95ft	3.95	882.1	
1.	142	286° 56'		6.5ft	- 1.4	876.7	
2.	96	327° 06'		6.4ft	- 1.5	876.6	
3.	65	2° 26'		4.9ft	0.0	878.1	
Inst.at Sta. J.	---	-----	------	----	----	----	5.00
						857.6	
1.	42	123° 11'		5.5ft	- .5	857.1	
2.	91	120° 08'		7.6ft	- 2.6	855.0	
3.	132	105°		12.1ft	- 7.1	850.5	
4.	110	48° 28'		10.9ft	- 5.9	851.7	
5.	87	358° 33'		6.1ft	- 1.8	855.8	
6.	126	317° 09'		6.4ft	- 1.4	856.2	
7.	120	276° 22'		1° 53'	4.0	871.6	
Sta. K	202	5° 56'	S[illegible]° 00'W	-0° 52'	- 3.1	864.5	
Inst.at Sta.K.	---	-----	----	-----	---	-------	4.9'

Sta.	Dist. in ft.	Az.	Bearing	V.An.	Dif.in Elev.	Elev.	H.I.
1.	62	88° 30'		8.2ft	- 3.3	861.2	
2.	77	266° 07'		5.7ft	- .8	863.7	
3.	122	266° 51'		6.0ft	- 1.1	863.4	
4.	170	307° 58'		8.5ft	- 3.6	860.9	
5.	93	320° 15'		8.7ft	- 3.8	860.7	
Sta.L	163	15° 44'	S17° 00W	8.8ft	- 3.9	860.6	
Inst.at Sta. L.	----	----	-----	----	----	----	5.0'
1.	85	127° 16'		5.0ft	0.0	860.6	
2.	83	62° 41'		5.3ft	- .3	860.3	
3.	166	60° 19'		-0° 03'	- .1	860.7	
4.	113	299° 53'		4.5ft	.5	860.1	
5.	151	321° 33'		4.3ft	.7	861.3	
Sta.M.	136	25° 47'	S26° 30'W	1.4ft	3.5	864.1	
Inst.at Sta.M.	----	-----	------	---	-----	----	5.1'
1.	152	82° 57'		3.7ft	1.4	865.5	
2.	270	83° 05'		1° 40'	7.9	872.0	
3.	397	66° 13'		0° 54'	6.2	870.3	
4.	172	47° 35'		4.5ft	.6	864.7	
5.	115	12° 34'		6.7ft	-1.6	863.5	
6.	250	53° 17'		6.8ft	-1.7	862.4	
Sta.A12	676	359° 48'		11.8ft	-6.7	857.4	

Elevation checks within 0.2ft on Sta. A12.

Contents of Packet.

1. List of Packet's Contents.

2. Topographic Map and Street Layout.

3. Detail of Sewage Sewer System,
Topographic Map and Street Layout.

Contents of Packet.

1. List of Brochure Articles.

2. Topographic Map and Street Layout.

3. Detailed Sewer System,
Topographic Map and Street Layout.

Pocket has: 3 maps

SUPPLEMENTARY MATERIAL