PROPOSED ADDITION TO THE
CITY OF EAST LANSING

Thesis for the Degree of B. S.
MICHIGAN STATE COLLEGE
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1947

Proposed Addition to the City

of East Lansing

A Thesis Submitted to

The Faculty of

MICHIGAN STATE COLLEGE

of

AGRICULTURE AND APPLIED SCIENCE

By

C. E. Atwater D. P. Ziemke

Candidates for the Degree of

Bachelor of Science

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Proposed Addition to the City of East Lansing

The land which was surveyed is located north of the city limits of East Lansing. It is trapezoidal in shape and is bounded by Bircham Drive on the south side. It is owned by the Walter Neller Realty Company, hence the name Neller Subdivision.

This land was chosen not only because of its location, but because the authors thought that its features were typical of those that would be encountered in most subdivision problems.

The problem was handled by dividing it in the following manner:

1. Reconnaisance
2. Location survey
3. Location of Bench Marks
4. Topographical survey
5. Cross-section elevations
6. Street, sidewalks, and lot design
7. Water supply
8. Sewer design
9. Estimated cost of project

Reconnaisance and General

Description

Permission was obtained from Mr. Walter Neller for the use of his land. With the help of the City Engineer of East Lansing, the approximate boundaries were obtained. The authors went over the land carefully and decided on the portion before described.

The land is rolling at the north end and decidedly level on the south end, as the topographical map will indicate. The general slope tends to begin at the upper NE corner and bear SW down to the SW corner. The level land on the southern end presented a good problem in the sewer design.

Location Survey

The East Lansing City Engineer was consulted for the location of the quarter section corner used and also the description of the property.

The quarter post, Section 7, T4N, R1W, was located and a line run from that point to the first control point. This was placed both in the field notes and on the topographical map.

Location of Bench Marks

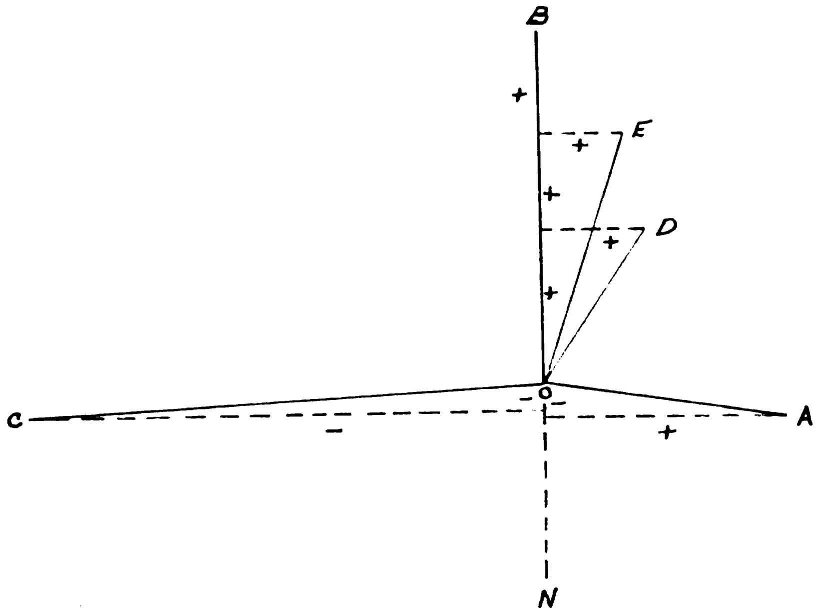
With the help of the East Lansing City Engineer the location of a known bench mark was obtained. From this the elevations of the control points were established as shown in the field notes. These were later used in the cross-sectioning for elevations.

Topographical Survey

From the point established by means of the quarter-section corner, a traverse was run close to the edge of the property to be subdivided. The deflection angles were repeated six times as indicated in the field notes. The traverse was then closed in computations that follow, by use of latitudes and departures in conjunction with the transit rule.

From the traverse that was established, the topographical features of the land were obtained with a transit and stadia rod.

Closure of Traverse



__Angles__

BOE = 10° 13' 45"

BOD = 26° 59' 05"

NOA = 83° 43' 50"

NOC = 89° 56' 50"

The error is -5" and it is all placed in angle DEA as shown in the field notes.

__Lengths of line__

BO = 1166.16'

EO = 770.51'

DO = 491.42'

CO = 625.95'

AO = 267.90'

__BO__

Latitude = -1166.16'

Departure = 0.00

BC

Lat. = (625.95) cos 89° 56' 50" = +0.57587

Dep. = (625.95) sin 89° 56' 50" = −625.95

CD

Lat. = (491.42) cos 26° 59' 05" = +437.91910

Dep. = (491.42) sin 26° 59' 05" = +222.98183

DE

Lat. - (770.51) cos 10° 13' 45" = +758.25839

Dep. = (770.51) sin 10° 13' 45" = +136.83487

EA

Lat. = (267.90) cos 83° 43' 50" = − 29.25736

Dep. = (267.90) sin 83° 43' 50" = +266.29796

Line	Latitudes		Departures	
	+	−	+	−
AB		1166.16000	0.0	0.0
BC	0.57587			625.95000
CD	437.91910		222.98183	
DE	758.25889		136.83487	
EF		29.25736	266.29796	
	1196.75386	1195.41736	626.11466	625.95000

Difference in Lats. = +1.33650'

Difference in Deps. = +0.16466'

Adjustment by Transit Rule

$$\frac{\text{Lat. or Dep. corr.}}{\text{Total error in Lat. or Dep.}} = \frac{\text{Lat. or Dep. of line}}{\text{Sum of all Lat. or Dep.}}$$

BC

Latitude correction = −0.00032174

Departure correction = +0.082319

CD

Latitude correction = −0.24466429

Departure correction = −0.029324513

DE

Latitude correction = −0.4236373

Departure correction = −0.017995259

EF

Latitude correction = +0.016346012

Departure correction = −0.03502105

AB

Latitude correction = +0.6515306

Departure correction = 0.0

Line	Corrected Latitudes +	Corrected Latitudes −	Corrected Departures +	Corrected Departures −
AB		1166.81153	0.0	0.0
BC	0.57555			626.03232
CD	437.67444		222.95251	
DE	757.83525		136.81687	
EF		29.27371	266.26294	
	1196.08524	1196.08524	626.03232	626.03232

Corrected sides of traverse

AB = 1166.81' BC = 626.032' CD = 491.189' DE = 770.086

EF = 267.867'

Cross-section Elevations

From the traverse previously established, the cross-section was planned. Points were placed at one-hundred foot intervals on the traverse lines. The level was placed at each of the one-hundred foot stations on line AB and aligned on a previously established point on line CD and DE, as the case was. On arbitrary lines intersecting both AB and CD, or AB and DE, as the case was, perpendiculars were established at fifty foot intervals. Where these perpendiculars intersected the line established by sighting the level, elevations were taken. This grid system covered the area in question very satisfactorily.

Street, Sidewalk, and Lot Design

The requirements for additions to the city of East Lansing were obtained from the City Hall, and are as follows:

1. Width of streets are 30' back to back of curb
2. 60' right-of-way for streets
3. Lots not less than 5,000 square feet

Since the authors wished to make the lots as desirable as possible, most of them will exceed the minimum requirements. The lots were varied in size in order to relieve monotony and to give a wider selection to the buyer.

The streets were designed with two main objectives in mind: first, to facilitate placement of the sewer lines; and, secondly, to place them in an attractive position.

T he sidewalks were placed one foot inside of the right-of-way for easier construction and maintenance. The sidewalks are to be made 4' wide and constructed of concrete.

The plan view of the streets, sidewalks, and lots are on an enclosed plate. Also enclosed is a cross-section of the streets.

Water Supply

Location of existing water mains and specifications were obtained from the city of East Lansing. The specifications and computations for the water mains are as follows:

An existing 8" line runs under Bircham Drive, between Bailey and Abbott Road, at a depth of 5'. This was used as the source of supply for all mains in the subdivision. Pressure on the 8" line is 50 psi.

The facts necessary for consideration in laying out the water lines were:

1. Feeders not more than 3,000 feet apart
2. Fire hydrant supply pipes not less than 6" for residential areas, with 6" cross-mains not to exceed 600 feet
3. Pressure on fire hydrants should not be less than 20 psi
4. Frost line for this region is 36"

<u>Computations</u>

The longest water line of the subdivision will be 1404 feet. This line will serve 85 people. These figures are the maximum of any line in the subdivision.

Fire demand for 85 people:

$$F.D. = 1020(0.085)^{\frac{1}{2}}\left[1 - 0.01(0.085)^{\frac{1}{2}}\right]$$

$$= (1020)(0.292)(0.997)$$

$$= 298 \text{ g.p.m.}$$

For population of 85 at 100 g.c.d. the consumption will be:

Max. rate $= \frac{(100)(2.50)(85)}{60} = 354$ g.p.m.

Total requirement for one line $= 298 + 354 = 652$ g.p.m.

Pressure $= 50$ p.s.i.

Using the Hazen-Williams formula for cast iron pipe with $C = 100$:

The head loss of 1404' of 6" pipe with 652 g.p.m. is 52'/100 or 75'/1404

$75 \times 0.433 = 32.5$ p.s.i. drop

$50 - 32.5 = 17.5$ p.s.i. remaining in the line at the end of 1404'. This is at the extreme edge of the subdivision, and of East Lansing, so the deficiency of 2.5 p.s.i. is over-looked.

The design will then consist of all 6" pipe at a depth of 5' as shown on the drawings.

All valves were placed so as to assure the isolation of any section without closing the remaining lines.

Sewer Design

Specifications for sewers in East Lansing were obtained from the City Engineer and are as follows:

1. Minimum size of pipe is 12"
2. Catch basin type of inlet to be installed
3. Combined sewer system is required
4. Minimum cover is 7.5'

One of the objectives in the street location design was the adaptability of the streets to a sewer system. The sewer lines were placed with respect to lot location, and the direction of flow determined. Distance between manholes was limited to 400' maximum and preferably 350'. Manholes were also placed at any appreciable change in direction of the streets, in order to facilitate cleaning, keep off private property, and also maintain somewhat of an equal distance from sewer lines to opposite lots. Catch basins were placed at street intersections in such a manner that water would not gather at cross-walks.

Complete rainfall data for the past 26 years was obtained from the East Lansing weather bureau station. The five storms of greatest intensity were plotted for each "time of duration" group. The rainfall data was converted to intensity of rainfall in inches per hour, and these values plotted against time of duration of each storm. Curves were drawn through the two highest points plotted. The design was based on the second or thirteen year curve. This represents a liberal allowance for a residential district.

The subdivision area was divided into smaller areas draining into separate manholes. These divisions are shown on a map enclosed. The inlet time for the most remote drainage area was taken to be ten minutes. A recognized value of 0.4 (built-up residential district) was used for the coefficient of permeability (I) in the design computations.

Velocities were kept between 3.5 and 10 feet per second. An effort was made to have the sewer grade conform to the grade of natural ground, but this was not possible in all cases. In the cases of unfavorable natural ground slopes, it was attempted to balance cost of deeper excavation against cost of greater size pipe. Maximum depth of pipe is 13.1 feet.

In all cases, the design is such that pipes meeting at manholes will have their crowns on the same plane. In the case of 90° changes of direction, a 0.3 foot drop was allowed for velocity head loss. For changes of direction of less than 90°, a 0.1 foot drop was allowed.

The point of concentration for the entire subdivision is at manhole 19. The sewage was led from manhole 19 to an existing 48" city sewer which is referred to as manhole 20. Since manhole 20 is approximately 23' feet underground, a drop manhole will

will be necessary in order for it to receive the subdivision sewage at the least possible cost.

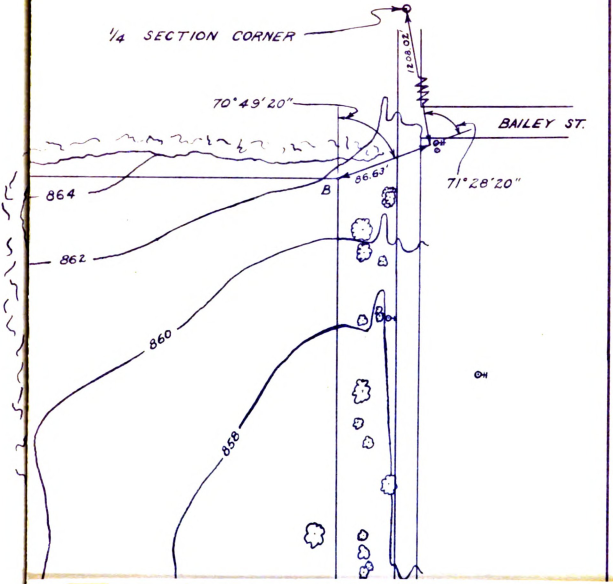
Estimated Cost of Project

The cost of the project was arrived at in the following manner:

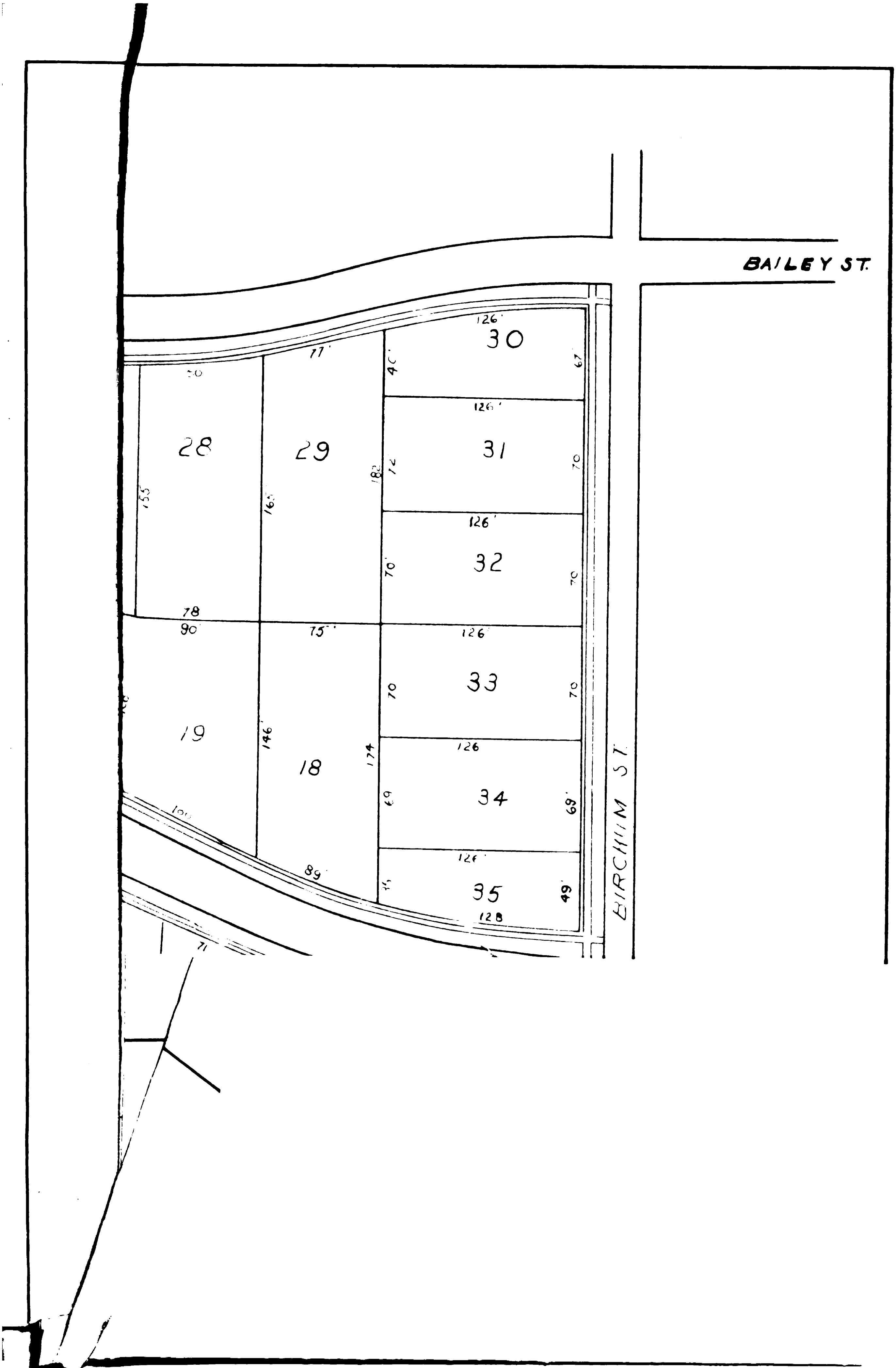
4338' of 6" water pipe @ $2.00		$ 8,676.00
12 fire hydrants @ $150.00		1,800.00
15-6" water valves @ $50.00		750.00
2299' of 12" sewer pipe (av. depth-9')	@ $2.36	3,424.64
704' " 15" " " " "	@ $2.76	1943.04
1075' " 18" " " " "	@ $3.51	3,773.25
543' " 24" " " " "	@ $5.29	2,867.47
683' " 10" " " " "	@ $2.13	1,454.79
19 Manholes @ $161.00		3,059.00
38 catch basins @ $100.00		3,800.00
11,660 sq. yds. concrete pavement @ $3.00		34,980.00
6,994' of curb and gutter @ $1.50		10,491.00
22,176 sq. ft. concrete sidewalks @ $0.15		3,326.40
3,335 cu. yds. of cut and fill for streets	@ $0.50	1,667.50
15% addition for engineering & contingencies		12,301.81
5% for sales expense		4,715.70
Cost of 15.21 acres land @ $200.00		3,042.00
25% for owner's profit		25,517.90
	TOTAL	$127,589.50

Therefore, cost of average lot is $2500.00

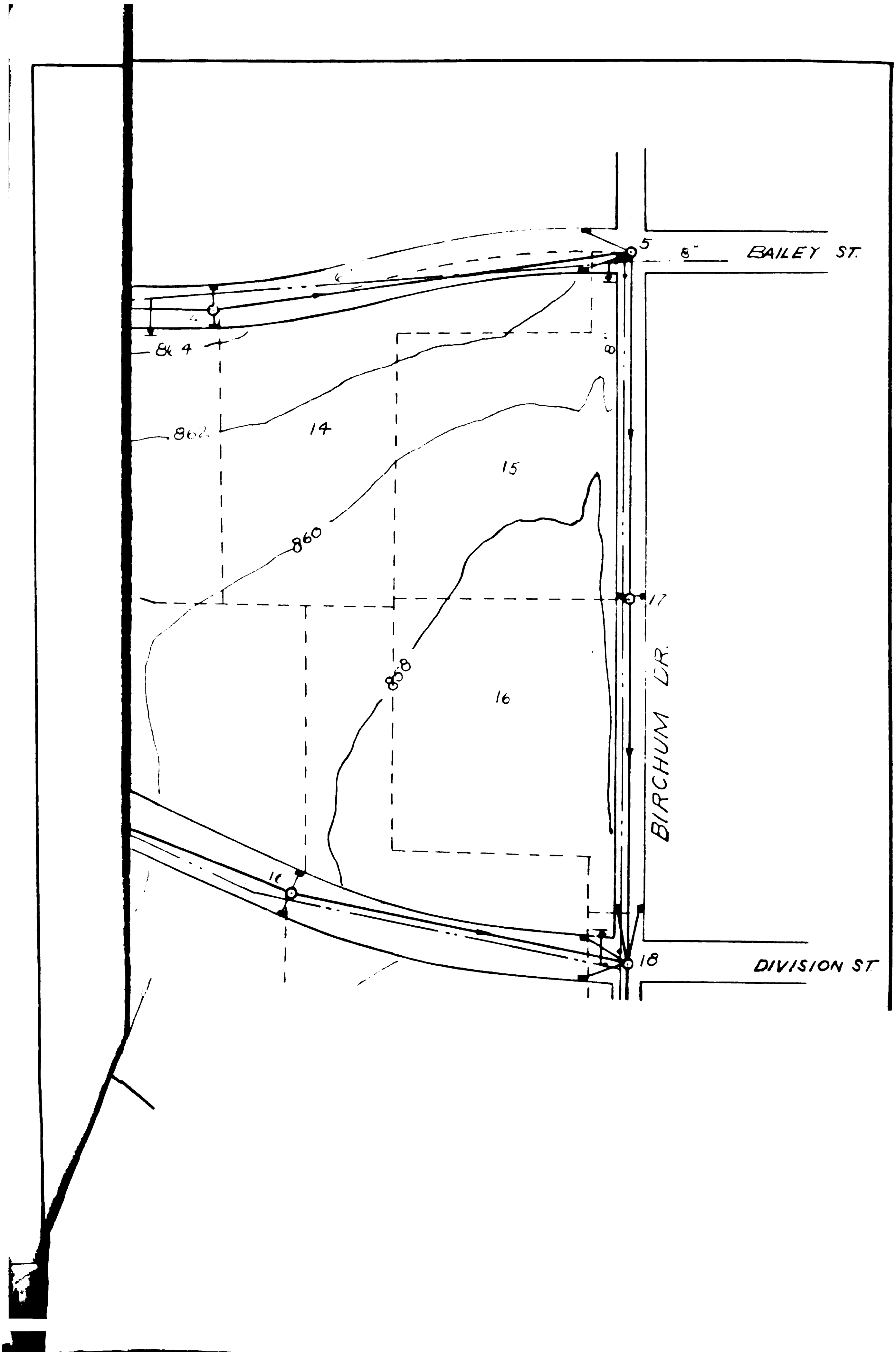
The selling price for the average lot may seem somewhat high at $2500.00. However, it must be remembered that the lots in this subdivision are larger than the average city lot. Also, the market is far from normal in that labor and material costs are very high, and because of the scarcity of building materials, the demand (and therefore the price) for building sites is low.



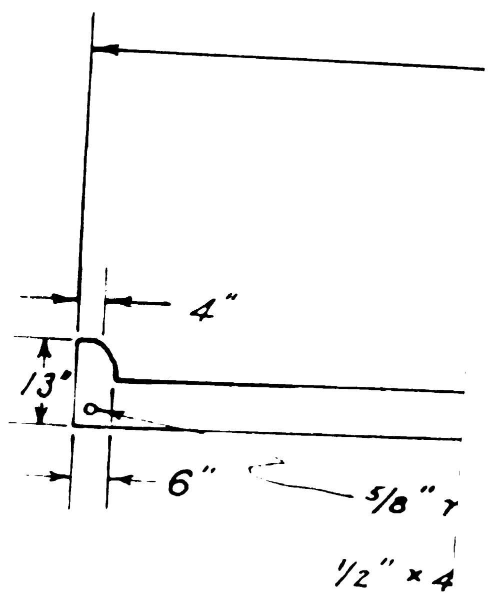
1/4 SECTION CORNER
1208.02'
70°49'20"
BAILEY ST.
86.63'
B
71°28'20"
864
862
860
858



BAILEY ST.
BIRCHUM ST.
28
29
30
31
32
33
34
35
19
18


BAILEY ST.
DIVISION ST
BIRCHUM DR.
5
8"
14
15
16
17
18
862
860
858
864

RAINFA

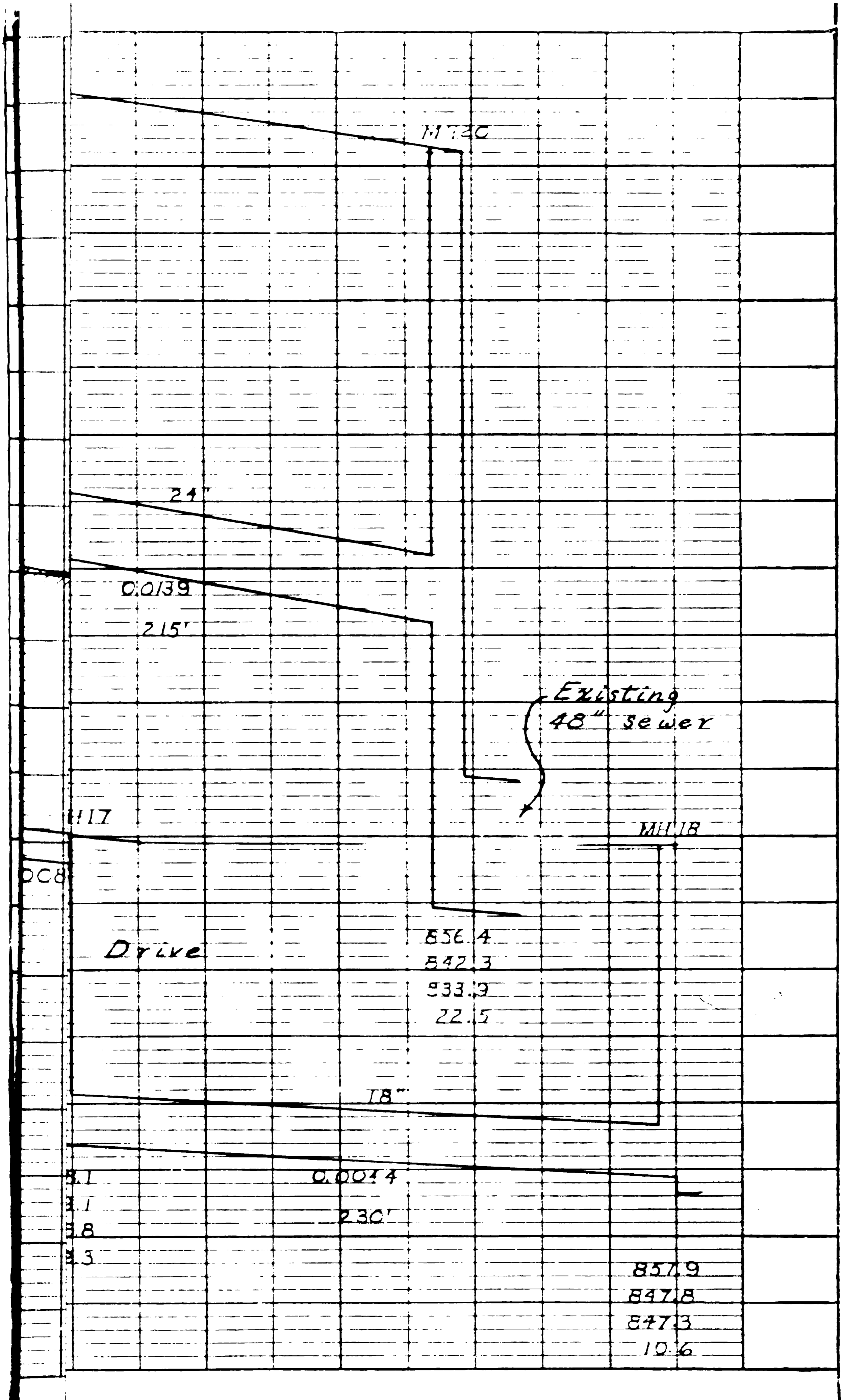


Not

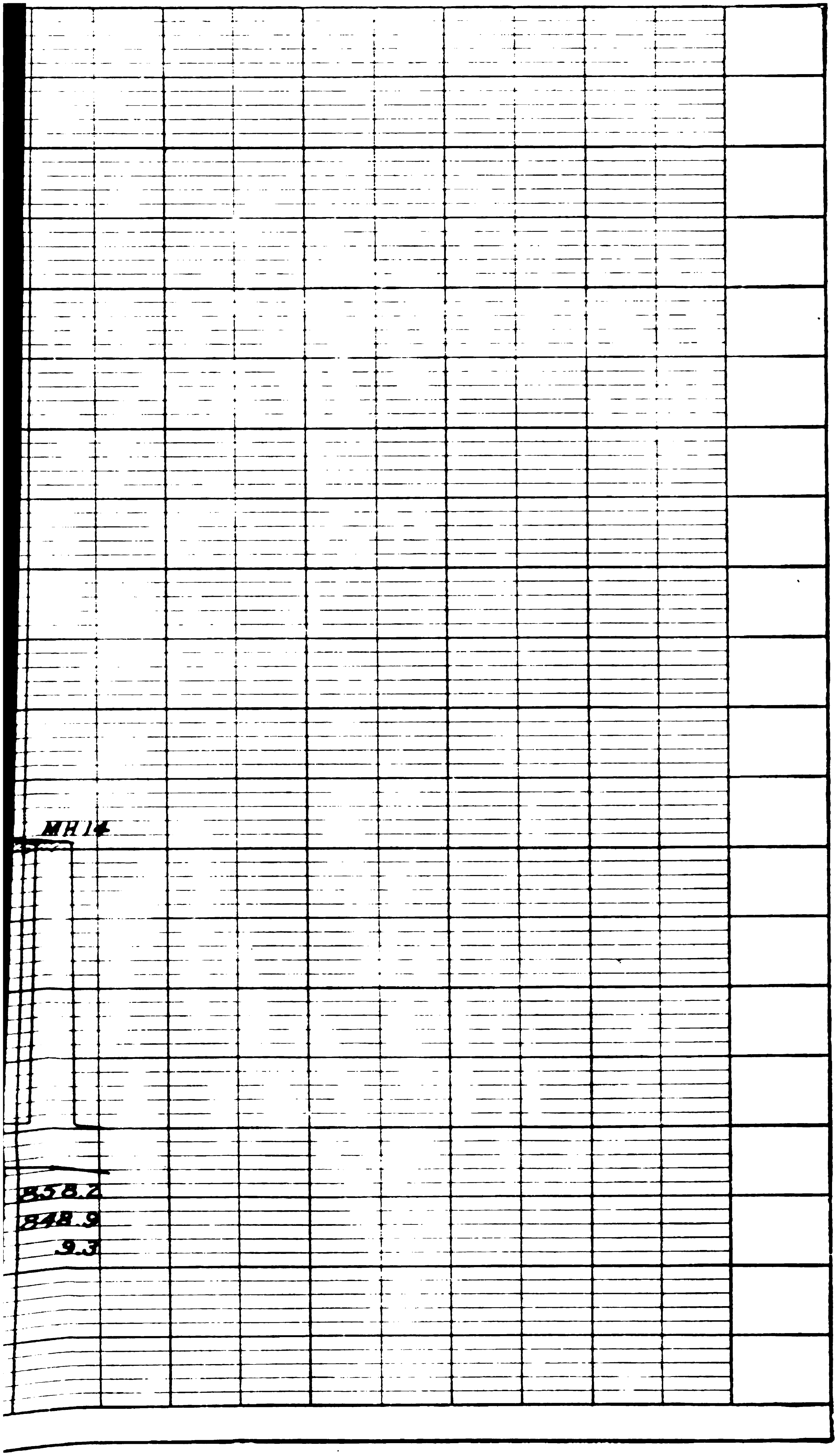
C

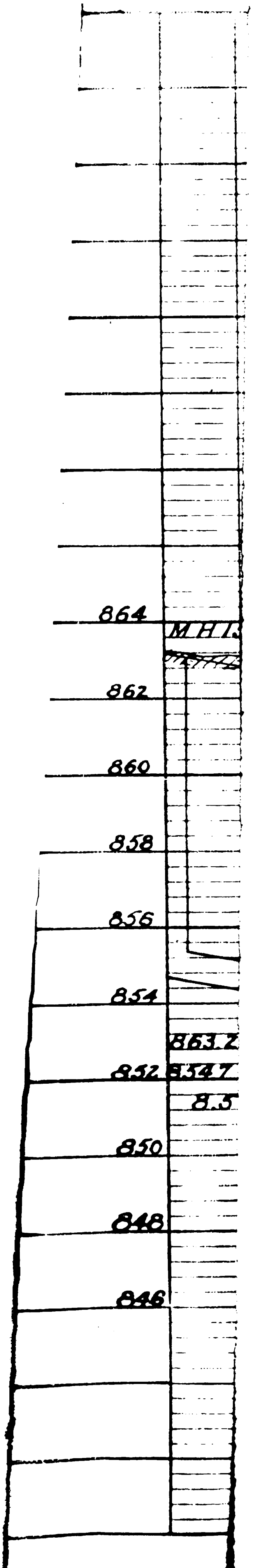
C

Line No.	Location	Man[illegible]	Capacity of sewer, cu. ft. per sec.	Ground Elevations		Invert Elevations		Line No.
				Upper End	Lower End	Upper End	Lower End	
1	Bailey St.	[illegible]	5.8	880.0	873.1	871.5	864.6	1
2	Bailey St	[illegible]	5.2	873.1	867.5	864.6	859.0	2
3	Bailey St	[illegible]	3.1	867.5	864.1	859.0	855.6	3
4	Bailey St.	[illegible]	6.0	864.1	862.0	855.3	853.2	4
5	Birchum Dr.	[illegible]	9.0	862.0	858.1	853.0	849.1	5
6	Birchum Dr.	[illegible]	7.0	858.1	857.9	848.8	847.8	6
7	Division St.	[illegible]	4.1	863.2	858.3	854.7	849.8	7
8	Division St	[illegible]	5.9	858.3	857.9	849.5	847.8	8
9	Birchum Dr.	[illegible]	16.1	857.9	858.7	847.3	845.6	9
10	Leon Ave	[illegible]	2.8	864.6	864.1	856.1	855.6	10
11	Leon Ave.	[illegible]	2.7	864.1	863.3	855.5	854.8	11
12	Leon Ave.	[illegible]	2.8	863.3	862.8	854.7	854.2	12
13	Post Ave.	[illegible]	3.6	880.1	876.9	871.6	868.4	13
14	Charles St.	[illegible]	5.8	876.9	868.6	868.1	860.1	14
15	Charles St.	[illegible]	5.0	868.6	862.8	860.1	854.3	15
16	Charles St.	[illegible]	9.4	862.8	860.9	853.7	851.8	16
17	Charles St.	[illegible]	9.9	860.9	858.2	851.7	849.0	17
18	Charles St.	[illegible]	11.0	858.2	858.7	848.9	846.1	18
19	Birchum Dr.	[illegible]	26.2	858.7	856.4	845.3	842.3	19



24"
0.0139
215'
Existing
48" sewer
MH 18
Drive
856.4
842.3
833.9
22.5
18"
0.0044
230'
857.9
847.8
847.3
10.6


MH 14
858.2
848.9
9.3



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