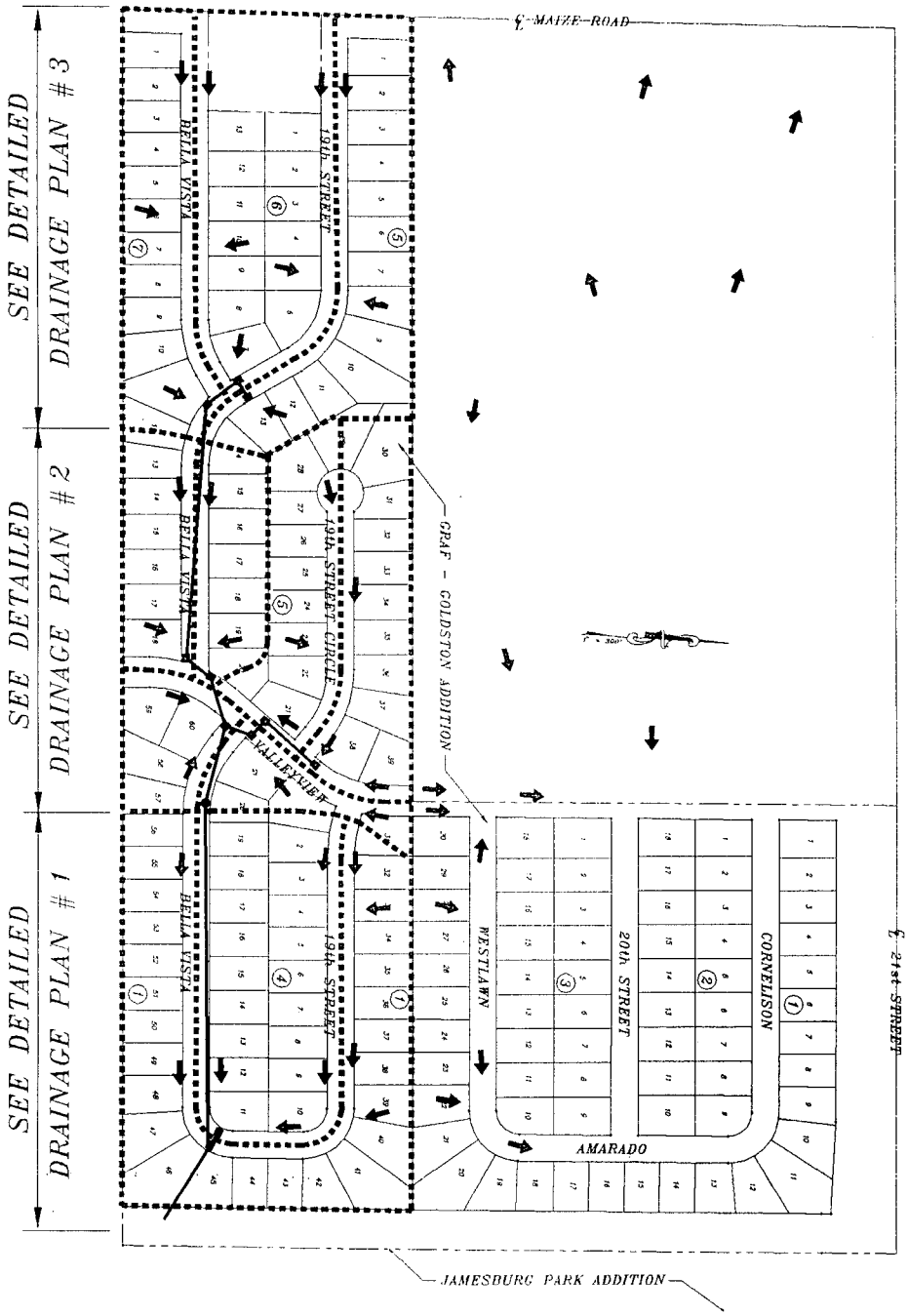
DRAINAGE CALCULATIONS

FOR

GRAF-GOLDSTON ADDITION
WICHITA, KANSAS

MARCH 1992

ENGINEERING & SURVEYING
2554 N. Cleveland • P.O. Box 2264
Wichita, KS. 67201 • (316) 263-6620



OVERALL DRAINAGE PLAN

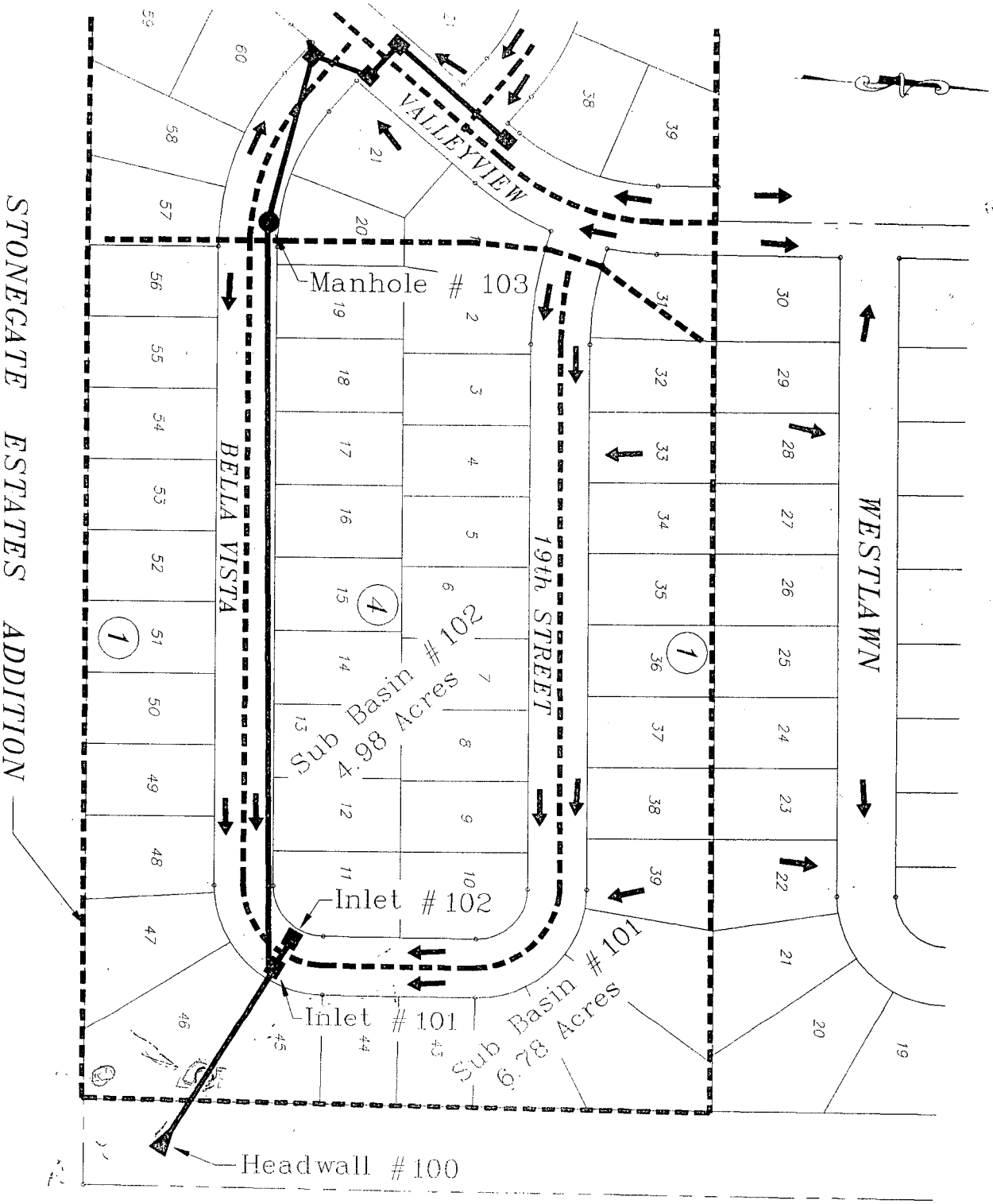
1"=400'

GRAF—GOLDSTON ADDITION
WICHITA, KANSAS

Terra Tech Inc.

ENGINEERING• SURVEYING
234 N. Cleveland - P.O. Box 244
Wichita, KS. 67201 - (316) 263-6620

DATE: March 13, 1992



DETAILED DRAINAGE AREA #1

1"=150'

GRAF — GOLDSTON ADDITION
WICHITA, KANSAS

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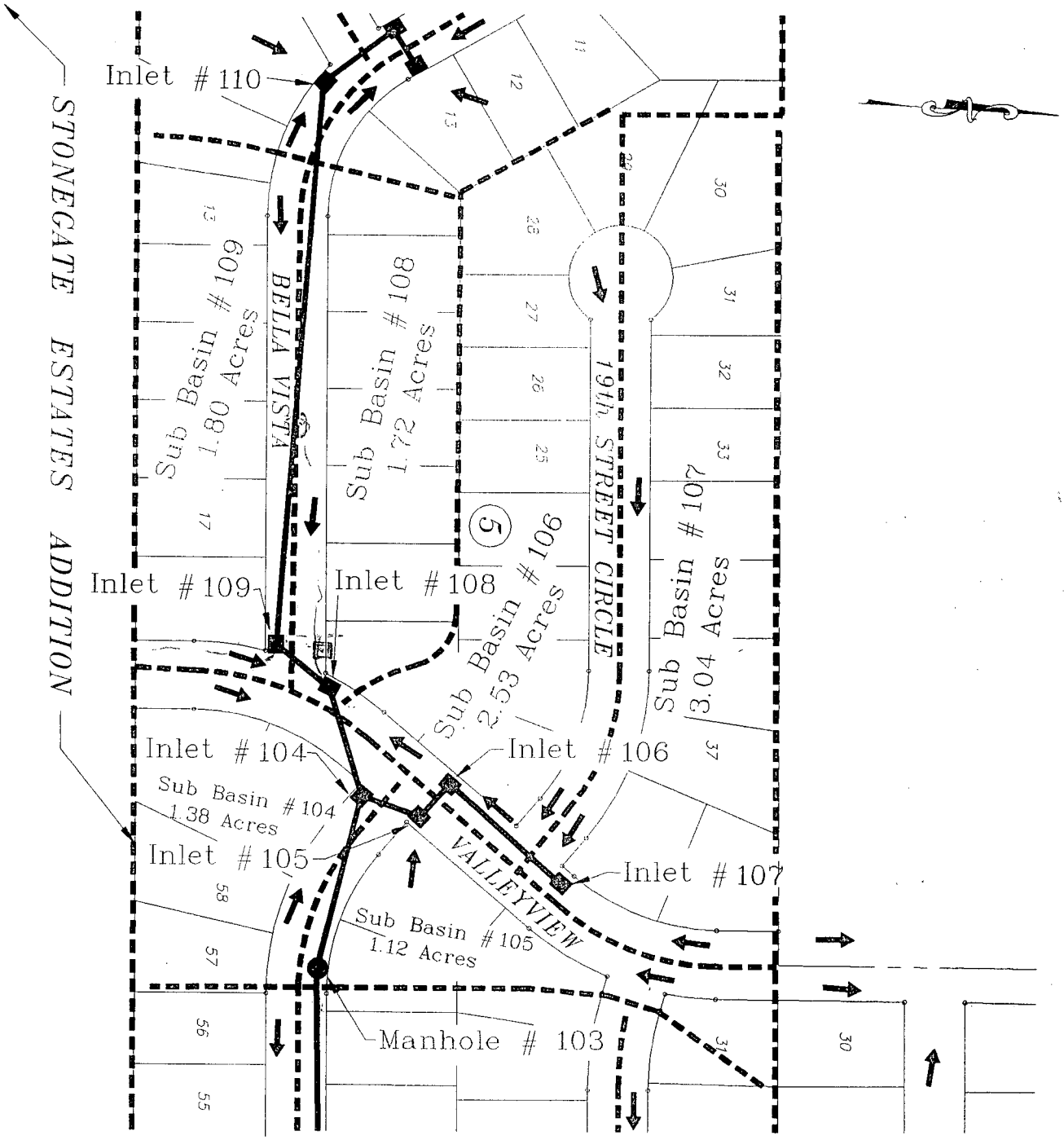
DATE: March 13, 1992



DETAILED DRAINAGE AREA #2

1"=150'

GRAF – GOLDSTON ADDITION
WICHITA, KANSAS

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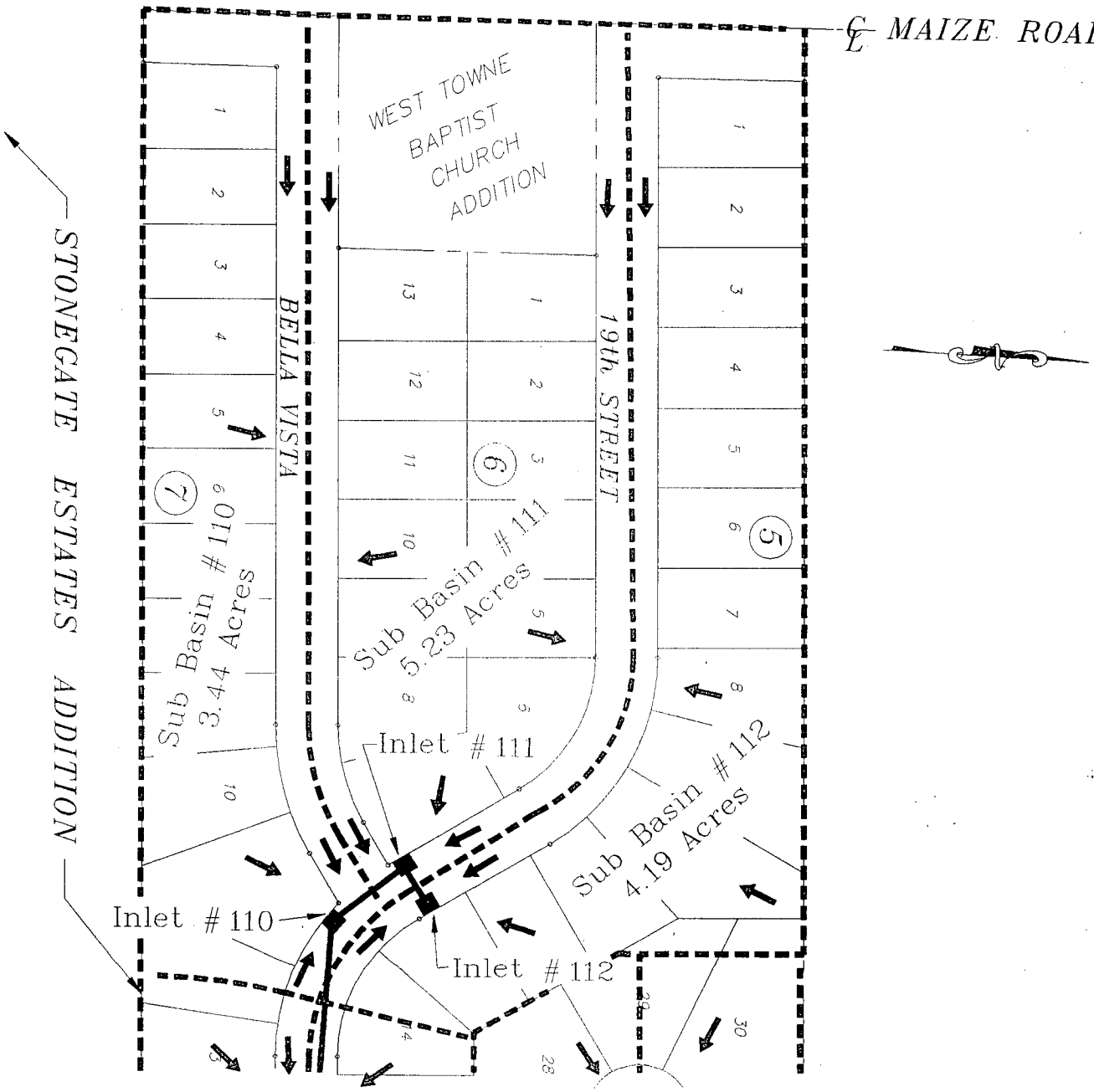
Wichita, KS. 67201 – (316) 263-6620

DATE: March 13, 1992



DETAILED DRAINAGE AREA #3

1"=150'

GRAF – GOLDSTON ADDITION
WICHITA, KANSAS

Terra Tech Inc.

ENGINEERING● SURVEYING
234 N. Cleveland – P.O. Box 244
Wichita, KS. 67201 – (316) 263-6620

DATE: March 13, 1992

April 15, 1986

ATTACHMENT A
DRAINAGE CRITERIA MANUAL

CITY OF WICHITA, KANSAS

RAINFALL INTENSITY TABLE FOR SEDGWICK COUNTY, KANSAS

The following tabulation contains rainfall intensity in inches per hour as derived from ESSA Weather Bureau Technical Paper 40 Modified to NWS Hydro-35, 1977 During First Hour

DURATION IN MINUTES	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5	4.18	5.57	6.53	7.41	8.52	9.48	10.32
6	3.99	5.32	6.25	7.09	8.16	9.09	9.89
7	3.81	5.09	5.99	6.81	7.84	8.74	9.50
8	3.66	4.89	5.75	6.55	7.55	8.42	9.15
9	3.52	4.70	5.54	6.31	7.28	8.13	8.83
10	3.39	4.52	5.34	6.09	7.04	7.86	8.54
11	3.27	4.36	5.16	5.89	6.81	7.61	8.27
12	3.18	4.21	4.99	5.71	6.60	7.38	8.02
13	3.05	4.08	4.84	5.53	6.41	7.17	7.79
14	2.96	3.95	4.69	5.37	6.23	6.97	7.57
15	2.87	3.83	4.56	5.22	6.06	6.78	7.37
16	2.78	3.72	4.43	5.08	5.90	6.60	7.18
17	2.71	3.61	4.31	4.95	5.75	6.44	7.00
18	2.63	3.51	4.20	4.83	5.61	6.29	6.84
19	2.56	3.42	4.10	4.71	5.47	6.14	6.68
20	2.50	3.33	4.00	4.60	5.35	6.00	6.53
21	2.44	3.25	3.90	4.50	5.23	5.87	6.39
22	2.38	3.17	3.81	4.40	5.12	5.75	6.26
23	2.32	3.10	3.73	4.31	5.01	5.63	6.13
24	2.27	3.03	3.65	4.22	4.91	5.52	6.01
25	2.22	2.96	3.57	4.13	4.81	5.41	5.90
26	2.20	2.90	3.50	4.05	4.72	5.31	5.79
27	2.16	2.84	3.43	3.98	4.63	5.21	5.69
28	2.14	2.78	3.37	3.90	4.55	5.12	5.59
29	2.11	2.72	3.30	3.83	4.47	5.03	5.49
30	2.08	2.67	3.24	3.76	4.39	4.94	5.40
31	2.05	2.62	3.19	3.70	4.32	4.86	5.32
32	2.02	2.57	3.10	3.63	4.25	4.79	5.22
33	1.99	2.52	3.05	3.57	4.18	4.71	5.14
34	1.96	2.48	3.01	3.51	4.11	4.63	5.07
35	1.93	2.44	2.98	3.46	4.05	4.56	5.00
36	1.91	2.39	2.93	3.41	3.99	4.50	4.93
37	1.89	2.35	2.88	3.36	3.93	4.43	4.86
38	1.87	2.32	2.84	3.31	3.87	4.37	4.79
39	1.85	2.28	2.80	3.26	3.82	4.31	4.73
40	1.83	2.24	2.76	3.22	3.76	4.25	4.66
41	1.81	2.21	2.72	3.17	3.71	4.19	4.60
42	1.79	2.18	2.68	3.13	3.66	4.13	4.54
43	1.77	2.14	2.64	3.09	3.61	4.08	4.49
44	1.75	2.11	2.61	3.05	3.57	4.03	4.43
45	1.73	2.08	2.57	3.01	3.52	3.98	4.38

City of Wichita
Rainfall Intensity (2 YEAR)

Minutes	Intensity
15.0	3.83
15.1	3.82
15.2	3.81
15.3	3.80
15.4	3.79
15.5	3.77
15.6	3.76
15.7	3.75
15.8	3.74
15.9	3.73
16.0	3.72
16.1	3.71
16.2	3.70
16.3	3.69
16.4	3.68
16.5	3.66
16.6	3.65
16.7	3.64
16.8	3.63
16.9	3.62
17.0	3.61
17.1	3.60
17.2	3.59
17.3	3.58
17.4	3.57
17.5	3.56
17.6	3.55
17.7	3.54
17.8	3.53
17.9	3.52
18.0	3.51
18.1	3.50
18.2	3.49
18.3	3.48
18.4	3.47
18.5	3.47
18.6	3.46
18.7	3.45
18.8	3.44
18.9	3.43
19.0	3.42

Minutes	Intensity
19.0	3.42
19.1	3.41
19.2	3.40
19.3	3.39
19.4	3.38
19.5	3.38
19.6	3.37
19.7	3.36
19.8	3.35
19.9	3.34
20.0	3.33
20.1	3.32
20.2	3.31
20.3	3.31
20.4	3.30
20.5	3.29
20.6	3.28
20.7	3.27
20.8	3.27
20.9	3.26
21.0	3.25
21.1	3.24
21.2	3.23
21.3	3.23
21.4	3.22
21.5	3.21
21.6	3.20
21.7	3.19
21.8	3.19
21.9	3.18
22.0	3.17
22.1	3.16
22.2	3.16
22.3	3.15
22.4	3.14
22.5	3.13
22.6	3.13
22.7	3.12
22.8	3.11
22.9	3.11
23.0	3.1

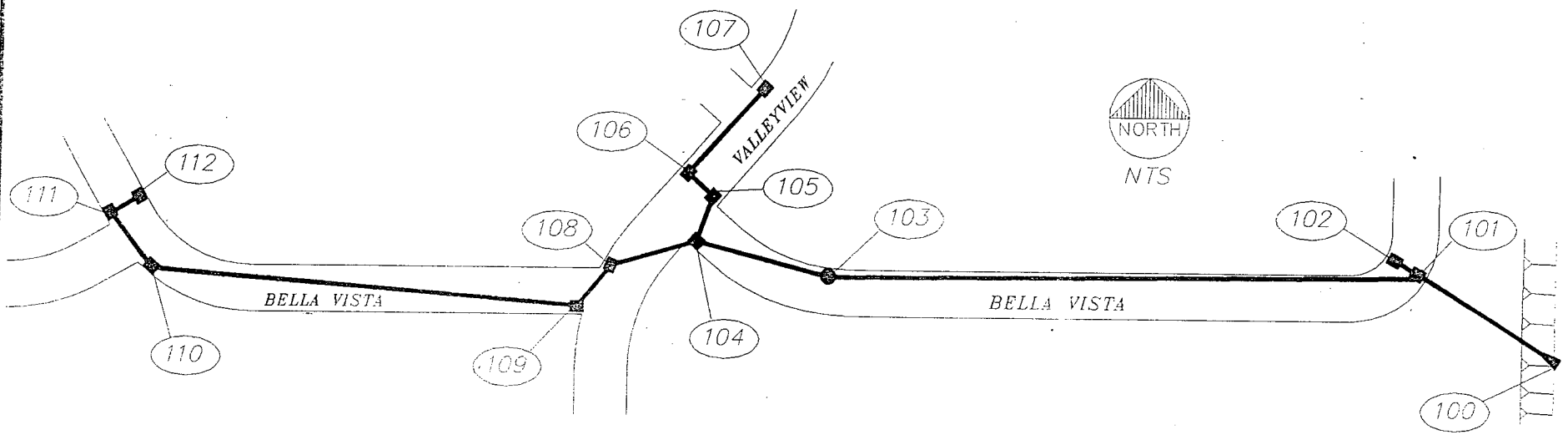
HYDROLOGY DATA SHEET

Terra Tech Inc.
ENGINEERING • SURVEYING
234 N. Cleveland – P.O. Box 244
Wichita, KS. 67201 – (316) 263-6620

PROJECT: GRAF – GOLDSTON ADDITION
ITEM: PHASE II STORM SEWER (SYSTEM 100)
RETURN PERIOD: 2 COMPUTATIONS BY: RDF

PROJECT NO. 347
DATE: 3-13-92
REVISIONS BY:

SCHEMATIC DIAGRAM:



TRIBUTARY AREA								HYDROLOGY SUMMATION				CONDUIT DATA					
SUB BASIN (1)	C (2)	AREA (acres) (3)	SLOPE (%) (4)	LENGTH (feet) (5)	T_{c_0} (minutes) (6)	I_0 in./hr. (7)	Q_0 (cfs) (8)	Tc (minutes) (9)	I in./hr. (10)	Q (cfs) (11)	ΣQ (cfs) (12)	PIPE (inches) (13)	SLOPE (%) (14)	VELOCITY (ft./sec.) (15)	LENGTH (feet) (16)	T_t (minutes) (17)	$T_c + T_t$ (minutes) (18)
112	0.5	4.19	—	—	15	3.83	8.0	15	3.83	8.0	8.0						
												15	1.3	6.5	36	0.1	15.1
111	0.5	5.23	—	—	15	3.83	10.0	15.1	3.82	10.0	18.0						
												24	0.5	5.7	82	0.2	15.3
110	0.5	3.44	—	—	15	3.83	6.6	15.3	3.80	6.5	24.5						
												30	0.3	5.0	540	1.5	16.8
109	0.5	1.80	—	—	15	3.83	3.4	16.8	3.63	3.3	27.8						
												30	0.4	5.7	81	0.2	17.0
108	0.5	1.72	—	—	15	3.83	3.3	17.0	3.61	3.1	30.9						
												30	0.5	6.3	115	0.3	17.3
104	—	—															

HYDROLOGY DATA SHEET

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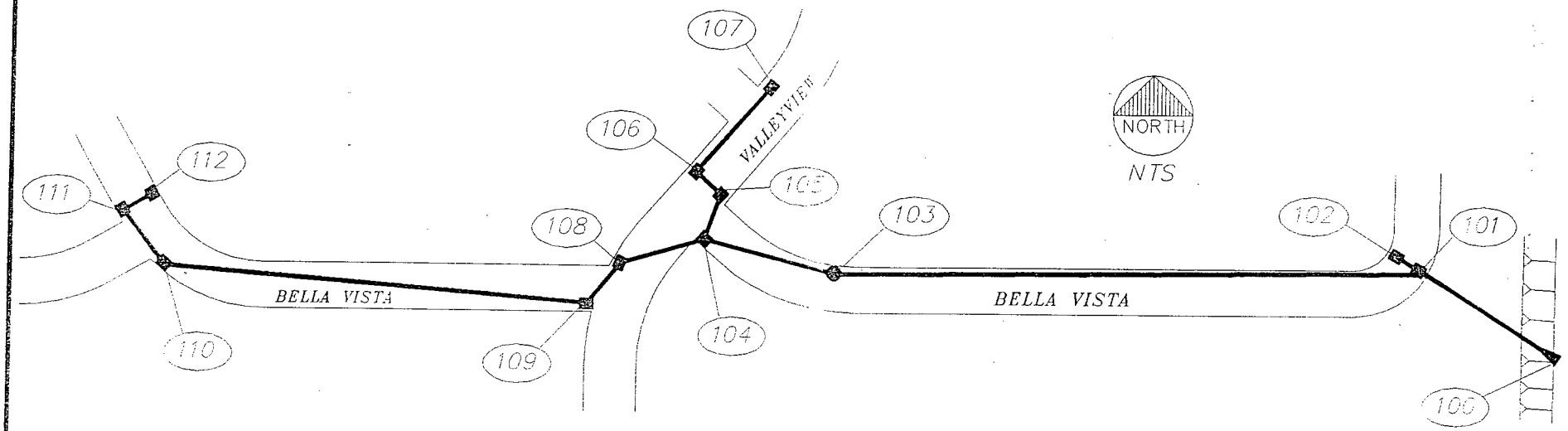

TRIBUTARY AREA								HYDROLOGY SUMMATION				CONDUIT DATA					
SUB BASIN (1)	C (2)	AREA (acres) (3)	SLOPE (%) (4)	LENGTH (feet) (5)	T_{c_0} (minutes) (6)	I_0 in./hr. (7)	Q_0 (cfs) (8)	Tc (minutes) (9)	I in./hr. (10)	Q (cfs) (11)	ΣQ (cfs) (12)	PIPE (inches) (13)	SLOPE (%) (14)	VELOCITY (ft./sec.) (15)	LENGTH (feet) (16)	T_t (minutes) (17)	$T_c + T_t$ (minutes) (18)
107	0.5	3.04			15	3.83	5.8	15	3.83	5.8	5.8						
												15	0.7	4.7	140	0.5	15.5
106	0.5	2.53			15	3.83	4.8	15.5	3.77	4.8	10.6						
												18	0.9	6.0	41	0.1	15.6
105	0.5	1.12			15	3.83	2.1	15.6	3.76	2.1	12.7						
												21	0.5	5.3	76	0.2	15.8
104	M.	—															

HYDROLOGY DATA SHEET

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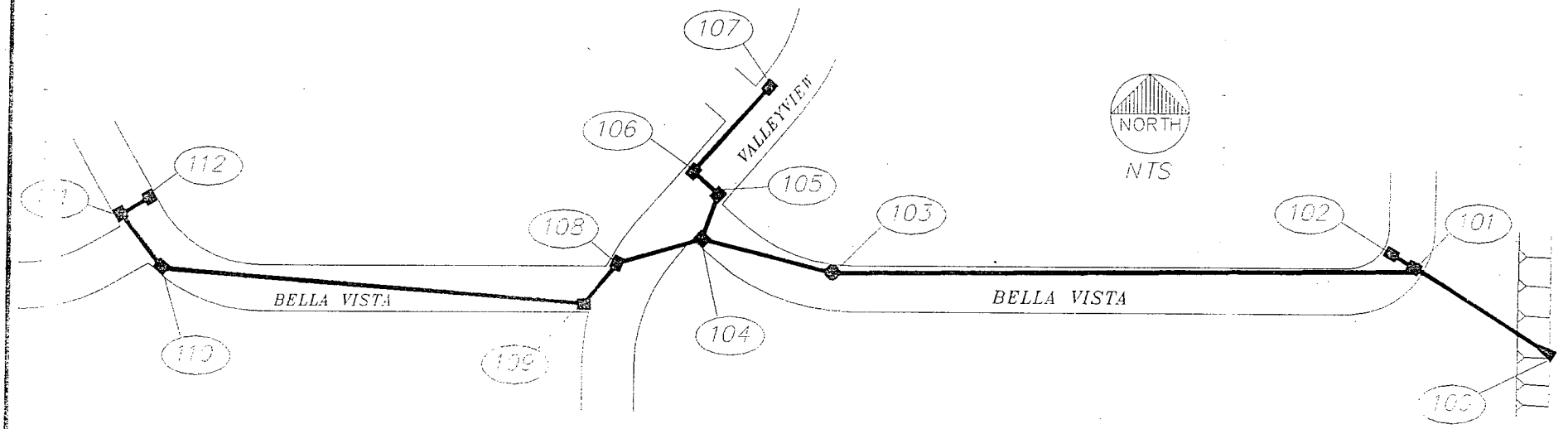
SCHEMATIC DIAGRAM:



TRIBUTARY AREA								HYDROLOGY SUMMATION				CONDUIT DATA					
SUB BASIN (1)	C (2)	AREA (acres) (3)	SLOPE (%) (4)	LENGTH (feet) (5)	T_{c_0} (minutes) (6)	I_0 in./hr. (7)	Q_0 (cfs) (8)	Tc (minutes) (9)	I in./hr. (10)	Q (cfs) (11)	ΣQ (cfs) (12)	PIPE (inches) (13)	SLOPE (%) (14)	VELOCITY (ft./sec.) (15)	LENGTH (feet) (16)	T_t (minutes) (17)	$T_c + T_t$ (minutes) (18)
104	0.5	1.38			15	3.83	2.6	17.3	3.58	2.5	46.1						
												36	0.4	6.5	158	0.4	17.7
103	MH	0									46.1						
												36	0.4	6.5	732	1.9	19.6
101		—															

HYDROLOGY DATA SHEET

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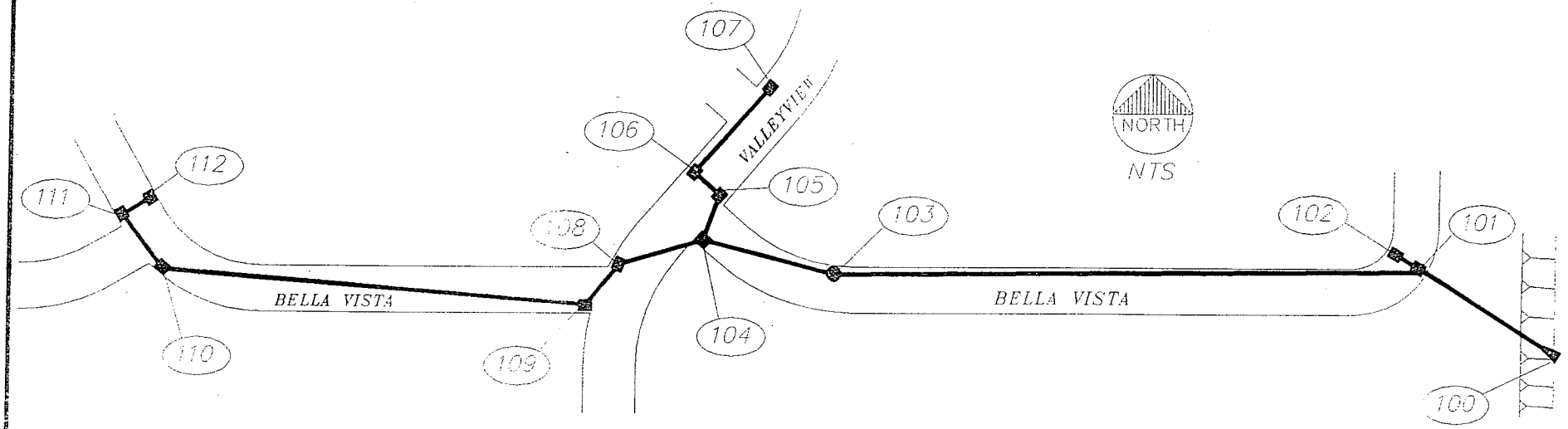
PAGE 4 OF 4
PROJECT NO. 347
DATE: 3-13-92
REVISIONS BY:

SCHEMATIC DIAGRAM:



TRIBUTARY AREA								HYDROLOGY SUMMATION				CONDUIT DATA					
SUB BASIN (1)	C (2)	AREA (acres) (3)	SLOPE (%) (4)	LENGTH (feet) (5)	T_{c_0} (minutes) (6)	I_0 in./hr. (7)	Q_0 (cfs) (8)	Tc (minutes) (9)	I in./hr. (10)	Q (cfs) (11)	ΣQ (cfs) (12)	PIPE (inches) (13)	SLOPE (%) (14)	VELOCITY (ft./sec.) (15)	LENGTH (feet) (16)	T_t (minutes) (17)	$T_c + T_t$ (minutes) (18)
102	0.5	4.98			15	3.83	9.5	15	3.83	9.5	9.5						
												18	0.7	5.4	36	0.1	15.1
101		—															
101	0.5	6.78			15	3.83	13.0	20.3	3.31	11.2	66.8						
												60	0.06	3.4	220	1.1	20.7
100																	
101	0.5	36.2			21	6.39	115.7	21	6.39	115.7	115.7						
		(100 YEAR STORM)										60	0.35	5.9	220		
100																	

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Graf-Goldston SWS

Comment: 112-111

Solve For Full Flow Slope

Given Input Data:

Diameter.....	1.25 ft
Manning's n.....	0.012
Discharge.....	8.00 cfs

Computed Results:

Full Flow Channel Slope	0.0131 ft/ft
Full Flow Depth.....	1.25 ft
Velocity.....	6.52 fps
Flow Area.....	1.23 sf
Critical Depth....	1.12 ft
Critical Slope....	0.0116 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	8.00 cfs
QMAX @.94D.....	8.61 cfs
Froude Number.....	FULL

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Graf-Goldston SWS

Comment: 111-110

Solve For Full Flow Slope

Given Input Data:

Diameter.....	2.00 ft
Manning's n.....	0.012
Discharge.....	18.00 cfs

Computed Results:

Full Flow Channel Slope	0.0054 ft/ft
Full Flow Depth.....	2.00 ft
Velocity.....	5.73 fps
Flow Area.....	3.14 sf
Critical Depth....	1.53 ft
Critical Slope....	0.0062 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	18.00 cfs
QMAX @.94D.....	19.36 cfs
Froude Number.....	FULL

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Graf-Goldston SWS

Comment: 110-109

Solve For Full Flow Slope

Given Input Data:

Diameter.....	2.50 ft
Manning's n.....	0.012
Discharge.....	24.50 cfs

Computed Results:

Full Flow Channel Slope	0.0030 ft/ft
Full Flow Depth.....	2.50 ft
Velocity.....	4.99 fps
Flow Area.....	4.91 sf
Critical Depth....	1.69 ft
Critical Slope....	0.0048 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	24.50 cfs
QMAX @.94D.....	26.35 cfs
Froude Number.....	FULL

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Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Graf-Goldston SWS

Comment: 109-108

Solve For Full Flow Slope

Given Input Data:

Diameter.....	2.50 ft
Manning's n.....	0.012
Discharge.....	27.80 cfs

Computed Results:

Full Flow Channel Slope	0.0039 ft/ft
Full Flow Depth.....	2.50 ft
Velocity.....	5.66 fps
Flow Area.....	4.91 sf
Critical Depth....	1.80 ft
Critical Slope....	0.0052 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	27.80 cfs
QMAX @.94D.....	29.90 cfs
Froude Number.....	FULL

Open Channel Flow Module, Version 3.12 (c) 1990
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Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Graf-Goldston SWS

Comment: 108-104

Solve For Full Flow Slope

Given Input Data:

Diameter.....	2.50 ft
Manning's n.....	0.012
Discharge.....	30.90 cfs

Computed Results:

Full Flow Channel Slope	0.0048 ft/ft
Full Flow Depth.....	2.50 ft
Velocity.....	6.29 fps
Flow Area.....	4.91 sf
Critical Depth....	1.89 ft
Critical Slope....	0.0057 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	30.90 cfs
QMAX @.94D.....	33.24 cfs
Froude Number.....	FULL

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Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Graf-Goldston SWS

Comment: 107-106

Solve For Full Flow Slope

Given Input Data:

Diameter.....	1.25 ft
Manning's n.....	0.012
Discharge.....	5.80 cfs

Computed Results:

Full Flow Channel Slope	0.0069 ft/ft
Full Flow Depth.....	1.25 ft
Velocity.....	4.73 fps
Flow Area.....	1.23 sf
Critical Depth....	0.98 ft
Critical Slope....	0.0076 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	5.80 cfs
QMAX @.94D.....	6.24 cfs
Froude Number.....	FULL

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Graf-Goldston SWS

Comment: 106-105

Solve For Full Flow Slope

Given Input Data:

Diameter.....	1.50 ft
Manning's n.....	0.012
Discharge.....	10.60 cfs

Computed Results:

Full Flow Channel Slope	0.0087 ft/ft
Full Flow Depth.....	1.50 ft
Velocity.....	6.00 fps
Flow Area.....	1.77 sf
Critical Depth....	1.25 ft
Critical Slope....	0.0084 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	10.60 cfs
QMAX @.94D.....	11.40 cfs
Froude Number.....	FULL

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Graf-Goldston SWS

Comment: 105-104

Solve For Full Flow Slope

Given Input Data:

Diameter.....	1.75 ft
Manning's n.....	0.012
Discharge.....	12.70 cfs

Computed Results:

Full Flow Channel Slope	0.0055 ft/ft
Full Flow Depth.....	1.75 ft
Velocity.....	5.28 fps
Flow Area.....	2.41 sf
Critical Depth....	1.33 ft
Critical Slope....	0.0064 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	12.70 cfs
QMAX @.94D.....	13.66 cfs
Froude Number.....	FULL

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Graf-Goldston SWS

Comment: 104-103

Solve For Full Flow Slope

Given Input Data:

Diameter.....	3.00 ft
Manning's n.....	0.012
Discharge.....	46.10 cfs

Computed Results:

Full Flow Channel Slope	0.0041 ft/ft
Full Flow Depth.....	3.00 ft
Velocity.....	6.52 fps
Flow Area.....	7.07 sf
Critical Depth....	2.21 ft
Critical Slope....	0.0051 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	46.10 cfs
QMAX @.94D.....	49.59 cfs
Froude Number.....	FULL

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Graf-Goldston SWS

Comment: 103-101

Solve For Full Flow Slope

Given Input Data:

Diameter.....	3.00 ft
Manning's n.....	0.012
Discharge.....	46.10 cfs

Computed Results:

Full Flow Channel Slope	0.0041 ft/ft
Full Flow Depth.....	3.00 ft
Velocity.....	6.52 fps
Flow Area.....	7.07 sf
Critical Depth....	2.21 ft
Critical Slope....	0.0051 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	46.10 cfs
QMAX @.94D.....	49.59 cfs
Froude Number.....	FULL

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Graf-Goldston SWS

Comment: 102-101

Solve For Full Flow Slope

Given Input Data:

Diameter.....	1.50 ft
Manning's n.....	0.012
Discharge.....	9.50 cfs

Computed Results:

Full Flow Channel Slope	0.0070 ft/ft
Full Flow Depth.....	1.50 ft
Velocity.....	5.38 fps
Flow Area.....	1.77 sf
Critical Depth....	1.19 ft
Critical Slope....	0.0074 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	9.50 cfs
QMAX @.94D.....	10.22 cfs
Froude Number.....	FULL

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Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Graf-Goldston SWS

Comment: 101-100 (2 year storm)

Solve For Full Flow Slope

Given Input Data:

Diameter.....	5.00 ft
Manning's n.....	0.012
Discharge.....	66.80 cfs

Computed Results:

Full Flow Channel Slope	0.0006 ft/ft
Full Flow Depth.....	5.00 ft
Velocity.....	3.40 fps
Flow Area.....	19.63 sf
Critical Depth....	2.31 ft
Critical Slope....	0.0030 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	66.80 cfs
QMAX @.94D.....	71.86 cfs
Froude Number.....	FULL

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Graf-Goldston SWS

Comment: 101-100 (100 year storm flow)

Solve For Full Flow Slope

Given Input Data:

Diameter.....	5.00 ft
Manning's n.....	0.012
Discharge.....	115.70 cfs

Computed Results:

Full Flow Channel Slope	0.0017 ft/ft
Full Flow Depth.....	5.00 ft
Velocity.....	5.89 fps
Flow Area.....	19.63 sf
Critical Depth....	3.07 ft
Critical Slope....	0.0035 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	115.70 cfs
QMAX @.94D.....	124.46 cfs
Froude Number.....	FULL

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

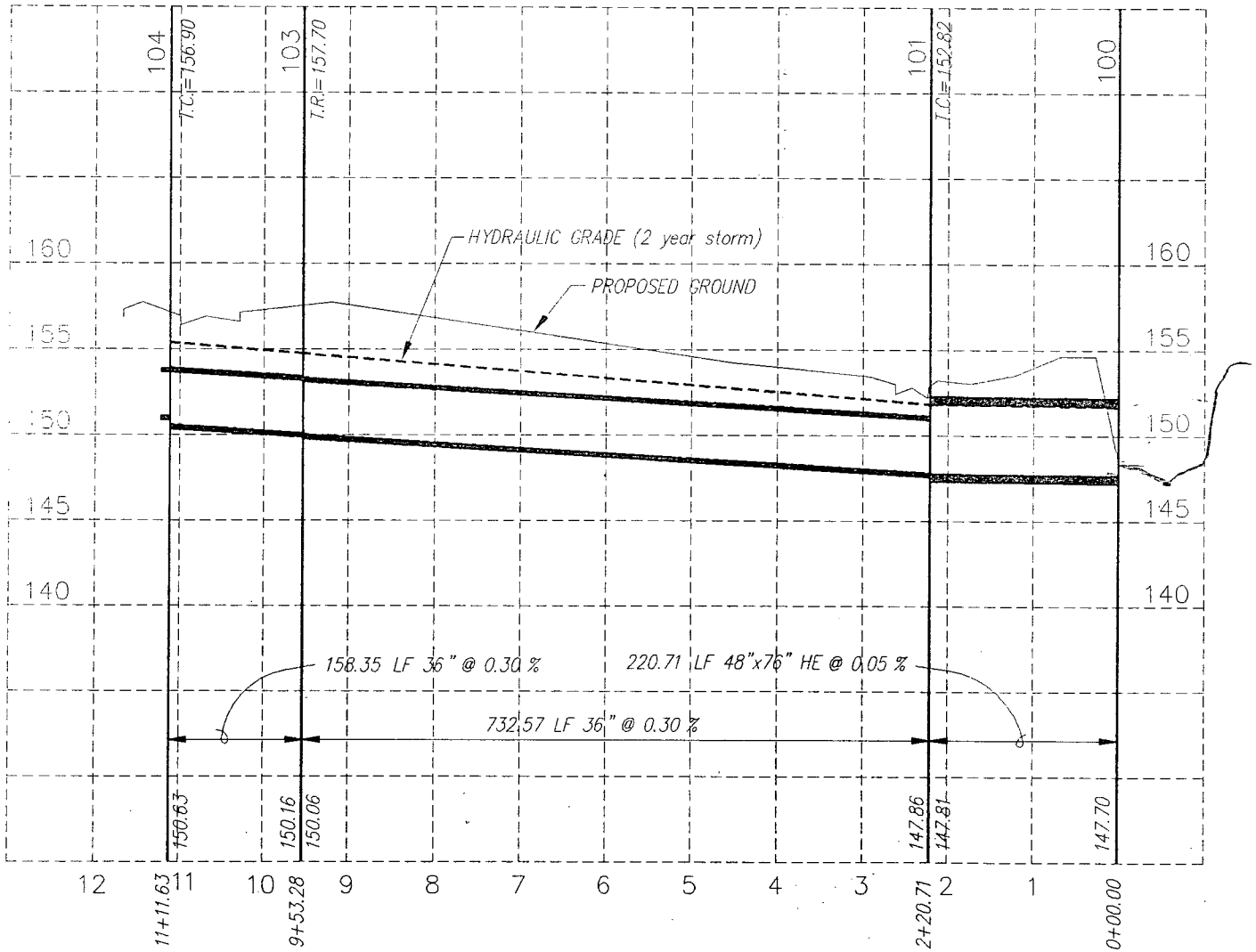
HYDROLOGY DATA SHEET

Terra Tech Inc.
ENGINEERING • SURVEYING
234 N. Cleveland – P.O. Box 244
Wichita, KS. 67201 – (316) 263-6620

PROJECT: *GRAF-GOLDSTON ADDITION*
ITEM: *Storm Sewer Profiles*
RETURN PERIOD: *2 yr.* COMPUTATIONS BY: *RDF*

PROJECT NO. *347*
DATE: *3-16-92*
REVISIONS BY:

SCHEMATIC PROFILE



HYDROLOGY DATA SHEET

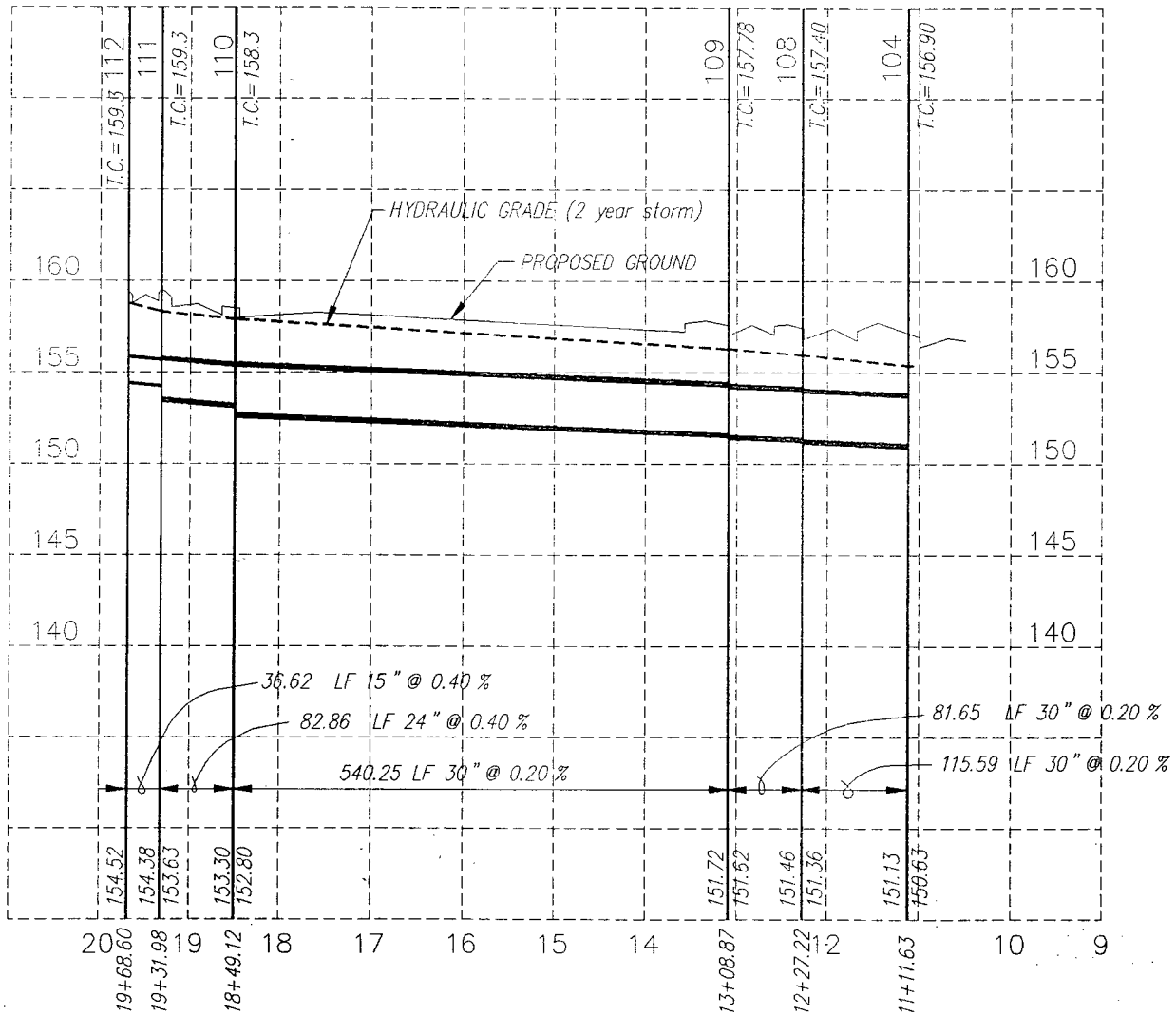
Terra Tech Inc.

ENGINEERING • SURVEYING
234 N. Cleveland – P.O. Box 244
Wichita, KS. 67201 – (316) 263-6620

PROJECT: GRAF-GOLDSTON ADDITION
ITEM: Storm Sewer Profiles
RETURN PERIOD: 2 yr. COMPUTATIONS BY: RDF

PAGE 2 OF 3
PROJECT NO. 347
DATE: 3-16-92
REVISIONS BY:

SCHEMATIC PROFILE



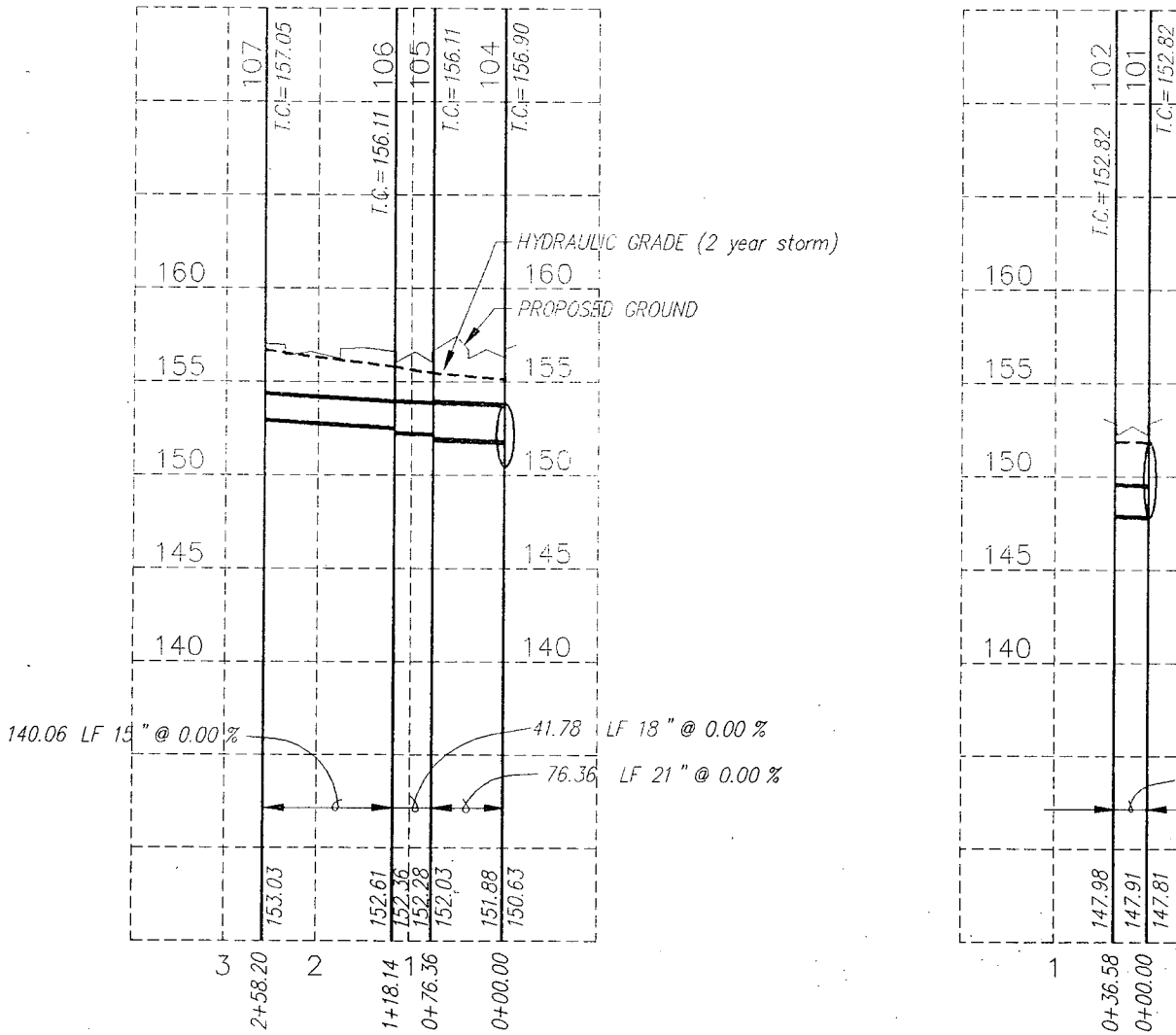
HYDROLOGY DATA SHEET

Terra Tech Inc.
ENGINEERING • SURVEYING
234 N. Cleveland - P.O. Box 244
Wichita, KS. 67201 - (316) 263-6620

PROJECT: *GRAF-GOLDSTON ADDITION*
ITEM: *Storm Sewer Profiles*
RETURN PERIOD: *2 yr.* COMPUTATIONS BY: *RDF*

PROJECT NO. *347*
DATE: *3-16-92*
REVISIONS BY:

SCHEMATIC PROFILE



CALCULATION SHEET

Terra Tech Inc.

ENGINEERING • SURVEYING
234 N. Cleveland – P.O. Box 244
Wichita, KS. 67201 – (316) 263-6620

PROJECT: GRAF - GOLDSTON ADD
ITEM: STREET FLOW
COMPUTATIONS BY: RDE

PAGE 1 OF 1
PROJECT NO. 347
DATE: 3-14-92
REVISIONS BY: _____
REV. DATE: _____

STREET FLOW
2 YR STORM

C = 0.5
TC = 15 min
I_2 = 3.83

INLET NO.	FLOW FROM	STREET SLOPE %	AREA (acres)	FLOW (cfs)	FLOW DEPTH
101	19th (N)	0.32	3.81	7.3	0.47
	Bella Vista (W)	0.55	2.97	5.7	0.39
102	19th (N)	0.32	2.60	5.0	0.41
	Bella Vista (W)	0.55	2.38	4.5	0.36
103	Manhole				
104	Valleyview	0.44	1.38	2.6	0.30
105	Valleyview	0.44	1.12	2.1	0.28
106	Valleyview	0.32	2.53	4.8	0.40
107	Valleyview	0.50	3.04	5.8	0.40
108	Valleyview	0.44	1.72	3.3	0.33
109	Bella Vista	0.44	1.80	3.4	0.34
110	Bella Vista	0.50	3.44	6.6	0.42
111	Bella Vist. (SW)	0.50	2.76	5.3	0.39
	19th (NW)	0.53	2.47	4.7	0.37
112	19th (NW)	0.53	3.67	7.0	0.42
	19th (SE)	0.32	0.52	1.0	0.22

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GRAF STREETS

Comment: Inlet 101 - flow from 19th (N)

Solve For Depth

Given Input Data:

Left Side Slope..	0.01:1 (H:V)
Right Side Slope.	33.00:1 (H:V)
Manning's n.....	0.016
Channel Slope....	0.0032 ft/ft
Discharge.....	7.30 cfs

Computed Results:

Depth.....	0.47 ft
Velocity.....	1.97 fps
Flow Area.....	3.70 sf
Flow Top Width...	15.64 ft
Wetted Perimeter.	16.11 ft
Critical Depth...	0.41 ft
Critical Slope...	0.0066 ft/ft
Froude Number....	0.71 (flow is Subcritical)

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GRAF STREETS

Comment: Inlet 101 - flow from Bella Vista (W)

Solve For Depth

Given Input Data:

Left Side Slope..	0.01:1 (H:V)
Right Side Slope.	33.00:1 (H:V)
Manning's n.....	0.016
Channel Slope....	0.0055 ft/ft
Discharge.....	5.70 cfs

Computed Results:

Depth.....	0.39 ft
Velocity.....	2.27 fps
Flow Area.....	2.51 sf
Flow Top Width...	12.87 ft
Wetted Perimeter.	13.27 ft
Critical Depth...	0.37 ft
Critical Slope...	0.0068 ft/ft
Froude Number....	0.91 (flow is Subcritical)

Open Channel Flow Module, Version 3.12 (c) 1990
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Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GRAF STREETS

Comment: Inlet 102 - flow from 19th (N)

Solve For Depth

Given Input Data:

Left Side Slope..	0.01:1 (H:V)
Right Side Slope.	33.00:1 (H:V)
Manning's n.....	0.016
Channel Slope....	0.0032 ft/ft
Discharge.....	5.00 cfs

Computed Results:

Depth.....	0.41 ft
Velocity.....	1.79 fps
Flow Area.....	2.79 sf
Flow Top Width...	13.57 ft
Wetted Perimeter.	13.98 ft
Critical Depth...	0.36 ft
Critical Slope...	0.0069 ft/ft
Froude Number....	0.70 (flow is Subcritical)

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Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GRAF STREETS

Comment: Inlet 102 - flow from Bella Vista (W)

Solve For Depth

Given Input Data:

Left Side Slope..	0.01:1 (H:V)
Right Side Slope.	33.00:1 (H:V)
Manning's n.....	0.016
Channel Slope....	0.0055 ft/ft
Discharge.....	4.50 cfs

Computed Results:

Depth.....	0.36 ft
Velocity.....	2.14 fps
Flow Area.....	2.10 sf
Flow Top Width...	11.78 ft
Wetted Perimeter.	12.14 ft
Critical Depth...	0.34 ft
Critical Slope...	0.0070 ft/ft
Froude Number....	0.89 (flow is Subcritical)

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Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GRAF STREETS

Comment: Inlet 104 - flow from Bella Vista & Valley View

Solve For Depth

Given Input Data:

Left Side Slope..	0.01:1 (H:V)
Right Side Slope.	33.00:1 (H:V)
Manning's n.....	0.016
Channel Slope....	0.0044 ft/ft
Discharge.....	2.60 cfs

Computed Results:

Depth.....	0.30 ft
Velocity.....	1.72 fps
Flow Area.....	1.52 sf
Flow Top Width...	10.00 ft
Wetted Perimeter.	10.31 ft
Critical Depth...	0.27 ft
Critical Slope...	0.0075 ft/ft
Froude Number....	0.78 (flow is Subcritical)

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GRAF STREETS

Comment: Inlet 105 - flow from Valley View

Solve For Depth

Given Input Data:

Left Side Slope..	0.01:1 (H:V)
Right Side Slope.	33.00:1 (H:V)
Manning's n.....	0.016
Channel Slope....	0.0044 ft/ft
Discharge.....	2.10 cfs

Computed Results:

Depth.....	0.28 ft
Velocity.....	1.63 fps
Flow Area.....	1.29 sf
Flow Top Width...	9.23 ft
Wetted Perimeter.	9.51 ft
Critical Depth...	0.25 ft
Critical Slope...	0.0078 ft/ft
Froude Number....	0.77 (flow is Subcritical)

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GRAF STREETS

Comment: Inlet 106 - flow from Valley View

Solve For Depth

Given Input Data:

Left Side Slope..	0.01:1 (H:V)
Right Side Slope.	33.00:1 (H:V)
Manning's n.....	0.016
Channel Slope....	0.0032 ft/ft
Discharge.....	4.80 cfs

Computed Results:

Depth.....	0.40 ft
Velocity.....	1.78 fps
Flow Area.....	2.70 sf
Flow Top Width...	13.36 ft
Wetted Perimeter.	13.77 ft
Critical Depth...	0.35 ft
Critical Slope...	0.0069 ft/ft
Froude Number....	0.70 (flow is Subcritical)

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Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GRAF STREETS

Comment: Inlet 107 - flow from Valley View

Solve For Depth

Given Input Data:

Left Side Slope..	0.01:1 (H:V)
Right Side Slope.	33.00:1 (H:V)
Manning's n.....	0.016
Channel Slope....	0.0050 ft/ft
Discharge.....	5.80 cfs

Computed Results:

Depth.....	0.40 ft
Velocity.....	2.20 fps
Flow Area.....	2.64 sf
Flow Top Width...	13.19 ft
Wetted Perimeter.	13.59 ft
Critical Depth...	0.38 ft
Critical Slope...	0.0068 ft/ft
Froude Number....	0.87 (flow is Subcritical)

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GRAF STREETS

Comment: Inlet 108 - flow from Valley View

Solve For Depth

Given Input Data:

Left Side Slope..	0.01:1 (H:V)
Right Side Slope.	33.00:1 (H:V)
Manning's n.....	0.016
Channel Slope....	0.0044 ft/ft
Discharge.....	3.30 cfs

Computed Results:

Depth.....	0.33 ft
Velocity.....	1.82 fps
Flow Area.....	1.81 sf
Flow Top Width...	10.94 ft
Wetted Perimeter.	11.27 ft
Critical Depth...	0.30 ft
Critical Slope...	0.0073 ft/ft
Froude Number....	0.79 (flow is Subcritical)

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GRAF STREETS

Comment: Inlet 109 - flow from Bella Vista

Solve For Depth

Given Input Data:

Left Side Slope..	0.01:1 (H:V)
Right Side Slope.	33.00:1 (H:V)
Manning's n.....	0.016
Channel Slope....	0.0044 ft/ft
Discharge.....	3.40 cfs

Computed Results:

Depth.....	0.34 ft
Velocity.....	1.84 fps
Flow Area.....	1.85 sf
Flow Top Width...	11.06 ft
Wetted Perimeter.	11.40 ft
Critical Depth...	0.30 ft
Critical Slope...	0.0073 ft/ft
Froude Number....	0.79 (flow is Subcritical)

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GRAF STREETS

Comment: Inlet 110 - flow from Bella Vista

Solve For Depth

Given Input Data:

Left Side Slope..	0.01:1 (H:V)
Right Side Slope.	33.00:1 (H:V)
Manning's n.....	0.016
Channel Slope....	0.0050 ft/ft
Discharge.....	6.60 cfs

Computed Results:

Depth.....	0.42 ft
Velocity.....	2.27 fps
Flow Area.....	2.90 sf
Flow Top Width...	13.85 ft
Wetted Perimeter.	14.27 ft
Critical Depth...	0.40 ft
Critical Slope...	0.0067 ft/ft
Froude Number....	0.87 (flow is Subcritical)

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GRAF STREETS

Comment: Inlet 111 - flow from Bella Vista (SW)

Solve For Depth

Given Input Data:

Left Side Slope..	0.01:1 (H:V)
Right Side Slope.	33.00:1 (H:V)
Manning's n.....	0.016
Channel Slope....	0.0050 ft/ft
Discharge.....	5.30 cfs

Computed Results:

Depth.....	0.39 ft
Velocity.....	2.15 fps
Flow Area.....	2.46 sf
Flow Top Width...	12.75 ft
Wetted Perimeter.	13.14 ft
Critical Depth...	0.36 ft
Critical Slope...	0.0069 ft/ft
Froude Number....	0.86 (flow is Subcritical)

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GRAF STREETS

Comment: Inlet 111 - flow from 19th (NW)

Solve For Depth

Given Input Data:

Left Side Slope..	0.01:1 (H:V)
Right Side Slope.	33.00:1 (H:V)
Manning's n.....	0.016
Channel Slope....	0.0053 ft/ft
Discharge.....	4.70 cfs

Computed Results:

Depth.....	0.37 ft
Velocity.....	2.13 fps
Flow Area.....	2.20 sf
Flow Top Width...	12.06 ft
Wetted Perimeter.	12.43 ft
Critical Depth...	0.35 ft
Critical Slope...	0.0070 ft/ft
Froude Number....	0.88 (flow is Subcritical)

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GRAF STREETS

Comment: Inlet 112 - flow from 19th (NW)

Solve For Depth

Given Input Data:

Left Side Slope..	0.01:1 (H:V)
Right Side Slope.	33.00:1 (H:V)
Manning's n.....	0.016
Channel Slope....	0.0053 ft/ft
Discharge.....	7.00 cfs

Computed Results:

Depth.....	0.42 ft
Velocity.....	2.36 fps
Flow Area.....	2.97 sf
Flow Top Width...	14.00 ft
Wetted Perimeter.	14.43 ft
Critical Depth...	0.41 ft
Critical Slope...	0.0066 ft/ft
Froude Number....	0.90 (flow is Subcritical)

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GRAF STREETS

Comment: Inlet 112 - flow from 19th (SE)

Solve For Depth

Given Input Data:

Left Side Slope..	0.01:1 (H:V)
Right Side Slope.	33.00:1 (H:V)
Manning's n.....	0.016
Channel Slope....	0.0032 ft/ft
Discharge.....	1.00 cfs

Computed Results:

Depth.....	0.22 ft
Velocity.....	1.20 fps
Flow Area.....	0.83 sf
Flow Top Width...	7.42 ft
Wetted Perimeter.	7.65 ft
Critical Depth...	0.19 ft
Critical Slope...	0.0086 ft/ft
Froude Number....	0.63 (flow is Subcritical)

Open Channel Flow Module, Version 3.12 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

CALCULATION SHEET

Terra Tech Inc.

ENGINEERING • SURVEYING
234 N. Cleveland - P.O. Box 244
Wichita, KS. 67201 - (316) 263-6620

PROJECT: GRAF-GOLDSTON ADDITION
ITEM:
COMPUTATIONS BY: RDF
REVISIONS BY:

PAGE 1 OF 1
PROJECT NO. 342
DATE: 3-14-92
REV. DATE:

STREET FLOW
(100 year storm)

Check flow on Bella Vista (west of Inlet 101 & 102

D.A. = 36.21 acres
C = 0.5
T.C. = 21 minutes
I(100) = 6.39 in/hr
Q(100) = 36.21x0.5x6.39 = 115.7 cfs
Q(2) (flow in storm sewer) = -66.8 cfs
Street Flow = 48.9 cfs

STREET FLOW CAPACITY

Street Width =	28	Feet
X-sec Area =	9.52	Sq. Ft.
Street Grade =	0.55	%
Walk Grade =	0.30	Feet
Right-of-Way =	58	Feet
X-sec. ROW =	22.42	Sq. Ft.

Capacity of street (cb-cb)

n =	0.016	
A =	9.52	Sq. Ft.
P =	29.10	
R =	0.3271	
R 2/3 =	0.4748	
S 1/2 =	0.0742	
Q =	31.1	CFS

Capacity of street (row-row)

n =	0.021	
A =	22.42	Sq. Ft.
P =	59.10	
R =	0.3794	
R 2/3 =	0.5240	
S 1/2 =	0.0742	
Q =	62.7	CFS

CALCULATION SHEET

Terra Tech Inc.

ENGINEERING • SURVEYING
234 N. Cleveland – P.O. Box 244
Wichita, KS. 67201 – (316) 263-6620

PROJECT: _____ PAGE _____ OF _____
ITEM: _____ PROJECT NO. _____
COMPUTATIONS BY: _____ DATE: _____
REVISIONS BY: _____ REV. DATE: _____

REQUIRED INLETS
(2 Year Storm)

For Inlets in sump condition Refer to Chart #1073.03 (Copy attached) Q_{Allow} = 10 cfs

For inlets on grade, Assume 50% is intercepted & 50% bypassed to next inlet

INLET	Q_2	INLET CONDITION	REQUIRED COW-Type IA
101	13.0	Sump	2
102	9.5	Sump	1
103	Manhole	—	—
104	2.16	Sump	1
105	2.1	Sump	1
106	4.8+1.7=6.5	Sump	1
107	5.8	Sump	1
108	3.3	ON-GRADE	1
109	3.4	Sump	1
110	6.6	Sump	1
111	10.0	Sump	1
112	8.0	Sump	1

CALCULATION SHEET

Terra Tech Inc.

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234 N. Cleveland – P.O. Box 244
Wichita, KS. 67201 – (316) 263-6620

PROJECT: _____
ITEM: _____
COMPUTATIONS BY: _____

PAGE ____ OF ____
PROJECT NO. _____
DATE: _____
REVISIONS BY: _____
REV. DATE: _____

INLETS 101 & 102
(100 Yr. Storm)

D.A. = 36.21 Acres
C = 0.5
t_c = 21 min
I_{100} = 6.39 in/hr
Q_{100} = 36.21 × 0.5 × 6.39 = 115.7 cfs
Q_2 = (pipe 103-101) = -46.1 cfs

Street Flow = 69.6 cfs.

INLETS
H = 10" + 0.3' = 1.133'
h = 6" = 0.500'

H/h = 2.266

Q/L = 2.7 cfs/L.F.

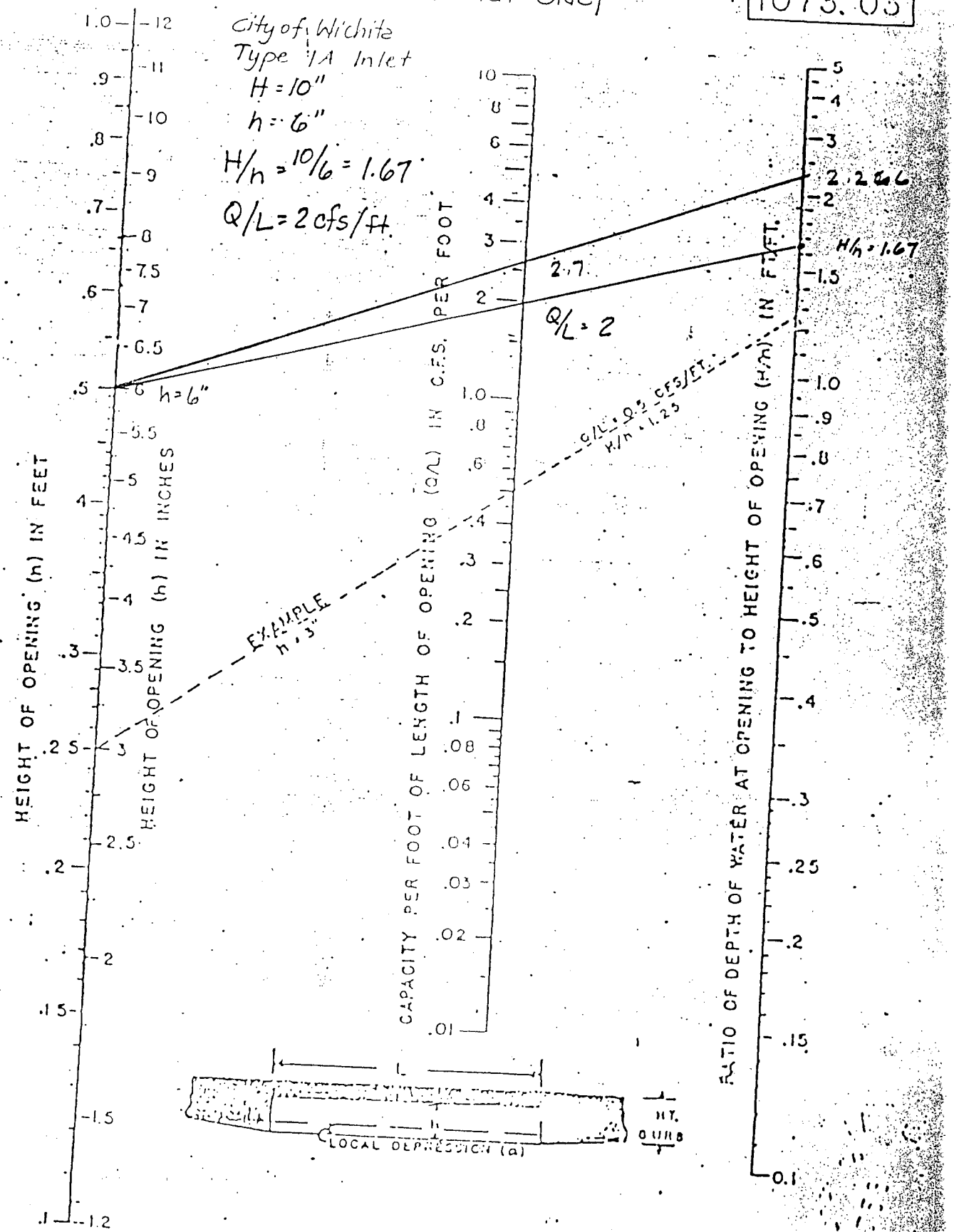
Flow = 69.6/2.7 = 25.8 LF

USE 5 - 5 LF Type IA inlets
OR EQUIVALENT

SUMP CONDITION ONLY

1073.03

City of Wichita
Type 1A Inlet
H = 10"
h = 6"
H/h = 10/6 = 1.67
Q/L = 2 cfs/ft.



BUREAU OF PUBLIC ROADS
DIVISION TWO WASH., D. C.

NOMOGRAPH FOR CAPACITY OF CURB OPENING INLETS AT LOW POINTS