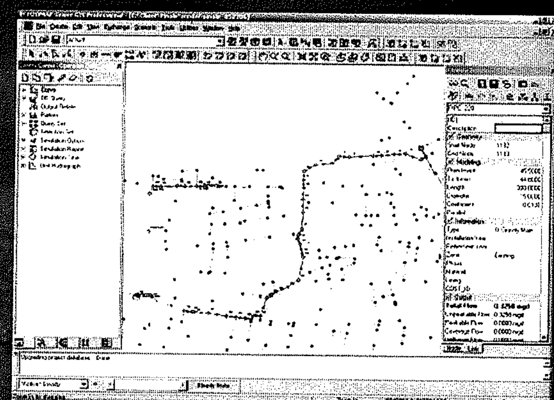
City of Pinole

FINAL

Panattoni Sewer Study

TECHNICAL MEMORANDUM
HYDRAULIC ANALYSIS



June 2006

Carollo Engineers

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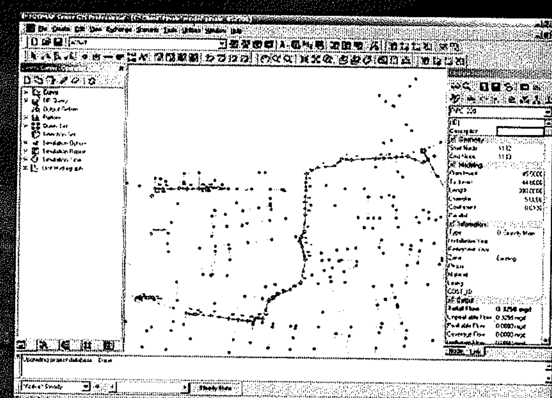

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REGISTERED PROFESSIONAL ENGINEER
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STATE OF CALIFORNIA

6/7/06

City of Pinole
Panattoni Sewer Study

TECHNICAL MEMORANDUM
HYDRAULIC ANALYSIS

FINAL
June 2006

2700 YGNACIO VALLEY ROAD, SUITE 300 • WALNUT CREEK, CALIFORNIA 94598 • (925) 932-1710 • FAX (925) 930-0208
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NOTES

8" LINE THRU PANATONI FINE

1.0 INTRODUCTION

The City of Pinole (City) retained Carollo Engineers (Carollo) to perform a hydraulic analysis using a hydraulic model to determine the impact of development and modified collection system operations on a portion of their sewer collection system. The City is located in Contra Costa County approximately 17 miles north of Oakland, CA with a population of 19,465 (California Department of Finance, 2006). The City owns and operates its own wastewater treatment plant located on Tennet Avenue.

The purpose of this study is to determine the following.

- Determine the minimum necessary pipe diameter (I.D.) to accommodate proposed Panattoni and Sugar City developments as well as flow currently handled by the San Pablo Pump Station.
- Determine the impacts of development and San Pablo Pump Station flow on the Hazel Pump Station.
- Determine the impacts of the rerouted flow on the existing collection system downstream of the Hazel Pump Station.

2.0 MODEL CONSTRUCTION

2.1 Physical Model

The hydraulic model was constructed in H2OMap Sewer by MWHSoft using City Geographical Information System (GIS) data, collection system survey data, and the United States Geological Survey (USGS) National Elevation Dataset (NED). Figure 1 illustrates the modeled portion of the collection system and Table 1 presents pipe and manhole data.

2.2 Model Assumptions

Based upon available information it was necessary to make a number of assumptions to develop the hydraulic model. Table 2 presents the assumptions made for this study. The assumptions with the greatest impact on model results are those associated with infiltration/inflow (I/I) estimation (assumptions 10, 14, and 15 of Table 2). If greater accuracy is required these assumptions can be refined by gathering site specific flow monitoring data and performing additional I/I analysis.

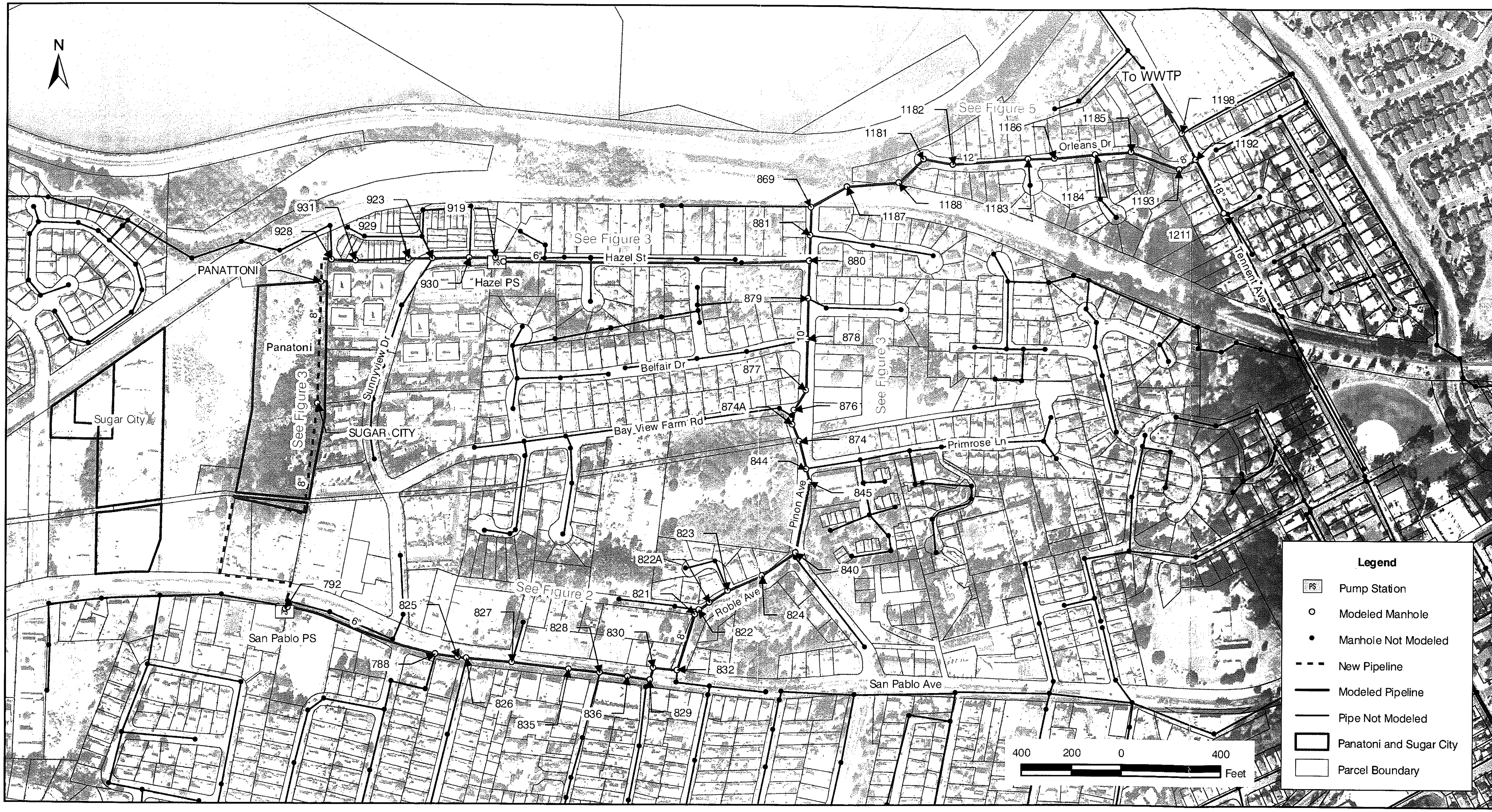

Figure 1
MODELED SYSTEM
PANATTONI SEWER STUDY
CITY OF PINOLE

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May 25, 2006

Data
oni Sewer Study
Pinole

US Manhole ID	DS Manhole ID	US Rim Elevation (Feet)	US Invert (Feet)	DS Rim Elevation (Feet)	DS Invert (Feet)	Length (Feet)	Diameter (Inches)	Slope (%)
788	825	115.47	110.50	117.66	107.40	97	8	3.20
825	826	117.66	107.40	117.81	106.40	31	8	3.23
826	827	117.81	106.40	117.21	100.50	185	6	3.19
835	828	116.41	100.43	112.28	100.40	128	6	0.02
836	829	107.16	95.10	103.16	91.00	92	6	4.46
827	835	117.21	100.50	116.41	100.43	232	6	0.03
828	836	112.28	100.40	107.16	95.10	118	6	4.49
823	824	86.46	74.50	88.49	72.00	162	8	1.54
821	822	91.42	78.20	89.53	77.00	25	8	4.80
840	845	77.13	68.80	74.49	61.20	314	8	2.42
845	844	74.49	61.20	73.92	58.50	70	10	3.86
844	874	73.92	58.50	71.77	54.50	100	10	4.00
877	878	58.91	54.90	58.35	53.90	230	10	0.43
878	879	58.35	53.90	58.47	52.20	160	10	1.06
879	880	58.47	52.20	67.24	50.60	168	10	0.95
880	881	67.24	50.60	65.02	49.00	100	10	1.60
881	869	65.02	49.00	58.90	47.40	100	10	1.60
869	1187	58.90	47.40	52.60	46.80	218	12	0.28
1187	1188	52.60	46.80	59.88	46.30	175	12	0.29
1188	1181	59.88	46.30	62.88	45.90	127	12	0.31
829	830	103.16	91.00	101.97	90.00	45	8	2.22
830	832	101.97	90.00	98.23	87.80	105	8	2.10
832	821	98.23	87.80	91.42	78.20	205	8	4.68
1181	1182	62.88	45.90	64.27	45.50	127	12	0.31
1182	1183	64.27	45.50	57.40	44.60	300	12	0.30
1183	1186	57.40	44.60	55.15	44.30	108	12	0.28
1186	1184	55.15	44.30	49.24	43.80	164	12	0.30

Data
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US Manhole ID	DS Manhole ID	US Rim Elevation (Feet)	US Invert (Feet)	DS Rim Elevation (Feet)	DS Invert (Feet)	Length (Feet)	Diameter (Inches)	Slope (%)
1184	1185	49.24	43.80	42.68	34.20	140	12	6.86
1185	1193	42.68	34.20	18.73	8.90	210	12	12.05
1193	1192	18.73	8.90	9.83	1.60	85	8	8.59
1211	1192	16.55	1.20	9.83	0.10	250	18	0.44
930	919	33.36	28.80	35.22	27.60	105	12	1.14
1192	1198	9.83	0.10	10.32	0.50	122	24	-0.33
923	930	33.15	30.40	33.36	28.80	149	12	1.07
HAZEL_CHAM	880	35.20	50.00	67.24	51.00	1,261	6	-0.08
AN_PABLO_CHAM	788	98.80	100.00	115.47	110.50	636	6	-1.65
931	929	36.20	31.20	34.27	30.80	213	12	0.19
929	923	34.27	30.80	33.15	30.40	96	12	0.42
876	877	66.13	54.40	58.91	54.90	90	10	-0.56
874	874A	71.77	54.50	69.78	54.45	35	10	0.14
874A	876	69.78	54.45	66.13	54.40	35	10	0.14
928	931	36.70	31.70	36.20	31.20	96	12	0.52
822	822A	89.53	77.00	87.85	76.00	60	8	1.67
822A	823	87.85	76.00	86.46	74.50	98	8	1.53
824	840	88.49	72.00	77.13	68.80	152	8	2.11
792	SAN_PABLO_WW	98.81	87.50	98.80	87.45	10	12	0.50
919	HAZEL_WW	35.22	19.60	35.20	19.50	10	12	1.00
792	SUGAR_CITY	98.81	88.00	65.00	62.00	1,400	8	1.86
PANATTONI	928	88.00	52.70	36.70	31.70	100	8	21.00
SUGAR_CITY	PANATTONI	65.00	62.00	88.00	52.70	500	8	1.86

Table 2 Model Assumptions
Panattoni Sewer Study
City of Pinole

Assumptions	
1.	Model constructed in MWHSoft's H2OMap Sewer software.
2.	Steady-state simulations only.
3.	Where available City GIS/survey data was used for inverts.
4.	When inverts not available based on straight pipe slope between known inverts or 5 feet below rim.
5.	Rim elevations from USGS NED.
6.	Dry weather flows based on 216 gal per edu (consistent with WCWD).
7.	Panattoni development = 150,000 SF (3.4 Acres) of commercial area.
8.	Sugar City development = 6.0 acres of commercial/industrial area.
9.	Commercial/Industrial flows based on 2,000 gal per acre (consistent with WCWD).
10.	Infiltration and inflow equal to 12,000 gal per acre for existing land and 400 gal per acre for Panattoni development.
11.	PDWF = ADWF x 1.7 (consistent with WCWD).
12.	WWF = ADWF + I/I
13.	Total system ADWF = 3.5 MGD (from City website).
14.	Wet weather peaking factor of 6.0 (based on City staff input of New Year's 2006 event).
15.	I/I assumed to be equally distributed throughout system.

2.3 Flow Estimates

Using the assumptions in Table 2, flow estimates were calculated for the model. Table 3 presents a summary of estimated flows for the model input points. Flow was calculated using the following equations.

- ADWF = # Connections x 216 gpd per connection for residential customers
- ADWF = # Acres x 2,000 gpd per acre for commercial/industrial customers

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Sewer Study
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Connections	Unit	GPD/Unit	ADWF (GPD)	PDWF (GPD)	Area (SF)	Area (Acres)	I/I (GPAD)	I/I (GPD)	WWF (GPD)
10	EDU	216	2,160	3,672	93,859	2.15	12,000	25,856	28,016
10	EDU	216	2,160	3,672	81,832	1.88	12,000	22,543	24,703
17	EDU	216	3,672	6,242	120,785	2.77	12,000	33,274	36,946
5	EDU	216	1,080	1,836	45,009	1.03	12,000	12,399	13,479
14,700	EDU	216	3,175,200	5,397,840	53,338,642	1,224.49	12,000	14,693,841	17,869,041
70	EDU	216	15,120	25,704	527,719	12.11	12,000	145,377	160,497
293	EDU	216	63,288	107,590	1,560,475	35.82	12,000	429,883	493,171
6	EDU	216	1,296	2,203	209,541	4.81	12,000	57,725	59,021
9	EDU	216	1,944	3,305	65,845	1.51	12,000	18,139	20,083
40	EDU	216	8,640	14,688	349,077	8.01	12,000	96,165	104,805
48	EDU	216	10,368	17,626	359,384	8.25	12,000	99,004	109,372
23	EDU	216	4,968	8,446	135,047	3.10	12,000	37,203	42,171
30	EDU	216	6,480	11,016	272,768	6.26	12,000	75,143	81,623
272	EDU	216	58,752	99,878	2,578,464	59.19	12,000	710,321	769,073
73	EDU	216	15,768	26,806	689,718	15.83	12,000	190,005	205,773
4	EDU	216	864	1,469	48,301	1.11	12,000	13,306	14,170
56	EDU	216	12,096	20,563	509,756	11.70	12,000	140,429	152,525
52	EDU	216	11,232	19,094	395,255	9.07	12,000	108,886	120,118
15	EDU	216	3,240	5,508	147,294	3.38	12,000	40,577	43,817
20	EDU	216	4,320	7,344	136,044	3.12	12,000	37,478	41,798
31	EDU	216	6,696	11,383	339,996	7.81	12,000	93,663	100,359
290	EDU	216	62,640	106,488	567,964	13.04	12,000	156,464	219,104
166	EDU	216	35,856	60,955	1,364,293	31.32	12,000	375,838	411,694
16,240			**3,507,840**	**5,963,328**	**63,937,067**	**1,467.79**		**17,613,517**	**21,121,357**
3.4	*Acre*	*2,000*	*6,887*	*11,708*	*338,198*	*7.76*	*400*	*3,106*	*9,993*
6.0	*Acre*	*2,000*	*12,000*	*20,400*	*261,360*	*6.00*	*400*	*2,400*	*14,400*
			3,526,727	**5,995,436**	**64,536,625**	**1,481.56**		**17,619,023**	**21,145,750**

PF (WWF/ADWF) = 6.0

In determining the amount of I/I in the system, the I/I rate was adjusted until a peaking factor (WWF to ADWF ratio) of 6.0 was achieved based on flow at the City's wastewater treatment plant during the New Year's 2006 storm. New development at Panattoni will add 6,887 gpd of average dry weather flow (ADWF) and 9,993 gpd wet weather flow (WWF). Development at Sugar City will add 12,000 gpd of ADWF and 14,400 gpd of WWF. The new development does not add a significant amount of flow when compared to the 3.5 mgd generated by existing customers.

3.0 HYDRAULIC ANALYSIS

The estimated flows were input into the hydraulic model and analyzed under different flow scenarios. Table 4 presents the six scenarios analyzed by the model. The scenarios of most interest are Scenarios 3 and 6 where the sewer collection system is stressed.

Table 4 Model Scenarios
Panattoni Sewer Study
City of Pinole

Scenario	Flows	Panattoni and Sugar City Included?	San Pablo PS Operational?	Hazel PS Operational?
Existing				
1	ADWF(1)	No	Yes	Yes
2	PDWF(2)	No	Yes	Yes
3	WWF(3)	No	Yes	Yes
Future				
4	ADWF	Yes	No	Yes
5	PDWF	Yes	No	Yes
6	WWF	Yes	No	Yes

Notes:
(1) ADWF = Average Dry Weather Flow
(2) PDWF = Peak Dry Weather Flow
(3) WWF = Wet Weather Flow = ADWF + Infiltration/Inflow

Table 5 presents the model results for the hydraulic analysis. Under dry weather flow conditions the collection system appears to have adequate capacity. While the Tennet

Results
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Pinole

San Pablo PS	8" Roble Ave[1]			8" Panattoni[2]			15" Orleans Dr[3]			18" Tennett Ave Trunk[4]			24" Tennett Ave Trunk[5]		
Flow (MGD)	Flow (MGD)	d/D	Full Q (MGD)	Flow (MGD)	d/D	Full Q (MGD)	Flow (MGD)	d/D	Full Q (MGD)	Flow (MGD)	d/D	Full Q (MGD)	Flow (MGD)	d/D	Full Q (MGD)
0.06	0.11	0.17	1.69	---	---	---	0.33	0.25	2.29	3.18	0.62	4.52	3.51	1.00	21.15
0.11	0.19	0.22	1.69	---	---	---	0.55	0.33	2.29	5.40	1.00	4.52	5.96	1.00	21.15
0.49	0.99	0.55	1.69	---	---	---	3.18	1.00	2.29	17.87	1.00	4.52	21.12	1.00	21.15
---	0.05	0.11	1.69	0.08	0.10	3.59	0.34	0.26	2.29	3.18	0.62	4.52	3.53	1.00	21.15
---	0.08	0.15	1.69	0.14	0.13	3.59	0.59	0.34	2.29	5.40	1.00	4.52	6.00	1.00	21.15
---	0.50	0.37	1.69	0.52	0.26	3.59	3.20	1.00	2.29	17.87	1.00	4.52	21.15	1.00	21.15

206, slope = 4.68%)
) = NEW02, slope = 21%)
= 220, slope = 0.3%)
D = 230, slope = 0.44%)
D = 566, slope = -0.33%)
include rerouting San Pablo PS flow to Hazel PS via new Panattoni line, Panattoni flow and Sugar City flow.

Figures 2 through 5 are hydraulic profiles of the modeled collection system for before (Scenario 3) and after (Scenario 6) conditions. By taking eliminating the San Pablo Pump Station and rerouting its flow to the Hazel Pump Station, the San Pablo and Roble Avenue sewer mains see marked decreases in manhole surcharging (see Figure 2). While the Pinon Avenue sewer main receives some relief from surcharging, it remains capacity deficient (see Figure 3) even with elimination of the San Pablo Pump Station. Figure 4 illustrates the hydraulic grade line for Hazel Street. No capacity issues are observed for either the before or after condition (addition of the Panattoni development and Sugar City development and elimination of the San Pablo Pump Station). Because of the steep pipe grade (6% to 21%) an 8-inch pipe is adequate to convey flow from

the San Pablo Pump Station, Panattoni development, and Sugar City development. Figure 5 illustrates the hydraulic grade line of the Orleans sewer main from Hazel Street to Tennent Avenue. The existing 15-inch pipeline is capacity deficient as indicated by the hydraulic grade line being steeper than the pipe slope. Although no overflows are predicted in this area, the model indicates the sewer main upstream of the railroad track will have surcharges and overflows. The pipeline under the railroad and the 10-inch pipeline on Pinon Avenue may also need improvements pending additional analysis.

3.1 I/I Rehabilitation Potential

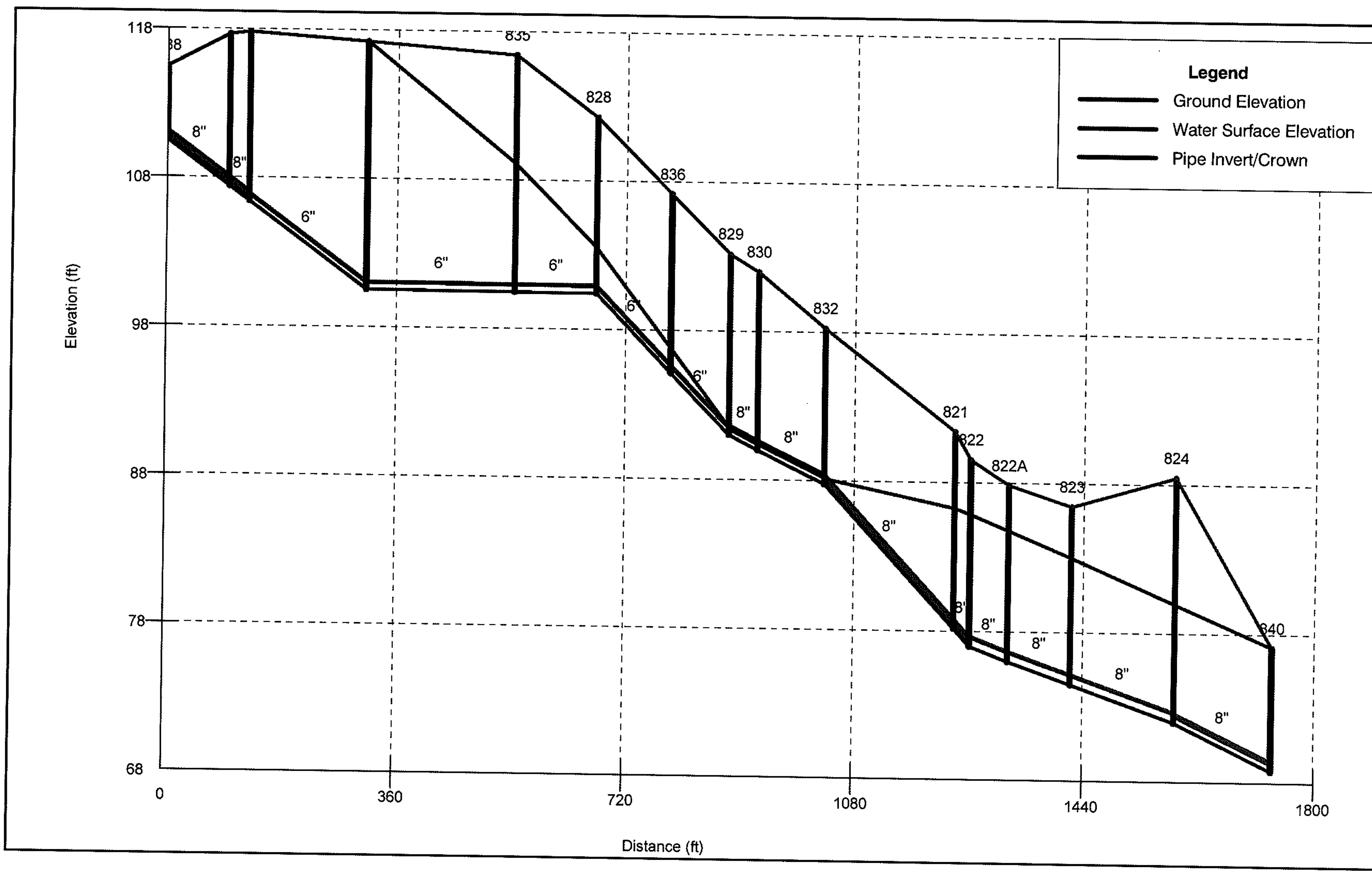
Further simulations were conducted to determine the impact of I/I reduction on the collection system and Hazel Pump Station improvements. The San Pablo Pump Station tributary area was chosen due to its small size and pipeline age. I/I reductions of 30 and 50 percent were simulated in the model. While flow to the Hazel Pump Station was reduced, the Pinon trunk still experienced significant surcharging with the model predicting overflows in some areas. Due to the significant assumptions made in flows and I/I distribution, a more detailed I/I analysis is recommended to determine rehabilitation potential.

4.0 RECOMMENDATIONS

The following are recommendations based on the above hydraulic analysis and assumptions. Further analysis may be required to determine more precise pump station flows.

- Confirm the size of the Panattoni and Sugar City developments.
- An 8-inch (I.D.) pipeline is required from the San Pablo Pump Station through the Panattoni development and connecting to the existing system at Hazel Street. The new pipeline will convey flow from the existing San Pablo Pump Station tributary area and the Panattoni and Sugar City developments.

San Pablo Ave Profile - With San Pablo PS



San Pablo Ave Profile - Without San Pablo PS

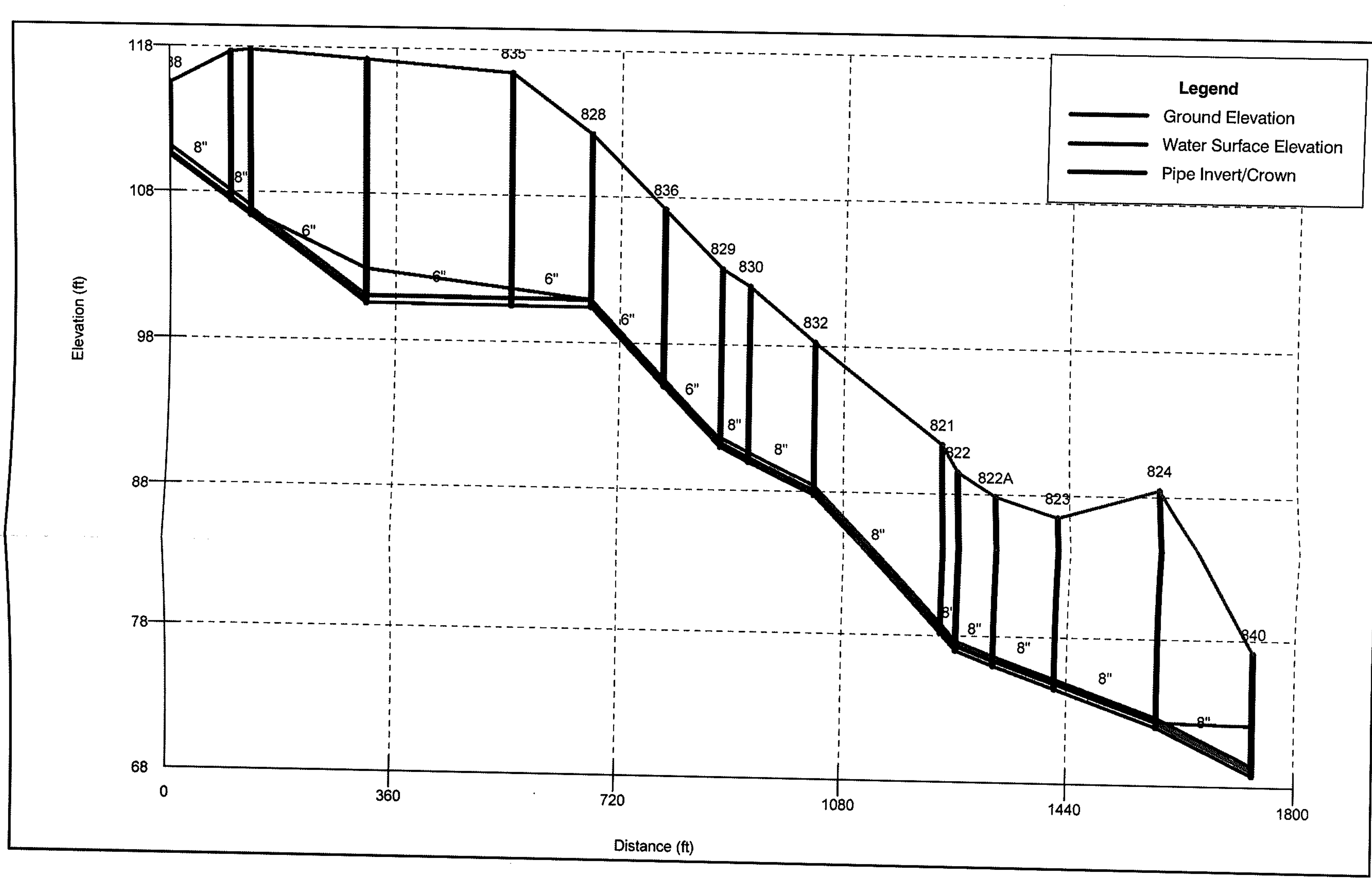


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Figure 2
SAN PABLO AVE PROFILE
PANATTONI SEWER STUDY
CITY OF PINOLE

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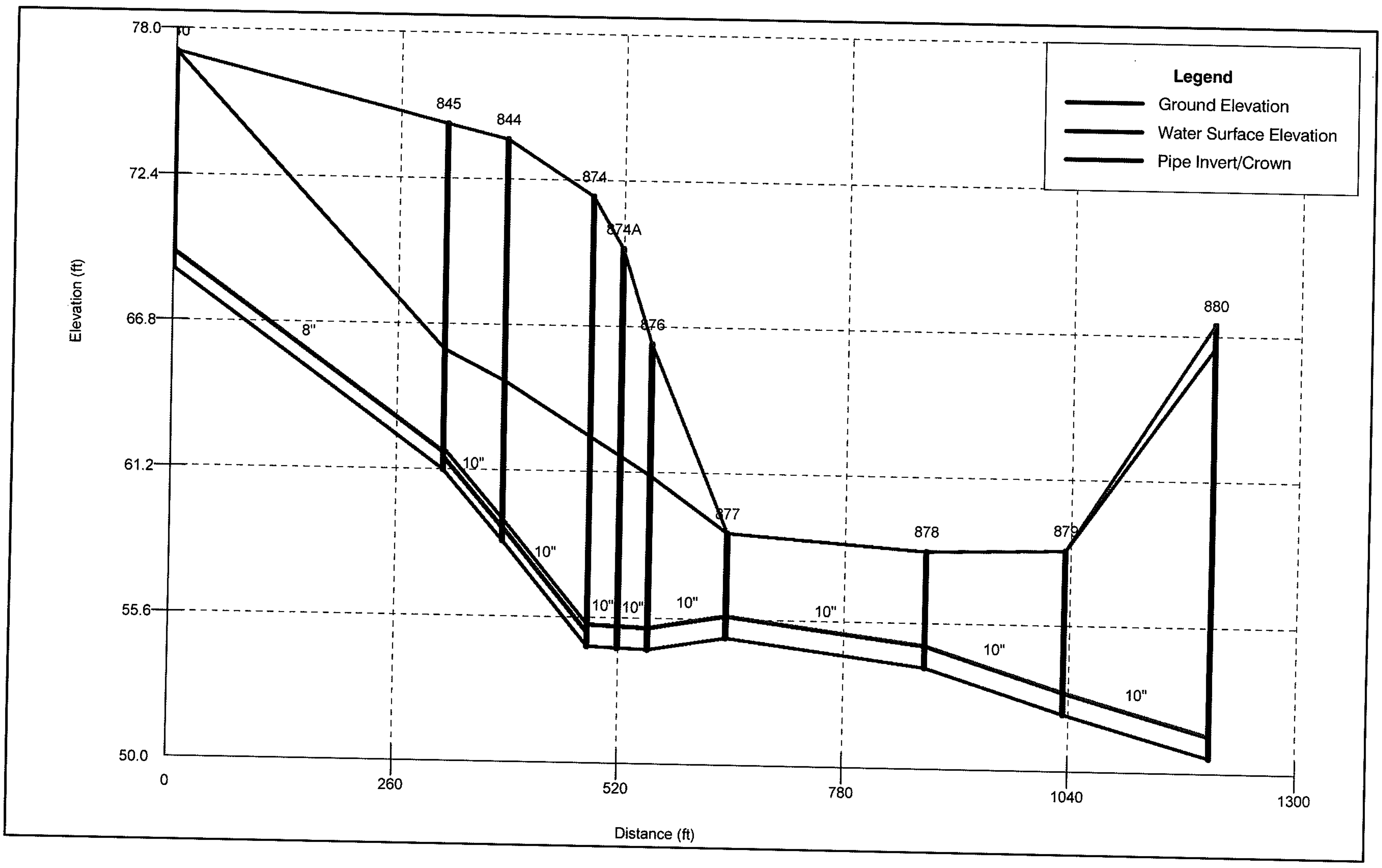
Pinon Ave Profile - With San Pablo PS



Pinon Ave Profile - Without San Pablo PS

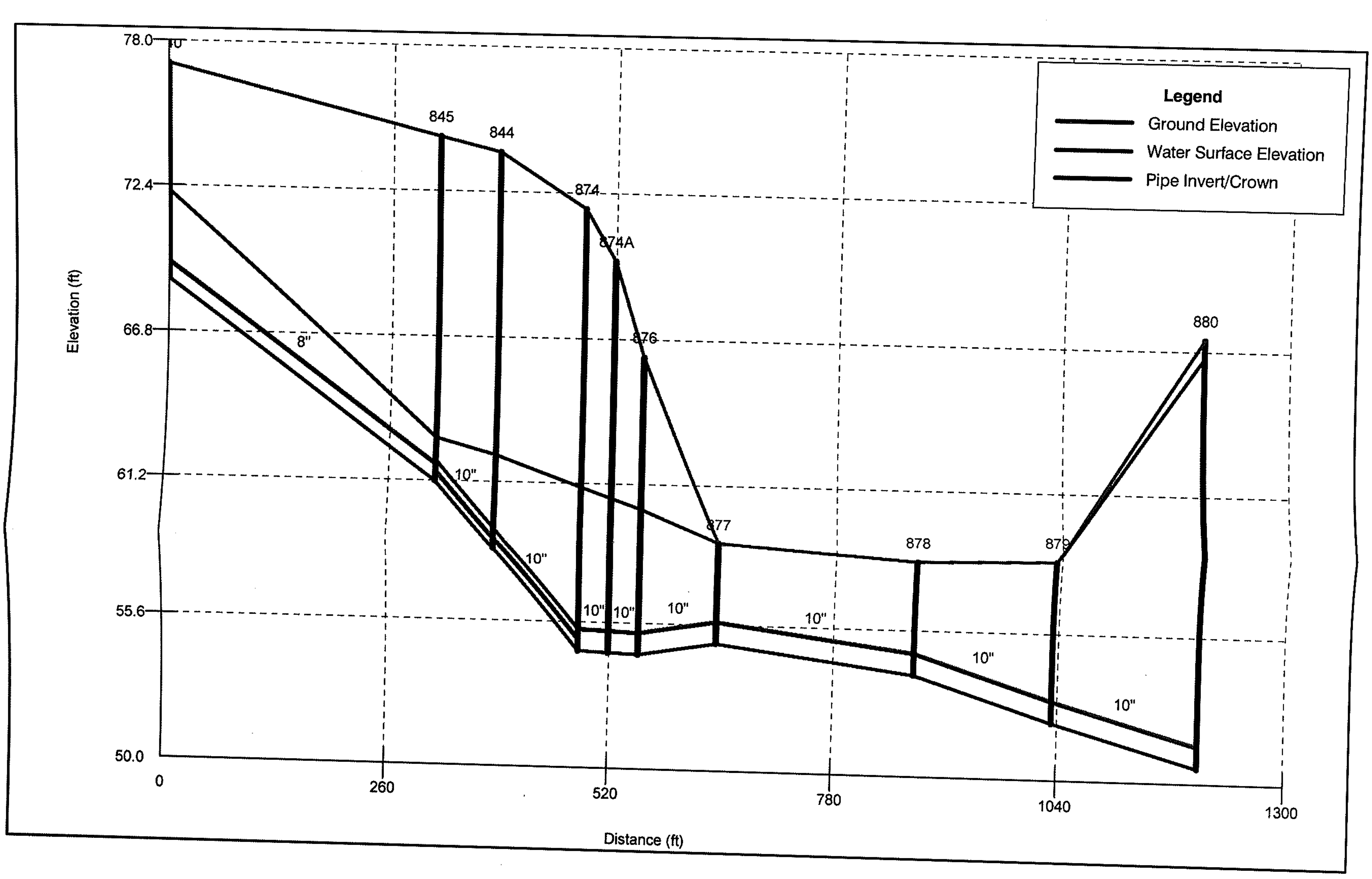


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Figure 3
PINON AVE PROFILE
PANATTONI SEWER STUDY
CITY OF PINOLE

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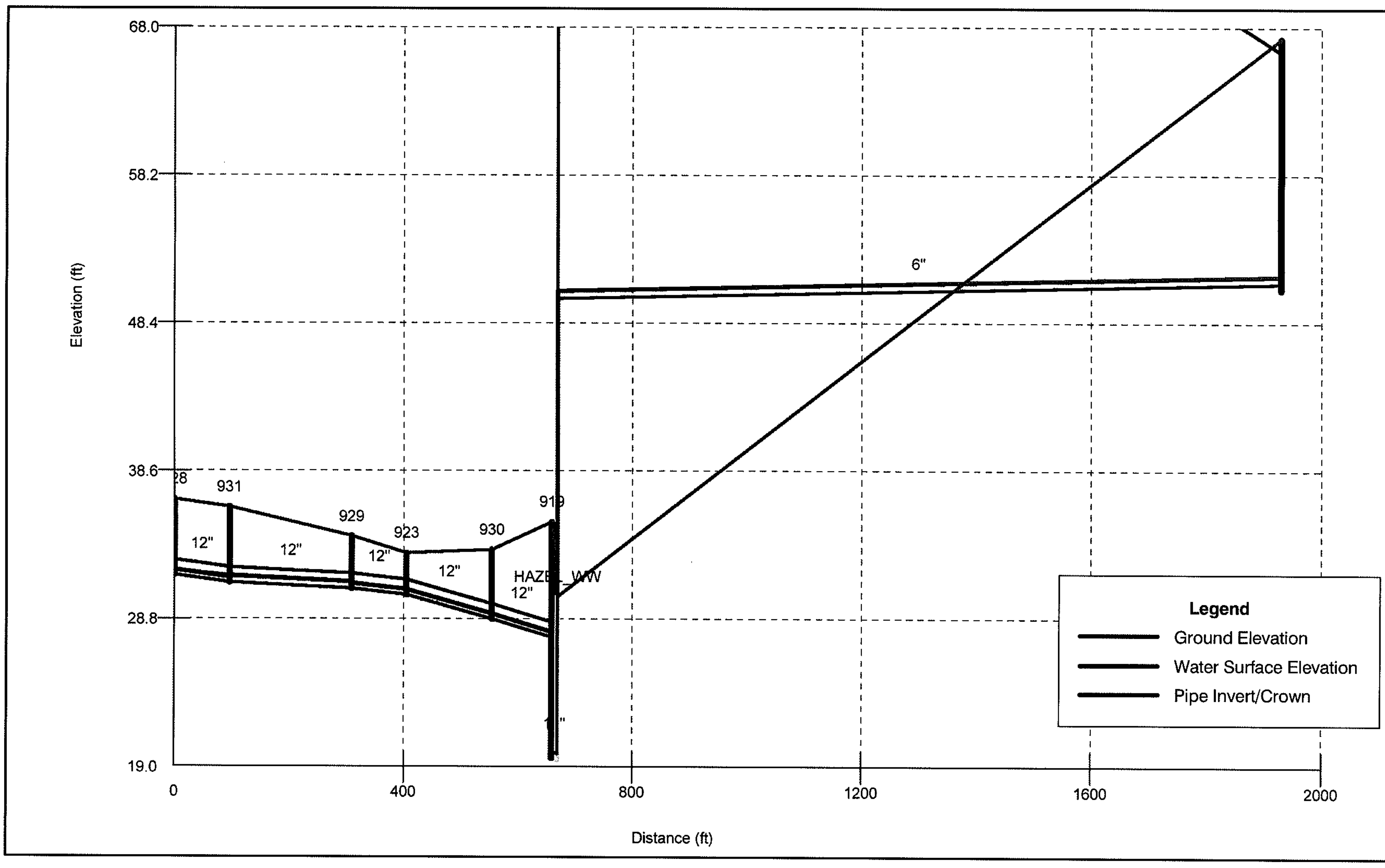
Hazel Street Profile - With San Pablo PS



Hazel Street Profile - Without San Pablo PS

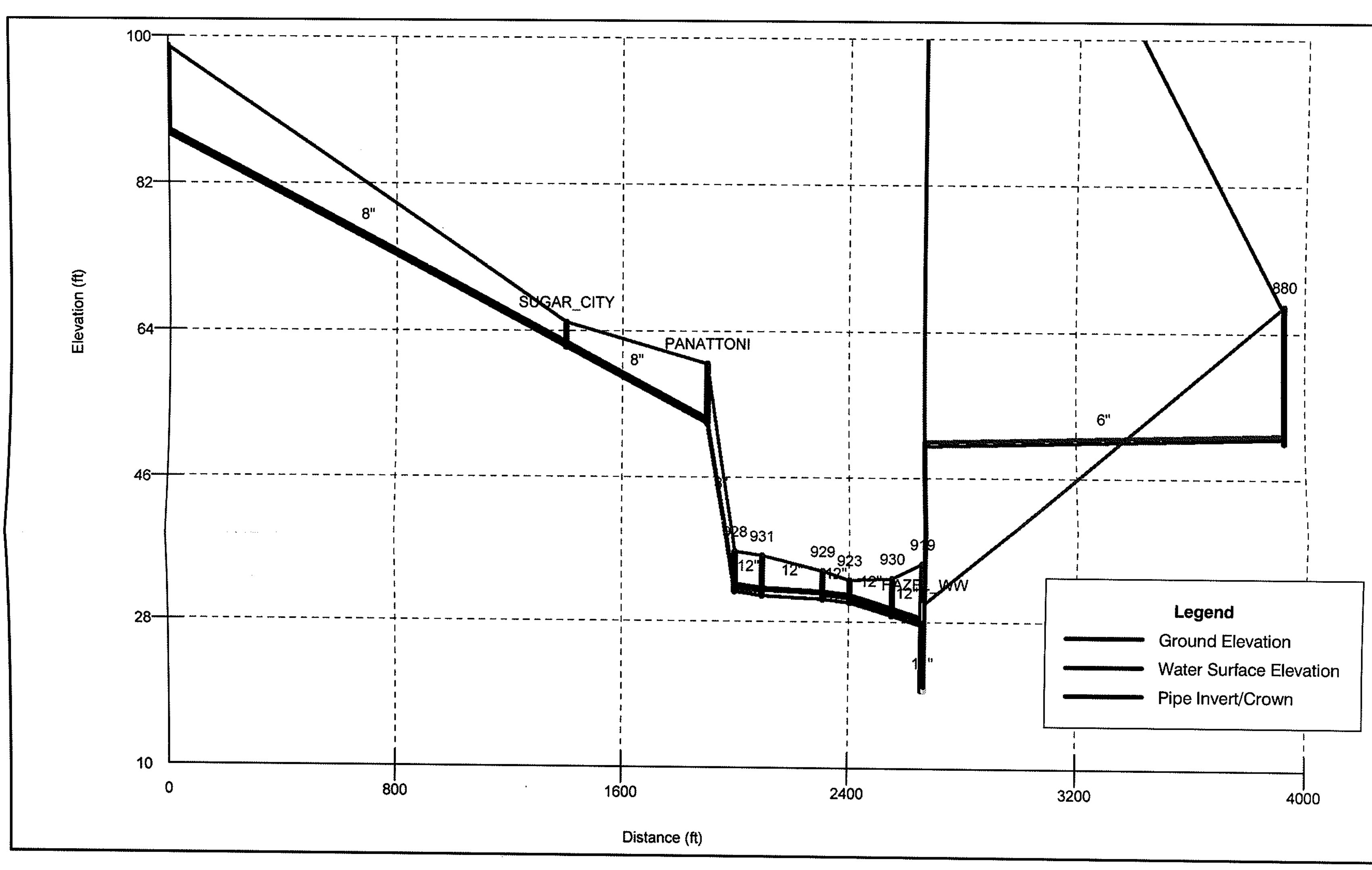


Figure 4
HAZEL ST PROFILE
PANATTONI SEWER STUDY
CITY OF PINOLE

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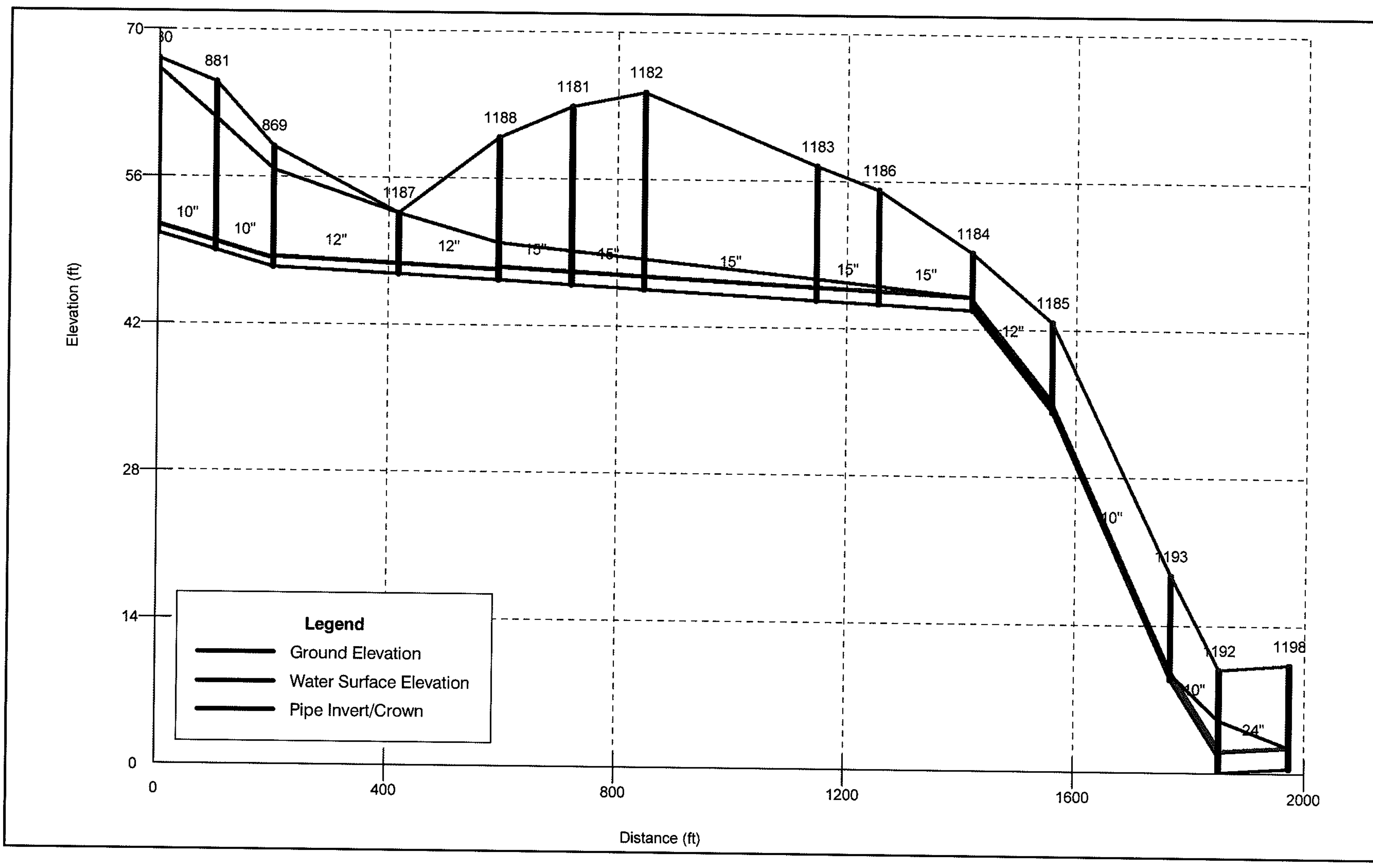
May 27, 2006

Orleans Dr Profile - With San Pablo PS



Orleans Dr Profile - Without San Pablo PS

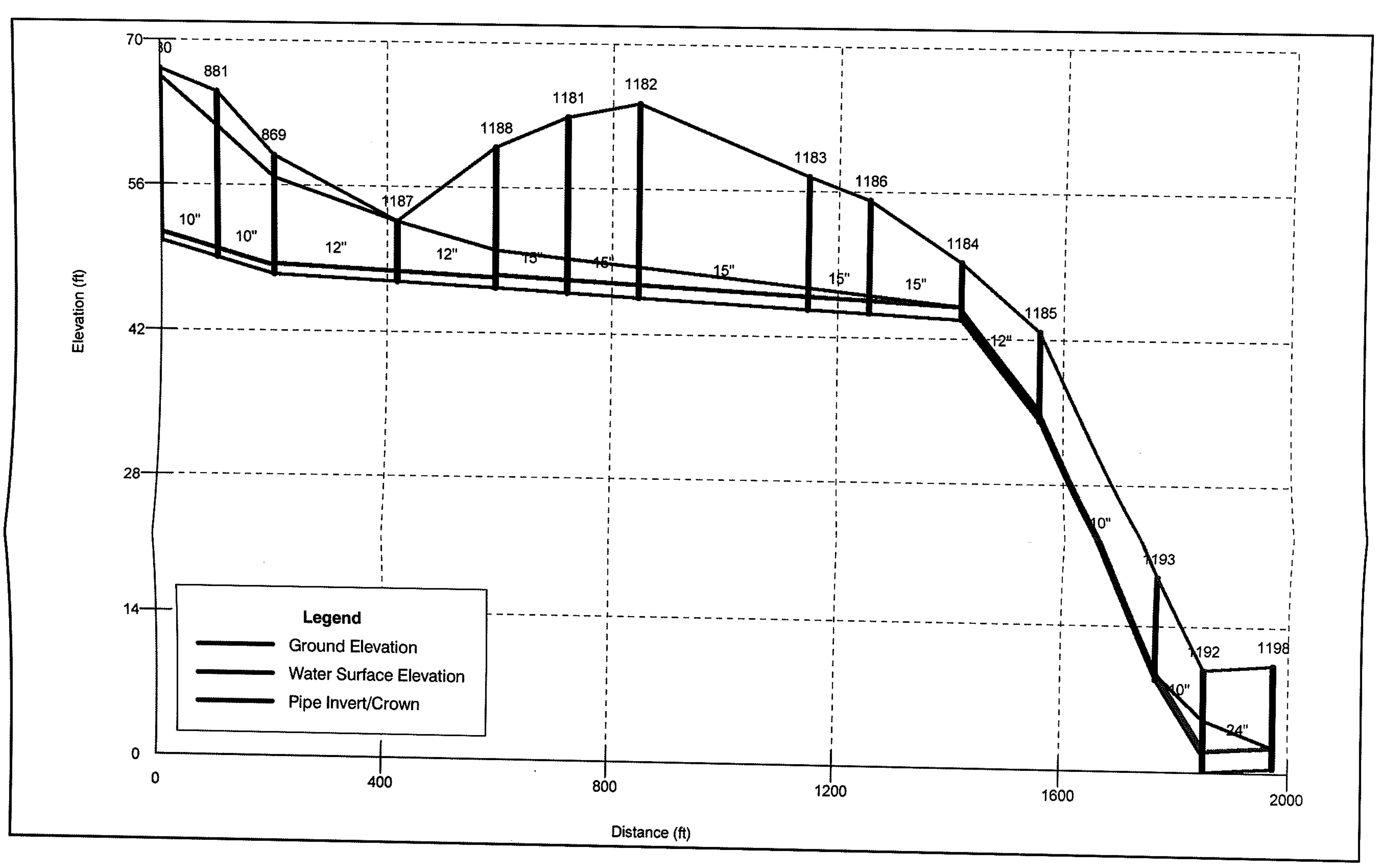


Figure 5
ORLEANS DR PROFILE
PANATTONI SEWER STUDY
CITY OF PINOLE

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May 27, 2006

- Replace the 6-inch Hazel Pump Station transite force main because of the high probability of catastrophic failure that other utilities have discovered through condition assessments.

- Because of ongoing operations and maintenance concerns, upgrade the Hazel Pump Station. Table 6 presents a cost estimate to upgrade the pump station with a structure, 3-20 hp VFD pumps, new electrical and instrumentation, standby diesel generator, and force main. The Hazel Pump Station upgrade is estimated to cost $891,000.

- Conduct a I/I study of the entire collection system to determine rehabilitation potential.

azel Pump Station Upgrade Cost Estimate
nattoni Sewer Study
ty of Pinole

ement	Qty	Unit	Unit Cost	Construction Cost	Estimating, Engr, Constr Mgmt, and Legal/Admin (50%)	Total Estimated Cost
main	1,000	LF	$119	$119,000	$59,500	$178,500
	3	Each	$25,000	$75,000	$37,500	$112,500
trumentation	1	LS	$100,000	$100,000	$50,000	$150,000
ucture	1	LS	$150,000	$150,000	$75,000	$225,000
or	1	LS	$50,000	$50,000	$25,000	$75,000
ts	1	LS	$100,000	$100,000	$50,000	$150,000
				$594,000	**$297,000**	**$891,000**

8446 (May 2006, San Francisco)