ENGINEERING
FIRE PROTECTION

May 8, 2023

Via Email
ken@scenicwonders.com

Ken LeBlanc
KL Water and Land LLC
7548 Henness Circle
Yosemite National Park, CA 95389
Re: Fire Flow Analysis

Dear Mr. LeBlanc,

Engineering Fire Protection, LLC (EFP) has been retained by KL Water & Land LLC (Client) to provide fire code analysis for the properties located at 7548 Henness Circle, Yosemite National Park, CA 95389. This report has been prepared to determine the fire flow demand, fire flow volume, fire service line sizing, fire sprinkler system lead-in sizing and domestic water main sizing as well as the building fire separation recommendation.

APPLICABLE STANDARDS AND CODES

- California Fire Code 2022 (CFC)
- California Building Code 2022 (CBC)
- California Residential Code 2022 (CRC)
- NFPA 13D, 2022 Edition
- NFPA 1142, 2022 Edition
- Rural Wildfire Regulations of Mariposa County, including Titles 8, 16, 17
- PRC 4290 codes

Building Information

Eight buildings are currently proposed within the Scenic Wonders properties. Building 1 is proposed to be a single family residence with a building area of 5,000 sqft. Building 2 is proposed to be a single family residence with a building area of 3,850 sqft. Building 3 is proposed to be a mixed-use with a 2-bedroom single family residence, a public laundry room and a commercial garage, the building area will be 3,200 sqft in total. Building 5, Building 7 and Building 8 are proposed to be two-family residences with a building area of 1,150 sqft. Both Building 4 and Building 6 are proposed to be four-family residences with a building area of 2,700 sqft. All the buildings will be built to meet Type VB Construction Type.

Fire Flow Calculation

The public municipal water supply system is unavailable to the property, therefore, a private water supply system is proposed to meet both domestic water demand and fire flow demand. With the approval of the State Fire Marshal Office, NFPA 1142 is allowed to be adopted to determine the fire flow demand for the proposed properties.

Because the buildings are less than 50-ft from each other, Structures with Exposure Hazards method in compliance with NFPA 1142 Section 4.3 is adopted for the fire flow water supply volume calculations.

$$WS_{min} = \frac{VS_{tot}}{OHC}(CC) \times 1.5 \qquad [4.3.1]$$

where:

WS_{min} = minimum water supply in gal (For results in L, multiply by 3.785.)

VS_{tot} = total volume of structure in ft^3 (If volume is measured in m^3, multiply by 35.3.)

OHC = occupancy hazard classification number

CC = construction classification number

Based on the calculations, Building 1 has the highest fire flow demand of the eight buildings, a total fire flow volume of 21,500 Gal, and supplied at minimum 1,000 gpm fire flow rate for 21.5 mins. According to the client's provided data, the domestic demand is 190 gpm. Therefore, the tank is required to be sized to provide minimum 21,500 Gal of water for fire fighting purpose while still meeting the 3,800 Gal of domestic water demand. To meet the fire flow/domestic demand, two 25,000 Gal tank are proposed for the property.

In compliance with CFC Table C102.1, for fire flow demand less than 1,750 gpm, one minimum hydrant is required to be installed with 312.5-ft minimum distance between the hydrant and the frontage of the fire access lane serving the buildings. To meet the travel distance requirement, two hydrants are proposed.

Hydrant #1 is proposed to cover Building 1, 2, 4, 5, 6, 7 and 8 with the 220-ft as the maximum travel distance (Hydrant #1 to Building 2). Hydrant #1 has 40-ft elevation difference with the base of the tank, based on the hydraulic calculations, the residual pressure at the outlet of Hydrant #1 when flowing 1,000 gpm is 15 psi (25 psi when the tank is full). The hydrant is proposed to be supplied directly by the dedicated 8-inch private fire main, refer to Attachment #1, Site Sketch for more detail.

Hydrant #2 is proposed to cover Building 1, 2, 3, 5, 6, 7 and 8 with the 265-ft as the maximum travel distance (Hydrant #2 respectively to Building 2 and Building 3). Building 4 is proposed to built within 15-ft from Hydrant#2, less than 40-ft, the minimum hydrant to building distance in compliance with NFPA 24 Section 7.2.3. However, Hydrant #1 is within 220-ft from Building 4, providing fire fighter a different option when the Hydrant #2 is deemed dangerous to use. Hydrant #2 has 31-ft elevation difference with the base of the tank, based on the hydraulic calculations, the residual pressure at the outlet of Hydrant #2 when flowing 1,000 gpm is 11 psi (21 psi when the tank is full). The hydrant is proposed to be supplied directly by the dedicated 8-inch private fire main, refer to Attachment #1, Site Sketch for more detail.

Fire Sprinkler System Requirement

Fire sprinkler systems are required to be provided throughout the buildings containing Group R occupancies.

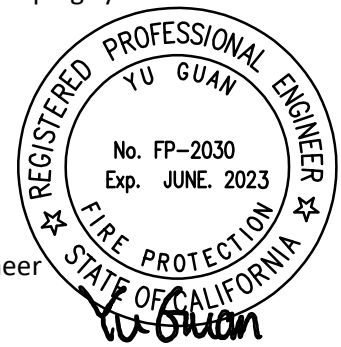
In compliance with CRC Section R313.2 and Section R313.3, single-family units and two-family units including Building 1, Building 2, Building 5, Building 7, and Building 8 are required to be protected by a fire sprinkler system designed per NFPA 13D standard.

Fire Barriers designed in compliance with CBC Section 707.3.10 are proposed to the four-unit buildings like Building 4 and Building 6 to separate the four units into two two-unit fire areas. In compliance with CBC Section 903.3.1.3, the two buildings are required to be protected by a fire sprinkler system designed per NFPA 13D standard.

For Building 3 that is considered as a mixed-use building with a single family residence (Group R-3), a public laundry room (Group B) and a commercial garage (Group S-1), a **Fire Wall** design compliance with CBC Section 706 is required to be installed to separate the building into residential building and commercial building. In compliance with CBC Section 903.3.1.3, the residential building portion is required to be protected by a fire sprinkler system designed per NFPA 13D standard. In compliance with CBC Section 903.2.9, the commercial building portion is not required to be protected by a fire sprinkler system.

Water Supply Requirement

The design team proposes 2 inch CPVC pipes as combined supply lead-in for each building along with 4 inch Schedule 80 PVC pipe as the domestic underground to meet both fire sprinkler system demand and domestic demand. The combined fire sprinkler/domestic demand to the discharge side of the boost pump installed at the base on the tank is 220 gpm at 36.5 psi. The fire sprinkler system demand is 30 gpm at 40 psi for any building (it's anticipated to have one building on fire), the combined domestic demand is 190 gpm for all the buildings. Therefore, the domestic boost pumps must be sized to meet the demand of 220 gpm at 36.5 psi. To improve the system reliability, we recommend using redundant pumps in duplex or triplex configurations, the pumping system should alternate pumping cycles between the pumps.



Submitted By:

Yifan Xuan
Fire Protection Consultant

Reviewed By:

Yu Guan, PE
Fire Protection Engineer

Attachment 1: Site Sketch

Attachment 2: Hydrant Demand Hydraulic Calculation Report

Attachment 3: Domestic/Sprinkler Demand Hydraulic Calculation Report

Attachment 4: Fire Flow and Domestic Demand Calculation Spreadsheet

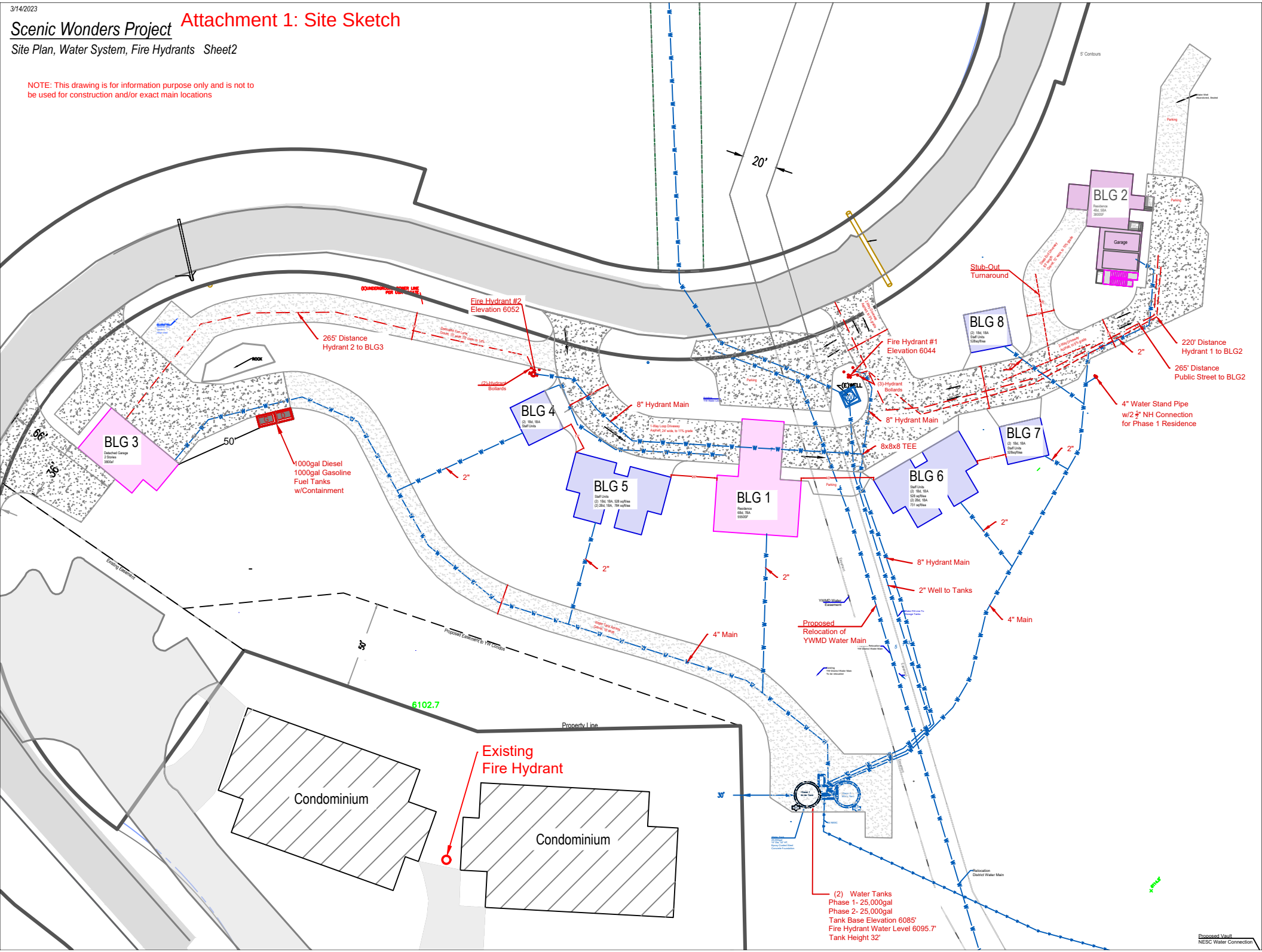
3/14/2023

Scenic Wonders Project

Attachment 1: Site Sketch

Site Plan, Water System, Fire Hydrants Sheet2

NOTE: This drawing is for information purpose only and is not to be used for construction and/or exact main locations

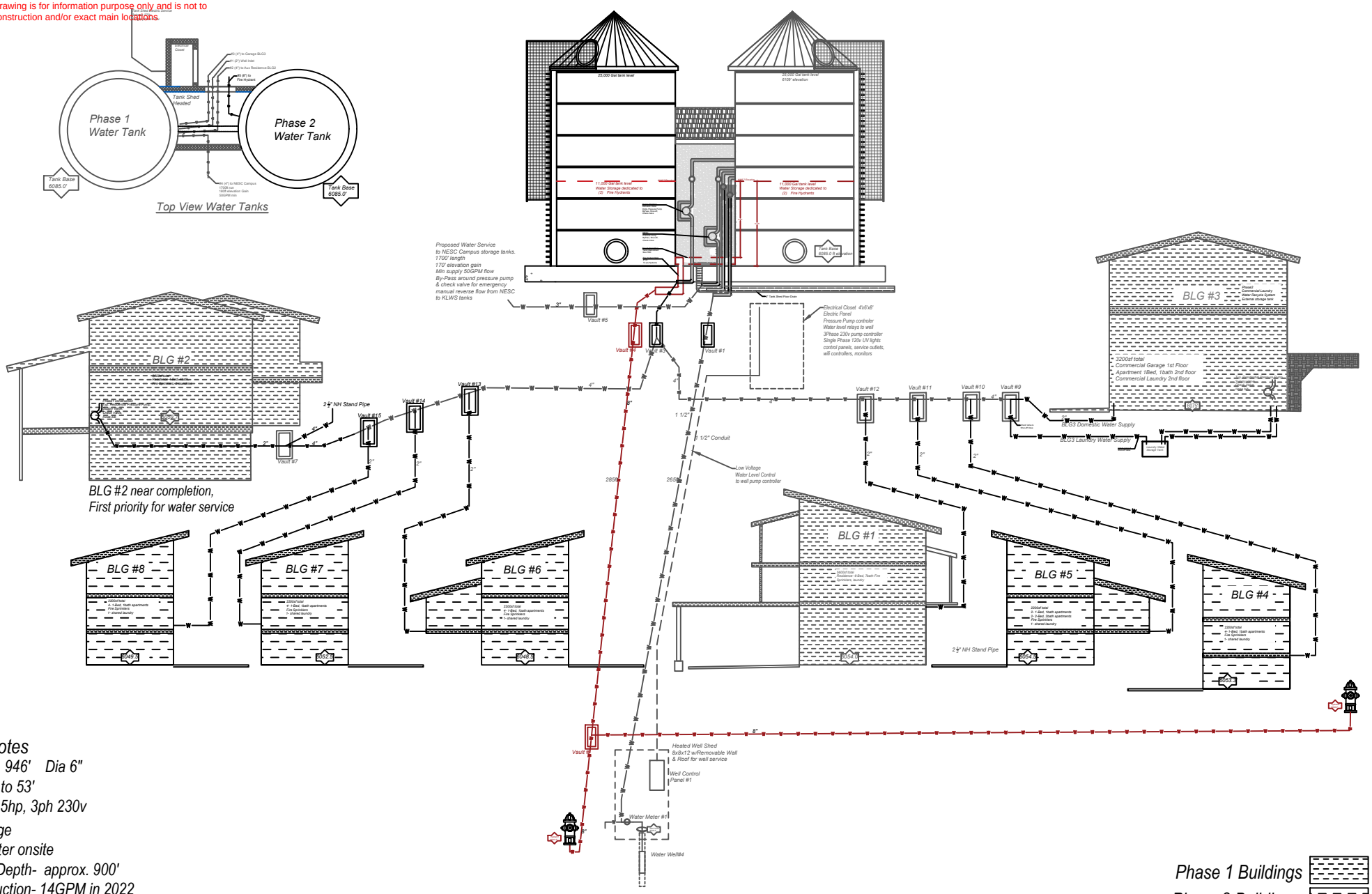


Attachment 1: Site Sketch

Scenic Wonders Project
Water System Schmatic 3/13/2023

NOTE: This drawing is for information purpose only and is not to be used for construction and/or exact main locations.

Top View Water Tanks



Well#4 Notes

Well Depth- 946' Dia 6"
Casing- 11" to 53'
Well Pump- 5hp, 3ph 230v
1 1/2" Discharge
1" water meter onsite
Well Pump Depth- approx. 900'
Water Production- 14GPM in 2022
Static Water Level- 770ft, July, 2021

Phase 1 Buildings
Phase 2 Buildings

Hydraulic Overview

Job Number: 1
Report Description: Residential

Job

Job Number: 1	Design Engineer:
Job Name: Drawing1	Phone: / FAX:
Address 1:	State Certification/License Number:
Address 2:	AHJ:
Address 3:	Job Site/Building:

System

	Hose Streams: 1000.00
	Number Of Sprinklers Calculated: 0 / 0
System Pressure Demand: 2.995	System Flow Demand: 1000.00
Total Demand: 1000.00 @ 2.995	Pressure Result: +11.258 (79.0%)

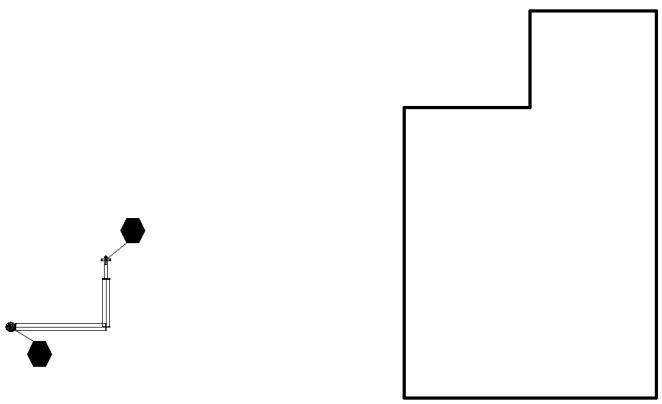
Supplies

Node	Name	Flow(gpm)	Hose Flow(gpm)	Static(psi)	Residual(psi)
1	Water Supply	1500.00		14.300	14.200

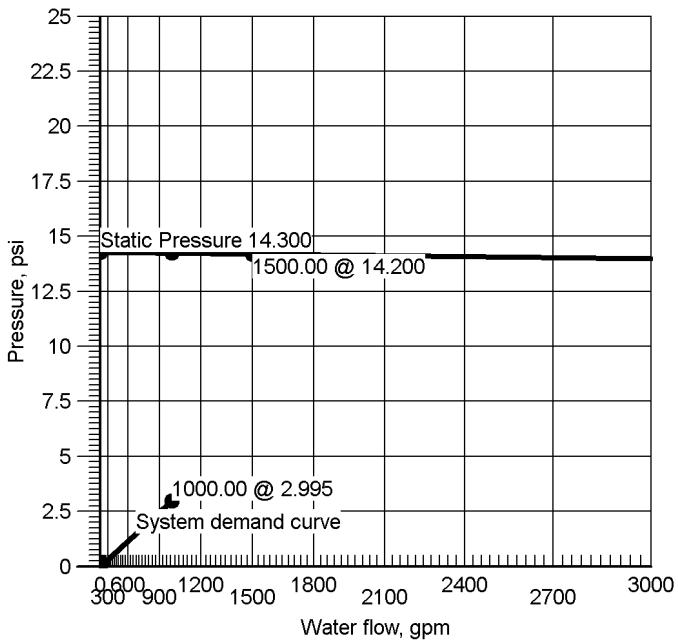
Check Point Gauges

Identifier	Pressure(psi)	K-Factor(K)	Flow(gpm)

hydrant.cad



Water Supply at Node 1 (1500.00, 0.00, 14.300, 14.200)



Hydraulic Summary

Job

Job Number: 1	Design Engineer:
Job Name: Drawing1	State Certification/License Number:
Address 1:	AHJ:
Address 2:	Job Site/Building:
Address 3:	Drawing Name: hydrant.cad

System

Most Demanding Sprinkler Data: K-Factor at

Hose Allowance At Source: 0.00

Additional Hose Supplies

Node	Flow(gpm)
Hydrant At Node 3	1000.00

Total Hose Streams: 1000.00

System Flow Demand	Total Water Required (Including Hose Allowance)
1000.00	1000.00

Maximum Pressure Unbalance In Loops: 0.000

Maximum Velocity Above Ground:

Maximum Velocity Under Ground	
5.64 between nodes 1 and 3	

Volume capacity of Wet Pipes	Volume capacity of Dry Pipes
1305.99gal	

Remote Area(s)

AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area

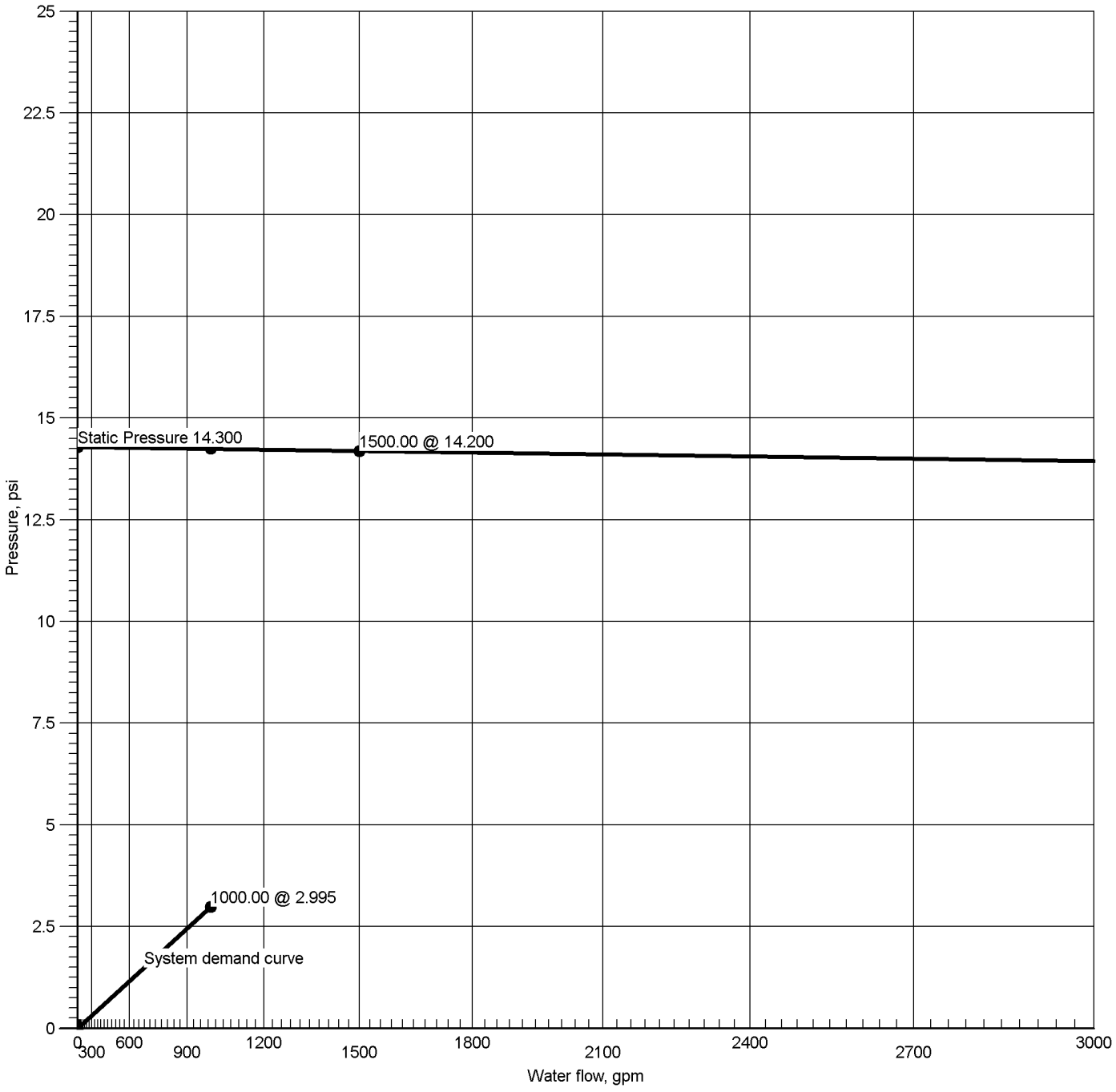
Supplies

Node	Name	Hose Flow (gpm)	Static (psi)	Residual (psi)	@	Flow (gpm)	Available (psi)	@	Total Demand (gpm)	Required (psi)	Safety Margin (psi)
1	Water Supply		14.300	14.200		1500.00	14.253		1000.00	2.995	11.258

Contractor

	Contractor Number	Contact Name	Contact Title
Name of Contractor:		Phone	Extension
Address 1:		FAX	
Address 2:		E-mail	
Address 3:		Web-Site	

Water Supply at Node 1



Hydraulic Graph	Water Supply at Node 1
Static: Pressure	14.300
Residual: Pressure	14.200 @ 1500.00
Available Pressure at System Demand	14.253 @ 1000.00
Required Pressure at System Demand	2.995 @ 1000.00
Required Pressure at System Demand (Including Hose Allowance at Source)	2.995 @ 1000.00

Summary Of Outflowing Devices

Device	Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)		
Hydrant 3	1000.00	1000.00	0	0.000		

Most Demanding Sprinkler Data

Node Analysis

Job Number: 1
Report Description: Residential

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)	
1	0'-0	S	2.995	1000.00	

Hydraulic Analysis

Job Number: 1
Report Description: Residential

Pipe Type / Downstream / Upstream	Diameter / Elevation	Flow / Discharge	Velocity / K-Factor	HWC / Pt	Pn	Friction Loss / Fittings	Length / Eq. Length / Total Length	Pressure Summary
• • • • • Route 1 • • • • •								
UG	8.5100	1000.00	5.64	140		0.005082	442'-0	Pf 2.995
3	0'-0	1000.00		0.000		Hydrant,	147'-3	Pe
1	0'-0			2.995		7EE(16'-4½), E(32'-8½), S	589'-3	Pv

Equivalent Pipe Lengths of Valves and Fittings (C=120 only)

$$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}}\right)^{4.87} = \text{Factor}$$

C Value Multiplier

Value Of C	100	130	140	150
Multiplying Factor	0.713	1.16	1.33	1.51

Pipe Type Legend

AO	Arm-Over
BL	Branch Line
CM	Cross Main
DN	Drain
DR	Drop
DY	Dynamic
FM	Feed Main
FR	Feed Riser
MS	Miscellaneous
OR	Outrigger
RN	Riser Nipple
SP	Sprig
ST	Stand Pipe
UG	Underground

Units Legend

Diameter	Inch
Elevation	Foot
Flow	gpm
Discharge	gpm
Velocity	fps
Pressure	psi
Length	Foot
Friction Loss	psi/Foot
HWC	Hazen-Williams Constant
Pt	Total pressure at a point in a pipe
Pn	Normal pressure at a point in a pipe
Pf	Pressure loss due to friction between points
Pe	Pressure due to elevation difference between indicated points
Pv	Velocity pressure at a point in a pipe

Fittings Legend

ALV	Alarm Valve
AngV	Angle Valve
b	Bushing
BalV	Ball Valve
BFP	Backflow Preventer
BV	Butterfly Valve
C	Cross Flow Turn 90°
cplg	Coupling
Cr	Cross Run
CV	Check Valve
DelV	Deluge Valve
DPV	Dry Pipe Valve
E	90° Elbow
EE	45° Elbow
Ee1	11¼° Elbow
Ee2	22½° Elbow
f	Flow Device
fd	Flex Drop
FDC	Fire Department Connection
fE	90° FireLock(TM) Elbow
fEE	45° FireLock(TM) Elbow
flg	Flange
FN	Floating Node
fT	FireLock(TM) Tee
g	Gauge
GloV	Globe Valve
GV	Gate Valve
Ho	Hose
Hose	Hose
HV	Hose Valve
Hyd	Hydrant
LtE	Long Turn Elbow
mecT	Mechanical Tee
Noz	Nozzle
P1	Pump In
P2	Pump Out
PIV	Post Indicating Valve
PO	Pipe Outlet
PrV	Pressure Relief Valve
PRV	Pressure Reducing Valve
red	Reducer/Adapter
S	Supply
sCV	Swing Check Valve
SFx	Seismic Flex
Spr	Sprinkler
St	Strainer
T	Tee Flow Turn 90°
Tr	Tee Run
U	Union
WirF	Wirsbo
WMV	Water Meter Valve
Z	Cap

Hydraulic Overview

Job Number: 1
Report Description: Residential

Job

Job Number: 1	Design Engineer:
Job Name: Drawing1	Phone: / FAX:
Address 1:	State Certification/License Number:
Address 2:	AHJ:
Address 3:	Job Site/Building:

System

	Hose Streams: 1000.00
	Number Of Sprinklers Calculated: 0 / 0
System Pressure Demand: 1.857	System Flow Demand: 1000.00
Total Demand: 1000.00 @ 1.857	Pressure Result: +15.396 (89.2%)

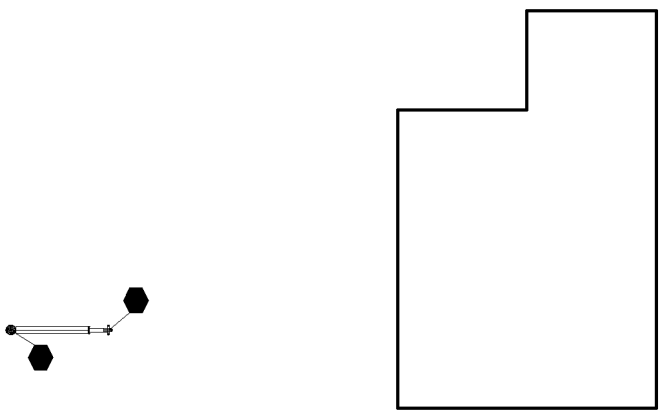
Supplies

Node	Name	Flow(gpm)	Hose Flow(gpm)	Static(psi)	Residual(psi)
1	Water Supply	1500.00		17.300	17.200

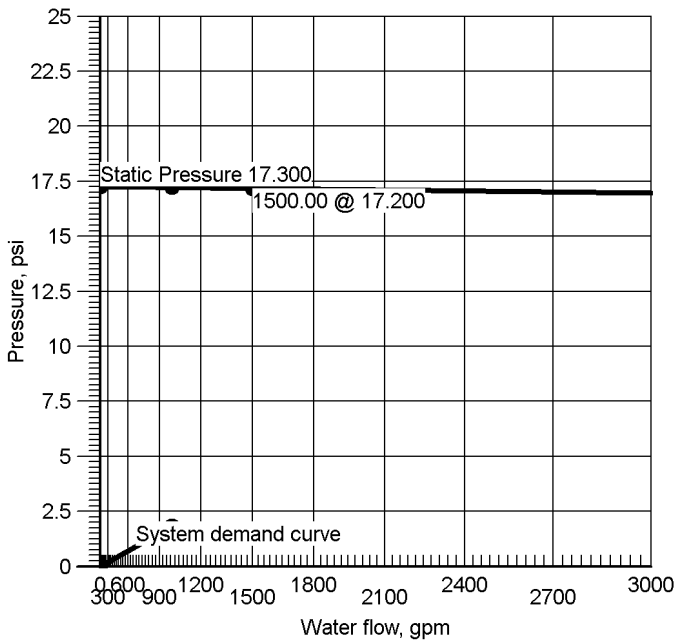
Check Point Gauges

Identifier	Pressure(psi)	K-Factor(K)	Flow(gpm)

hydrant-1.cad



Water Supply at Node 1 (1500.00, 0.00, 17.300, 17.200)



Hydraulic Summary

Job

Job Number: 1	Design Engineer:
Job Name: Drawing1	State Certification/License Number:
Address 1:	AHJ:
Address 2:	Job Site/Building:
Address 3:	Drawing Name: hydrant-1.cad

System

Most Demanding Sprinkler Data: K-Factor at

Hose Allowance At Source: 0.00

Additional Hose Supplies

Node	Flow(gpm)
Hydrant At Node 3	1000.00

Total Hose Streams: 1000.00

System Flow Demand: 1000.00

Total Water Required (Including Hose Allowance): 1000.00

Maximum Pressure Unbalance In Loops: 0.000

Maximum Velocity Above Ground:

Maximum Velocity Under Ground: 5.64 between nodes 1 and 3

Volume capacity of Wet Pipes: 886.42gal

Volume capacity of Dry Pipes:

Remote Area(s)

AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area

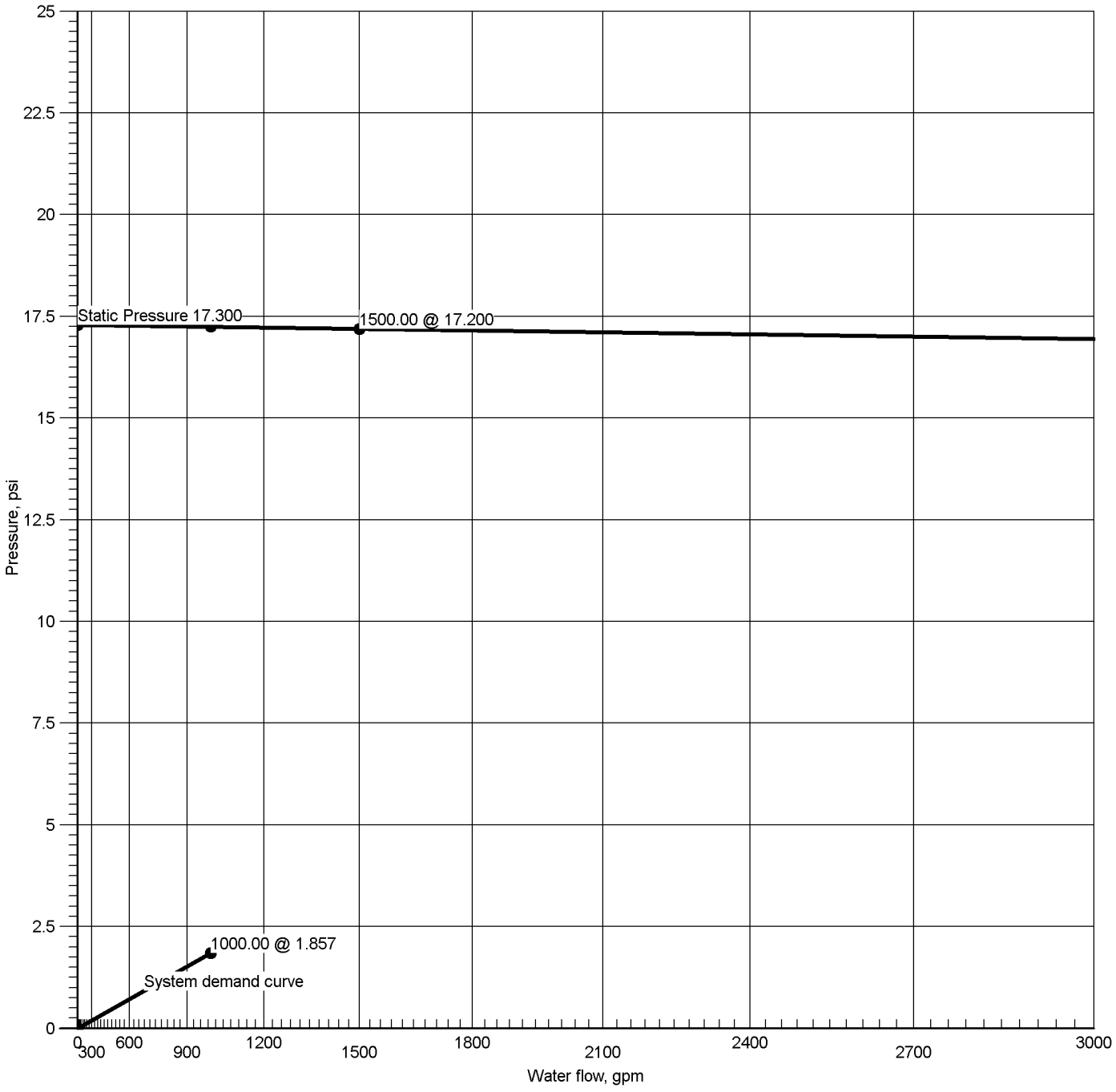
Supplies

Node	Name	Hose Flow (gpm)	Static (psi)	Residual (psi) @ Flow (gpm)	Available (psi) @ Total Demand (gpm)	Required (psi)	Safety Margin (psi)
1	Water Supply		17.300	17.200 @ 1500.00	17.253 @ 1000.00	1.857	15.396

Contractor

	Contractor Number:	Contact Name:	Contact Title:
Name of Contractor:		Phone:	Extension:
Address 1:		FAX:	
Address 2:		E-mail:	
Address 3:		Web-Site:	

Water Supply at Node 1



Hydraulic Graph	Water Supply at Node 1
Static: Pressure	17.300
Residual: Pressure	17.200 @ 1500.00
Available Pressure at System Demand	17.253 @ 1000.00
Required Pressure at System Demand	1.857 @ 1000.00
Required Pressure at System Demand (Including Hose Allowance at Source)	1.857 @ 1000.00

Summary Of Outflowing Devices

Device	Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)		
Hydrant 3	1000.00	1000.00	0	0.000		

Most Demanding Sprinkler Data

Node Analysis

Job Number: 1
Report Description: Residential

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)	
1	0'-0	S	1.857	1000.00	

Hydraulic Analysis

Job Number: 1
Report Description: Residential

Pipe Type / Downstream / Upstream	Diameter / Elevation	Flow / Discharge	Velocity / K-Factor	HWC / Pt	Pn	Friction Loss / Fittings	Length / Eq. Length / Total Length	Pressure Summary
• • • • • Route 1 • • • • •								
UG	8.5100	1000.00	5.64	140		0.005082	300'-0	Pf 1.857
3	0'-0	1000.00		0.000		Hydrant,	65'-5½	Pe
1	0'-0			1.857		4EE(16'-4½), S	365'-5½	Pv

Equivalent Pipe Lengths of Valves and Fittings (C=120 only)

$$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}}\right)^{4.87} = \text{Factor}$$

C Value Multiplier

Value Of C	100	130	140	150
Multiplying Factor	0.713	1.16	1.33	1.51

Pipe Type Legend

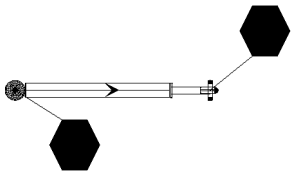
AO	Arm-Over
BL	Branch Line
CM	Cross Main
DN	Drain
DR	Drop
DY	Dynamic
FM	Feed Main
FR	Feed Riser
MS	Miscellaneous
OR	Outrigger
RN	Riser Nipple
SP	Sprig
ST	Stand Pipe
UG	Underground

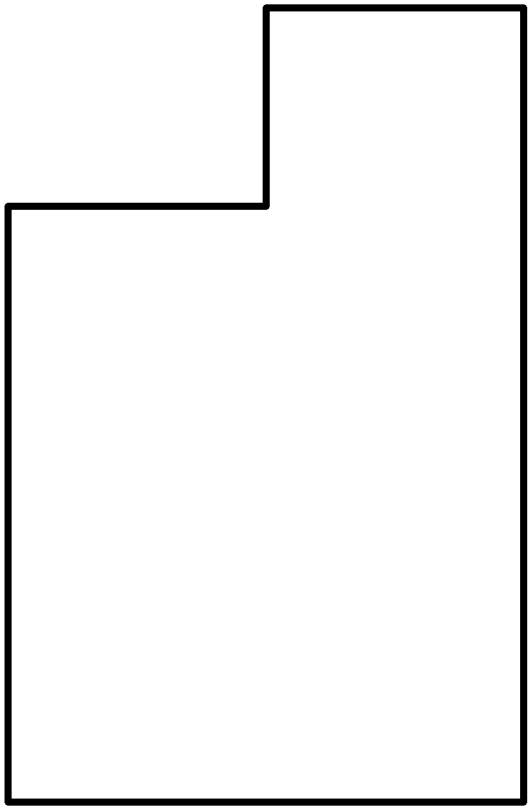
Units Legend

Diameter	Inch
Elevation	Foot
Flow	gpm
Discharge	gpm
Velocity	fps
Pressure	psi
Length	Foot
Friction Loss	psi/Foot
HWC	Hazen-Williams Constant
Pt	Total pressure at a point in a pipe
Pn	Normal pressure at a point in a pipe
Pf	Pressure loss due to friction between points
Pe	Pressure due to elevation difference between indicated points
Pv	Velocity pressure at a point in a pipe

Fittings Legend

ALV	Alarm Valve
AngV	Angle Valve
b	Bushing
BalV	Ball Valve
BFP	Backflow Preventer
BV	Butterfly Valve
C	Cross Flow Turn 90°
cplg	Coupling
Cr	Cross Run
CV	Check Valve
DelV	Deluge Valve
DPV	Dry Pipe Valve
E	90° Elbow
EE	45° Elbow
Ee1	11¼° Elbow
Ee2	22½° Elbow
f	Flow Device
fd	Flex Drop
FDC	Fire Department Connection
fE	90° FireLock(TM) Elbow
fEE	45° FireLock(TM) Elbow
flg	Flange
FN	Floating Node
fT	FireLock(TM) Tee
g	Gauge
GloV	Globe Valve
GV	Gate Valve
Ho	Hose
Hose	Hose
HV	Hose Valve
Hyd	Hydrant
LtE	Long Turn Elbow
mecT	Mechanical Tee
Noz	Nozzle
P1	Pump In
P2	Pump Out
PIV	Post Indicating Valve
PO	Pipe Outlet
PrV	Pressure Relief Valve
PRV	Pressure Reducing Valve
red	Reducer/Adapter
S	Supply
sCV	Swing Check Valve
SFx	Seismic Flex
Spr	Sprinkler
St	Strainer
T	Tee Flow Turn 90°
Tr	Tee Run
U	Union
WirF	Wirsbo
WMV	Water Meter Valve
Z	Cap





Hydraulic Overview

Job Number: 1
Report Description: Ordinary Group II

Job

Job Number: 1	Design Engineer:
Job Name: Drawing1	Phone: / FAX:
Address 1:	State Certification/License Number:
Address 2:	AHJ:
Address 3:	Job Site/Building:

System

	Hose Streams: 220.00
	Number Of Sprinklers Calculated: 0 / 0
System Pressure Demand: 36.475	System Flow Demand: 220.00
Total Demand: 220.00 @ 36.475	Pressure Result: +15.631 (30.0%)

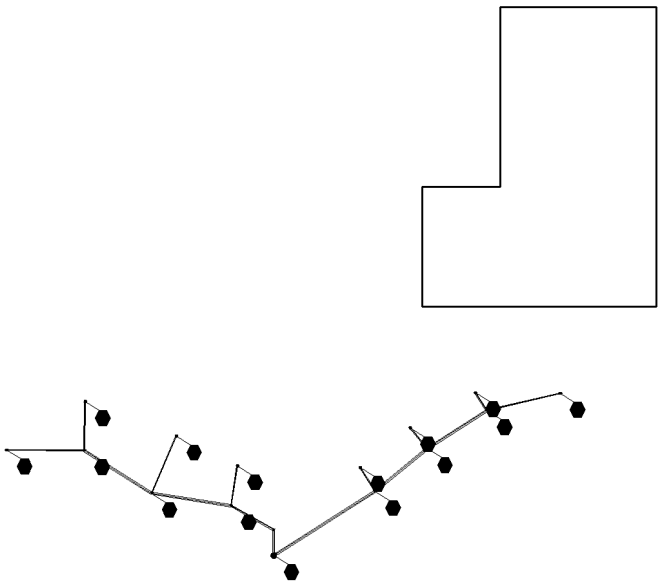
Supplies

Node	Name	Flow(gpm)	Hose Flow(gpm)	Static(psi)	Residual(psi)
1	Water Supply	250.00		60.000	50.000

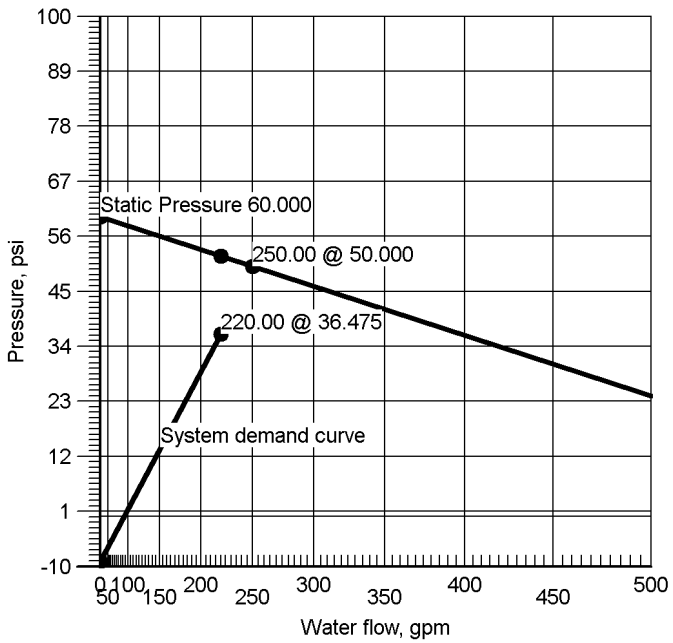
Check Point Gauges

Identifier	Pressure(psi)	K-Factor(K)	Flow(gpm)

domestic demand.cad



Water Supply at Node 1 (250.00, 0.00, 60.000, 50.000)



Hydraulic Summary

Job

Job Number: 1	Design Engineer:
Job Name: Drawing1	State Certification/License Number:
Address 1:	AHJ:
Address 2:	Job Site/Building:
Address 3:	Drawing Name: domestic demand.cad

System

Most Demanding Sprinkler Data: K-Factor at

Hose Allowance At Source: 0.00

Additional Hose Supplies

Node	Flow(gpm)
Hose At Node 14	15.00
Hose At Node 3	27.00
Hose At Node 15	15.00
Hose At Node 16	15.00
Hose At Node 17	30.00
Hose At Node 18	53.00
Hose At Node 19	35.00
Hose At Node 20	30.00

Total Hose Streams: 220.00

System Flow Demand	Total Water Required (Including Hose Allowance)
220.00	220.00

Maximum Pressure Unbalance In Loops: 0.000

Maximum Velocity Above Ground: 3.56 between nodes 11 and 19

Maximum Velocity Under Ground	
5.40 between nodes 6 and 18	

Volume capacity of Wet Pipes	Volume capacity of Dry Pipes
542.34gal	

Remote Area(s)

AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area

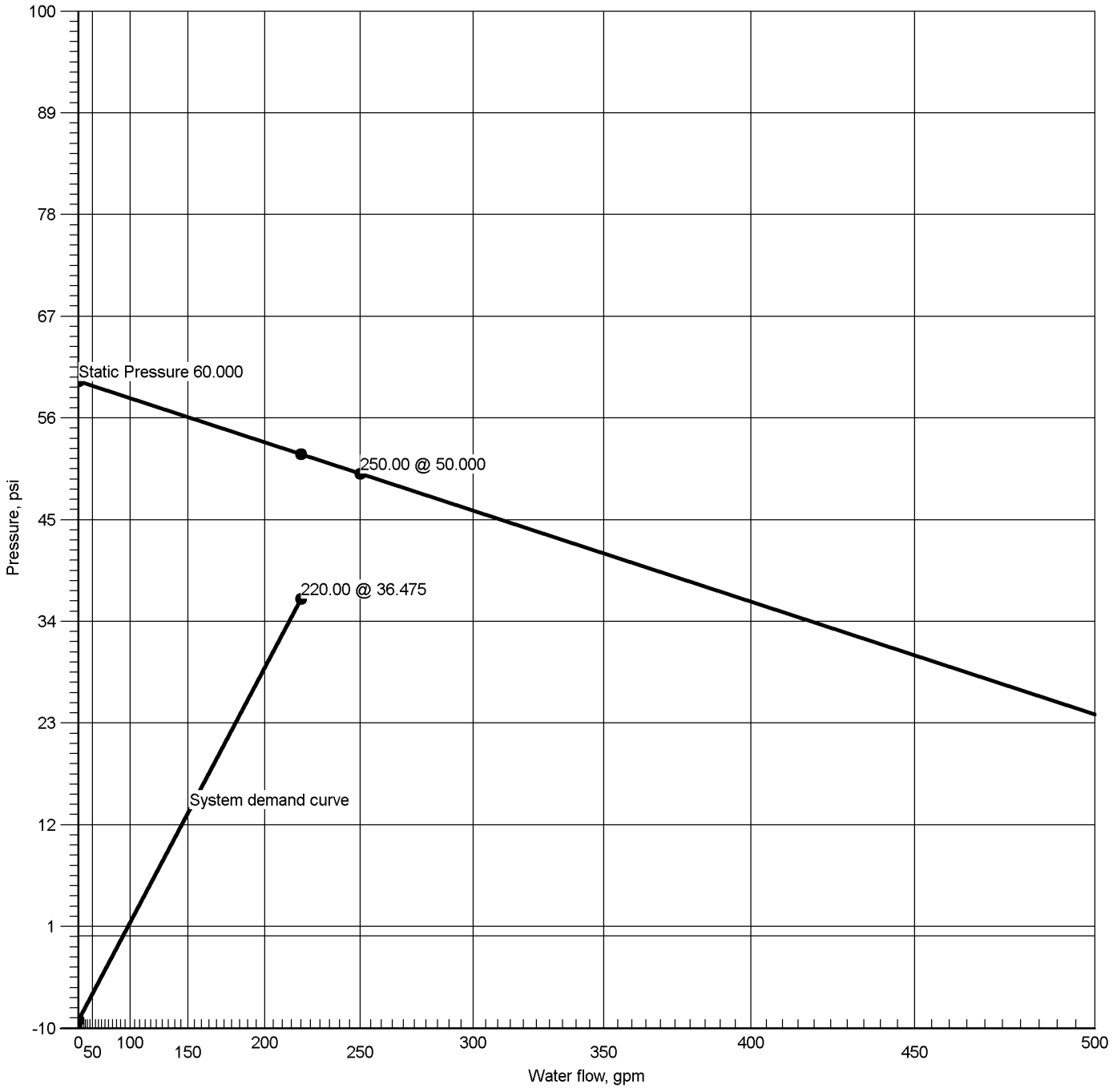
Supplies

Node	Name	Hose Flow (gpm)	Static (psi)	Residual (psi) @ Flow (gpm)	Available (psi) @ Total Demand (gpm)	Required (psi)	Safety Margin (psi)
1	Water Supply		60.000	50.000 @ 250.00	52.106 @ 220.00	36.475	15.631

Contractor

	Contractor Number	Contact Name	Contact Title
Name of Contractor:		Phone	Extension
Address 1		FAX	
Address 2		E-mail	
Address 3		Web-Site	

Water Supply at Node 1



Hydraulic Graph
Water Supply at Node 1

Static: Pressure
60.000

Residual: Pressure
50.000 @ 250.00

Available Pressure at System Demand
52.106 @ 220.00

Required Pressure at System Demand
36.475 @ 220.00

Required Pressure at System Demand (Including Hose Allowance at Source)
36.475 @ 220.00

Summary Of Outflowing Devices

Job Number: 1
Report Description: Ordinary Group II

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)		
Hose	3	27.00	27.00	4.27	45.042		
Hose	14	15.00	15.00	2.37	50.562		
Hose	15	15.00	15.00	2.37	48.387		
Hose	16	15.00	15.00	2.37	49.381		
Hose	17	30.00	30.00	4.74	47.598		
Hose	18	53.00	53.00	8.38	40.000		
Hose	19	35.00	35.00	5.53	47.407		

⇨ Most Demanding Sprinkler Data

Node Analysis

Job Number: 1
Report Description: Ordinary Group II

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)	
1	23'-0	S, EE(7'-8)	36.475	220.00	
3	-0'-0	Hose(-39.983)(31'-0)	45.042	27.00	
14	-11'-0	Hose(-40.058)(31'-0)	50.562	15.00	
15	-7'-0	Hose(-40.058)(31'-0)	48.387	15.00	
16	-8'-0	Hose(-40.058)(31'-0)	49.381	15.00	
17	-6'-0	Hose(-40.058)(31'-0)	47.598	30.00	
18	2'-0	Hose(-40.000)(31'-0)	40.000	53.00	
19	-6'-0	Hose(-40.058)(31'-0)	47.407	35.00	
20	-12'-0	Hose(-40.058)(31'-0)	50.638	30.00	
2	23'-0	T(10'-0)	36.041		
4	23'-0	T(10'-0)	36.066		
6	23'-0	T(10'-0)	35.643		
8	23'-0	T(10'-0)	36.121		
9	23'-0	T(10'-0)	35.815		
11	23'-0	T(10'-0)	36.103		

Pipe Type / Downstream / Upstream	Diameter / Elevation	Flow / Discharge	Velocity / K-Factor	HWC / Pt	Pn	Friction Loss / Fittings	Length / Eq. Length / Total Length	Pressure Summary
• • • • • Route 1 • • • • •								
UG	2.0030	53.00	5.40	150		0.022392	165'-0	Pf 4.747
18	2'-0	53.00		40.000		Hose(-40.000)(31'-0)	47'-0	Pe -9.104
6	23'-0			35.643		3EE(2'-0), T(10'-0)	212'-0	Pv
UG	4.2300	68.00	1.55	150		0.000932	130'-0	Pf 0.171
6	23'-0	15.00		35.643		Flow (q) from Route 5	53'-9½	Pe
9	23'-0			35.815		2Ee2(7'-8), T(38'-5)	183'-9½	Pv
UG	4.2300	98.00	2.24	150		0.001832	96'-0	Pf 0.288
9	23'-0	30.00		35.815		Flow (q) from Route 4	61'-5½	Pe
11	23'-0			36.103		3EE(7'-8), T(38'-5)	157'-5½	Pv
UG	4.2300	133.00	3.04	150		0.003223	100'-0	Pf 0.372
11	23'-0	35.00		36.103		Flow (q) from Route 3	15'-4½	Pe
1	23'-0			36.475		2EE(7'-8), S	115'-4½	Pv
		0.00				Hose Allowance At Source		
1		220.00						
• • • • • Route 2 • • • • •								
CM	2.0030	27.00	2.75	150		0.006430	110'-0	Pf 0.971
3	-0'-0	27.00		45.042		Hose(-39.983)(31'-0)	41'-0	Pe -9.971
2	23'-0			36.041		T(10'-0)	151'-0	Pv
UG	4.2300	42.00	0.96	150		0.000382	25'-0	Pf 0.024
2	23'-0	15.00		36.041		Flow (q) from Route 7	38'-5	Pe
4	23'-0			36.066		T(38'-5)	63'-5	Pv
UG	4.2300	57.00	1.30	150		0.000672	44'-0	Pf 0.055
4	23'-0	15.00		36.066		Flow (q) from Route 6	38'-5	Pe
8	23'-0			36.121		T(38'-5)	82'-5	Pv
UG	4.2300	87.00	1.99	150		0.001470	210'-0	Pf 0.354
8	23'-0	30.00		36.121		Flow (q) from Route 8	30'-9	Pe
1	23'-0			36.475		4Ee2(7'-8)	240'-9	Pv
• • • • • Route 3 • • • • •								
CM	2.0030	35.00	3.56	150		0.010392	81'-0	Pf 1.268
19	-6'-0	35.00		47.407		Hose(-40.058)(31'-0)	41'-0	Pe -12.572
11	23'-0			36.103		T(10'-0)	122'-0	Pv
• • • • • Route 4 • • • • •								
CM	2.0030	30.00	3.05	150		0.007814	60'-0	Pf 0.789
17	-6'-0	30.00		47.598		Hose(-40.058)(31'-0)	41'-0	Pe -12.572
9	23'-0			35.815		T(10'-0)	101'-0	Pv
• • • • • Route 5 • • • • •								
CM	2.0030	15.00	1.53	150		0.002167	80'-0	Pf 0.262
15	-7'-0	15.00		48.387		Hose(-40.058)(31'-0)	41'-0	Pe -13.006
6	23'-0			35.643		T(10'-0)	121'-0	Pv
• • • • • Route 6 • • • • •								
CM	2.0030	15.00	1.53	150		0.002167	16'-0	Pf 0.124
16	-8'-0	15.00		49.381		Hose(-40.058)(31'-0)	41'-0	Pe -13.439
4	23'-0			36.066		T(10'-0)	57'-0	Pv
• • • • • Route 7 • • • • •								
CM	2.0030	15.00	1.53	150		0.002167	60'-0	Pf 0.219
14	-11'-0	15.00		50.562		Hose(-40.058)(31'-0)	41'-0	Pe -14.740
2	23'-0			36.041		T(10'-0)	101'-0	Pv
• • • • • Route 8 • • • • •								
CM	2.0030	30.00	3.05	150		0.007814	43'-0	Pf 0.656
20	-12'-0	30.00		50.638		Hose(-40.058)(31'-0)	41'-0	Pe -15.173
8	23'-0			36.121		T(10'-0)	84'-0	Pv

Equivalent Pipe Lengths of Valves and Fittings (C=120 only)

$$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}}\right)^{4.87} = \text{Factor}$$

C Value Multiplier

Value Of C	100	130	140	150
Multiplying Factor	0.713	1.16	1.33	1.51

Pipe Type	Diameter	Flow	Velocity	HWC		Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	

Pipe Type Legend

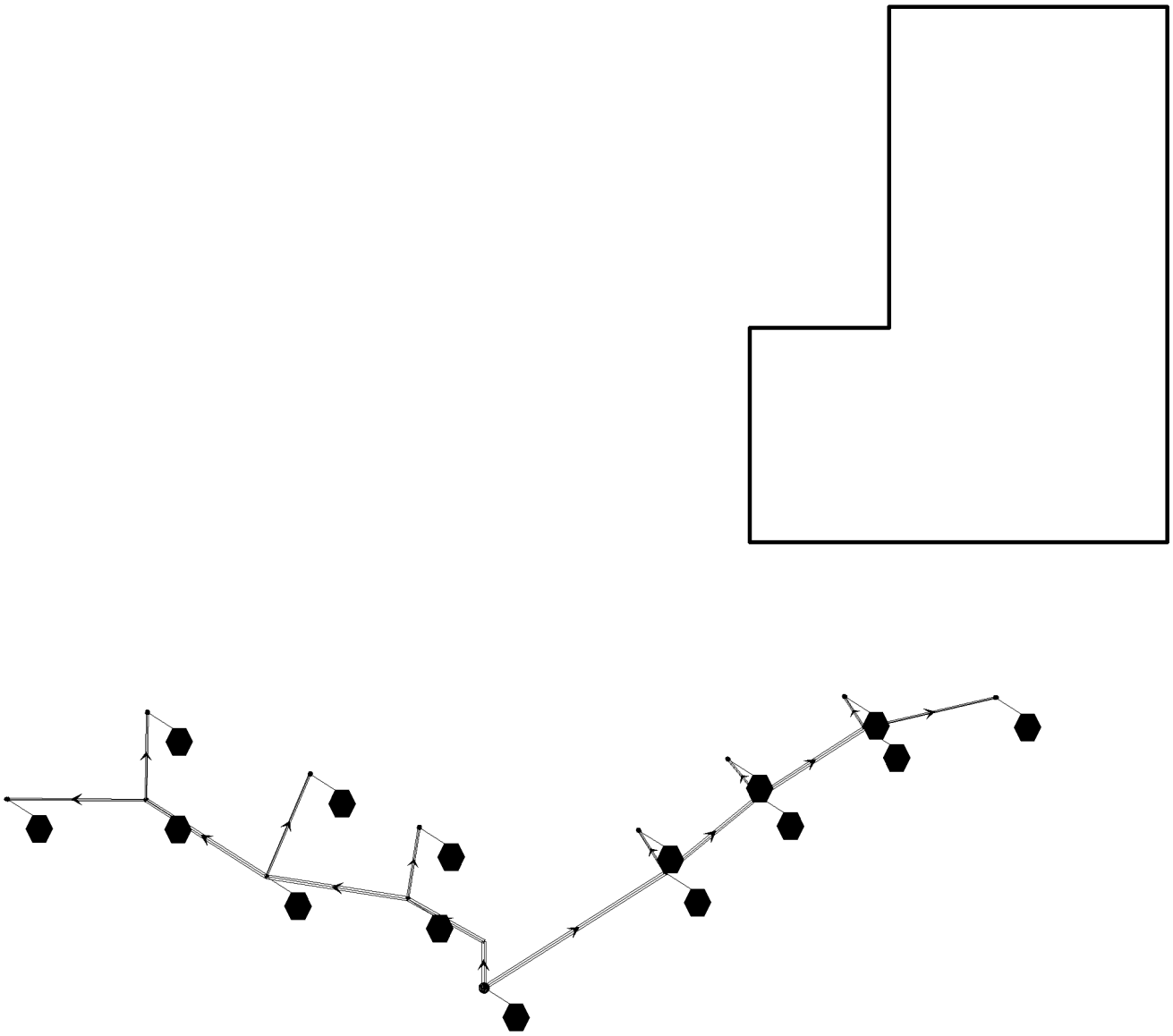
AO	Arm-Over
BL	Branch Line
CM	Cross Main
DN	Drain
DR	Drop
DY	Dynamic
FM	Feed Main
FR	Feed Riser
MS	Miscellaneous
OR	Outrigger
RN	Riser Nipple
SP	Sprig
ST	Stand Pipe
UG	Underground

Units Legend

Diameter	Inch
Elevation	Foot
Flow	gpm
Discharge	gpm
Velocity	fps
Pressure	psi
Length	Foot
Friction Loss	psi/Foot
HWC	Hazen-Williams Constant
Pt	Total pressure at a point in a pipe
Pn	Normal pressure at a point in a pipe
Pf	Pressure loss due to friction between points
Pe	Pressure due to elevation difference between indicated points
Pv	Velocity pressure at a point in a pipe

Fittings Legend

ALV	Alarm Valve
AngV	Angle Valve
b	Bushing
BalV	Ball Valve
BFP	Backflow Preventer
BV	Butterfly Valve
C	Cross Flow Turn 90°
cplg	Coupling
Cr	Cross Run
CV	Check Valve
DelV	Deluge Valve
DPV	Dry Pipe Valve
E	90° Elbow
EE	45° Elbow
Ee1	11¼° Elbow
Ee2	22½° Elbow
f	Flow Device
fd	Flex Drop
FDC	Fire Department Connection
fE	90° FireLock(TM) Elbow
fEE	45° FireLock(TM) Elbow
flg	Flange
FN	Floating Node
fT	FireLock(TM) Tee
g	Gauge
GloV	Globe Valve
GV	Gate Valve
Ho	Hose
Hose	Hose
HV	Hose Valve
Hyd	Hydrant
LtE	Long Turn Elbow
mecT	Mechanical Tee
Noz	Nozzle
P1	Pump In
P2	Pump Out
PIV	Post Indicating Valve
PO	Pipe Outlet
PrV	Pressure Relief Valve
PRV	Pressure Reducing Valve
red	Reducer/Adapter
S	Supply
sCV	Swing Check Valve
SFx	Seismic Flex
Spr	Sprinkler
St	Strainer
T	Tee Flow Turn 90°
Tr	Tee Run
U	Union
WirF	Wirsbo
WMV	Water Meter Valve
Z	Cap



Revisions include Water Supply Fixture Units (WSFU)

2/18/2023 Scenic Wonders Project- Domestic Water Flows w/o Fire Sprinklers

w/ sqaure footage and volume of each building

BLG1- 7ba, 6bd, 1 kitch	5000sf	66890cf	increased 10% of actual	
	GPM	WSFU		
7 WC	8.4	17.5	Structures with Exposure Hazards	
9 BA/Bar sink	10.8	9	occupancy hazard classification number	7
7 tub/shower	12.25	28	construction classification number	1.5
2 washing ma	3.4	8		
2 kitchen sink	3.6	3		
1 Dishwashe	1.7	1.5		
2 hose bibs	34	3.5		
		70.5	BLG1 Total WSFU	
	35	BLG1 Total GPM Domestic Water Flow		
	21500.36	fire flow volume (gal)		

[4.3.1]

$$WS_{min} = \frac{VS_{tot}}{OHC}(CC)\times 1.5$$

where:
WS_{min} = minimum water supply in gal (For results in L, multiply by 3.785.)
VS_{tot} = total volume of structure in ft^3 (If volume is measured in m^3, multiply by 35.3.)
OHC = occupancy hazard classification number
CC = construction classification number

BLG2- 5ba, 4bd, 1 kitch	3850sf	40000cf	As is built building	
	GPM	WSFU		
5 WC	6	12.5	Structures with Exposure Hazards	
6 BA/Bar sink	7.2	6	occupancy hazard classification number	7
3 tub/shower	5.4	12	construction classification number	1.5
1 Kitchen sin	1.8	1.5		
1 dishwasher	1.2	1.5		
1 shower	1.8	2		
2 laundry wa	3.4	8		
2 hose bibs	34	3.5		
		47	BLG2 Total WSFU	
	27	BLG2 Total Domestic Water Flow		
	12857.14	fire flow volume (gal)		

[4.3.1]

$$WS_{min} = \frac{VS_{tot}}{OHC}(CC)\times 1.5$$

where:
WS_{min} = minimum water supply in gal (For results in L, multiply by 3.785.)
VS_{tot} = total volume of structure in ft^3 (If volume is measured in m^3, multiply by 35.3.)
OHC = occupancy hazard classification number
CC = construction classification number

BLG3- Garage, 2ba, 1bd, 1 kitcher	3200sf	34000cf	increased 10%	
	GPM	WSFU		
2 WC	2.4	5	Structures with Exposure Hazards	
2 BA sinks	2.4	2	occupancy hazard classification number	5
2 Utilitiy Sink	3.4	3	construction classification number	1.5
1 Kitchen sin	1.8	1.5		
1 dishwasher	1.7	1.5		
1 tub/shower	1.75	4	Commercial Laundry has	
4 commercial	17	12	water storage tank mixing recycled and fresh water, pressure pump, check valve isolation	
4 hose bibs	68	5.5		
		34.5	BLG3 Total WSFU	
	23	BLG3 Total Domestic Water Flow		
	15300	fire flow volume (gal)		

[4.3.1]

$$WS_{min} = \frac{VS_{tot}}{OHC}(CC)\times 1.5$$

where:
WS_{min} = minimum water supply in gal (For results in L, multiply by 3.785.)
VS_{tot} = total volume of structure in ft^3 (If volume is measured in m^3, multiply by 35.3.)
OHC = occupancy hazard classification number
CC = construction classification number

BLG4- (2) 1bd apartmer	1150sf	12900cf	increased 10%	
	GPM	WSFU		
2WC	2.4	5	Structures with Exposure Hazards	
2 BA Sinks,	2.4	2	occupancy hazard classification number	7
2 showers	3.5	4	construction classification number	1.5
2 Kitchen sin	3.6	3		
2 dishwasher	3.4	3		
1 hose bib	17	2.5		
		19.5	BLG4 Total WSFU	
	15	BLG4 Total Domestic Water Flow		
	4146.429	fire flow volume (gal)		

[4.3.1]

$$WS_{min} = \frac{VS_{tot}}{OHC}(CC)\times 1.5$$

where:
WS_{min} = minimum water supply in gal (For results in L, multiply by 3.785.)
VS_{tot} = total volume of structure in ft^3 (If volume is measured in m^3, multiply by 35.3.)
OHC = occupancy hazard classification number
CC = construction classification number

BLG5- (2) 1bed, (2) 2be	2700sf	32000cf	increased 10%
	GPM	WSFU	
6 WC	7.2	15	Structures with Exposure Hazards
6 BA Sinks	7.2	6	occupancy hazard classification number 7
6 showers	10.5	12	construction classification number 1.5
4 kitchen sink	7.2	6	
4 dishwasher	6.8	6	
3 hose bibs	51	4.5	
1 Laundry Wa	1.7	4	
		53.5	BLG5 Total WSFU
		30	BLG5 Total Domestic Water Flow

10285.71 fire flow volume (gal)

[4.3.1]

$$WS_{min} = \frac{VS_{tot}}{OHC}(CC)\times 1.5$$

where:
WS_{min} = minimum water supply in gal (For results in L, multiply by 3.785.)
VS_{tot} = total volume of structure in ft³ (If volume is measured in m³, multiply by 35.3.)
OHC = occupancy hazard classification number
CC = construction classification number

BLG6- (2) 1bed, (2) 2be	2700sf	32000cf	increased 10%
	GPM	WSFU	
6 WC	7.2	15	Structures with Exposure Hazards
6 BA Sinks	7.2	6	occupancy hazard classification number 7
6 showers	10.5	12	construction classification number 1.5
4 kitchen sink	7.2	6	
4 dishwasher	6.8	6	
3 hose bibs	51	4.5	
1 Laundry Wa	1.7	4	
		53.5	BLG6 Total WSFU
		30	BLG6 Total Domestic Water Flow

10285.71 fire flow volume (gal)

[4.3.1]

$$WS_{min} = \frac{VS_{tot}}{OHC}(CC)\times 1.5$$

where:
WS_{min} = minimum water supply in gal (For results in L, multiply by 3.785.)
VS_{tot} = total volume of structure in ft³ (If volume is measured in m³, multiply by 35.3.)
OHC = occupancy hazard classification number
CC = construction classification number

BLG7- (2) 1bd apartmer	1150sf	12900cf	increased 10%
	GPM	WSFU	
2WC	2.4	5	Structures with Exposure Hazards
2 BA Sinks,	2.4	2	occupancy hazard classification number 7
2 showers	3.5	4	construction classification number 1.5
2 Kitchen sink	3.6	3	
2 dishwasher	3.4	3	
1 hose bib	17	2.5	
		19.5	BLG7 Total WSFU
		15	BLG7 Total Domestic Water Flow

4146.429 fire flow volume (gal)

[4.3.1]

$$WS_{min} = \frac{VS_{tot}}{OHC}(CC)\times 1.5$$

where:
WS_{min} = minimum water supply in gal (For results in L, multiply by 3.785.)
VS_{tot} = total volume of structure in ft³ (If volume is measured in m³, multiply by 35.3.)
OHC = occupancy hazard classification number
CC = construction classification number

BLG8- (2) 1bd apartmer	1150sf	12900cf	increased 10%
	GPM	WSFU	
2WC	2.4	5	Structures with Exposure Hazards
2 BA Sinks,	2.4	2	occupancy hazard classification number 7
2 showers	3.5	4	construction classification number 1.5
2 Kitchen sink	3.6	3	
2 dishwasher	3.4	3	
1 hose bib	17	2.5	
		19.5	BLG8 Total WSFU
		15	BLG8 Total Domestic Water Flow

4146.429 fire flow volume (gal)

[4.3.1]

$$WS_{min} = \frac{VS_{tot}}{OHC}(CC)\times 1.5$$

where:
WS_{min} = minimum water supply in gal (For results in L, multiply by 3.785.)
VS_{tot} = total volume of structure in ft³ (If volume is measured in m³, multiply by 35.3.)
OHC = occupancy hazard classification number
CC = construction classification number

264	Total 8 Buildings WSFU
190	Total 8 Buildings Max domestic water flow rate GPM
21500.36	Highest Fire Flow Volume
1000	Highest Fire Flow Demand

Fixture Flow Rates	
WC 1.28g pe	1.2
BA Faucet	1.2 gpm
Shower fauce	1.8
Tub/Shower f	1.75
Kitchen Fauc	1.8
Dishwasher	1.6
Hose Bib 5/8	17
Laundry Was	1.6
Utilitiy sink Fa	1.8

WSFU Units	
WC	2.5
Lav/Bar	1
Tub/Shower	4
Shower head	2
Washer	4
Kitchen	1.5
Dish Washer	1.5
Hose Bib	2.5

Average american household flow rate 6 - 12gpm

3/4" water meter 2-20gpm
5/8" garden hose 17gpm
3/8" flex water supply line 1.7 gpm