



## **Pacific Surveying & Engineering, Inc**

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June 14, 2023

City of Bellingham  
Planning and Community Development Department  
210 Lottie Street  
Bellingham, Washington 98225

**Attn: Kathy Bell, Senior Planner**  
**Re: The Woods at Viewcrest – SUB2022-0011**  
**Response to RFI dated 12-21-22**

Dear Ms. Bell,

The purpose of this letter is to provide our response to one item on the above referenced City of Bellingham Request for Information (RFI). Page 5 of the RFI includes a request for information related to “Public Infrastructure”, specifically domestic water service. The RFI “action item” states the following:

*Verify the existing water system layout is consistent with the City’s Development Guidelines or resubmit a revised water service layout that complies with these Development Guidelines for maximum gridded spacing. Additionally, verify the overall water system proposed to serve the preliminary plan has sufficient pressure and fire flow.*

Our response to this action item is discussed below in two separate sections, Development Standards Compliance and Water Pressure Calculations.

### **Development Standards Compliance**

Section 6 of the City of Bellingham Public Works Department Development Guidelines & Improvement Standards provides the standards for watermain development in the City of Bellingham. Section 6-2.01.01 provides the standards related to pipe diameter and gridded spacing as follows:

*The minimum size watermain shall be 6 inches in diameter with an average gridded spacing not to exceed 600 feet. An 8-inch diameter main shall be used where an average grid of 600 feet is not possible, however, the maximum ungridded length may not exceed 1,500 feet. Four-inch diameter pipes may be allowed by the Department when future extension is not anticipated, such as in a cul-de-sac, provided the main does not serve a fire hydrant.*

For the purposes of preparing this RFI response, we assume that all watermains serving hydrants at The Woods at Viewcrest will be a minimum of 8-inch diameter ductile iron. The maximum length of any watermain from Viewcrest Road to a fire hydrant occurs between

Viewcrest Road and the vicinity of Lot #27. That length of watermain is currently proposed to be approximately 1,015 lineal feet, thus complying with the maximum ungridded length of 1,500 feet for 8-inch watermains required by the Development Standards. Please note that while the minimum pipe diameter serving any hydrant is planned to be a minimum of 8-inches, some watermains may need to be upsized to 12-inch diameter to meeting pressure requirements during fire flow conditions as discussed later in this analysis.

### **Water Pressure Calculations**

Attached are water pressure calculations that represent two different conditions. We have separately calculated the water pressure during static conditions (water not flowing), and during a 1,500 gallon per minute fireflow event.

The static pressure calculation has been performed for the future water service that is anticipated to be at the highest elevation within the subdivision. The highest water service elevation will have the lowest static water pressure. The highest water service elevation is currently projected to be elevation 330' serving Lot #7. Our calculations indicate that the static water pressure at the Lot #7 water service will be approximately 55 psi. Typically, water service connections shall maintain a minimum pressure of 30 psi during normal operating conditions. It is our opinion that the static water pressure at Lot #7 will be adequate.

We also calculated the water pressure at the highest water service elevation during an assumed 1,500 gallon per minute fire flow condition. We assumed that a fire flow demand would occur at the proposed fire hydrant near Station 16+25 on "West Road" near Lot #8. Our calculations indicate that the water pressure at Lot #7 will fall to 47 psi during the fire flow condition, assuming that all watermains between the hydrant and Viewcrest Road will be 12-inches in diameter. The resultant 47 psi pressure during the fireflow condition is considered adequate since the typical standard is to achieve a minimum of 20 psi during fireflow conditions.

While our fire flow pressure calculations assume that the watermain diameters will be 12-inches, it is possible that some of the watermains could be reduced to 8-inches upon further examination and review between our engineering department and the City Public Works Department. Nonetheless, it is our opinion that the general water system piping configuration as currently designed will exceed minimum required system pressures during a fireflow demand without additional water system configuration modifications.

Please do not hesitate to contact me directly if you have any questions.

Sincerely,  
Pacific Surveying and Engineering, Inc.



Jeff Vander Yacht, P.E.  
Engineering Manager and Principal



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Project: VIEWCREST

Job Number: 2019196

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Work Product:

WATER PRESSURE CALCS

Date: 6-14-23

## STATIC WATER-PRESSURE CALCULATION

HIGHEST SERVICE ELEVATION - LOT #7

ASSUME METER ELEV = 330' (LOT #7)

CITY PRESSURE ZONE = 457 SOUTH

$$\text{STATIC PRESSURE} = (457' - 330') \times 62.4 \text{ PCF} / 144$$

$$\text{MINIMUM STATIC PRESSURE} = 55 \text{ PSI}$$

## FIRE FLOW - PRESSURE CALCULATION

LOT #7

ASSUME 1,500 GPM FIRE FLOW DEMAND  
AT HYDRANT, WEST ROAD, STA 16+25

ASSUME 12" Ø WATERMAINS

PIPE LENGTH / VIEWCREST TO  
WEST ROAD STA 16+25 = 605'



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Project: \_\_\_\_\_ Job Number: \_\_\_\_\_ Page: 2/2

Work Product: \_\_\_\_\_ Date: \_\_\_\_\_

$$VELOCITY = 4.26 \text{ FT/SEC}$$

$$FRICTION LOSS = 0.88 \text{ FT/100 FT}$$

$$TOTAL FRICTION LOSS = 6.05 \times 0.88 = 5.3'$$

$$TOTAL FRICTION LOSS = 5.3' \times 62.4 / 144 = 2.3 \text{ PSI}$$

ASSUME 5 PSI MAXIMUM MINOR LOSSES

$$PRESSURE AT LOT \#7 = 55 \text{ PSI} - 2.3 \text{ PSI} - 5 \text{ PSI}$$

$$PRESSURE AT LOT \#7 = 47 \text{ PSI}$$

DURING 1,500 GPM FIRE FLOW

# Friction of water in pipes (continued)

| Gallons Per Minute                 | Velocity Feet Per Second | Velocity Head In Feet | Head Loss In Feet Per 100 Ft. | Gallons Per Minute                  | Velocity Feet Per Second | Velocity Head In Feet | Head Loss In Feet Per 100 Ft. | Gallons Per Minute                 | Velocity Feet Per Second | Velocity Head In Feet | Head Loss In Feet Per 100 Ft. |
|------------------------------------|--------------------------|-----------------------|-------------------------------|-------------------------------------|--------------------------|-----------------------|-------------------------------|------------------------------------|--------------------------|-----------------------|-------------------------------|
| <b>12" Pipe (12.000" I.D.)</b>     |                          |                       |                               | <b>12" O.D. Pipe (11.750" I.D.)</b> |                          |                       |                               | <b>14" O.D. Pipe (13.25" I.D.)</b> |                          |                       |                               |
| 1000                               | 2.84                     | .13                   | .42                           | 1000                                | 2.96                     | .14                   | .46                           | 700                                | 1.63                     | .04                   | .13                           |
| 1100                               | 3.12                     | .15                   | .50                           | 1100                                | 3.25                     | .16                   | .55                           | 800                                | 1.86                     | .05                   | .17                           |
| 1200                               | 3.41                     | .18                   | .58                           | 1200                                | 3.55                     | .20                   | .64                           | 900                                | 2.09                     | .07                   | .21                           |
| 1300                               | 3.69                     | .21                   | .67                           | 1300                                | 3.84                     | .23                   | .74                           | 1000                               | 2.33                     | .08                   | .26                           |
| 1400                               | 3.98                     | .25                   | .77                           | 1400                                | 4.14                     | .27                   | .85                           | 1100                               | 2.56                     | .10                   | .31                           |
| 1500                               | 4.26                     | .28                   | .88                           | 1500                                | 4.44                     | .31                   | .97                           | 1200                               | 2.79                     | .12                   | .36                           |
| 1600                               | 4.55                     | .32                   | .99                           | 1600                                | 4.73                     | .35                   | 1.10                          | 1300                               | 3.02                     | .14                   | .42                           |
| 1800                               | 5.11                     | .41                   | 1.23                          | 1800                                | 5.33                     | .44                   | 1.36                          | 1400                               | 3.26                     | .17                   | .48                           |
| 2000                               | 5.68                     | .50                   | 1.50                          | 2000                                | 5.92                     | .54                   | 1.66                          | 1500                               | 3.49                     | .19                   | .54                           |
| 2200                               | 6.25                     | .61                   | 1.78                          | 2200                                | 6.51                     | .66                   | 1.98                          | 1600                               | 3.72                     | .22                   | .61                           |
| 2400                               | 6.81                     | .72                   | 2.10                          | 2400                                | 7.10                     | .78                   | 2.32                          | 1700                               | 3.95                     | .24                   | .68                           |
| 2600                               | 7.38                     | .85                   | 2.43                          | 2600                                | 7.69                     | .92                   | 2.69                          | 1800                               | 4.19                     | .27                   | .76                           |
| 2800                               | 7.95                     | .98                   | 2.78                          | 2800                                | 8.28                     | 1.07                  | 3.09                          | 1900                               | 4.42                     | .30                   | .84                           |
| 3000                               | 8.52                     | 1.13                  | 3.17                          | 3000                                | 8.88                     | 1.23                  | 3.51                          | 2000                               | 4.65                     | .34                   | .92                           |
| 3500                               | 9.95                     | 1.54                  | 4.21                          | 3500                                | 10.3                     | 1.6                   | 4.67                          | 2500                               | 5.81                     | .52                   | 1.40                          |
| 4000                               | 11.4                     | 2.0                   | 5.39                          | 4000                                | 11.8                     | 2.2                   | 5.97                          | 3000                               | 6.98                     | .76                   | 1.96                          |
| 4500                               | 12.8                     | 2.5                   | 6.70                          | 4500                                | 13.3                     | 2.7                   | 7.43                          | 3500                               | 8.15                     | 1.03                  | 2.60                          |
| 5000                               | 14.2                     | 3.1                   | 8.15                          | 5000                                | 14.8                     | 3.4                   | 9.03                          | 4000                               | 9.31                     | 1.35                  | 3.32                          |
| 5500                               | 15.6                     | 3.8                   | 9.72                          | 5500                                | 16.3                     | 4.1                   | 10.8                          | 4500                               | 10.5                     | 1.7                   | 4.13                          |
| 6000                               | 17.0                     | 4.5                   | 11.4                          | 6000                                | 17.7                     | 4.9                   | 12.6                          | 5000                               | 11.6                     | 2.1                   | 5.03                          |
| 6500                               | 18.4                     | 5.3                   | 13.2                          | 6500                                | 19.2                     | 5.7                   | 14.7                          | 6000                               | 14.0                     | 3.0                   | 7.05                          |
| 7000                               | 19.9                     | 6.2                   | 15.2                          | 7000                                | 20.7                     | 6.7                   | 16.8                          | 7000                               | 16.3                     | 4.1                   | 9.38                          |
| 7500                               | 21.3                     | 7.1                   | 17.3                          | 7500                                | 22.2                     | 7.7                   | 19.1                          | 8000                               | 18.6                     | 5.4                   | 12.0                          |
| 8000                               | 22.7                     | 8.0                   | 19.4                          | 8000                                | 23.7                     | 8.7                   | 21.5                          | 9000                               | 20.9                     | 6.8                   | 14.9                          |
| 8500                               | 24.2                     | 9.1                   | 21.7                          | 8500                                | 25.1                     | 8.8                   | 24.1                          | 10000                              | 23.3                     | 8.4                   | 18.1                          |
| 9000                               | 25.6                     | 10.2                  | 24.2                          | 9000                                | 26.6                     | 11.0                  | 26.8                          | 11000                              | 25.6                     | 10.2                  | 21.6                          |
| <b>16" O.D. Pipe (15.25" I.D.)</b> |                          |                       |                               | <b>18" O.D. Pipe (17.18" I.D.)</b>  |                          |                       |                               | <b>20" O.D. Pipe (19.18" I.D.)</b> |                          |                       |                               |
| 700                                | 1.23                     | .02                   | .07                           | 700                                 | .97                      | .01                   | .04                           | 1200                               | 1.33                     | .03                   | .06                           |
| 800                                | 1.41                     | .03                   | .09                           | 800                                 | 1.11                     | .02                   | .05                           | 1400                               | 1.55                     | .04                   | .08                           |
| 900                                | 1.58                     | .04                   | .11                           | 900                                 | 1.25                     | .02                   | .06                           | 1600                               | 1.78                     | .05                   | .10                           |
| 1000                               | 1.76                     | .05                   | .13                           | 1000                                | 1.38                     | .03                   | .07                           | 1800                               | 2.00                     | .06                   | .13                           |
| 1200                               | 2.11                     | .07                   | .18                           | 1200                                | 1.66                     | .04                   | .10                           | 2000                               | 2.22                     | .08                   | .15                           |
| 1400                               | 2.46                     | .09                   | .24                           | 1400                                | 1.94                     | .06                   | .13                           | 2500                               | 2.78                     | .12                   | .23                           |
| 1600                               | 2.81                     | .12                   | .31                           | 1600                                | 2.21                     | .08                   | .17                           | 3000                               | 3.33                     | .17                   | .32                           |
| 1800                               | 3.16                     | .16                   | .38                           | 1800                                | 2.49                     | .10                   | .22                           | 3500                               | 3.89                     | .24                   | .43                           |
| 2000                               | 3.51                     | .19                   | .47                           | 2000                                | 2.77                     | .12                   | .26                           | 4000                               | 4.45                     | .31                   | .55                           |
| 2500                               | 4.39                     | .30                   | .70                           | 2500                                | 3.46                     | .19                   | .39                           | 5000                               | 5.55                     | .48                   | .83                           |
| 3000                               | 5.27                     | .43                   | .99                           | 3000                                | 4.15                     | .27                   | .55                           | 6000                               | 6.67                     | .69                   | 1.17                          |
| 3500                               | 6.15                     | .59                   | 1.31                          | 3500                                | 4.85                     | .37                   | .74                           | 7000                               | 7.78                     | .94                   | 1.55                          |
| 4000                               | 7.03                     | .77                   | 1.68                          | 4000                                | 5.54                     | .48                   | .94                           | 8000                               | 8.89                     | 1.2                   | 1.98                          |
| 4500                               | 7.91                     | .97                   | 2.09                          | 4500                                | 6.23                     | .60                   | 1.17                          | 10000                              | 11.1                     | 1.9                   | 3.00                          |
| 5000                               | 8.79                     | 1.2                   | 2.54                          | 5000                                | 6.92                     | .74                   | 1.42                          | 12000                              | 13.3                     | 2.7                   | 4.20                          |
| 6000                               | 10.5                     | 1.7                   | 3.56                          | 6000                                | 8.31                     | 1.1                   | 1.99                          | 14000                              | 15.5                     | 3.7                   | 5.59                          |
| 7000                               | 12.3                     | 2.4                   | 4.73                          | 7000                                | 9.70                     | 1.5                   | 2.65                          | 15000                              | 16.7                     | 4.3                   | 6.35                          |
| 8000                               | 14.1                     | 3.1                   | 6.06                          | 8000                                | 11.1                     | 1.9                   | 3.39                          | 16000                              | 17.8                     | 4.9                   | 7.15                          |
| 9000                               | 15.8                     | 3.9                   | 7.53                          | 9000                                | 12.5                     | 2.4                   | 4.22                          | 18000                              | 20.0                     | 6.2                   | 8.90                          |
| 10000                              | 17.6                     | 4.8                   | 9.15                          | 10000                               | 13.8                     | 3.0                   | 5.12                          | 20000                              | 22.2                     | 7.7                   | 10.80                         |
| 11000                              | 19.3                     | 5.8                   | 10.9                          | 12000                               | 16.6                     | 4.3                   | 7.18                          | 22000                              | 24.4                     | 9.3                   | 12.90                         |
| 12000                              | 21.1                     | 6.9                   | 12.8                          | 14000                               | 19.4                     | 5.8                   | 9.55                          | 24000                              | 26.7                     | 11.1                  | 15.10                         |
| 13000                              | 22.8                     | 8.1                   | 14.9                          | 16000                               | 22.1                     | 7.6                   | 12.2                          | 25000                              | 27.8                     | 12.0                  | 16.30                         |
| 14000                              | 24.6                     | 9.4                   | 17.1                          | 18000                               | 24.9                     | 9.6                   | 15.2                          | 26000                              | 28.9                     | 13.0                  | 17.60                         |
| 15000                              | 26.3                     | 10.7                  | 19.2                          | 20000                               | 27.7                     | 11.9                  | 18.5                          | 28000                              | 31.1                     | 15.0                  | 20.10                         |
| 16000                              | 28.1                     | 12.3                  | 21.8                          | 22000                               | 30.3                     | 14.3                  | 22.0                          | 30000                              | 33.3                     | 17.2                  | 22.90                         |