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**B.     HYDROLOGIC CALCULATIONS**

**BDS Engineering, Inc.**  
CIVIL ENGINEERS

PROJECT: VILLAGE PLACE APARTMENTS

ENGINEER: Tara Mugane

PROJECT NO.: 14-18

| DATE: <u>APRIL 2018</u> |                |                 |                                  |       |      |
|-------------------------|----------------|-----------------|----------------------------------|-------|------|
| Year Storm              | P <sub>6</sub> | P <sub>24</sub> | P <sub>6</sub> / P <sub>24</sub> | a*    | n*   |
| 1                       | 1.02           | 1.82            | 56.0%                            | 7.59  | 0.65 |
| 2                       | 1.30           | 2.33            | 55.8%                            | 9.67  | 0.65 |
| 10                      | 1.99           | 3.60            | 55.3%                            | 14.81 | 0.65 |
| 50                      | 2.81           | 5.08            | 55.3%                            | 20.91 | 0.65 |
| 100                     | 3.19           | 5.78            | 55.2%                            | 23.73 | 0.65 |

Note: Initial and Travel Times are calculated based on Fig 3-3 and 3-4 of the County Hydrology Manual, \*StormCad Software Variables

| T <sub>c</sub> MINIMUM = |                  |                    |              |               |                         |                         |              |                   |      |       |         |     |        |    | 5 minutes                             |                    |      |      |      |      |          |       |       |        |        |
|--------------------------|------------------|--------------------|--------------|---------------|-------------------------|-------------------------|--------------|-------------------|------|-------|---------|-----|--------|----|---------------------------------------|--------------------|------|------|------|------|----------|-------|-------|--------|--------|
| DRAINAGE<br>AREA NO.     | UPSTREAM<br>NODE | DOWNSTREAM<br>NODE | AREA<br>(SF) | AREA<br>(AC.) | IMPERVIOUS<br>AREA (SF) | LENGTH OF<br>FLOW (FT.) | SLOPE<br>(%) | % IMPER-<br>VIOUS | C    | ΣCA   | Initial |     | Travel |    | ΣT <sub>c</sub> <sup>1</sup><br>(min) | I (per att. chart) |      |      |      |      | ΣQ (CFS) |       |       |        |        |
|                          |                  |                    |              |               |                         |                         |              |                   |      |       | Li      | Ti  | Lt     | Tt |                                       | 1                  | 2    | 10   | 50   | 100  | 1        | 2     | 10    | 50     | 100    |
| PRE - DEVELOPMENT        |                  |                    |              |               |                         |                         |              |                   |      |       |         |     |        |    |                                       |                    |      |      |      |      |          |       |       |        |        |
|                          |                  |                    |              |               |                         |                         |              |                   |      |       |         |     |        |    |                                       |                    |      |      |      |      |          |       |       |        |        |
| EX-1                     | 105              | 104                | 11552        | 0.27          | 9819                    | 150                     | 0.7%         | 85.00%            | 0.81 | 0.21  | 60      | 4.6 |        |    | 5.00                                  | 2.69               | 3.43 | 5.24 | 7.40 | 8.40 | 0.58     | 0.74  | 1.13  | 1.59   | 1.81   |
| EX-1                     | 104              | 103                | 947938       | 21.50         | 545064                  | 1509                    | 0.7%         | 57.50%            | 0.64 | 13.98 |         |     |        |    | 12.20                                 | 1.51               | 1.93 | 2.95 | 4.16 | 4.73 | 21.13    | 26.94 | 41.23 | 58.22  | 66.10  |
| EX-2                     | 103              | 102                | 429843       | 9.87          | 279398                  | 557                     | 0.7%         | 65.00%            | 0.69 | 20.79 |         |     |        |    | 13.30                                 | 1.43               | 1.82 | 2.79 | 3.94 | 4.47 | 29.73    | 37.89 | 58.00 | 81.89  | 92.97  |
| EX-3                     | 102              | 101                | 819729       | 18.82         | 600042                  | 560                     | 0.3%         | 73.20%            | 0.74 | 34.72 |         |     |        |    | 16.17                                 | 1.26               | 1.61 | 2.46 | 3.47 | 3.94 | 43.77    | 55.78 | 85.39 | 120.57 | 136.88 |
| EX-4                     | 101              | 100                | 184841       | 4.24          | 185                     | 641                     | 0.2%         | 0.10%             | 0.30 | 35.99 |         |     |        |    | 21.05                                 | 1.06               | 1.36 | 2.07 | 2.93 | 3.33 | 38.27    | 48.78 | 74.66 | 105.43 | 119.69 |
|                          |                  |                    |              | 54.69         |                         |                         |              |                   |      |       |         |     |        |    |                                       |                    |      |      |      |      |          |       |       |        |        |
| POST - DEVELOPMENT       |                  |                    |              |               |                         |                         |              |                   |      |       |         |     |        |    |                                       |                    |      |      |      |      |          |       |       |        |        |
| EX-1                     | 105              | 104                | 11552        | 0.27          | 9819                    | 150                     | 0.7%         | 85.00%            | 0.81 | 0.21  | 60      | 4.6 |        |    | 5.00                                  | 2.69               | 3.43 | 5.24 | 7.40 | 8.40 | 0.56     | 0.72  | 1.10  | 1.55   | 1.77   |
| EX-1                     | 104              | 103                | 947938       | 21.50         | 545064                  | 1509                    | 0.7%         | 57.50%            | 0.64 | 13.98 |         |     |        |    | 12.20                                 | 1.51               | 1.93 | 2.95 | 4.16 | 4.73 | 21.13    | 26.94 | 41.23 | 58.22  | 66.10  |
| EX-2                     | 103              | 102                | 429843       | 9.87          | 279398                  | 557                     | 0.7%         | 65.00%            | 0.69 | 20.79 |         |     |        |    | 13.30                                 | 1.43               | 1.82 | 2.79 | 3.94 | 4.47 | 29.73    | 37.89 | 58.00 | 81.89  | 92.97  |
| EX-3                     | 102              | 101                | 819729       | 18.82         | 600042                  | 560                     | 0.3%         | 73.20%            | 0.74 | 34.72 |         |     |        |    | 16.17                                 | 1.26               | 1.61 | 2.46 | 3.47 | 3.94 | 43.77    | 55.78 | 85.39 | 120.57 | 136.88 |
| A,B,C,D,E                | 101              | 100                | 184841       | 4.24          | 59630                   | 641                     | 0.2%         | 32.26%            | 0.50 | 36.84 |         |     |        |    | 20.74                                 | 1.07               | 1.37 | 2.09 | 2.96 | 3.36 | 39.55    | 50.41 | 77.16 | 108.96 | 123.69 |
|                          |                  |                    |              | 54.69         |                         |                         |              |                   |      |       |         |     |        |    |                                       |                    |      |      |      |      |          |       |       |        |        |
|                          |                  |                    |              |               |                         |                         |              |                   |      |       |         |     |        |    |                                       |                    |      |      |      |      |          |       |       |        |        |

<sup>1</sup> Junction Analysis based on San Diego County Hydrology Manual Section 3.4.2. Calculations are attached.



## PRE-DEVELOPMENT :

### Q<sub>100</sub> ANALYSIS

Node 105 → 104

$$A = 11,552 \text{ SF} = 0.27 \text{ ACRE}$$

$$\Delta \text{ELEV} = 1429 - 1428 = 1' \quad S = 0.7\%$$

$$L = 150' \Rightarrow L_m = 60' \quad \left( \begin{array}{l} \text{①} \\ \text{BASED ON SD COUNTY HYDROLOGY} \\ \text{MANUAL TABLE 3-2} \end{array} \right)$$

$$T_c = 5 \text{ min (minimum)}$$

$$C = 0.81 \text{ (Gen. Comm.)} \quad \left( \begin{array}{l} \text{②} \\ \text{BASED ON SD COUNTY} \\ \text{HYDROLOGY MANUAL} \\ \text{TABLE 3-1} \end{array} \right)$$

$$I = 8.40 \text{ in/hr} \quad \left( \begin{array}{l} \text{③} \\ \text{BASED ON EXCEL} \\ \text{SPREADSHEET} \end{array} \right)$$

$$Q_{100} = 1.81 \text{ CFS}$$

(BASED ON RATIONAL METHOD)

Node 104 → 103

$$A = 936,386 \text{ SF} = 21.50 \text{ ACRE}$$

$$\Delta \text{ELEV} = 1428 - 1418 = 10' \quad S = 0.7\%$$

$$L = 1,509'$$

$$C_{\text{avg}} \Rightarrow \text{MDR (4.3 DU/A)} \quad 468,960 \text{ SF} \times 0.48 = 225,101$$

$$\text{G. COM} \quad 467,426 \text{ SF} \times 0.81 = 378,615$$

$$603,716 / 936,386 = 0.64 \quad \text{②}$$

$$C_{\text{avg}} = 0.64$$

$$\% \text{ IMP} \quad 468,960 \times 0.30 = 140,688$$

$$467,426 \times 0.85 = 397,312$$

$$538,000 / 936,386 = 57.5\%$$

$$\% \text{ IMP} = 57.5\% \quad \text{②}$$

# STREET FLOW ANALYSIS (104 → 103):

$$Q_{avg} = Q_{104} + g_{avg} \left( \frac{A_{104-103}}{2} \right)$$

1<sup>st</sup> ASSUMPTION:

$$g_{avg} = 3.2 \text{ cfs/acre}$$

$$Q_{avg} = 1.81 + 3.2 \left( \frac{21.50}{2} \right) = 36.21 \text{ cfs}$$

$$V = 3.5 \text{ fps} \quad \text{④} \quad \text{(PER SD COUNTY HYDROLOGY MANUAL FIG. 3-6)}$$

$$T_t = \frac{1509 \text{ LF}}{3.5 \text{ FPS}} \cdot \frac{1}{60} = 7.2 \text{ min}$$

$$T_{103} = 5 + 7.2 \text{ min} = 12.2 \text{ min}$$

$$I = 4.73 \text{ in/hr} \quad \text{③}$$

$$Q = \sum C.A \cdot I$$

$$[(0.27 \times 0.81) + (21.50 \times 0.64)] \cdot 4.73 = 66.1 \text{ cfs}$$

CHECK  $Q_{avg}$

$$Q_{avg} = 1.81 + \frac{(66.1 - 1.81)}{2} = 33.96 \text{ cfs} \neq 36.21 \text{ cfs}$$

2<sup>nd</sup> ASSUMPTION:

$$g_{avg} = 3.0 \text{ cfs/acre}$$

$$Q_{avg} = 1.8 + 3.0 \left( \frac{21.50}{2} \right) = 34.1 \text{ cfs}$$

$$V = 3.5 \text{ fps} \quad \text{④}$$

$$T_t = 7.2 \text{ min} \quad \boxed{T_{103} = 12.2 \text{ min}}$$

$$I = 4.73 \text{ in/hr} \quad \text{③}$$

$$Q = [0.27 \times 0.81] + (21.50 \times 0.64) \cdot 4.73 = 66.1 \text{ cfs}$$

CHECK  $Q_{avg}$

$$Q_{avg} = 1.81 + \frac{(66.1 - 1.81)}{2} = 34.0 \approx 34.1 \text{ OK}$$

$$\boxed{Q_{103} = 66.1 \text{ CFS}}$$

Node 103 → 102

$$A = 429,843 \text{ SF} = 9.87 \text{ ACRE}$$

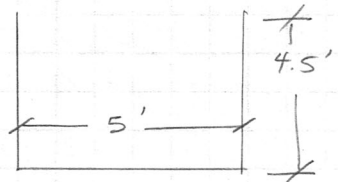
$$\Delta \text{ELEV} = 1418' - 1414' = 4' \quad S = 0.7\%$$

$$L = 557'$$

EXISTING CONCRETE CHANNEL

$$C = 0.69 \quad (2) \quad \text{HDR (24 du/a)}$$

$$\Sigma C.A = 20.79$$



1<sup>st</sup> ASSUMPTION:

$$g_{avg} = 2.5 \text{ cfs/acre}$$

$$Q_{avg} = 66.1 + \frac{2.5(9.87)}{2} = 78.4 \text{ cfs}$$

$$n = 0.016 \quad (\text{fair condition})$$

$$V = 8.17 \text{ fps} \quad (5) \quad (\text{PER HYDRAFLOW EXPRESS SOFTWARE})$$

$$T_L = \frac{557'}{8.17} \cdot \frac{1}{60} = 1.1 \text{ min}$$

$$T_C = 12.2 + 1.1 = 13.3 \text{ min}$$

$$I = 4.47 \text{ in/hr} \quad (3)$$

$$Q = \Sigma C.A \times I = 20.79 \times 4.47 = 92.9 \text{ cfs}$$

CHECK  $Q_{avg}$

$$Q_{avg} = 66.1 + \frac{(92.9 - 66.1)}{2} = 79.5 \text{ cfs} \neq 78.4 \text{ cfs}$$

2<sup>nd</sup> ASSUMPTION:

$$g_{avg} = 2.7 \text{ cfs/acre}$$

$$Q_{avg} = 66.1 + \frac{2.7(9.87)}{2} = 79.4 \text{ cfs}$$

$$V = 8.19 \text{ fps} \quad (5)$$

$$T_L = \frac{557'}{8.17} \cdot \frac{1}{60} = 1.1 \text{ min} \quad T_C = 13.3 \text{ min}$$

$$I = 4.47 \text{ in/hr} \quad (3)$$

$$Q = 20.79 \times 4.47 = 92.9 \text{ cfs}$$

CHECK  $Q_{AVG}$

$$Q_{AVG} = 66.1 + \frac{(92.9 - 66.1)}{2} = 79.5 \text{ cfs} = 79.4 \text{ cfs} \quad \underline{OK}$$

$$Q_{102} = 92.9 \text{ cfs}$$

$$T_{C102} = 13.3 \text{ min}$$

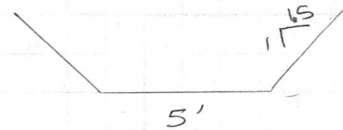
Node 102 → 101

$$A = 819,729 \text{ SF} = 18.82 \text{ ACRE}$$

$$\Delta \text{ELEV} = 144 - 142.30 = 1.7, \quad S = 0.3\%$$

$$L = 560'$$

EXISTING NATURAL CHANNEL  
BASED ON R.S. # 2380  
SHT 10 OF 13



$n = 0.04$  (6) (BASED ON SAN DIEGO COUNTY DRAINAGE  
DESIGN MANUAL, TABLE A-5)

|             |                                               | % IMP        |
|-------------|-----------------------------------------------|--------------|
| $C_{avg} =$ | G. Com $526,256 \times 0.81 = 426,267$        | 85%          |
|             | HDR (24 in/a) $235,173 \times 0.69 = 162,269$ | 65%          |
|             | NATURAL $58,300 \times 0.30 = 17,490$         | 0%           |
|             | <u><math>606,026 / 819,729</math></u>         | <u>73.2%</u> |
|             | $C_{avg} = 0.74$                              |              |

$$\Sigma C \cdot A = 34.72$$

1<sup>st</sup> ASSUMPTION

$$q_{avg} = 2.0 \text{ cfs/acre}$$

$$Q_{AVG} = 92.9 + 2 \left( \frac{18.82}{2} \right) = 111.72 \text{ cfs}$$

$$V = 3.22 \text{ fps (5)}$$

$$T_t = \frac{560'}{3.22} \cdot \frac{1}{60} = 2.90 \text{ min}$$

$$T_c = 13.3 + 2.90 = 16.2 \text{ min}$$

$$I = 3.94 \text{ (3)}$$

$$Q = 34.72 \cdot 3.94 = 136.80 \text{ cfs}$$

CHECK  $Q_{AVG}$

$$Q_{AVG} = 92.9 + \left( \frac{136.80 - 92.9}{2} \right) = 114.85 \text{ cfs} \neq 111.72 \text{ cfs}$$



## 2ND ASSUMPTION

$$q_{avg} = 2.3 \text{ cfs/acre}$$

$$Q_{avg} = 92.9 + \frac{2.3(18.82)}{2} = 114.54 \text{ cfs}$$

$$V = 3.25 \text{ fps } \boxed{5}$$

$$T_t = \frac{560}{3.25} \cdot \frac{1}{60} = 2.87 \text{ min}$$

$$T_c = 13.3 + 2.87 = 16.17 \text{ min}$$

$$I = 3.94 \text{ in/hr } \boxed{3}$$

$$Q = 34.72 \times 3.94 = 136.80 \text{ cfs}$$

Check  $Q_{avg}$

$$Q_{avg} = 92.9 + \frac{(136.80 - 92.9)}{2} = 114.85 \approx 114.54$$

$$Q_{101} = 136.80 \text{ cfs} \quad T_c = 16.17 \text{ min}$$

Node 101  $\rightarrow$  100

$$A = 184,841 \text{ sf} = 4.24 \text{ acre}$$

$$L = 641' \quad S = 0.2\%$$

$C_{avg} \Rightarrow$

$$\text{NATURAL} \quad 183,872 \times 0.3$$

$$\text{ROOF} \quad \frac{969 \times 0.9}{56034/184,841}$$

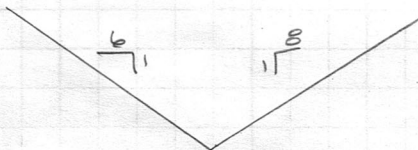
$$C_{avg} = 0.30$$

$$\frac{\% \text{ IMP}}{0}$$

$$\frac{0.1}{0.1\%}$$

$$0.1\%$$

$$\Sigma CA = 35.99$$



$$n = 0.04 \quad (\boxed{6})$$

1st ASSUMPTION

$$g_{avg} = 4.0 \text{ cfs/acre}$$

$$Q_{avg} = 136.80 + 4 \left( \frac{4.24}{2} \right) = 145.28 \text{ cfs}$$

$$V = 2.19 \text{ fps} \quad (5)$$

$$T_t = \frac{641}{2.19} \cdot \frac{1}{60} = 4.88 \text{ min}$$

$$T_c = 16.17 + 4.88 = 21.05 \text{ min}$$

$$I = 3.33 \text{ in/hr} \quad (3)$$

$$Q = 35.99 \times 3.33 = 119.8 \text{ cfs}$$

Check  $Q_{avg}$

$$Q_{avg} = 136.80 + \left( \frac{136.80 - 119.8}{2} \right) = 145.30 \text{ cfs} = 145.28 \text{ cfs}$$

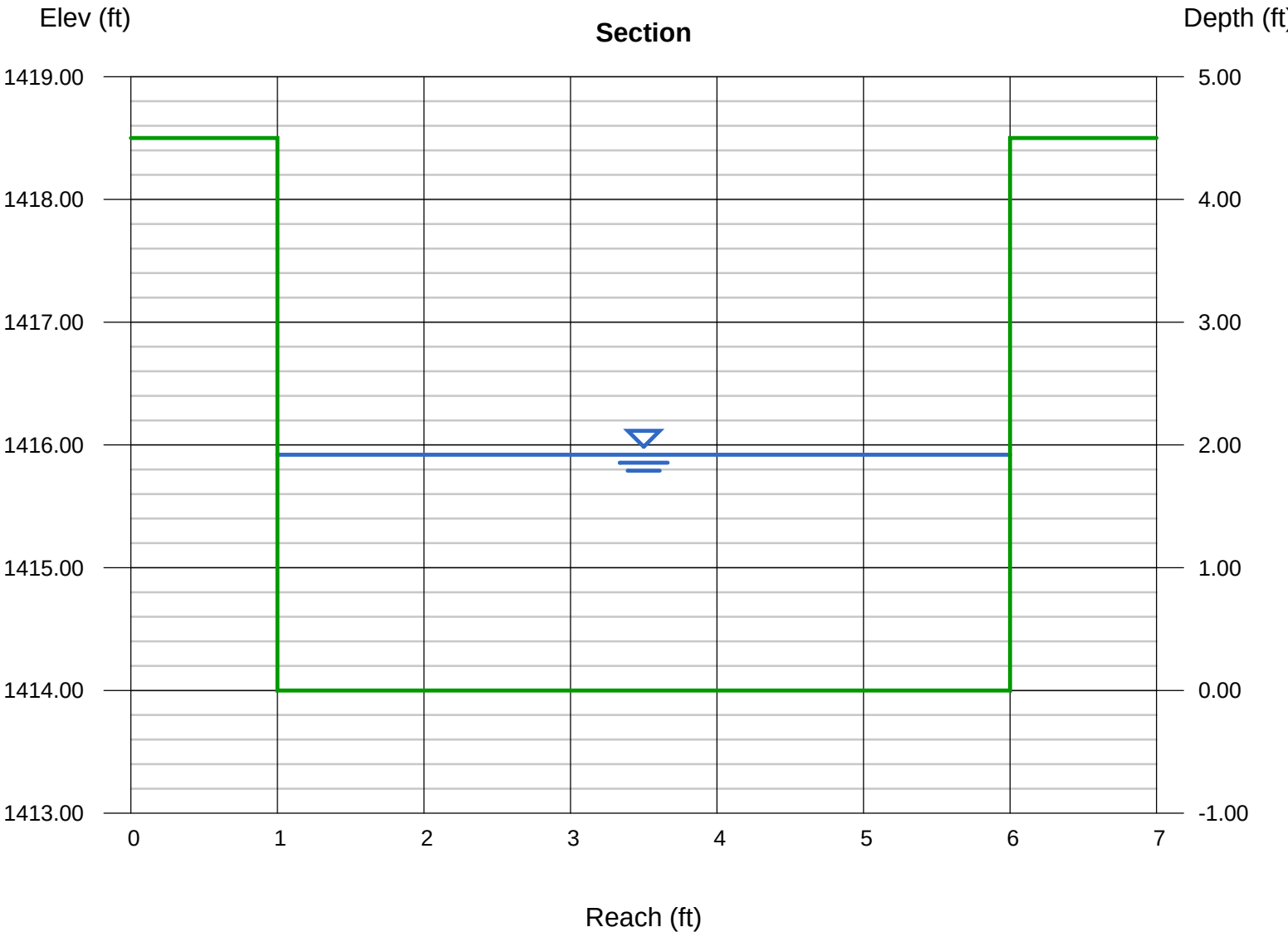
OK

$$Q_{100} = 119.8 \text{ cfs}, T_c = 21.05 \text{ min}, V = 2.1 \text{ fps}$$

# Channel Report

## NODE 103 --> 102 EXIST CONC CHANNEL (1ST ASSUMPTION)

|                     |           |                     |         |
|---------------------|-----------|---------------------|---------|
| <b>Rectangular</b>  |           | <b>Highlighted</b>  |         |
| Bottom Width (ft)   | = 5.00    | Depth (ft)          | = 1.92  |
| Total Depth (ft)    | = 4.50    | Q (cfs)             | = 78.40 |
|                     |           | Area (sqft)         | = 9.60  |
| Invert Elev (ft)    | = 1414.00 | Velocity (ft/s)     | = 8.17  |
| Slope (%)           | = 0.70    | Wetted Perim (ft)   | = 8.84  |
| N-Value             | = 0.016   | Crit Depth, Yc (ft) | = 1.97  |
|                     |           | Top Width (ft)      | = 5.00  |
|                     |           | EGL (ft)            | = 2.96  |
| <b>Calculations</b> |           |                     |         |
| Compute by:         | Known Q   |                     |         |
| Known Q (cfs)       | = 78.40   |                     |         |

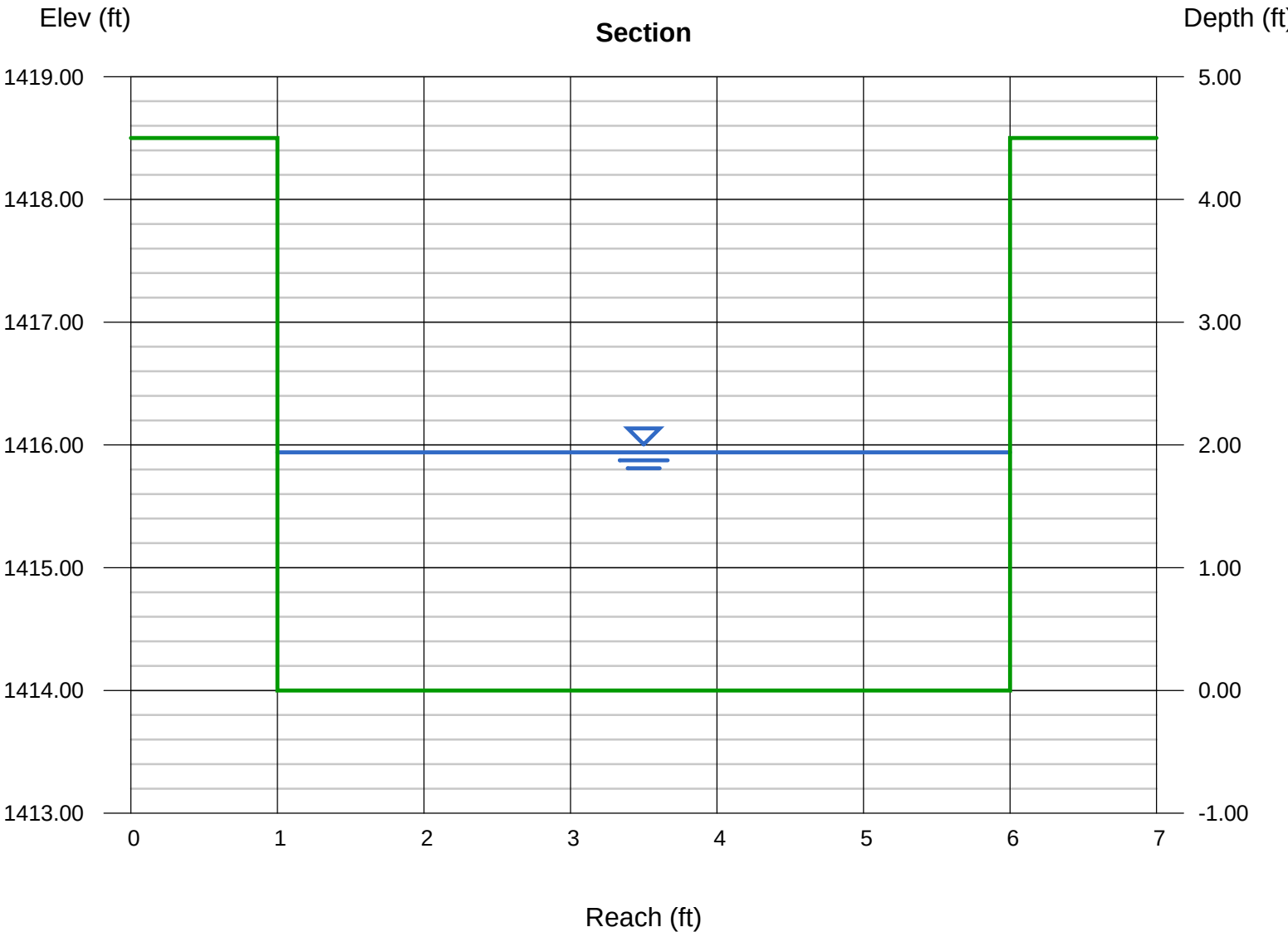




# Channel Report

## NODE 103 --> 102 EXIST CONC CHANNEL (2ND ASSUMPTION)

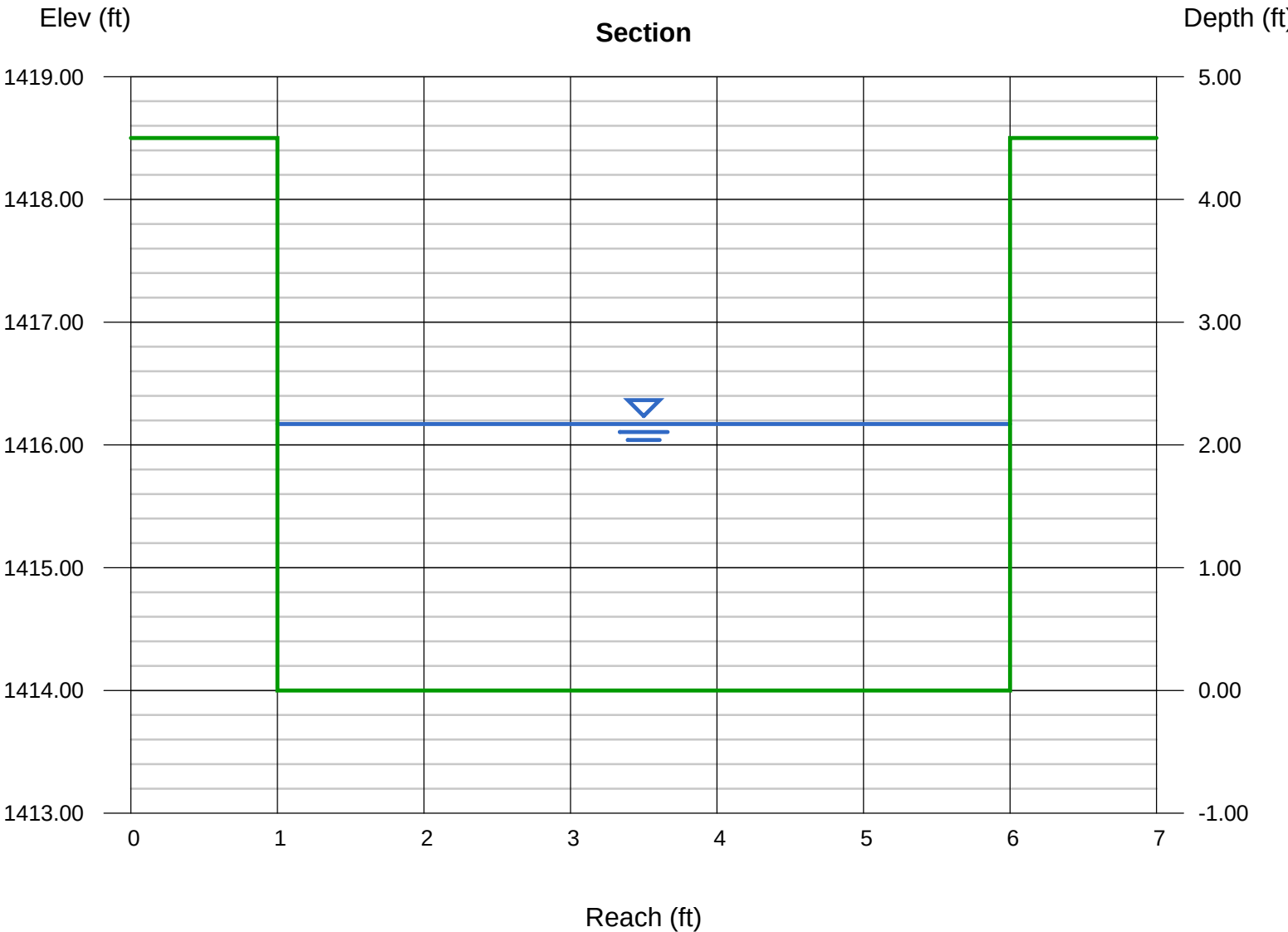
|                     |           |                     |         |
|---------------------|-----------|---------------------|---------|
| <b>Rectangular</b>  |           | <b>Highlighted</b>  |         |
| Bottom Width (ft)   | = 5.00    | Depth (ft)          | = 1.94  |
| Total Depth (ft)    | = 4.50    | Q (cfs)             | = 79.40 |
|                     |           | Area (sqft)         | = 9.70  |
| Invert Elev (ft)    | = 1414.00 | Velocity (ft/s)     | = 8.19  |
| Slope (%)           | = 0.70    | Wetted Perim (ft)   | = 8.88  |
| N-Value             | = 0.016   | Crit Depth, Yc (ft) | = 1.99  |
|                     |           | Top Width (ft)      | = 5.00  |
|                     |           | EGL (ft)            | = 2.98  |
| <b>Calculations</b> |           |                     |         |
| Compute by:         | Known Q   |                     |         |
| Known Q (cfs)       | = 79.40   |                     |         |



# Channel Report

## NODE 103 --> 102 EXIST CONC CHANNEL (FINAL)

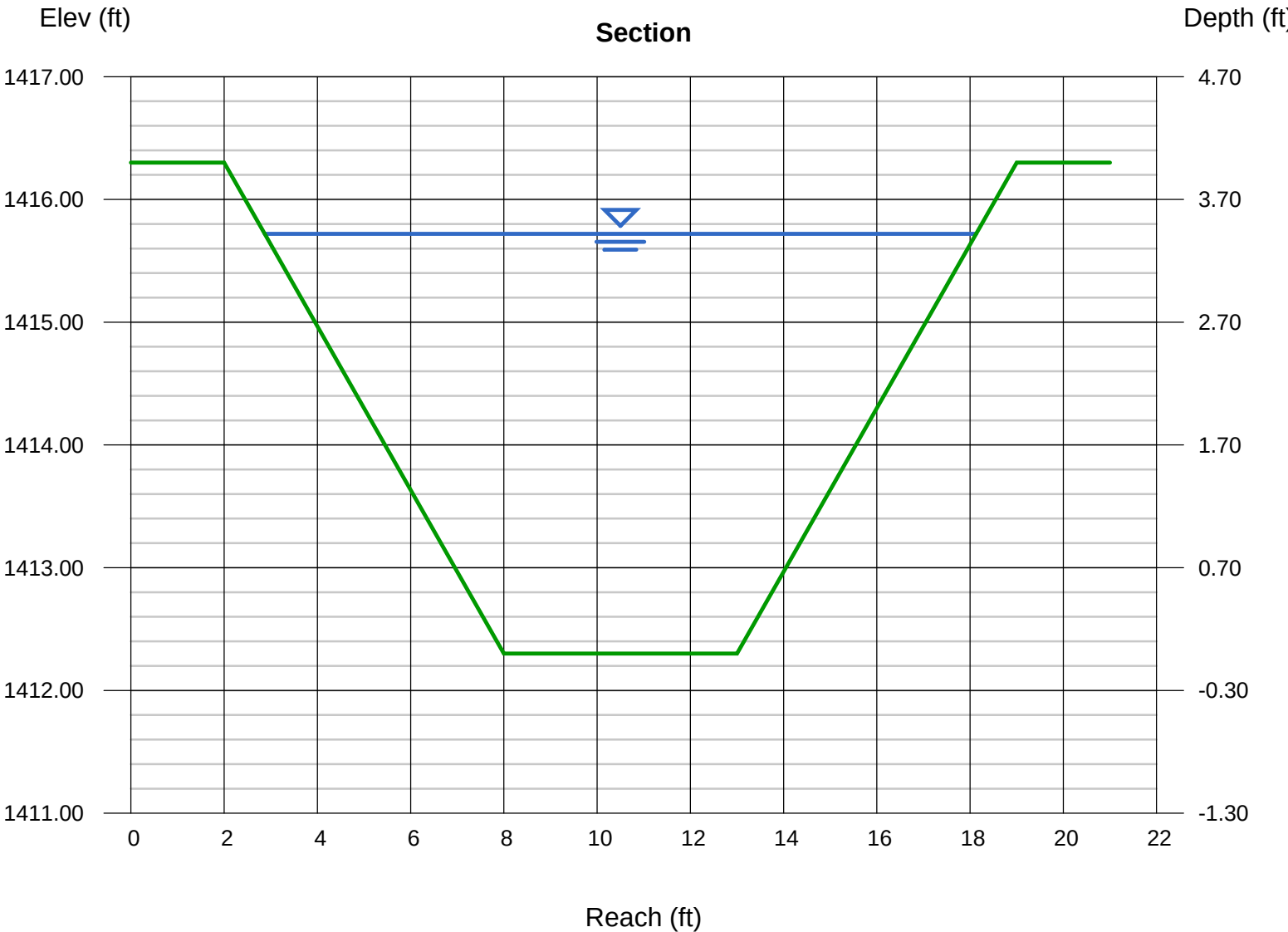
|                     |           |                     |         |
|---------------------|-----------|---------------------|---------|
| <b>Rectangular</b>  |           | <b>Highlighted</b>  |         |
| Bottom Width (ft)   | = 5.00    | Depth (ft)          | = 2.17  |
| Total Depth (ft)    | = 4.50    | Q (cfs)             | = 92.90 |
|                     |           | Area (sqft)         | = 10.85 |
| Invert Elev (ft)    | = 1414.00 | Velocity (ft/s)     | = 8.56  |
| Slope (%)           | = 0.70    | Wetted Perim (ft)   | = 9.34  |
| N-Value             | = 0.016   | Crit Depth, Yc (ft) | = 2.21  |
|                     |           | Top Width (ft)      | = 5.00  |
|                     |           | EGL (ft)            | = 3.31  |
| <b>Calculations</b> |           |                     |         |
| Compute by:         | Known Q   |                     |         |
| Known Q (cfs)       | = 92.90   |                     |         |



# Channel Report

## NODE 102 --> 101 EXIST NATURAL CHANNEL (1ST ASSUMPTION)

|                     |              |                     |          |
|---------------------|--------------|---------------------|----------|
| <b>Trapezoidal</b>  |              | <b>Highlighted</b>  |          |
| Bottom Width (ft)   | = 5.00       | Depth (ft)          | = 3.42   |
| Side Slopes (z:1)   | = 1.50, 1.50 | Q (cfs)             | = 111.72 |
| Total Depth (ft)    | = 4.00       | Area (sqft)         | = 34.64  |
| Invert Elev (ft)    | = 1412.30    | Velocity (ft/s)     | = 3.22   |
| Slope (%)           | = 0.30       | Wetted Perim (ft)   | = 17.33  |
| N-Value             | = 0.040      | Crit Depth, Yc (ft) | = 2.03   |
| <b>Calculations</b> |              | Top Width (ft)      | = 15.26  |
| Compute by:         |              | EGL (ft)            | = 3.58   |
| Known Q (cfs)       |              |                     |          |
| = 111.72            |              |                     |          |



# Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc.

Sunday, Apr 1 2018

## NODE 102 --> 101 EXIST NATURAL CHANNEL (2ND ASSUMPTION)

### Trapezoidal

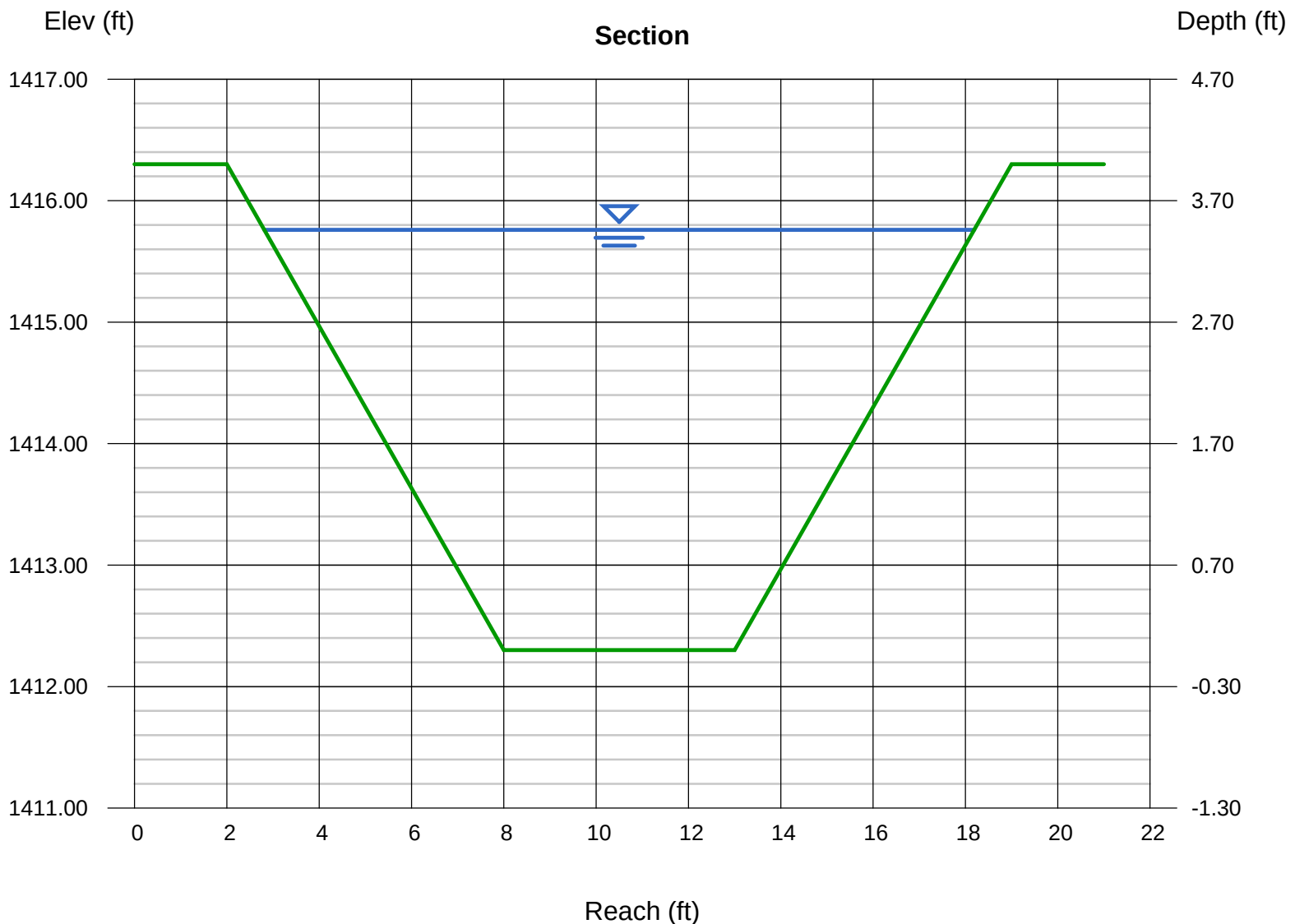
Bottom Width (ft) = 5.00  
Side Slopes (z:1) = 1.50, 1.50  
Total Depth (ft) = 4.00  
Invert Elev (ft) = 1412.30  
Slope (%) = 0.30  
N-Value = 0.040

### Highlighted

Depth (ft) = 3.46  
Q (cfs) = 114.54  
Area (sqft) = 35.26  
Velocity (ft/s) = 3.25  
Wetted Perim (ft) = 17.48  
Crit Depth, Yc (ft) = 2.06  
Top Width (ft) = 15.38  
EGL (ft) = 3.62

### Calculations

Compute by: Known Q  
Known Q (cfs) = 114.54



# Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc.

Sunday, Apr 1 2018

## NODE 102 --> 101 EXIST NATURAL CHANNEL FINAL)

### Trapezoidal

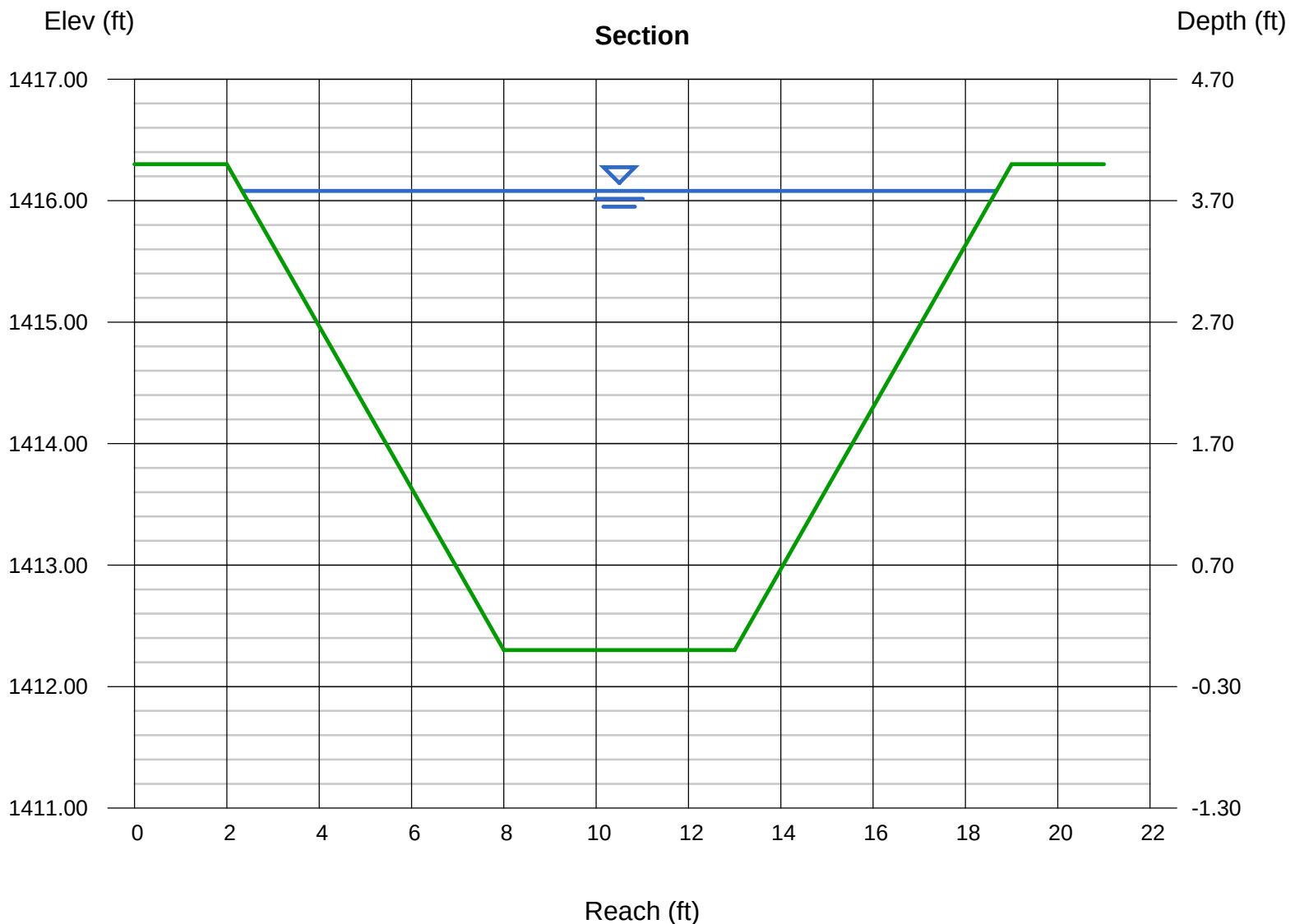
Bottom Width (ft) = 5.00  
Side Slopes (z:1) = 1.50, 1.50  
Total Depth (ft) = 4.00  
Invert Elev (ft) = 1412.30  
Slope (%) = 0.30  
N-Value = 0.040

### Calculations

Compute by: Known Q  
Known Q (cfs) = 136.80

### Highlighted

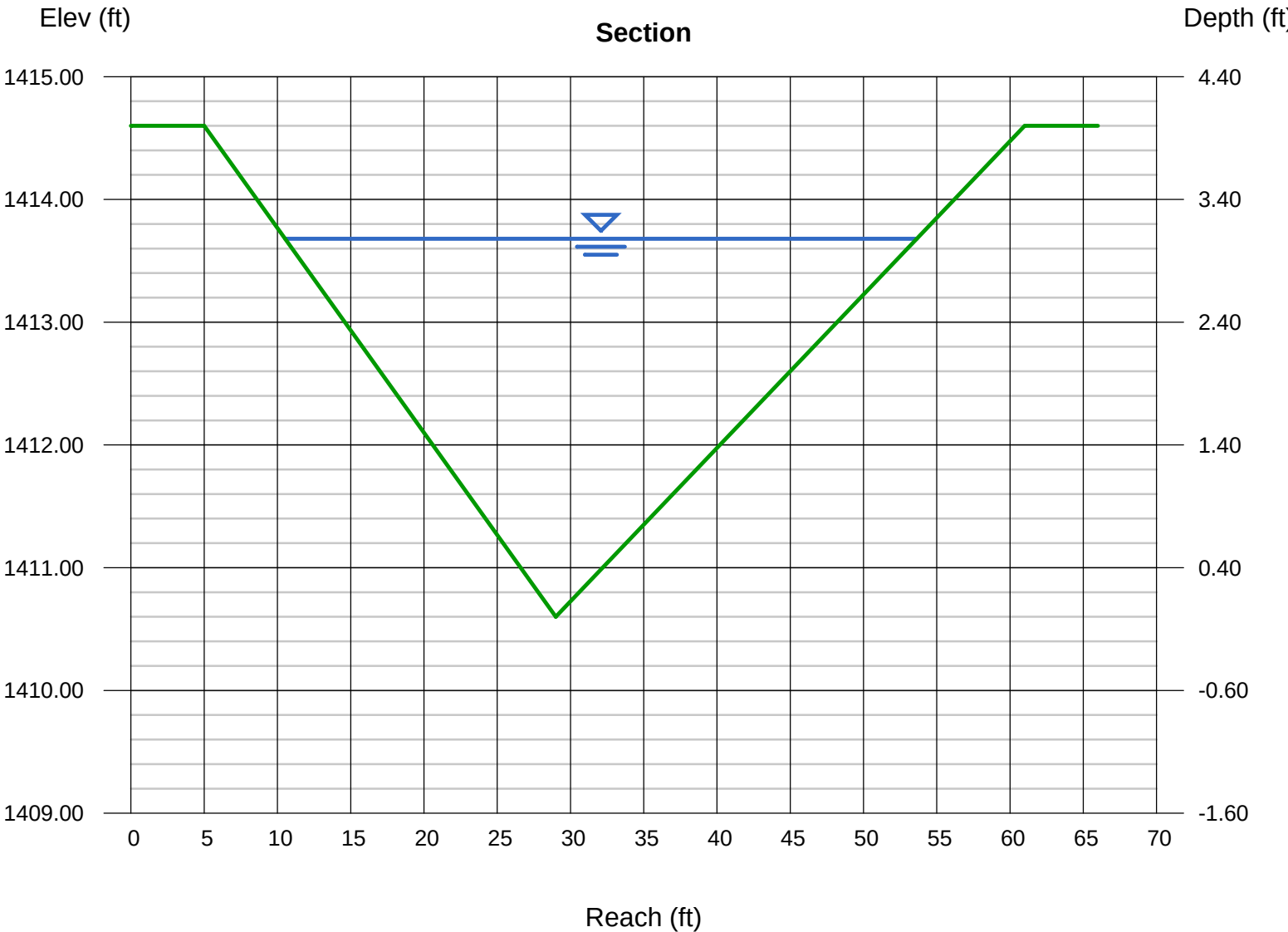
Depth (ft) = 3.78  
Q (cfs) = 136.80  
Area (sqft) = 40.33  
Velocity (ft/s) = 3.39  
Wetted Perim (ft) = 18.63  
Crit Depth, Yc (ft) = 2.27  
Top Width (ft) = 16.34  
EGL (ft) = 3.96



# Channel Report

## NODE 101 --> 100 EXIST NATURAL CHANNEL (1ST ASSUMPTION)

|                     |              |                     |          |
|---------------------|--------------|---------------------|----------|
| <b>Triangular</b>   |              | <b>Highlighted</b>  |          |
| Side Slopes (z:1)   | = 6.00, 8.00 | Depth (ft)          | = 3.08   |
| Total Depth (ft)    | = 4.00       | Q (cfs)             | = 145.28 |
|                     |              | Area (sqft)         | = 66.40  |
| Invert Elev (ft)    | = 1410.60    | Velocity (ft/s)     | = 2.19   |
| Slope (%)           | = 0.20       | Wetted Perim (ft)   | = 43.57  |
| N-Value             | = 0.040      | Crit Depth, Yc (ft) | = 1.94   |
|                     |              | Top Width (ft)      | = 43.12  |
|                     |              | EGL (ft)            | = 3.15   |
| <b>Calculations</b> |              |                     |          |
| Compute by:         | Known Q      |                     |          |
| Known Q (cfs)       | = 145.28     |                     |          |

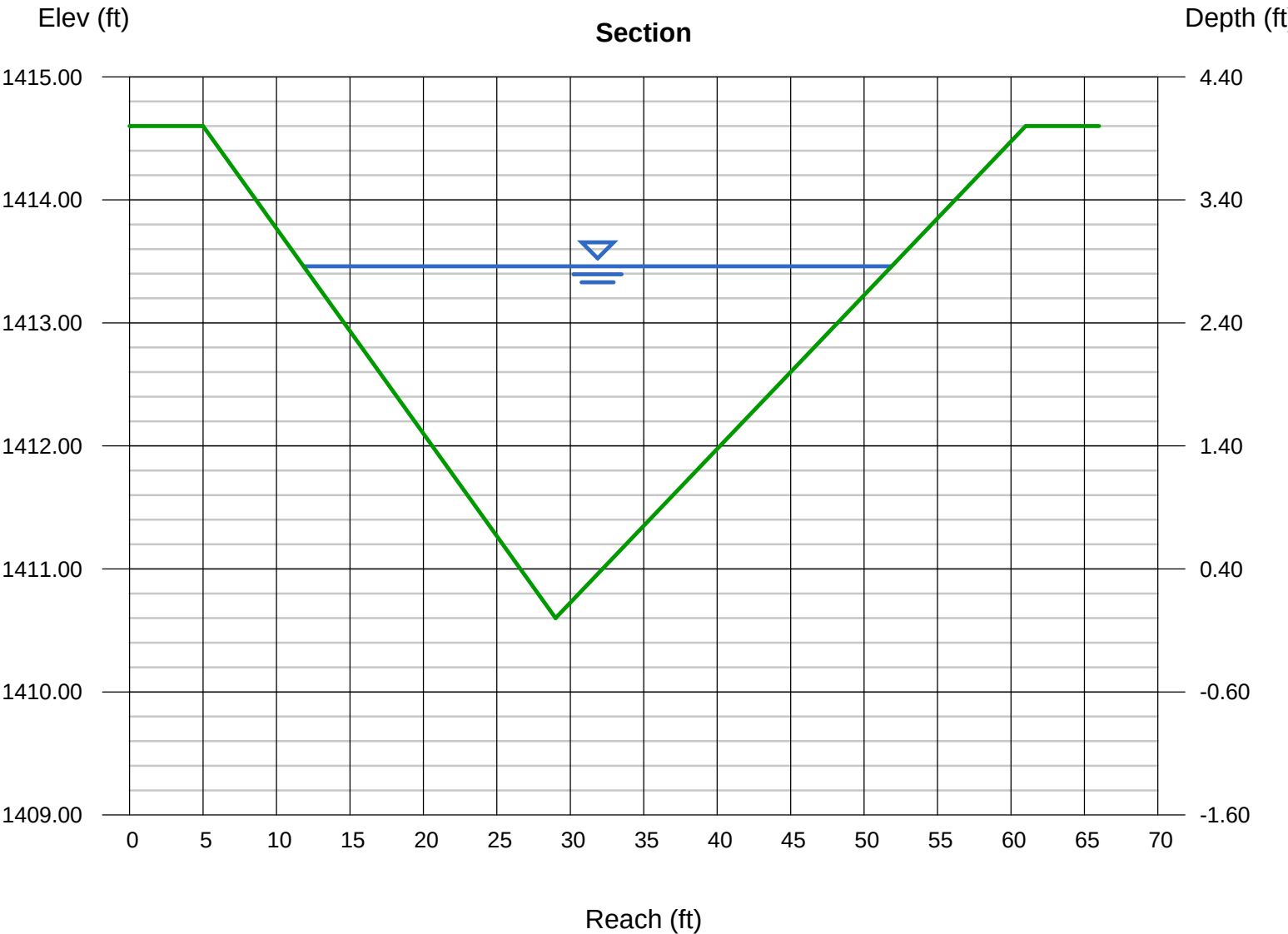




# Channel Report

## NODE 101 --> 100 EXIST NATURAL CHANNEL (FINAL)

|                     |              |                     |          |
|---------------------|--------------|---------------------|----------|
| <b>Triangular</b>   |              | <b>Highlighted</b>  |          |
| Side Slopes (z:1)   | = 6.00, 8.00 | Depth (ft)          | = 2.86   |
| Total Depth (ft)    | = 4.00       | Q (cfs)             | = 119.80 |
|                     |              | Area (sqft)         | = 57.26  |
| Invert Elev (ft)    | = 1410.60    | Velocity (ft/s)     | = 2.09   |
| Slope (%)           | = 0.20       | Wetted Perim (ft)   | = 40.45  |
| N-Value             | = 0.040      | Crit Depth, Yc (ft) | = 1.79   |
|                     |              | Top Width (ft)      | = 40.04  |
|                     |              | EGL (ft)            | = 2.93   |
| <b>Calculations</b> |              |                     |          |
| Compute by:         | Known Q      |                     |          |
| Known Q (cfs)       | = 119.80     |                     |          |



## POST-DEVELOPMENT

Node 105  $\rightarrow$  101

SAME AS PRE-DEVELOPMENT

$$Q_{101}(100\text{yr}) = 136.80 \text{ cfs} \quad T_c = 16.17 \text{ min}$$

Node 101  $\rightarrow$  100

$$A = 184,841 \text{ SF} = 4.24 \text{ ACRE}$$

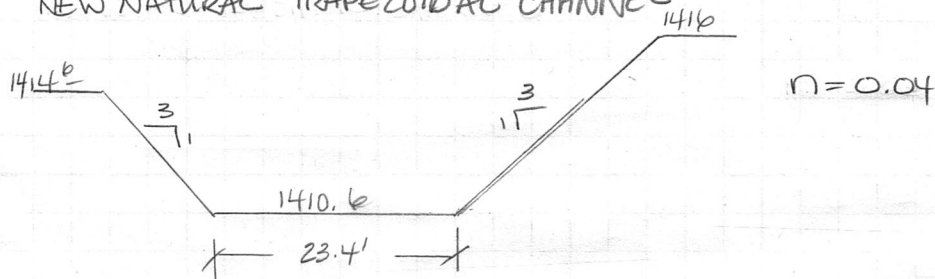
$$C_{avg} = 0.50 \quad (\text{PER DMA SUMMARY (A,B,C,D,E) TABLE})$$

$$L = 641 \text{ LF}$$

$$S = 0.2\%$$

$$\Sigma C \cdot A = 34.72 + (4.24)(0.50) = 36.84$$

NEW NATURAL TRAPEZOIDAL CHANNEL



### 1ST ASSUMPTION

$$q_{avg} = 3.5 \text{ cfs/acre}$$

$$Q_{AVG} = 136.80 + \frac{3.5(4.24)}{2} = 144.22 \text{ cfs}$$

$$V = 2.34 \text{ fps} \quad (5)$$

$$T_t = \frac{641}{2.34} \cdot \frac{1}{60} = 4.57$$

$$T_c = 16.17 + 4.57 = 20.74 \text{ min}$$

$$I = 3.36 \text{ in/hr} \quad (3)$$

$$Q = (\Sigma C \cdot A) I = 36.84 \times 3.36 = 123.78 \text{ cfs}$$

Check  $Q_{AVG}$

$$Q_{AVG} = 136.80 + \frac{(136.80 - 123.78)}{2} = 143.31 \text{ cfs} \neq 144.22 \text{ cfs}$$

2ND ASSUMPTION

$$q_{avg} = 3.1 \text{ cfs/acre}$$

$$Q_{avg} = 136.80 + \frac{3.1(4.24)}{2} = 143.37 \text{ cfs}$$

$$V = 2.34 \text{ fps} \quad (5)$$

$$T_t = \frac{641}{2.34} \cdot \frac{1}{60} = 4.57 \text{ min}$$

$$T_c = 16.17 + 4.57 = 20.74$$

$$I = 3.36 \text{ in/hr} \quad (3)$$

$$Q = 36.84 \times 3.36 = 123.78 \text{ cfs}$$

Check  $Q_{avg}$

$$Q_{avg} = 136.80 + \frac{(136.80 - 123.78)}{2} = 143.31 \approx 143.37 \text{ cfs}$$

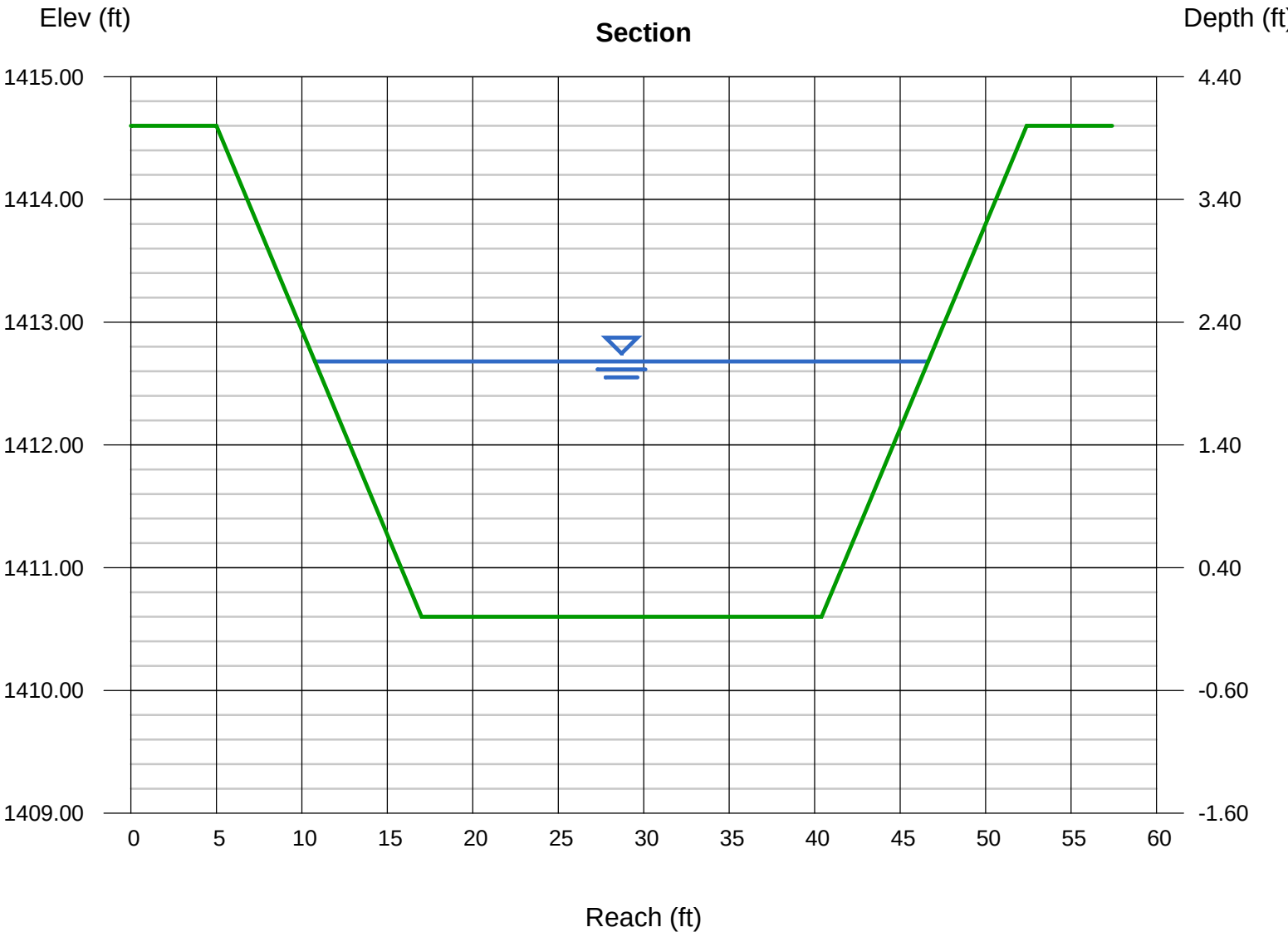
OK

$Q_{100} = 123.78 \text{ cfs}, T_c = 20.74, V = 2.2 \text{ fps}$

# Channel Report

## NODE 101 --> 100 NEW NATURAL CHANNEL (1ST ASSUMPTION)

|                     |              |                     |          |
|---------------------|--------------|---------------------|----------|
| <b>Trapezoidal</b>  |              | <b>Highlighted</b>  |          |
| Bottom Width (ft)   | = 23.40      | Depth (ft)          | = 2.08   |
| Side Slopes (z:1)   | = 3.00, 3.00 | Q (cfs)             | = 144.22 |
| Total Depth (ft)    | = 4.00       | Area (sqft)         | = 61.65  |
| Invert Elev (ft)    | = 1410.60    | Velocity (ft/s)     | = 2.34   |
| Slope (%)           | = 0.20       | Wetted Perim (ft)   | = 36.56  |
| N-Value             | = 0.040      | Crit Depth, Yc (ft) | = 1.02   |
| <b>Calculations</b> |              | Top Width (ft)      | = 35.88  |
| Compute by:         | Known Q      | EGL (ft)            | = 2.17   |
| Known Q (cfs)       | = 144.22     |                     |          |



# Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc.

Sunday, Apr 1 2018

## NODE 101 --> 100 NEW NATURAL CHANNEL (2ND ASSUMPTION)

### Trapezoidal

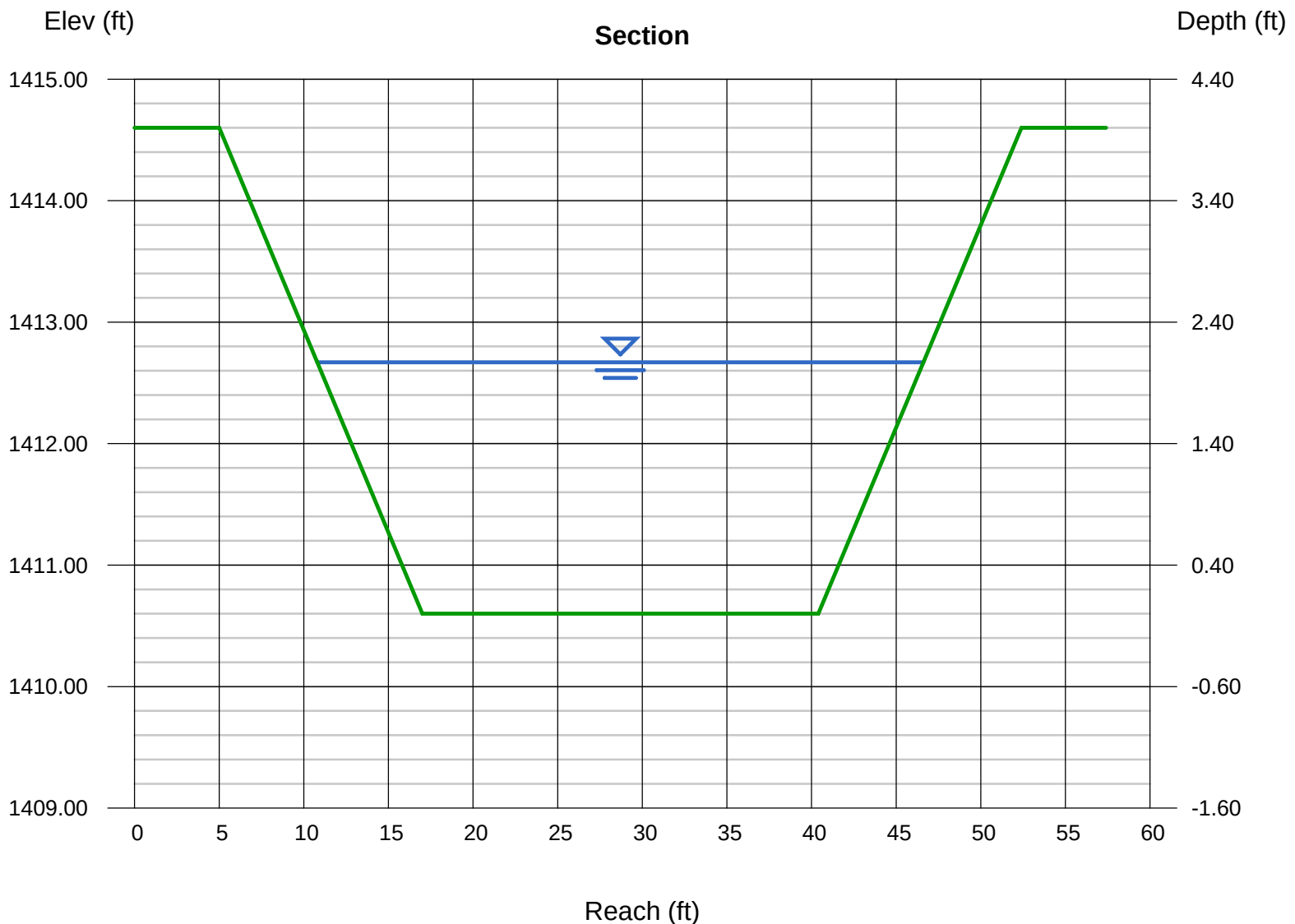
Bottom Width (ft) = 23.40  
Side Slopes (z:1) = 3.00, 3.00  
Total Depth (ft) = 4.00  
Invert Elev (ft) = 1410.60  
Slope (%) = 0.20  
N-Value = 0.040

### Highlighted

Depth (ft) = 2.07  
Q (cfs) = 143.37  
Area (sqft) = 61.29  
Velocity (ft/s) = 2.34  
Wetted Perim (ft) = 36.49  
Crit Depth, Yc (ft) = 1.01  
Top Width (ft) = 35.82  
EGL (ft) = 2.16

### Calculations

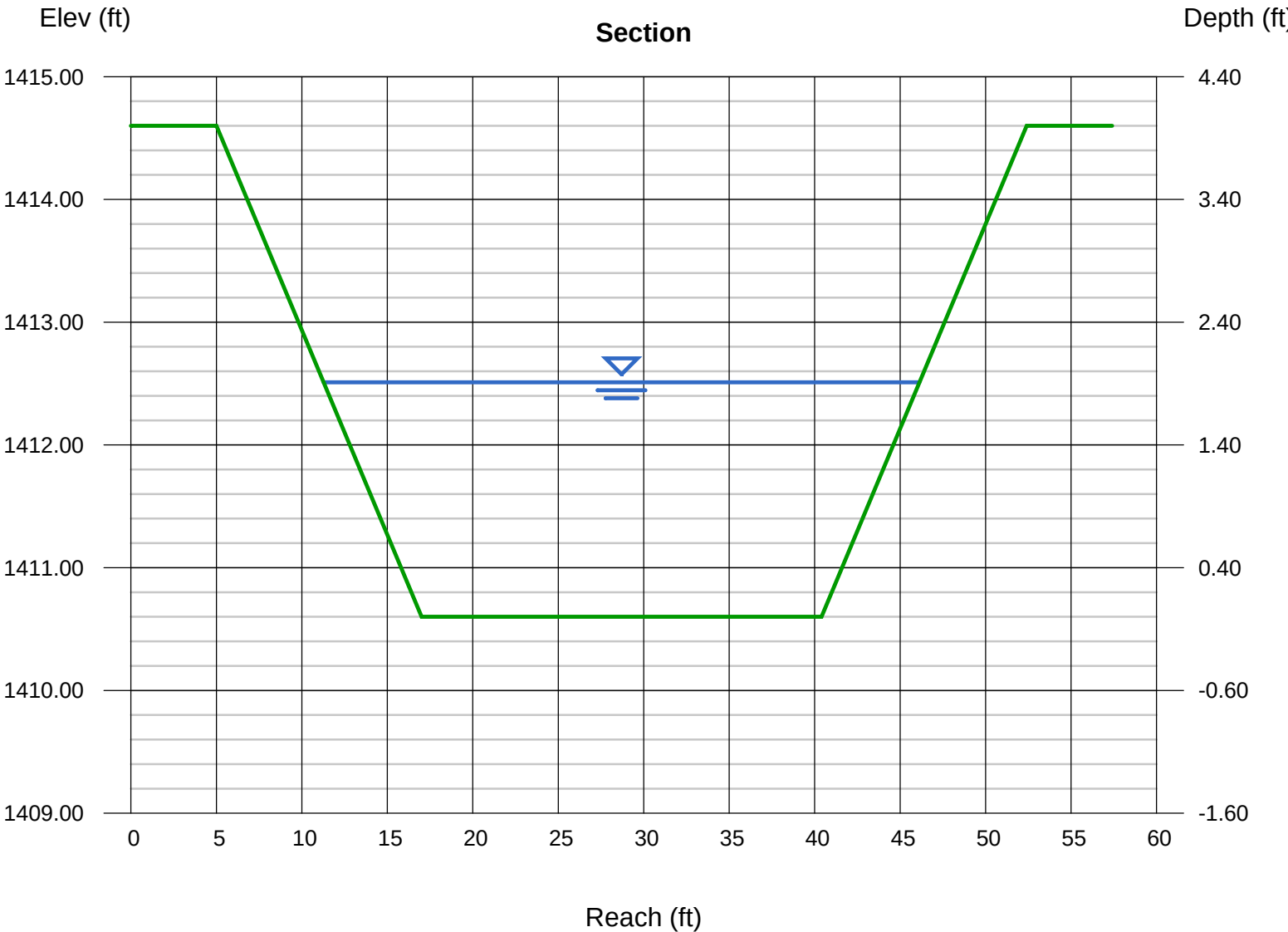
Compute by: Known Q  
Known Q (cfs) = 143.37



# Channel Report

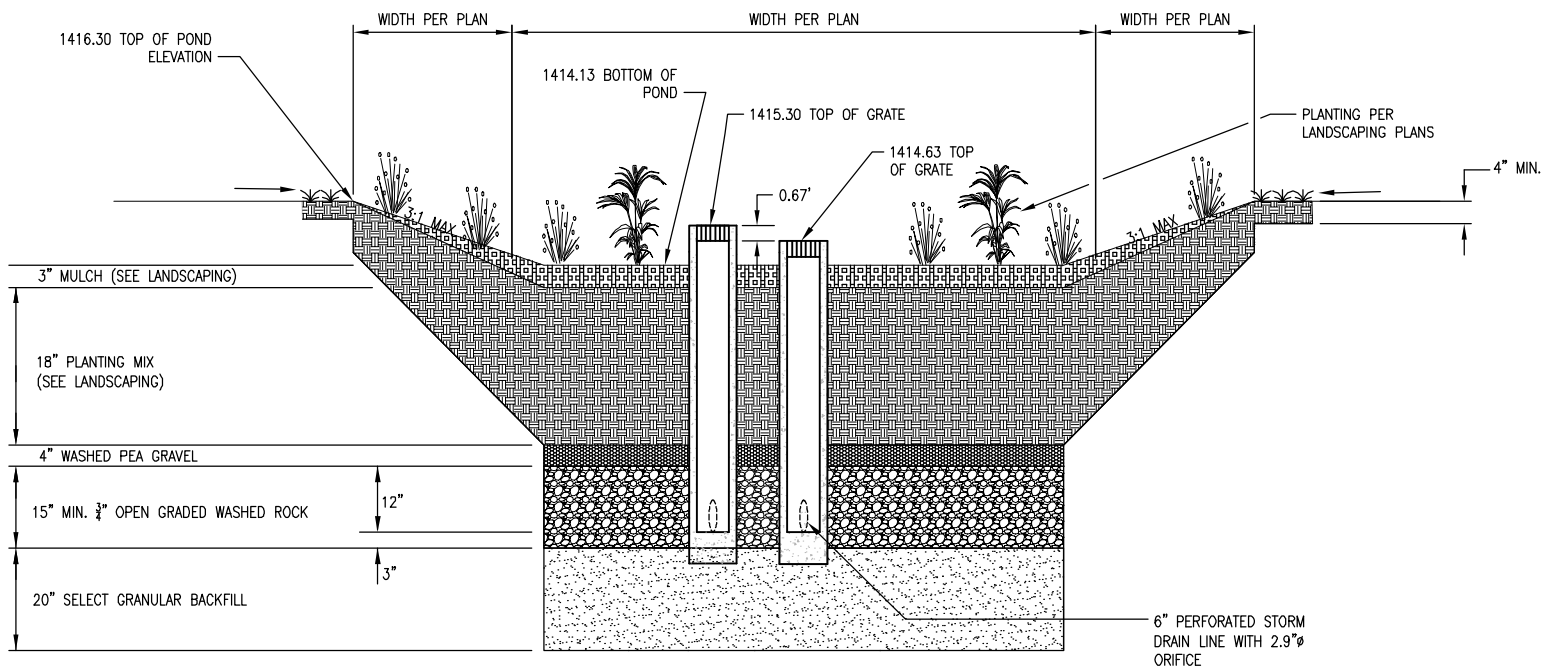
## NODE 101 --> 100 NEW NATURAL CHANNEL (FINAL)

|                     |              |                     |          |
|---------------------|--------------|---------------------|----------|
| <b>Trapezoidal</b>  |              | <b>Highlighted</b>  |          |
| Bottom Width (ft)   | = 23.40      | Depth (ft)          | = 1.91   |
| Side Slopes (z:1)   | = 3.00, 3.00 | Q (cfs)             | = 123.78 |
| Total Depth (ft)    | = 4.00       | Area (sqft)         | = 55.64  |
| Invert Elev (ft)    | = 1410.60    | Velocity (ft/s)     | = 2.22   |
| Slope (%)           | = 0.20       | Wetted Perim (ft)   | = 35.48  |
| N-Value             | = 0.040      | Crit Depth, Yc (ft) | = 0.92   |
| <b>Calculations</b> |              | Top Width (ft)      | = 34.86  |
| Compute by:         | Known Q      | EGL (ft)            | = 1.99   |
| Known Q (cfs)       | = 123.78     |                     |          |



POST DEVELOPMENT DRAINAGE AREAS A,B,C,D,E SUMMARY

| DESCRIPTION        | A1  | A2   | A3   | A4   | A5   | A6   | A7    | B1   | B2   | B3   | B4   | B5   | B6    | C1    | E1   | D1    | D2   | D3    | D4  | D5   | SUB-TOTAL                          | C                       | C*A     |
|--------------------|-----|------|------|------|------|------|-------|------|------|------|------|------|-------|-------|------|-------|------|-------|-----|------|------------------------------------|-------------------------|---------|
| BIO-FILTRATION     |     |      |      |      |      |      |       |      |      |      |      |      |       |       |      |       |      |       |     |      | 6805                               | 0.3                     | 2041.5  |
| B1                 | 0   | 0    | 0    | 0    | 0    | 0    | 6805  | 0    | 0    | 0    | 0    | 0    | 0     |       |      |       |      |       |     |      |                                    |                         |         |
| CONCRETE           |     |      |      |      |      |      |       |      |      |      |      |      |       |       |      |       |      |       |     |      | 15198                              | 0.9                     | 13678.2 |
| C1                 | 101 | 151  | 0    | 78   | 73   | 146  | 0     | 156  | 218  | 151  | 151  | 151  | 1676  | 1446  | 150  |       | 28   |       |     | 78   |                                    |                         |         |
| C2                 |     |      |      |      |      |      |       |      |      | 145  |      | 146  | 47    | 217   | 151  |       | 126  |       |     |      |                                    |                         |         |
| C3                 |     |      |      |      |      |      |       |      |      |      |      | 210  | 189   | 47    | 543  |       |      |       |     |      |                                    |                         |         |
| C4                 |     |      |      |      |      |      |       |      |      |      |      |      | 93    | 889   |      |       |      |       |     |      |                                    |                         |         |
| C5                 |     |      |      |      |      |      |       |      |      |      |      |      | 1846  | 99    |      |       |      |       |     |      |                                    |                         |         |
| C6                 |     |      |      |      |      |      |       |      |      |      |      |      | 1484  | 110   |      |       |      |       |     |      |                                    |                         |         |
| C7                 |     |      |      |      |      |      |       |      |      |      |      |      | 694   | 457   |      |       |      |       |     |      |                                    |                         |         |
| C8                 |     |      |      |      |      |      |       |      |      |      |      |      |       | 2001  |      |       |      |       |     |      |                                    |                         |         |
| C9                 |     |      |      |      |      |      |       |      |      |      |      |      |       | 677   |      |       |      |       |     |      |                                    |                         |         |
| C10                |     |      |      |      |      |      |       |      |      |      |      |      |       | 143   |      |       |      |       |     |      |                                    |                         |         |
| C11                |     |      |      |      |      |      |       |      |      |      |      |      |       | 130   |      |       |      |       |     |      |                                    |                         |         |
| DECOMPOSED GRANITE |     |      |      |      |      |      |       |      |      |      |      |      |       |       |      |       |      |       |     |      | 13901                              | 0.3                     | 4170.3  |
| D1                 | 153 | 63   | 383  | 140  | 201  | 321  | 0     | 374  | 503  | 0    | 38   | 461  | 50    | 0     | 366  | 9096  | 885  |       |     | 142  |                                    |                         |         |
| D2                 |     | 255  |      |      |      |      |       |      |      |      |      |      | 470   |       |      |       |      |       |     |      |                                    |                         |         |
| LANDSCAPE          |     |      |      |      |      |      |       |      |      |      |      |      |       |       |      |       |      |       |     |      | 103019                             | 0.3                     | 30905.7 |
| L1                 | 349 | 1431 | 715  | 234  | 253  | 454  | 6922  | 551  | 537  | 1339 | 2225 | 1512 | 177   | 171   | 3034 | 30452 | 978  | 36784 |     | 2264 |                                    |                         |         |
| L2                 |     | 289  |      | 170  | 91   |      |       |      |      |      |      | 477  | 150   | 298   | 206  |       | 748  |       |     | 102  |                                    |                         |         |
| L3                 |     |      |      |      |      |      |       |      |      |      |      |      | 322   | 151   | 63   |       | 886  |       |     |      |                                    |                         |         |
| L4                 |     |      |      |      |      |      |       |      |      |      |      |      | 149   | 148   | 123  |       | 1518 |       |     |      |                                    |                         |         |
| L5                 |     |      |      |      |      |      |       |      |      |      |      |      | 69    | 232   |      |       | 165  |       |     |      |                                    |                         |         |
| L6                 |     |      |      |      |      |      |       |      |      |      |      |      | 298   | 541   |      |       |      |       |     |      |                                    |                         |         |
| L7                 |     |      |      |      |      |      |       |      |      |      |      |      | 72    | 159   |      |       |      |       |     |      |                                    |                         |         |
| L8                 |     |      |      |      |      |      |       |      |      |      |      |      | 28    | 185   |      |       |      |       |     |      |                                    |                         |         |
| L9                 |     |      |      |      |      |      |       |      |      |      |      |      | 10    | 85    |      |       |      |       |     |      |                                    |                         |         |
| L10                |     |      |      |      |      |      |       |      |      |      |      |      | 232   | 506   |      |       |      |       |     |      |                                    |                         |         |
| L11                |     |      |      |      |      |      |       |      |      |      |      |      | 54    | 83    |      |       |      |       |     |      |                                    |                         |         |
| L12                |     |      |      |      |      |      |       |      |      |      |      |      | 83    | 174   |      |       |      |       |     |      |                                    |                         |         |
| L13                |     |      |      |      |      |      |       |      |      |      |      |      | 99    | 72    |      |       |      |       |     |      |                                    |                         |         |
| L14                |     |      |      |      |      |      |       |      |      |      |      |      | 335   | 104   |      |       |      |       |     |      |                                    |                         |         |
| L15                |     |      |      |      |      |      |       |      |      |      |      |      | 174   | 324   |      |       |      |       |     |      |                                    |                         |         |
| L16                |     |      |      |      |      |      |       |      |      |      |      |      | 122   | 239   |      |       |      |       |     |      |                                    |                         |         |
| L17                |     |      |      |      |      |      |       |      |      |      |      |      | 312   | 110   |      |       |      |       |     |      |                                    |                         |         |
| L18                |     |      |      |      |      |      |       |      |      |      |      |      | 428   | 251   |      |       |      |       |     |      |                                    |                         |         |
| L19                |     |      |      |      |      |      |       |      |      |      |      |      | 188   | 104   |      |       |      |       |     |      |                                    |                         |         |
| L20                |     |      |      |      |      |      |       |      |      |      |      |      | 114   |       |      |       |      |       |     |      |                                    |                         |         |
| L21                |     |      |      |      |      |      |       |      |      |      |      |      | 323   |       |      |       |      |       |     |      |                                    |                         |         |
| L22                |     |      |      |      |      |      |       |      |      |      |      |      | 169   |       |      |       |      |       |     |      |                                    |                         |         |
| L23                |     |      |      |      |      |      |       |      |      |      |      |      | 126   |       |      |       |      |       |     |      |                                    |                         |         |
| L24                |     |      |      |      |      |      |       |      |      |      |      |      | 176   |       |      |       |      |       |     |      |                                    |                         |         |
| AC PAVEMENT        |     |      |      |      |      |      |       |      |      |      |      |      |       |       |      |       |      |       |     |      | 18264                              | 0.9                     | 16437.6 |
| P1                 | 0   | 0    | 0    | 0    | 0    | 0    | 0     | 0    | 0    | 0    | 0    | 0    | 2072  | 3571  | 0    |       |      |       | 249 |      |                                    |                         |         |
| P2                 |     |      |      |      |      |      |       |      |      |      |      |      | 4856  | 5148  |      |       |      |       |     |      |                                    |                         |         |
| P3                 |     |      |      |      |      |      |       |      |      |      |      |      | 2071  | 297   |      |       |      |       |     |      |                                    |                         |         |
| ROOFS              |     |      |      |      |      |      |       |      |      |      |      |      |       |       |      |       |      |       |     |      | 27654                              | 0.9                     | 24888.6 |
| R1                 | 0   | 1343 | 0    | 682  | 1482 | 743  | 0     | 0    | 0    | 2717 | 145  | 2972 | 626   | 472   | 3048 | 997   |      |       |     |      |                                    |                         |         |
| R2                 |     |      |      |      |      |      |       |      |      |      | 65   |      | 1226  | 1224  |      |       |      |       |     |      |                                    |                         |         |
| R3                 |     |      |      |      |      |      |       |      |      |      | 1309 |      | 312   | 1482  |      |       |      |       |     |      |                                    |                         |         |
| R4                 |     |      |      |      |      |      |       |      |      |      |      |      | 621   | 1547  |      |       |      |       |     |      |                                    |                         |         |
| R5                 |     |      |      |      |      |      |       |      |      |      |      |      | 624   | 1507  |      |       |      |       |     |      |                                    |                         |         |
| R6                 |     |      |      |      |      |      |       |      |      |      |      |      | 626   | 624   |      |       |      |       |     |      |                                    |                         |         |
| R7                 |     |      |      |      |      |      |       |      |      |      |      |      | 633   | 627   |      |       |      |       |     |      |                                    |                         |         |
| AREA TOTALS        | 603 | 3532 | 1098 | 1304 | 2100 | 1664 | 13727 | 1081 | 1258 | 4352 | 3933 | 5929 | 24426 | 26652 | 7684 | 40545 | 5334 | 36784 | 249 | 2586 | 184841 = A <sub>101--&gt;100</sub> | 0.50 = C <sub>avg</sub> |         |
|                    |     |      |      |      |      |      |       |      |      |      |      |      |       |       |      |       |      |       |     |      | 4.24 acres                         |                         |         |



**A** BIO-FILTRATION WITH PARTIAL RETENTION – SECTION A-A  
C-1  
NO SCALE



**BDS Engineering, Inc.**  
CIVIL ENGINEERS

PROJECT: VILLAGE PLACE APARTMENTS PROJECT NO.: 14-18

ENGINEER: T. Mugane DATE: APRIL 2018

*Based on County of San Diego Hydrology Manual Section 6*

**DETENTION BASIN STORAGE COMPUTATION, RATIONAL METHOD HYDROGRAPH PROCEDURE**

INPUT VARIABLES (URBAN CONDITIONS)

|                                        |                     |
|----------------------------------------|---------------------|
| Six hour precipitation amount (inches) | $P_6 =$ <u>3.19</u> |
| Time of concentration (min.)           | $T_c =$ <u>20.7</u> |
| Coefficient of runoff                  | $C =$ <u>0.67</u>   |
| Basin area (acres)                     | $A =$ <u>54.7</u>   |

COMPUTATION

Time to peak  
 $T_p = 2.0 T_c K_D / (1 + K_p) = 1.1072 T_c$   $T_p =$  22.92

Time of hydrograph to begin  
 $T_B = 20 - T_p$   $T_B =$  -2.92

Time of hydrograph to end  
 $T_E = 20 + 1.5 T_p$   $T_E =$  54.38

Peak flow  
 $Q_p = CIA$   $Q_p =$  123.2

$I_{T_c} = 7.44 P_6 / T_c^{0.645} =$  3.36 in/hr

Surrounding Flow ( $Q_s$ )

Depth of precipitation for 2 hours

$D_{120} = 7.44 P_6 / 120^{0.645}$  (2hr)

$D_{120} = 0.6785 P_6 =$  2.16 in

Depth of Precipitation for hydrograph

$D_H = (P_6 T_c^{0.355}) / 5.83 =$  1.60 in.

Surrounding intensity

$I_s = 60(D_{120} - D_H) / (120 - 2.5 T_c)$

$I_s =$  0.49 in/hr

$Q_s = C I_s A$   $Q_s =$  18.0

PLOT HYDROGRAPH AND SURROUNDING FLOW

OUTFLOW / BASIN SIZE (PRE DEVELOPMENT CONDITIONS)

Outflow

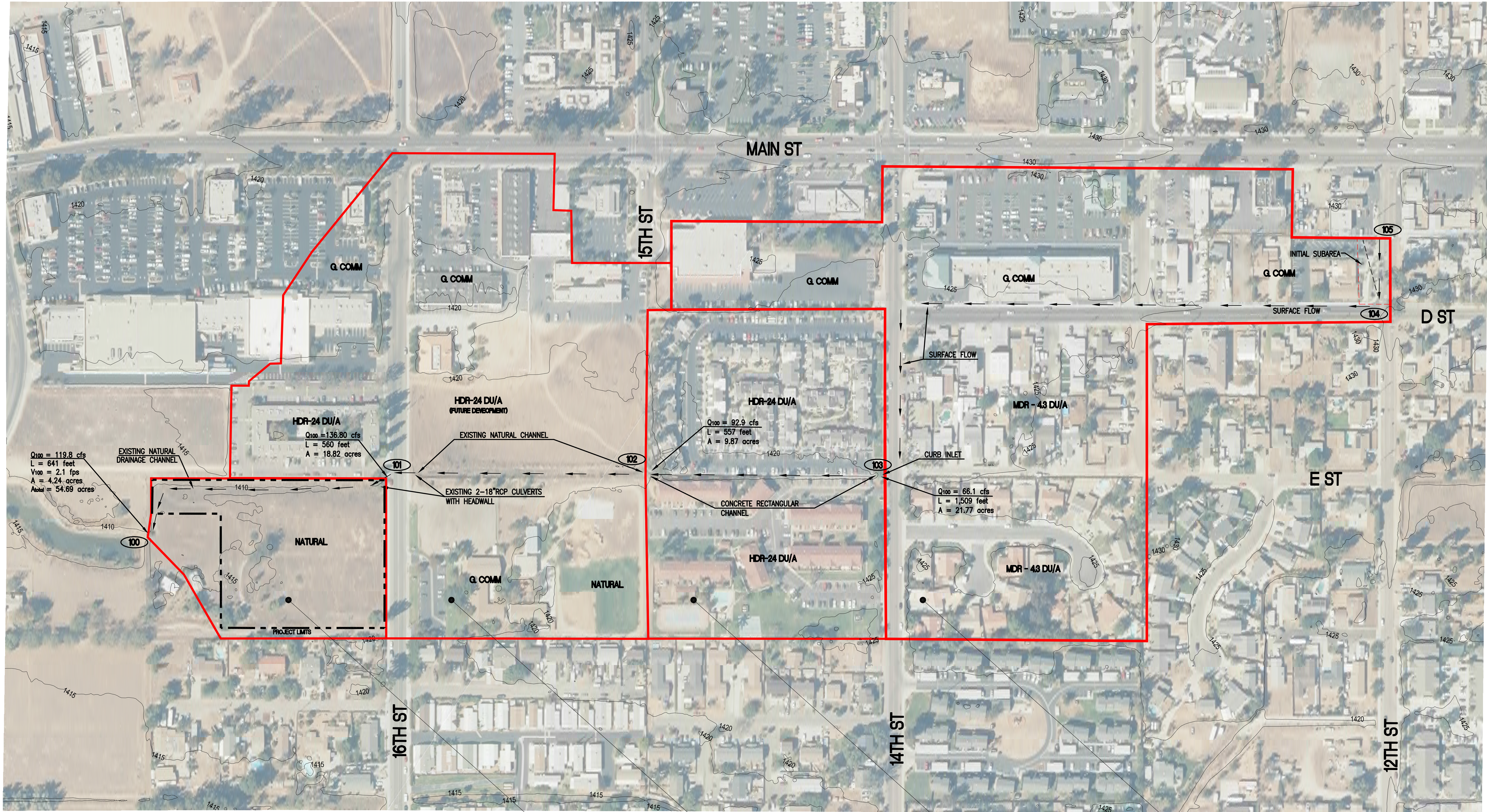
$C =$  0.66  $T_c =$  21.1 min

$I = 7.44 P_6 / T_c^{0.645} =$  3.32 in/hr

$Q_N = CIA$   $Q_N =$  119.9

RESERVOIR VOLUME ABOVE  $Q_s$  LEVEL, Cubic feet  $Vol =$  4882





## DRAINAGE MANAGEMENT AREAS

### LEGEND

ALL EXISTING ITEMS ARE SCREENED

EXISTING CONTOURS

PROJECT LIMITS

RIGHT-OF-WAY

NEW CONTOURS

CATCH BASIN

DRAINAGE DIRECTION

STORM DRAIN

NEW BUILDING (IMPERVIOUS)

DMA BOUNDARY

### SITE INFORMATION:

HYDROLOGIC SOIL GROUP: C

GROUND WATER DEPTH: 10-20 FEET

#### EX-4

| DRAINS TO NODE 100 |            |
|--------------------|------------|
| DESCRIPTION        | AREA (SF)  |
| NATURAL            | 183,872    |
| ROOFS              | 969        |
| G. COMM            | -          |
| MDR (4.3 DU/A)     | -          |
| HDR (24 DU/A)      | -          |
| TOTAL              | 184,841    |
|                    | 4.24 acres |

#### EX-3

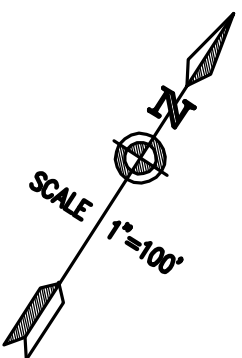
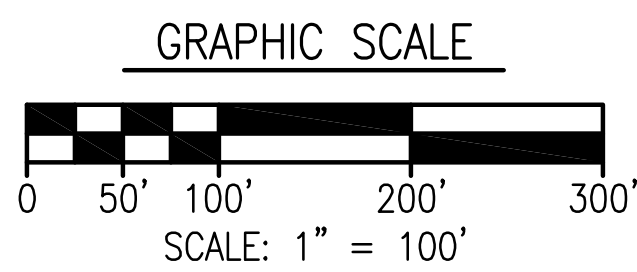
| DRAINS TO NODE 100 |             |
|--------------------|-------------|
| DESCRIPTION        | AREA (SF)   |
| NATURAL            | 58,300      |
| ROOFS              | -           |
| G. COMM            | 526,256     |
| MDR (4.3 DU/A)     | -           |
| HDR (24 DU/A)      | 235,173     |
| TOTAL              | 819,729     |
|                    | 18.82 acres |

#### EX-2

| DRAINS TO NODE 100 |           |
|--------------------|-----------|
| DESCRIPTION        | AREA (SF) |
| NATURAL            | -         |
| ROOFS              | -         |
| G. COMM            | -         |
| MDR (4.3 DU/A)     | -         |
| HDR (24 DU/A)      | 429,843   |
| TOTAL              | 429,843   |
|                    | 9.87 acre |

#### EX-1

| DRAINS TO NODE 100 |             |
|--------------------|-------------|
| DESCRIPTION        | AREA (SF)   |
| NATURAL            | -           |
| ROOFS              | -           |
| G. COMM            | 478,978     |
| MDR (4.3 DU/A)     | 468,960     |
| HDR (24 DU/A)      | -           |
| TOTAL              | 947,938     |
|                    | 21.77 acres |



VILLAGE PLACE APARTMENTS

521 16TH STREET, RAMONA, CA 92065

H1: PRE-DEVELOPMENT DRAINAGE

Revisions:

Sheet Title: PRE-DEVELOPMENT DRAINAGE

Sheet No.:

Project No: 14-18

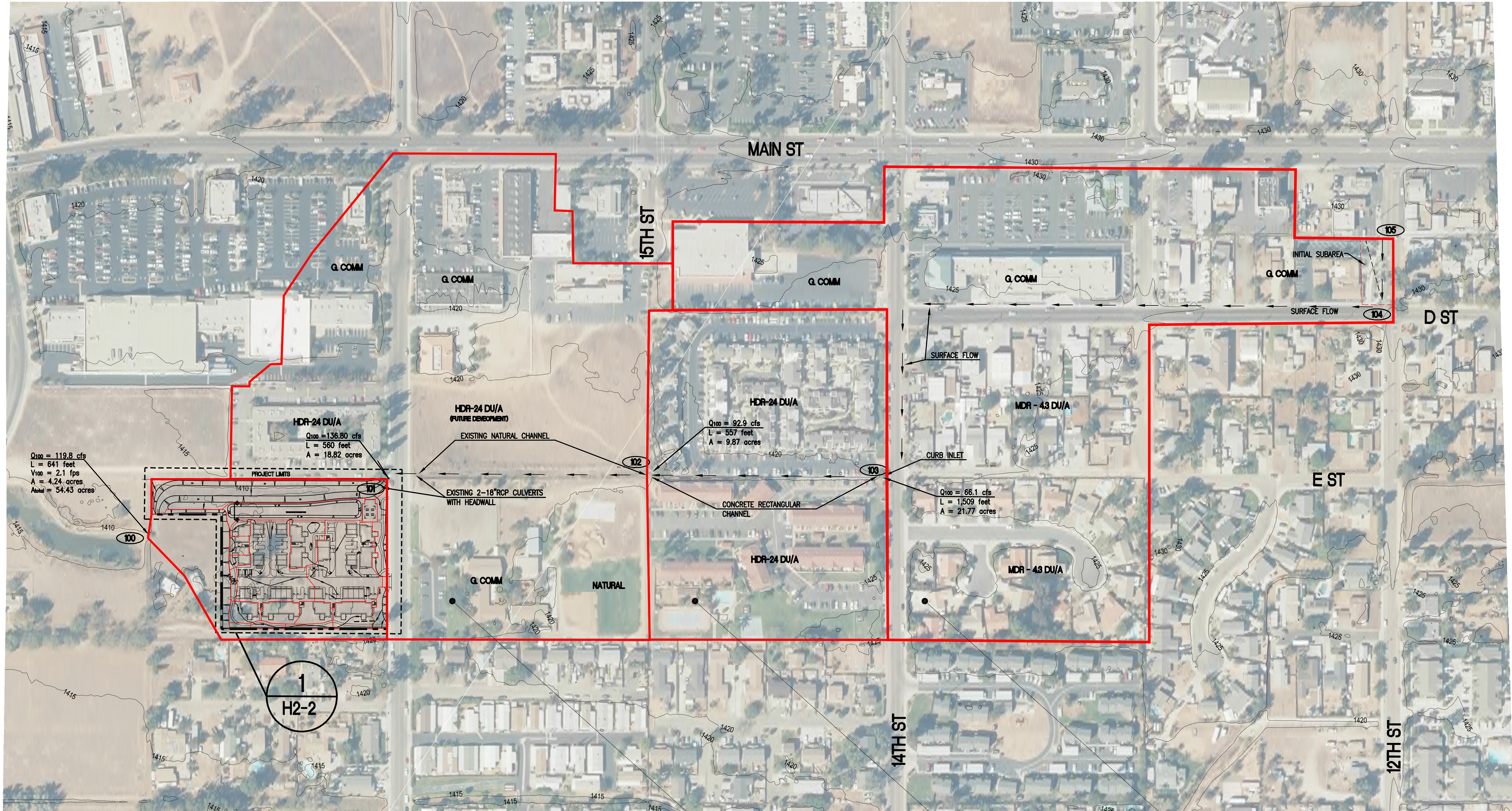
Date:

4/2/18

**BDS** Engineering, Inc.  
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5575 Lake Park Way, Suite 114  
San Jose, California 95129  
(415) 382-4992 FAX (415) 582-7428



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PLOT DATE: Apr 01, 2018 - 3:02pm



## DRAINAGE MANAGEMENT AREAS

### LEGEND

ALL EXISTING ITEMS ARE SCREENED

|                           |         |
|---------------------------|---------|
| EXISTING CONTOURS         | — 520 — |
| PROJECT LIMITS            | — — —   |
| RIGHT-OF-WAY              | — R/W — |
| NEW CONTOURS              | — 520 — |
| CATCH BASIN               | □       |
| DRAINAGE DIRECTION        | →       |
| STORM DRAIN               | — SD —  |
| NEW BUILDING (IMPERVIOUS) | ▨       |
| DMA BOUNDARY              | — — —   |

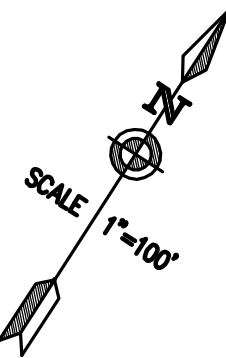
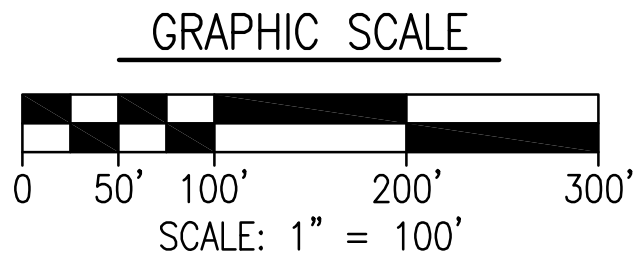
## SITE INFORMATION:

HYDROLOGIC SOIL GROUP: C  
GROUND WATER DEPTH: 10-20 FEET

| EX-3               |             |
|--------------------|-------------|
| DRAINS TO NODE 100 |             |
| DESCRIPTION        | AREA (SF)   |
| NATURAL            | 58,300      |
| ROOFS              | —           |
| G. COMM            | 526,256     |
| MDR (4.3 DU/A)     | —           |
| HDR (24 DU/A)      | 235,173     |
| TOTAL              | 819,729     |
|                    | 18.82 acres |

| EX-2               |           |
|--------------------|-----------|
| DRAINS TO NODE 100 |           |
| DESCRIPTION        | AREA (SF) |
| NATURAL            | —         |
| ROOFS              | —         |
| G. COMM            | —         |
| MDR (4.3 DU/A)     | —         |
| HDR (24 DU/A)      | 429,843   |
| TOTAL              | 429,843   |
|                    | 9.87 acre |

| EX-1               |             |
|--------------------|-------------|
| DRAINS TO NODE 100 |             |
| DESCRIPTION        | AREA (SF)   |
| NATURAL            | —           |
| ROOFS              | —           |
| G. COMM            | 478,978     |
| MDR (4.3 DU/A)     | 468,960     |
| HDR (24 DU/A)      | —           |
| TOTAL              | 947,938     |
|                    | 21.77 acres |



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VILLAGE PLACE APARTMENTS

521 16TH STREET, RAMONA, CA 92065

Revisions:

Sheet Title:  
DRAINAGE MANAGEMENT AREA EXHIBIT

Sheet No.:

Project No.: 14-18

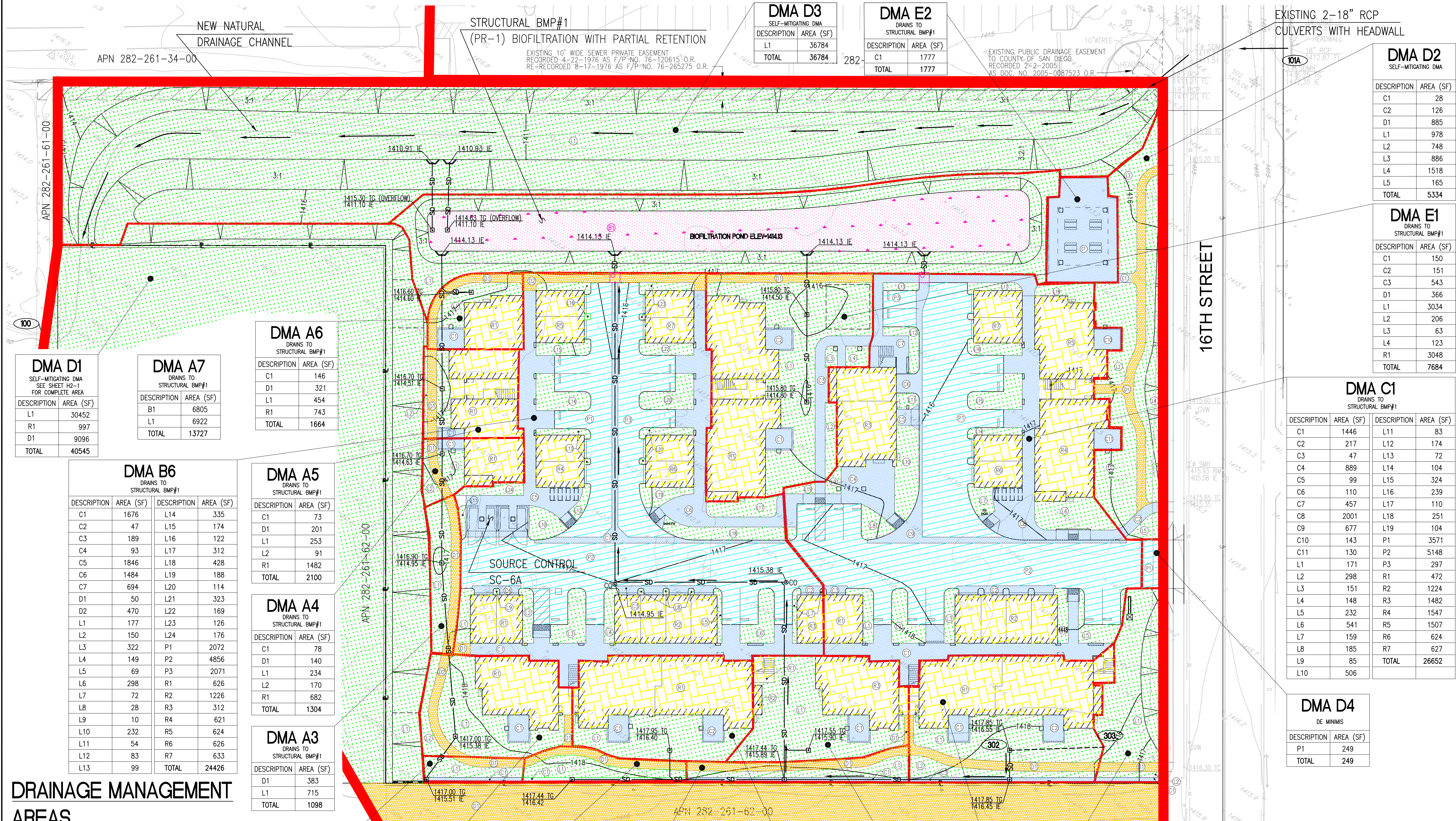
Date:

4-2-18

H2-1: POST-DEVELOPMENT DRAINAGE



DWG. FILE: L:\PROJECTS\1418\Area\1418\_Hydro\1418\_Hydro.dwg  
PLOT DATE: Apr 01, 2018 - 10:08am  
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## DRAINAGE MANAGEMENT AREAS

**LEGEND**  
ALL EXISTING ITEMS ARE SCREENED

EXISTING CONTOURS  
PROPERTY LINE  
RIGHT-OF-WAY  
NEW CONTOURS  
CATCH BASIN  
DRAINAGE DIRECTION  
STORM DRAIN  
NEW BUILDING (IMPERVIOUS)  
DMA BOUNDARY

① BIO-FILTRATION  
② CONCRETE PAVEMENT  
③ DECOMPOSED GRANITE  
④ LANDSCAPE  
⑤ ASPHALT PAVEMENT  
⑥ ROOFS

GRAPHIC SCALE  
0 5' 10' 20' 40' 60'  
SCALE: 1" = 20'

**DMA A6**  
DRAINS TO STRUCTURAL BMP#1

| DESCRIPTION  | AREA (SF)   |
|--------------|-------------|
| C1           | 146         |
| D1           | 321         |
| L1           | 454         |
| R1           | 743         |
| <b>TOTAL</b> | <b>1664</b> |

**DMA A5**  
DRAINS TO STRUCTURAL BMP#1

| DESCRIPTION  | AREA (SF)   |
|--------------|-------------|
| C1           | 73          |
| D1           | 201         |
| L1           | 253         |
| L2           | 91          |
| R1           | 1482        |
| <b>TOTAL</b> | <b>2100</b> |

**DMA A4**  
DRAINS TO STRUCTURAL BMP#1

| DESCRIPTION  | AREA (SF)   |
|--------------|-------------|
| C1           | 78          |
| D1           | 140         |
| L1           | 234         |
| L2           | 170         |
| R1           | 682         |
| <b>TOTAL</b> | <b>1304</b> |

**DMA A3**  
DRAINS TO STRUCTURAL BMP#1

| DESCRIPTION  | AREA (SF)   |
|--------------|-------------|
| D1           | 383         |
| L1           | 715         |
| <b>TOTAL</b> | <b>1098</b> |

**DMA A1**  
DRAINS TO STRUCTURAL BMP#1

| DESCRIPTION  | AREA (SF)  |
|--------------|------------|
| C1           | 101        |
| D1           | 153        |
| L1           | 349        |
| <b>TOTAL</b> | <b>603</b> |

**DMA A2**  
DRAINS TO STRUCTURAL BMP#1

| DESCRIPTION  | AREA (SF)   |
|--------------|-------------|
| C1           | 151         |
| D1           | 63          |
| D2           | 255         |
| L1           | 1431        |
| L2           | 289         |
| R1           | 1343        |
| <b>TOTAL</b> | <b>3532</b> |

**DMA B1**  
DRAINS TO STRUCTURAL BMP#1

| DESCRIPTION  | AREA (SF)   |
|--------------|-------------|
| C1           | 156         |
| D1           | 374         |
| L1           | 551         |
| <b>TOTAL</b> | <b>1081</b> |

**DMA B2**  
DRAINS TO STRUCTURAL BMP#1

| DESCRIPTION  | AREA (SF)   |
|--------------|-------------|
| C1           | 218         |
| D1           | 503         |
| L1           | 537         |
| <b>TOTAL</b> | <b>1258</b> |

**DMA B3**  
DRAINS TO STRUCTURAL BMP#1

| DESCRIPTION  | AREA (SF)   |
|--------------|-------------|
| C1           | 151         |
| C2           | 145         |
| L1           | 1339        |
| R1           | 2717        |
| <b>TOTAL</b> | <b>4352</b> |

**DMA B4**  
DRAINS TO STRUCTURAL BMP#1

| DESCRIPTION  | AREA (SF)   |
|--------------|-------------|
| C1           | 151         |
| D1           | 38          |
| L1           | 2225        |
| R1           | 145         |
| R2           | 65          |
| R3           | 1309        |
| <b>TOTAL</b> | <b>3933</b> |

**DMA B5**  
DRAINS TO STRUCTURAL BMP#1

| DESCRIPTION  | AREA (SF)   |
|--------------|-------------|
| C1           | 151         |
| C2           | 146         |
| C3           | 210         |
| D1           | 461         |
| L1           | 1512        |
| L2           | 477         |
| R1           | 2972        |
| <b>TOTAL</b> | <b>5929</b> |

**DMA D5**  
SELF-MITIGATING DMA

| DESCRIPTION  | AREA (SF)   |
|--------------|-------------|
| C1           | 78          |
| D1           | 142         |
| L1           | 2264        |
| L2           | 102         |
| <b>TOTAL</b> | <b>2586</b> |

**DMA SUMMARY (A, B, C, D, E)**

| DESCRIPTION            | TOTAL AREA (SF)   | NOTE                |
|------------------------|-------------------|---------------------|
| BIO-FILTRATION (B)     | 6805              | ENGINEERED PERVIOUS |
| CONCRETE (C)           | 15198             | IMPERVIOUS          |
| DECOMPOSED GRANITE (D) | 13901             | SEMI-PERVIOUS       |
| LANDSCAPE (L)          | 103019            | PERVIOUS            |
| AC PAVEMENT (P)        | 18264             | IMPERVIOUS          |
| ROOFS (R)              | 27654             | IMPERVIOUS          |
| <b>TOTAL</b>           | <b>184841</b>     |                     |
|                        | <b>4.24 acres</b> |                     |

## SITE INFORMATION:

HYDROLOGIC SOIL GROUP: C  
GROUND WATER DEPTH: 10-20 FEET  
CRITICAL COARSE SEDIMENT YIELD AREAS: NO CCSYAS ON SITE OR UPSTREAM OF SITE PER WMAA PCCSYA MAPS

1  
H2-2 ENLARGEMENT

**DMA D2**  
SELF-MITIGATING DMA

| DESCRIPTION  | AREA (SF)   |
|--------------|-------------|
| C1           | 28          |
| C2           | 126         |
| D1           | 885         |
| L1           | 978         |
| L2           | 748         |
| L3           | 886         |
| L4           | 1518        |
| L5           | 165         |
| <b>TOTAL</b> | <b>5334</b> |

**DMA E1**  
DRAINS TO STRUCTURAL BMP#1

| DESCRIPTION  | AREA (SF)   |
|--------------|-------------|
| C1           | 150         |
| C2           | 151         |
| C3           | 543         |
| D1           | 366         |
| L1           | 3034        |
| L2           | 206         |
| L3           | 63          |
| L4           | 123         |
| R1           | 3048        |
| <b>TOTAL</b> | <b>7684</b> |

**DMA C1**  
DRAINS TO STRUCTURAL BMP#1

| DESCRIPTION | AREA (SF) | DESCRIPTION  | AREA (SF)    |
|-------------|-----------|--------------|--------------|
| C1          | 1446      | L11          | 83           |
| C2          | 217       | L12          | 174          |
| C3          | 47        | L13          | 72           |
| C4          | 889       | L14          | 104          |
| C5          | 99        | L15          | 324          |
| C6          | 110       | L16          | 239          |
| C7          | 457       | L17          | 110          |
| C8          | 2001      | L18          | 251          |
| C9          | 677       | L19          | 104          |
| C10         | 143       | P1           | 3571         |
| C11         | 130       | P2           | 5148         |
| L1          | 171       | P3           | 297          |
| L2          | 298       | R1           | 472          |
| L3          | 151       | R2           | 1224         |
| L4          | 148       | R3           | 1482         |
| L5          | 232       | R4           | 1547         |
| L6          | 541       | R5           | 1507         |
| L7          | 159       | R6           | 624          |
| L8          | 185       | R7           | 627          |
| L9          | 85        | <b>TOTAL</b> | <b>26652</b> |
| L10         | 506       |              |              |

**DMA D4**  
DE MINIMIS

| DESCRIPTION  | AREA (SF)  |
|--------------|------------|
| P1           | 249        |
| <b>TOTAL</b> | <b>249</b> |

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**H2-2:- POST-DEVELOPMENT DRAINAGE**

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Project No.: 14-18  
Date: 4-2-18  
Sheet No.: