THE AURORA HIGHLANDS SUBDIVISION FILING NUMBER 21 – PLANNING AREA 70

UTILITY REPORT

August 2022

Prepared For:

Century Communities
8390 E Crescent Pkwy, Suite 650
Greenwood Village, CO 80111

Contact: Cindy Myers
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By:
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Contact: Eric Pearson
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APPROVED FOR ONE YEAR FROM THIS DATE	
City Engineer	**Date**
Aurora Water Department	**Date**

ENGINEER'S CERTIFICATION:

I hereby certify that this Utility Report and plan for The Aurora Highlands Subdivision Filing Number 21 - Planning Area 70, was prepared by me (or under my direction supervision) in accordance with the provisions of the Aurora Water, Sanitary Sewer, and Storm Drainage Infrastructure Standards and Specifications for the owners thereof.

_____

Eric Pearson, P.E. Date
State of Colorado No. 45415
For and on behalf of CAGE Civil Engineering

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SCOPE

The purpose of this Utility Report for The Aurora Highlands Subdivision Filing Number 21 - Planning Area 70 is to provide a proposed design including water demands/modeling and sanitary sewer generations associated with The Aurora Highlands Subdivision Filing Number 21 - Planning Area 70. This report will also demonstrate conformance with *The Aurora Highlands Master Utility Report*.

A. INTRODUCTION

1. Location

- The Aurora Highlands Subdivision Filing Number 21 - Planning Area 70 is located in northeastern Aurora, Colorado. The site is located north of 26th Avenue and 32nd Avenue (future alignment), east of Sunset Drive (future alignment), and west of Aurora Highlands Parkway (future alignment).
- The site is located in the Southwest quarter of Section 29, Township 3 South, Range 65 West of the Sixth Principal Meridian, City of Aurora, Adams County Colorado.
- See Vicinity Map below for overall site location:

VICINITY MAP

2. Proposed Development

- The Aurora Highlands Subdivision Filing Number 21 - Planning Area 70 consists of a variety of proposed land uses that include: 188 Single-Family Detached Lots and 96 motor court homes with associated infrastructure.

B. DOMESTIC WATER

1. System Layout

- The Aurora Highlands Subdivision Filing Number 21 - Planning Area 70 will be served by the City of Aurora (COA) water system with the proposed development integrating into Pressure Zone 3.
- Water transmission to the proposed development area is conveyed by means of multiple 12-inch waterlines.
- The proposed water system has been currently modeled with 8-inch PVC interior lines to serve the development (see Appendix B for details).
- The system has been studied under the assumption of full build out of the surrounding water network per *The Aurora Highlands Master Utility Study*, HR Green, January 2020. The full build out condition will be capable of serving the entirety of The Aurora Highlands Subdivision Filing Number 21 – Planning Area 70.

2. Water System Design Criteria

- The proposed water system to serve The Aurora Highlands Subdivision Filing Number 21 - Planning Area 70 is designed in accordance with Section 5.00 – Design Criteria and Construction Plans of the City of Aurora Water, Sanitary Sewer and Storm Drainage Infrastructure Standards and Specifications (COA Standards and Specifications).
    - DIP or PVC pipe shall be used exclusively.
    - The water distribution system must be designed to meet the Maximum Hour demand to Average Day demand ratio of 4.5:1 gallons per capita per day (gpcpd).
    - The water distribution system has been analyzed to meet the Maximum Day demand plus Fire Flow demand with a residual pressure of no less than 20 psi at any point within the water distribution system.
    - The maximum velocity in 16” to 24” mains during the Maximum Hour demand shall not exceed 4.5 fps
    - The maximum velocity in 8” to 12” mains during the Maximum Hour demand shall not exceed 3.0 fps
    - The maximum velocity in waterlines 6” or smaller during the Maximum Hour demand shall not exceed 2.5 fps.
    - The minimum diameter for water mains in a single family detached residential area shall be 8”. 6” water mains may be used in a single family detached residential area

as directed by COA for potential water quality issues.

- 4", 10" and 14" water mains are not permitted.

3. Water Demand Calculations

- Water demand calculations have been completed and applied to the proposed water system in accordance with COA Standards and Specifications. In calculating demands, the total number of units was counted within The Aurora Highlands Subdivision Filing Number 21 - Planning Area 70 development and classified as single-family lots (2.77 people/unit)
- Domestic water demand for residential loading is based on **101 gpcpd** with the respective Maximum Day and Maximum Hour factors of 2.8 and 4.5

TABLE 1: SYSTEM WIDE DEMANDS

Zoning	System Wide Demands					
	Average Day		Max Day		Max Hour	
	(gpd)	(gpm)	(gpm)	(mgd)	(gpm)	(mgd)
Residential	79,455	55	154	0.22	248	0.36
Total	**79,455**	**55**	**154**	**0.22**	**248**	**0.36**

4. Hydraulic Models

- The proposed water distribution system for The Aurora Highlands Subdivision Filing Number 21 - Planning Area 70 has been modeled using Bentley WaterCAD. Utilizing the calculated demands. Several scenarios were run within the model to accurately capture proposed operating conditions of the water system:
  - Average Day Demand
  - Max Hour Demand
  - Max Day Demand
  - Max Day Demand + Fire Flow Analysis
- Reservoir elevations of the connections to the water mains in Highlands Creek Boulevard and 32nd Avenue are based on pressures obtained from *The Aurora Highlands Master Utility Study*, HR Green, January 2020.
- Water system elevations were assigned to junctions according to the proposed elevations.
- A Hazen-Williams factor of C=150 is applied to proposed PVC waterlines.

5. Hydraulic Modeling Results

Average Day / Max Hour / Max Day Analysis

TABLE 2: HYDRAULIC MODELING RESULTS

Scenario	Minimum Pressure (psi)	Node	Maximum Pressure (psi)	Node	Maximum Velocity (fps)	Pipe
Average Day	71	J-17	89	J-48	1.40	P-48
Max Hour	71	J-17	89	J-48	1.59	P-48
Max Day	71	J-17	89	J-48	1.51	P-48

Fire Flow Analysis

- In accordance with COA Standards and Specifications the Max Day Demand Fire Flow Scenario was run to verify adequate fire flow system wide with a residual pressure of no less than 20 psi. The Fire Flow analysis is an integrated function which analyzes a selection designated as fire hydrants. This analysis provides the maximum available fire flow at the selected hydrants with a minimum residual pressure of 20 psi.
- The scenario was run utilizing all junctions representing residential, commercial, and industrial fire flow availability. The following fire flow requirements were used:
  - Residential, 1,500 gal/minute for 2 hours
  - School, 3,500 gal/minute for 3 hours
- The Fire Flow analysis indicated that the proposed water system satisfies the fire flow constraints of the minimum flow needed per demand calculations and a minimum pressure residual of 20 psi.

C. SANITARY SEWER

1. System Layout

- The proposed system will require a network of 8-inch and 18-inch mains to serve the different basins of the proposed development.
- The proposed system is planned to connect to an 8-inch sanitary main provided with the Highlands Creek Boulevard and 32nd Avenue construction. The Highlands Creek Boulevard and 32nd Avenue sanitary mains were analyzed in *The Aurora Highlands Master Utility Study*.

2. Sanitary Sewer Design Criteria

- The proposed sanitary sewer system to serve The Aurora Highlands Subdivision Filing Number 21 - Planning Area 70 development is designed in accordance with Section 5.00 – Utility Design Criteria and Construction Plans of the City of Aurora Water, Sanitary Sewer and Storm Drainage Infrastructure Standards and Specifications (COA Standards and Specifications).

- Maximum and minimum peaking factors of 4 and 1.7, respectively.
- Assume infiltration at 10% of average flow.
- Flow velocity shall not exceed 10 fps flowing full or half full
- A Manning's "n" value of 0.011 for PVC pipe.
- A minimum slope of 0.4% was utilized for analysis.
- Depth of flow in pipes 12 inches or smaller should not exceed 75% of capacity.
- Depth of flow in pipes larger than 12 inches should not exceed 80% of capacity.
- Minimum velocity of 2 fps at least once per day. Minimum slope of 0.4% will be analyzed for pipes to meet the 2 fps requirement.

3. Sanitary Sewer Flow Generations

- Sanitary sewer loading calculations have been completed and applied to the proposed sanitary system in accordance with *COA Standards and Specifications*. In calculating demands, the total number of units was counted within The Aurora Highlands Subdivision Filing Number 21 - Planning Area 70 development and classified as single-family lots (2.77 people/unit).
  - Average flow generation of 68 gallons per capita per day (gpcpd).
  - Peak factors were based on the *Master Utility Design Criteria for Water and Sanitary Sewer*, dated January 2020. Sanitary sewer flow calculations are provided in Appendix C.
- Sanitary basin boundaries for The Aurora Highlands Subdivision Filing Number 21 - Planning Area 70 were determined based on the proposed grade and flow direction of the site. Twelve major on-site sanitary basins were identified. All calculations and a map delineating the sanitary basins can be referenced in Appendix C.

4. Sanitary System Sewer Sizing

- Sanitary sewer system sizing was determined in accordance with the COA Standards and Specifications for maximum depth of flow of 75% capacity for all pipe sizes 12 inches and smaller and 80% for pipe sizes larger than 12 inches.
- The Hydraflow Express extension for Autodesk AutoCAD Civil 3D software will be used to calculate pipe capacities and velocities.
- Design points were established based on proposed roadway grades and flow direction. Design point and flow routing calculations are provided in Appendix C.
- Flows generated by The Aurora Highlands Subdivision Filing Number 21 - Planning Area 70 enter the sanitary sewer main within Highlands Creek Boulevard and 32nd Avenue at Design Points 11 and 1, respectively of the Master Utility Study.
- Refer to Appendix C for basin designations and calculations.

D. CONCLUSIONS

1. Domestic Water

- This Utility Report for The Aurora Highlands Subdivision Filing Number 21 - Planning Areas 70 is in compliance with the City of Aurora domestic water design criteria. Pressures at connections to water mains were taken from *The Aurora Highlands Master Utility Report*, HR Green, January 2020 and demonstrate compliance.
- Per *The Aurora Highlands Master Utility Report*, HR Green, January 2020, Planning Area 70 was evaluated for 401 dwelling units. For the proposed development analyzed in this report, only 284 dwelling units lie within Planning Area 70. This reduction in dwelling units will result in significantly less demand on the system.
- The domestic water system is comprised of 8-inch lines and is proposed to tie into the existing network and will satisfy the requirements for the Maximum Day Demand + Fire Flow scenario.
- No water system variances are requested at this time.

2. Sanitary Sewer

- This Utility Report for The Aurora Highlands Subdivision Filing Number 21 - Planning Area 70 is in compliance with the City of Aurora sanitary sewer design criteria.
- Per The Aurora Highlands Master Utility Report, HR Green, January 2020, Planning Area 70 was evaluated for 401 dwelling units. For the proposed development analyzed in this report, only 284 dwelling units lie within Planning Area 70.
- The following conclusions are drawn based on this study:
    - Proposed 8” local sanitary sewer lines will tie into a larger 10” and 12” proposed sanitary trunk lines.
    - The sanitary alignment should maintain a minimum slope of 1% acceptable design depths for the proposed development within the majority of the project area. All City of Aurora design standards in regard to pipe capacity and layout will be adhered to.
    - The Aurora Highlands Subdivision Filing Number 21 - Planning Area 70 can be referenced in *The Aurora Highlands Master Utility Report*, HR Green, January 2020. Design Point 11 of this report corresponds to Design Point 4.0 of the HR Green Report. The loadings determined at these design points are lower than the respective loadings generated in *The Aurora Highlands Master Utility Study*. Therefore, no revisions or amendments are required, and this study can be considered in compliance with the *Master Utility Report*.

E. LIST OF REFERENCES

1. *Water, Sanitary Sewer and Storm Drainage Infrastructure Standards and Specifications*, January 2020, City of Aurora, Colorado
2. *The Aurora Highlands Master Utility Report,* HR Green, November 2018.
3. *The Aurora Highlands Master Utility Report – Amendment 1,* HR Green, January 2020

APPENDIX A - MAPS & EXHIBITS

LEGEND:

BASIN LINE

BASIN LABEL — BASIN ID (1) / UNIT COUNT (10)

DESIGN POINT (2)

0 150' 300'

1" = 150' (HORIZONTAL)

PROJECT BENCHMARK:

CITY OF AURORA BENCHMARK 3S6636NE003 BEING A 3" DIAM. BRASS CAP (COA BM, 19-020B, E-090A) ATOP THE S. WALL @ THE S.E. COR. OF THE E. 26TH AVE. BRIDGE CROSSING OVER E-470. BRASS CAP AT LOWER STEP ON WALL WHERE THE RAILING ENDS ON THE E. END. AKA 19-020B.

ELEVATION = 5521.54 (NAVD88)

THE AURORA HIGHLANDS PP #17

TITLE: WATERCAD TRIBUTARY AREA MAP

DATE: JANUARY 12, 2022

CAGE CIVIL ENGINEERING

999 18TH STREET - S2110
DENVER, CO 80202
PHONE: 630-598-0007
WWW.CAGECIVIL.COM

LEGEND:

BASIN LINE

BASIN LABEL — BASIN ID (1) / UNIT COUNT (10)

DESIGN POINT (2)

0 150' 300'

1" = 150' (HORIZONTAL)

N

THE AURORA HIGHLANDS PP #17

TITLE: SANITARY SEWER TRIBUTARY AREA MAP

DATE: JANUARY 12, 2022

PROJECT BENCHMARK:

CITY OF AURORA BENCHMARK 3S6636NE003 BEING A 3" DIAM. BRASS CAP (COA BM, 19-020B, E-090A) ATOP THE S. WALL @ THE S.E. COR. OF THE E. 26TH AVE. BRIDGE CROSSING OVER E-470. BRASS CAP AT LOWER STEP ON WALL WHERE THE RAILING ENDS ON THE E. END. AKA 19-020B.

ELEVATION = 5521.54 (NAVD88)

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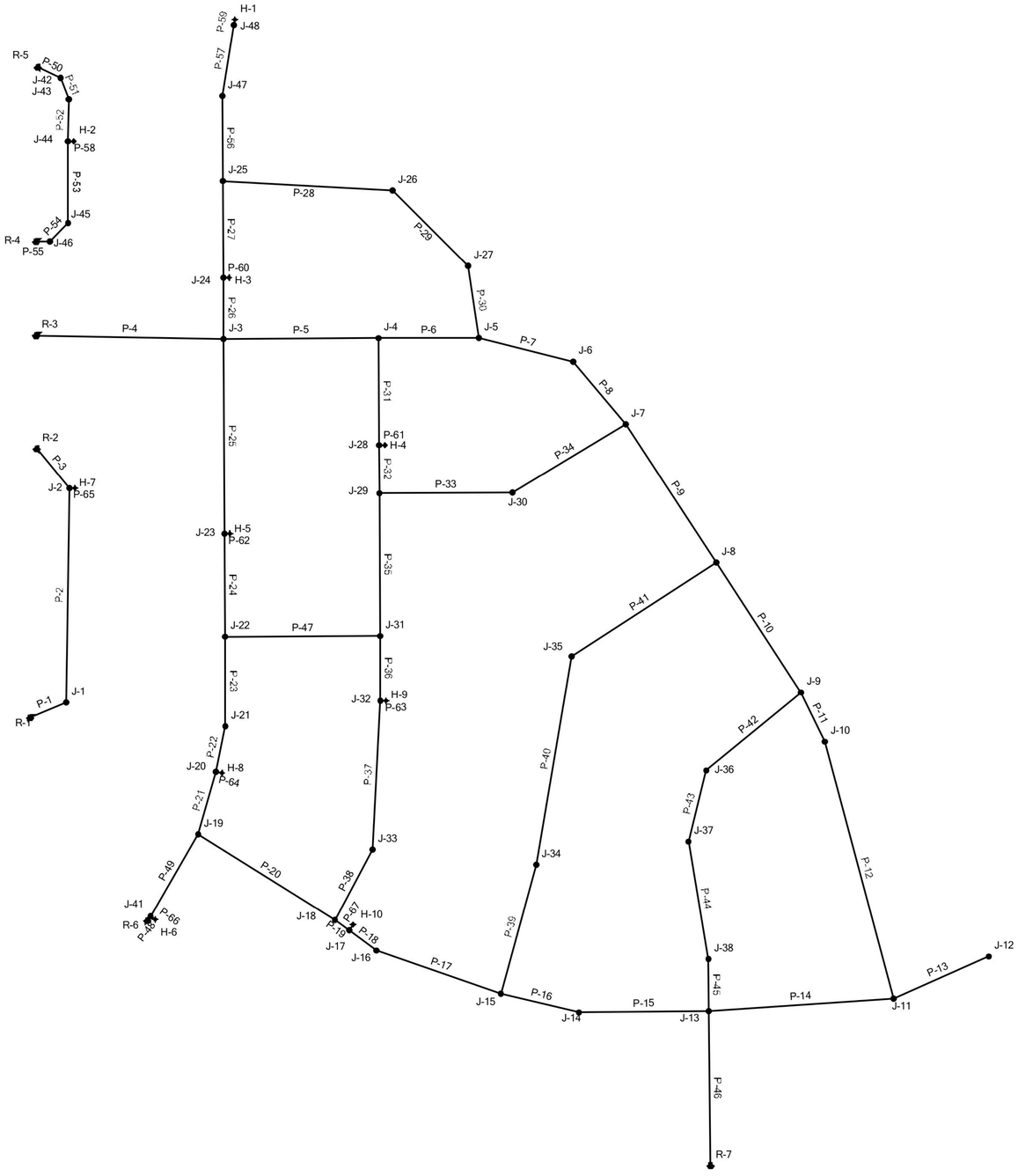
APPENDIX B - WATER SYSTEM CALCULATIONS

CAGE CIVIL ENGINEERING

PROJECT TAH Subdivision Filing No. 17
DATE 1/11/2022
BY Eric Pearson

RESIDENTIAL WATER USE	101	GPCPD	SINGLE-FAMILY POPULATION DENSITY	2.77	PERSONS/UNIT
COMMERCIAL/MIXED USE/CIVIC	1500	GPD/ACRE	MULTI-FAMILY POPULATION DENSITY	2.77	PERSONS/UNIT
SCHOOL (INDUSTRIAL) WATER USE	1200	GPD/ACRE			
PARKS & GREEN BELTS	1800	GPD/ACRE	RESIDENTIAL FIRE FLOW	1500	GPM FOR 2 HOURS
			COMMERCIAL / MULTI-FAMILY	2500	GPM FOR 2 HOURS
MAX. DAY / AVG. DAY	2.8		SCHOOL (INDUSTRIAL) FIRE FLOW	3500	GPM FOR 3 HOURS
MAX. HOUR / FLOW RATIO	4.5				

LAND USE	DEMAND POINT	JUNCTION	NO. OF SF UNITS	ACRES	AVG. DAY DEMAND (GPD)	AVG. DAY DEMAND (GPM)	MAX. DAY DEMAND (GPM)	MAX. HOUR DEMAND (GPM)	MAX. DAY + FIRE FLOW (GPM)
RESIDENTIAL	1	J-14	32	N/A	8,953	6.22	17.41	27.98	1,517
RESIDENTIAL	2	J-36	30	N/A	8,393	5.83	16.32	26.23	1,516
RESIDENTIAL	3	J-35	47	N/A	13,149	9.13	25.57	41.09	1,526
RESIDENTIAL	4	J-30	28	N/A	7,834	5.44	15.23	24.48	1,515
RESIDENTIAL	5	J-10	36	N/A	10,072	6.99	19.58	31.47	1,520
RESIDENTIAL	6	J-33	24	N/A	6,714	4.66	13.06	20.98	1,513
RESIDENTIAL	7	J-21	32	N/A	8,953	6.22	17.41	27.98	1,517
RESIDENTIAL	8	J-1	13	N/A	3,637	2.53	7.07	11.37	1,507
RESIDENTIAL	9	J-26	17	N/A	4,756	3.30	9.25	14.86	1,509
RESIDENTIAL	10	J-45	9	N/A	2,518	1.75	4.90	7.87	1,505
RESIDENTIAL	11	J-47	16	N/A	4,476	3.11	8.70	13.99	1,509
TOTALS	**N/A**	**N/A**	**284**	**18.9**	**79,455**	**55**	**154**	**248**	**16,654**



THE AURORA HIGHLANDS FLG 17

TITLE: WATERCAD LAYOUT MAP

DATE: JANUARY 12, 2022

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Active Scenario: Average Day

FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)
P-1	75	8.0	Ductile Iron	130.0	2	0.01
P-2	406	8.0	Ductile Iron	130.0	-1	0.00
P-3	97	8.0	Ductile Iron	130.0	-1	0.00
P-4	355	8.0	Ductile Iron	130.0	-100	0.64
P-5	294	8.0	Ductile Iron	130.0	-26	0.17
P-6	190	8.0	Ductile Iron	130.0	11	0.07
P-7	184	8.0	Ductile Iron	130.0	-5	0.03
P-8	155	8.0	Ductile Iron	130.0	-5	0.03
P-9	313	8.0	Ductile Iron	130.0	20	0.13
P-10	294	8.0	Ductile Iron	130.0	34	0.22
P-11	104	8.0	Ductile Iron	130.0	17	0.11
P-12	504	8.0	Ductile Iron	130.0	10	0.07
P-13	198	8.0	Ductile Iron	130.0	0	0.00
P-14	351	8.0	Ductile Iron	130.0	10	0.07
P-15	246	8.0	Ductile Iron	130.0	-47	0.30
P-16	152	8.0	Ductile Iron	130.0	-54	0.34
P-17	250	8.0	Ductile Iron	130.0	-77	0.49
P-18	64	8.0	Ductile Iron	130.0	-77	0.49
P-19	33	8.0	Ductile Iron	130.0	-77	0.49
P-20	306	8.0	Ductile Iron	130.0	-113	0.72
P-21	123	8.0	Ductile Iron	130.0	107	0.68
P-22	88	8.0	Ductile Iron	130.0	107	0.68
P-23	170	8.0	Ductile Iron	130.0	101	0.64
P-24	195	8.0	Ductile Iron	130.0	64	0.41
P-25	369	8.0	Ductile Iron	130.0	64	0.41
P-26	116	8.0	Ductile Iron	130.0	-9	0.06
P-27	183	8.0	Ductile Iron	130.0	-9	0.06
P-28	322	8.0	Ductile Iron	130.0	-13	0.08
P-29	203	8.0	Ductile Iron	130.0	-16	0.10
P-30	138	8.0	Ductile Iron	130.0	-16	0.10
P-31	203	8.0	Ductile Iron	130.0	-37	0.24
P-32	91	8.0	Ductile Iron	130.0	-37	0.24
P-33	252	8.0	Ductile Iron	130.0	31	0.20
P-34	251	8.0	Ductile Iron	130.0	25	0.16
P-35	270	8.0	Ductile Iron	130.0	-68	0.43
P-36	123	8.0	Ductile Iron	130.0	-31	0.20
P-37	282	8.0	Ductile Iron	130.0	-31	0.20
P-38	151	8.0	Ductile Iron	130.0	-36	0.23
P-39	253	8.0	Ductile Iron	130.0	23	0.15
P-40	400	8.0	Ductile Iron	130.0	23	0.15
P-41	327	8.0	Ductile Iron	130.0	14	0.09
P-42	233	8.0	Ductile Iron	130.0	17	0.11
P-43	139	8.0	Ductile Iron	130.0	11	0.07
P-44	226	8.0	Ductile Iron	130.0	11	0.07
P-45	98	8.0	Ductile Iron	130.0	11	0.07
P-46	293	8.0	Ductile Iron	130.0	69	0.44
P-47	294	8.0	Ductile Iron	130.0	36	0.23
P-48	10	8.0	Ductile Iron	130.0	220	1.40
P-49	180	8.0	Ductile Iron	130.0	220	1.40
P-50	48	8.0	Ductile Iron	130.0	1	0.00

Active Scenario: Average Day

FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)
P-51	44	8.0	Ductile Iron	130.0	1	0.00
P-52	79	8.0	Ductile Iron	130.0	1	0.00
P-53	154	8.0	Ductile Iron	130.0	1	0.00
P-54	49	8.0	Ductile Iron	130.0	-1	0.01
P-55	26	8.0	Ductile Iron	130.0	-1	0.01
P-56	161	8.0	Ductile Iron	130.0	3	0.02
P-57	136	8.0	Ductile Iron	130.0	0	0.00
P-58	11	8.0	Ductile Iron	130.0	0	0.00
P-59	10	8.0	Ductile Iron	130.0	0	0.00
P-60	11	8.0	Ductile Iron	130.0	0	0.00
P-61	11	8.0	Ductile Iron	130.0	0	0.00
P-62	10	8.0	Ductile Iron	130.0	0	0.00
P-63	11	8.0	Ductile Iron	130.0	0	0.00
P-64	12	8.0	Ductile Iron	130.0	0	0.00
P-65	11	8.0	Ductile Iron	130.0	0	0.00
P-66	11	8.0	Ductile Iron	130.0	0	0.00
P-67	13	8.0	Ductile Iron	130.0	0	0.00

Active Scenario: Average Day

FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-1	5,551.52	3	5,718.79	72
J-2	5,545.64	0	5,718.79	75
J-3	5,528.80	0	5,718.88	82
J-4	5,532.51	0	5,718.89	81
J-5	5,530.81	0	5,718.89	81
J-6	5,527.97	0	5,718.89	83
J-7	5,529.09	0	5,718.89	82
J-8	5,532.54	0	5,718.88	81
J-9	5,535.77	0	5,718.87	79
J-10	5,536.88	7	5,718.87	79
J-11	5,544.44	0	5,718.87	75
J-12	5,545.93	0	5,718.87	75
J-13	5,547.84	0	5,718.87	74
J-14	5,549.73	6	5,718.88	73
J-15	5,550.96	0	5,718.90	73
J-16	5,554.48	0	5,718.94	71
J-17	5,554.77	0	5,718.95	71
J-18	5,554.33	0	5,718.95	71
J-19	5,547.05	0	5,719.05	74
J-20	5,544.10	0	5,719.01	76
J-21	5,541.87	6	5,718.99	77
J-22	5,538.97	0	5,718.94	78
J-23	5,535.95	0	5,718.92	79
J-24	5,526.01	0	5,718.88	83
J-25	5,521.46	0	5,718.88	85
J-26	5,524.45	3	5,718.88	84
J-27	5,528.76	0	5,718.89	82
J-28	5,536.15	0	5,718.90	79
J-29	5,538.19	0	5,718.90	78
J-30	5,534.24	5	5,718.89	80
J-31	5,542.38	0	5,718.93	76
J-32	5,544.28	0	5,718.94	76
J-33	5,550.38	5	5,718.95	73
J-34	5,546.36	0	5,718.89	75
J-35	5,536.66	9	5,718.88	79
J-36	5,538.16	6	5,718.87	78
J-37	5,543.80	0	5,718.87	76
J-38	5,546.60	0	5,718.87	75
J-41	5,551.63	0	5,719.25	73
J-42	5,520.34	0	5,719.45	86
J-43	5,521.76	0	5,719.45	86
J-44	5,524.97	0	5,719.45	84
J-45	5,531.33	2	5,719.45	81
J-46	5,532.83	0	5,719.45	81
J-47	5,517.74	3	5,718.88	87
J-48	5,513.59	0	5,718.88	89

Active Scenario: Max Day

FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)
P-1	75	8.0	Ductile Iron	130.0	5	0.03
P-2	406	8.0	Ductile Iron	130.0	-2	0.01
P-3	97	8.0	Ductile Iron	130.0	-2	0.01
P-4	355	8.0	Ductile Iron	130.0	-74	0.47
P-5	294	8.0	Ductile Iron	130.0	-18	0.11
P-6	190	8.0	Ductile Iron	130.0	16	0.10
P-7	184	8.0	Ductile Iron	130.0	3	0.02
P-8	155	8.0	Ductile Iron	130.0	3	0.02
P-9	313	8.0	Ductile Iron	130.0	22	0.14
P-10	294	8.0	Ductile Iron	130.0	23	0.15
P-11	104	8.0	Ductile Iron	130.0	14	0.09
P-12	504	8.0	Ductile Iron	130.0	-5	0.03
P-13	198	8.0	Ductile Iron	130.0	0	0.00
P-14	351	8.0	Ductile Iron	130.0	-5	0.03
P-15	246	8.0	Ductile Iron	130.0	-33	0.21
P-16	152	8.0	Ductile Iron	130.0	-51	0.32
P-17	250	8.0	Ductile Iron	130.0	-77	0.49
P-18	64	8.0	Ductile Iron	130.0	-77	0.49
P-19	33	8.0	Ductile Iron	130.0	-77	0.49
P-20	306	8.0	Ductile Iron	130.0	-120	0.77
P-21	123	8.0	Ductile Iron	130.0	117	0.75
P-22	88	8.0	Ductile Iron	130.0	117	0.75
P-23	170	8.0	Ductile Iron	130.0	100	0.64
P-24	195	8.0	Ductile Iron	130.0	62	0.39
P-25	369	8.0	Ductile Iron	130.0	62	0.39
P-26	116	8.0	Ductile Iron	130.0	6	0.04
P-27	183	8.0	Ductile Iron	130.0	6	0.04
P-28	322	8.0	Ductile Iron	130.0	-3	0.02
P-29	203	8.0	Ductile Iron	130.0	-12	0.08
P-30	138	8.0	Ductile Iron	130.0	-12	0.08
P-31	203	8.0	Ductile Iron	130.0	-34	0.21
P-32	91	8.0	Ductile Iron	130.0	-34	0.21
P-33	252	8.0	Ductile Iron	130.0	34	0.22
P-34	251	8.0	Ductile Iron	130.0	19	0.12
P-35	270	8.0	Ductile Iron	130.0	-68	0.43
P-36	123	8.0	Ductile Iron	130.0	-30	0.19
P-37	282	8.0	Ductile Iron	130.0	-30	0.19
P-38	151	8.0	Ductile Iron	130.0	-43	0.27
P-39	253	8.0	Ductile Iron	130.0	27	0.17
P-40	400	8.0	Ductile Iron	130.0	27	0.17
P-41	327	8.0	Ductile Iron	130.0	1	0.01
P-42	233	8.0	Ductile Iron	130.0	9	0.06
P-43	139	8.0	Ductile Iron	130.0	-7	0.05
P-44	226	8.0	Ductile Iron	130.0	-7	0.05
P-45	98	8.0	Ductile Iron	130.0	-7	0.05
P-46	293	8.0	Ductile Iron	130.0	20	0.13
P-47	294	8.0	Ductile Iron	130.0	38	0.24
P-48	10	8.0	Ductile Iron	130.0	237	1.51
P-49	180	8.0	Ductile Iron	130.0	237	1.51
P-50	48	8.0	Ductile Iron	130.0	2	0.01

Active Scenario: Max Day

FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)
P-51	44	8.0	Ductile Iron	130.0	2	0.01
P-52	79	8.0	Ductile Iron	130.0	2	0.01
P-53	154	8.0	Ductile Iron	130.0	2	0.01
P-54	49	8.0	Ductile Iron	130.0	-3	0.02
P-55	26	8.0	Ductile Iron	130.0	-3	0.02
P-56	161	8.0	Ductile Iron	130.0	9	0.06
P-57	136	8.0	Ductile Iron	130.0	0	0.00
P-58	11	8.0	Ductile Iron	130.0	0	0.00
P-59	10	8.0	Ductile Iron	130.0	0	0.00
P-60	11	8.0	Ductile Iron	130.0	0	0.00
P-61	11	8.0	Ductile Iron	130.0	0	0.00
P-62	10	8.0	Ductile Iron	130.0	0	0.00
P-63	11	8.0	Ductile Iron	130.0	0	0.00
P-64	12	8.0	Ductile Iron	130.0	0	0.00
P-65	11	8.0	Ductile Iron	130.0	0	0.00
P-66	11	8.0	Ductile Iron	130.0	0	0.00
P-67	13	8.0	Ductile Iron	130.0	0	0.00

Active Scenario: Max Day

FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-1	5,551.52	7	5,718.79	72
J-2	5,545.64	0	5,718.79	75
J-3	5,528.80	0	5,718.84	82
J-4	5,532.51	0	5,718.85	81
J-5	5,530.81	0	5,718.84	81
J-6	5,527.97	0	5,718.84	83
J-7	5,529.09	0	5,718.84	82
J-8	5,532.54	0	5,718.84	81
J-9	5,535.77	0	5,718.83	79
J-10	5,536.88	20	5,718.83	79
J-11	5,544.44	0	5,718.83	75
J-12	5,545.93	0	5,718.83	75
J-13	5,547.84	0	5,718.83	74
J-14	5,549.73	17	5,718.84	73
J-15	5,550.96	0	5,718.85	73
J-16	5,554.48	0	5,718.89	71
J-17	5,554.77	0	5,718.90	71
J-18	5,554.33	0	5,718.91	71
J-19	5,547.05	0	5,719.02	74
J-20	5,544.10	0	5,718.98	76
J-21	5,541.87	17	5,718.95	77
J-22	5,538.97	0	5,718.90	78
J-23	5,535.95	0	5,718.88	79
J-24	5,526.01	0	5,718.84	83
J-25	5,521.46	0	5,718.84	85
J-26	5,524.45	9	5,718.84	84
J-27	5,528.76	0	5,718.84	82
J-28	5,536.15	0	5,718.85	79
J-29	5,538.19	0	5,718.86	78
J-30	5,534.24	15	5,718.85	80
J-31	5,542.38	0	5,718.89	76
J-32	5,544.28	0	5,718.89	76
J-33	5,550.38	13	5,718.90	73
J-34	5,546.36	0	5,718.85	75
J-35	5,536.66	26	5,718.84	79
J-36	5,538.16	16	5,718.83	78
J-37	5,543.80	0	5,718.83	76
J-38	5,546.60	0	5,718.83	75
J-41	5,551.63	0	5,719.25	73
J-42	5,520.34	0	5,719.45	86
J-43	5,521.76	0	5,719.45	86
J-44	5,524.97	0	5,719.45	84
J-45	5,531.33	5	5,719.45	81
J-46	5,532.83	0	5,719.45	81
J-47	5,517.74	9	5,718.84	87
J-48	5,513.59	0	5,718.84	89

Active Scenario: Max Hour

FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)
P-1	75	8.0	Ductile Iron	130.0	8	0.05
P-2	406	8.0	Ductile Iron	130.0	-3	0.02
P-3	97	8.0	Ductile Iron	130.0	-3	0.02
P-4	355	8.0	Ductile Iron	130.0	-50	0.32
P-5	294	8.0	Ductile Iron	130.0	-8	0.05
P-6	190	8.0	Ductile Iron	130.0	21	0.14
P-7	184	8.0	Ductile Iron	130.0	10	0.07
P-8	155	8.0	Ductile Iron	130.0	10	0.07
P-9	313	8.0	Ductile Iron	130.0	23	0.15
P-10	294	8.0	Ductile Iron	130.0	15	0.10
P-11	104	8.0	Ductile Iron	130.0	9	0.06
P-12	504	8.0	Ductile Iron	130.0	-22	0.14
P-13	198	8.0	Ductile Iron	130.0	0	0.00
P-14	351	8.0	Ductile Iron	130.0	-22	0.14
P-15	246	8.0	Ductile Iron	130.0	-14	0.09
P-16	152	8.0	Ductile Iron	130.0	-42	0.27
P-17	250	8.0	Ductile Iron	130.0	-74	0.47
P-18	64	8.0	Ductile Iron	130.0	-74	0.47
P-19	33	8.0	Ductile Iron	130.0	-74	0.47
P-20	306	8.0	Ductile Iron	130.0	-124	0.79
P-21	123	8.0	Ductile Iron	130.0	126	0.80
P-22	88	8.0	Ductile Iron	130.0	126	0.80
P-23	170	8.0	Ductile Iron	130.0	98	0.62
P-24	195	8.0	Ductile Iron	130.0	59	0.38
P-25	369	8.0	Ductile Iron	130.0	59	0.38
P-26	116	8.0	Ductile Iron	130.0	18	0.12
P-27	183	8.0	Ductile Iron	130.0	18	0.12
P-28	322	8.0	Ductile Iron	130.0	4	0.03
P-29	203	8.0	Ductile Iron	130.0	-11	0.07
P-30	138	8.0	Ductile Iron	130.0	-11	0.07
P-31	203	8.0	Ductile Iron	130.0	-30	0.19
P-32	91	8.0	Ductile Iron	130.0	-30	0.19
P-33	252	8.0	Ductile Iron	130.0	38	0.24
P-34	251	8.0	Ductile Iron	130.0	13	0.08
P-35	270	8.0	Ductile Iron	130.0	-67	0.43
P-36	123	8.0	Ductile Iron	130.0	-29	0.18
P-37	282	8.0	Ductile Iron	130.0	-29	0.18
P-38	151	8.0	Ductile Iron	130.0	-50	0.32
P-39	253	8.0	Ductile Iron	130.0	33	0.21
P-40	400	8.0	Ductile Iron	130.0	33	0.21
P-41	327	8.0	Ductile Iron	130.0	-9	0.05
P-42	233	8.0	Ductile Iron	130.0	6	0.04
P-43	139	8.0	Ductile Iron	130.0	-31	0.20
P-44	226	8.0	Ductile Iron	130.0	-31	0.20
P-45	98	8.0	Ductile Iron	130.0	-31	0.20
P-46	293	8.0	Ductile Iron	130.0	-39	0.25
P-47	294	8.0	Ductile Iron	130.0	39	0.25
P-48	10	8.0	Ductile Iron	130.0	250	1.59
P-49	180	8.0	Ductile Iron	130.0	250	1.59
P-50	48	8.0	Ductile Iron	130.0	2	0.02

Active Scenario: Max Hour

FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)
P-51	44	8.0	Ductile Iron	130.0	2	0.02
P-52	79	8.0	Ductile Iron	130.0	2	0.02
P-53	154	8.0	Ductile Iron	130.0	2	0.02
P-54	49	8.0	Ductile Iron	130.0	-5	0.03
P-55	26	8.0	Ductile Iron	130.0	-5	0.03
P-56	161	8.0	Ductile Iron	130.0	14	0.09
P-57	136	8.0	Ductile Iron	130.0	0	0.00
P-58	11	8.0	Ductile Iron	130.0	0	0.00
P-59	10	8.0	Ductile Iron	130.0	0	0.00
P-60	11	8.0	Ductile Iron	130.0	0	0.00
P-61	11	8.0	Ductile Iron	130.0	0	0.00
P-62	10	8.0	Ductile Iron	130.0	0	0.00
P-63	11	8.0	Ductile Iron	130.0	0	0.00
P-64	12	8.0	Ductile Iron	130.0	0	0.00
P-65	11	8.0	Ductile Iron	130.0	0	0.00
P-66	11	8.0	Ductile Iron	130.0	0	0.00
P-67	13	8.0	Ductile Iron	130.0	0	0.00

Active Scenario: Max Hour

FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-1	5,551.52	11	5,718.79	72
J-2	5,545.64	0	5,718.79	75
J-3	5,528.80	0	5,718.81	82
J-4	5,532.51	0	5,718.82	81
J-5	5,530.81	0	5,718.81	81
J-6	5,527.97	0	5,718.81	83
J-7	5,529.09	0	5,718.81	82
J-8	5,532.54	0	5,718.81	81
J-9	5,535.77	0	5,718.80	79
J-10	5,536.88	31	5,718.80	79
J-11	5,544.44	0	5,718.81	75
J-12	5,545.93	0	5,718.81	75
J-13	5,547.84	0	5,718.82	74
J-14	5,549.73	28	5,718.82	73
J-15	5,550.96	0	5,718.83	73
J-16	5,554.48	0	5,718.86	71
J-17	5,554.77	0	5,718.87	71
J-18	5,554.33	0	5,718.88	71
J-19	5,547.05	0	5,718.99	74
J-20	5,544.10	0	5,718.95	76
J-21	5,541.87	28	5,718.91	77
J-22	5,538.97	0	5,718.87	78
J-23	5,535.95	0	5,718.85	79
J-24	5,526.01	0	5,718.81	83
J-25	5,521.46	0	5,718.81	85
J-26	5,524.45	15	5,718.81	84
J-27	5,528.76	0	5,718.81	82
J-28	5,536.15	0	5,718.82	79
J-29	5,538.19	0	5,718.82	78
J-30	5,534.24	24	5,718.81	80
J-31	5,542.38	0	5,718.86	76
J-32	5,544.28	0	5,718.86	76
J-33	5,550.38	21	5,718.87	73
J-34	5,546.36	0	5,718.82	75
J-35	5,536.66	41	5,718.81	79
J-36	5,538.16	36	5,718.80	78
J-37	5,543.80	0	5,718.81	76
J-38	5,546.60	0	5,718.81	75
J-41	5,551.63	0	5,719.25	73
J-42	5,520.34	0	5,719.45	86
J-43	5,521.76	0	5,719.45	86
J-44	5,524.97	0	5,719.45	84
J-45	5,531.33	8	5,719.45	81
J-46	5,532.83	0	5,719.45	81
J-47	5,517.74	14	5,718.81	87
J-48	5,513.59	0	5,718.81	89

Fire Flow Node FlexTable: Fire Flow Results Table

Label	Satisfies Fire Flow Constraints?	Fire Flow (Needed) (gpm)	Flow (Total Needed) (gpm)	Flow (Total Available) (gpm)	Pressure (Calculated Residual) (psi)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Pipe w/ Maximum Velocity	Velocity of Maximum Pipe (ft/s)
H-1	True	1,500	1,500	1,500	80	70	H-10	P-56	9.63
H-2	True	1,500	1,500	1,500	83	71	H-10	P-58	9.57
H-3	True	1,500	1,500	1,500	81	70	H-10	P-60	9.57
H-4	True	1,500	1,500	1,500	77	70	H-10	P-61	9.57
H-5	True	1,500	1,500	1,500	77	70	H-10	P-62	9.57
H-6	True	1,500	1,500	1,500	72	71	H-10	P-48	10.03
H-7	True	1,500	1,500	1,500	74	71	H-10	P-65	9.57
H-8	True	1,500	1,500	1,500	74	70	H-10	P-64	9.57
H-9	True	1,500	1,500	1,500	73	70	H-10	P-63	9.57
H-10	True	1,500	1,500	1,500	69	69	J-17	P-67	9.57

APPENDIX C - SANITARY SEWER SYSTEM CALCULATIONS

CAGE CIVIL ENGINEERING

SANITARY SEWER DEMAND CALCULATIONS

PROJECT: TAH Filing No. 17
DATE: 1/11/2021
BY: Eric Pearson

POPULATION DENSITY		
Multi-Family		People per Unit
Single-Family	2.77	People per Unit
Age Restricted	2.77	People per Unit
Average Flow Generation	68	gpcpd

COMMERCIAL / SCHOOLS / INDUSTRIAL			
	Commercial	Schools / Industrial	
Average Flow Generation	1500	1200	gpd/acre
	0.0023213	0.00185704	gpd/acre
Equivalent Population	22	18	capita/acre

PEAKING FACTOR			
PF = 5/(p^0.167)	Where p = Population in thousands		
Min. PF =	1.7	Max PF =	4

Basin	Design Point	Notes	RESIDENTIAL SINGLE FAMILY: No. of Units	No. of Acres	Population Density (people/unit)	Equivalent Population	Average Flow Generation (gpcpd)	Average Day Flow (mgd)	Infil. @ 10% (mgd)	COMMERCIAL / SCHOOLS / INDUSTRIAL: Land Use	Total Acres	Population Density	Equivalent Population	Average Flow Generation (gpd/care)	Average Day Flow (mgd)	Infil. @ 10% (mgd)	CUMMULATIVE TOTALS: Cummulative Population	Peak Factor	Peak Flow (mgd)	Peak Flow + Infil. (mgd)	Estimated Pipe Slope (%)	Estimated Size at Given Slope	Pipe Velocity (ft/sec)	Percent Full at given Slope
TAH Subdivision Filing No. 7																								
1	1		32	N/A	2.77	89	68	0.006	0.001								89	4.0	0.02	0.02	0.5	8	2.24	25.2%
2	2		30	N/A	2.77	83	68	0.006	0.001								83	4.0	0.02	0.02	1.0	8	1.16	2.5%
3	3		47	N/A	2.77	130	68	0.009	0.001								130	4.0	0.04	0.04	1.0	8	0.97	3.4%
4	4		12	N/A	2.77	33	68	0.002	0.000								33	4.0	0.01	0.01	0.9	8	2.06	13.6%
5			36	N/A	2.77	100	68	0.007	0.001								100	4.0	0.03	0.03				
6	5		16	N/A	2.77	44	68	0.003	0.000								44	4.0	0.01	0.01				
7			24	N/A	2.77	66	68	0.005	0.000								66	4.0	0.02	0.02				
	6	Sum of Basins 6 & 7	40	N/A	2.77	111	68	0.008	0.001								111	4.0	0.03	0.03	0.4	8	2.2	36.3%
8			32	N/A	2.77	89	68	0.006	0.001								89	4.0	0.02	0.02	1.0	8	1.16	2.5%
	7	Sum of Basins 1, 2, 3, 4, 5, 6, 7, & 8	229	N/A	2.77	634	68	0.043	0.004								634	4.0	0.17	0.18				
9	8		13	N/A	2.77	36	68	0.002	0.000								36	4.0	0.01	0.01	0.4	8	2.27	38.0%
10	9		17	N/A	2.77	47	68	0.003	0.000								47	4.0	0.01	0.01	0.4	10	2.92	52.1%
11	10		9	N/A	2.77	25	68	0.002	0.000								25	4.0	0.01	0.01				
12			16	N/A	2.77	44	68	0.003	0.000								44	4.0	0.01	0.01				
	11	Sum of Basins 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, & 12	284	N/A	2.77	787	68	0.053	0.005								787	4.0	0.21	0.22	0.6	8	2.15	18.4%
	Design Point Total		**284**	**N/A**	**2.77**	**787**	**68**	**0.053**	**0.005**								**787**	**4.0**	**0.21**	**0.22**	**0.4**	**12**	**2.15**	**18.4%**

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jan 19 2022

DP 1

Circular

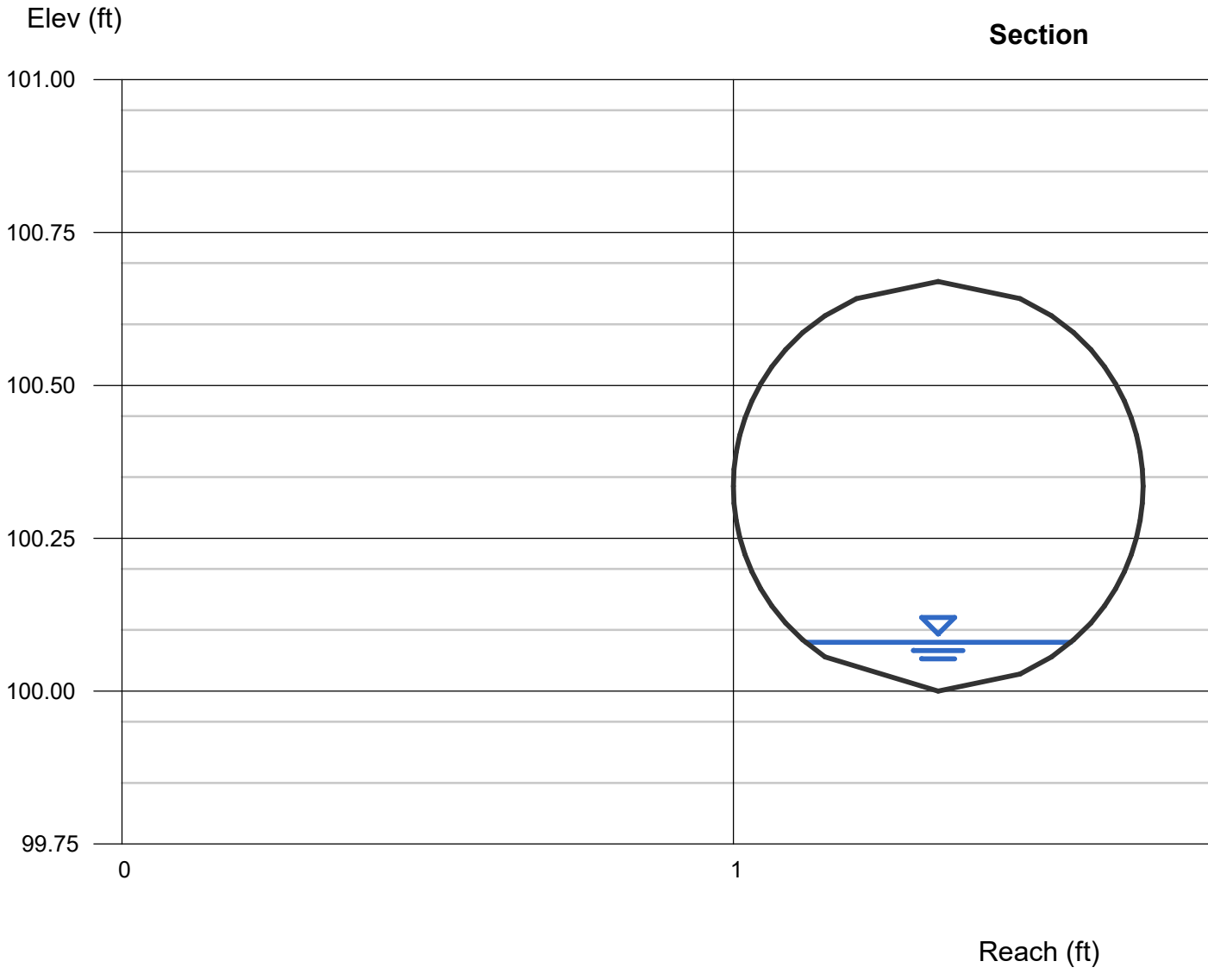
Diameter (ft)	= 0.67
Invert Elev (ft)	= 100.00
Slope (%)	= 1.13
N-Value	= 0.011

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.04

Highlighted

Depth (ft)	= 0.08
Q (cfs)	= 0.040
Area (sqft)	= 0.02
Velocity (ft/s)	= 1.65
Wetted Perim (ft)	= 0.48
Crit Depth, Yc (ft)	= 0.09
Top Width (ft)	= 0.44
EGL (ft)	= 0.12



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jan 19 2022

DP 2

Circular

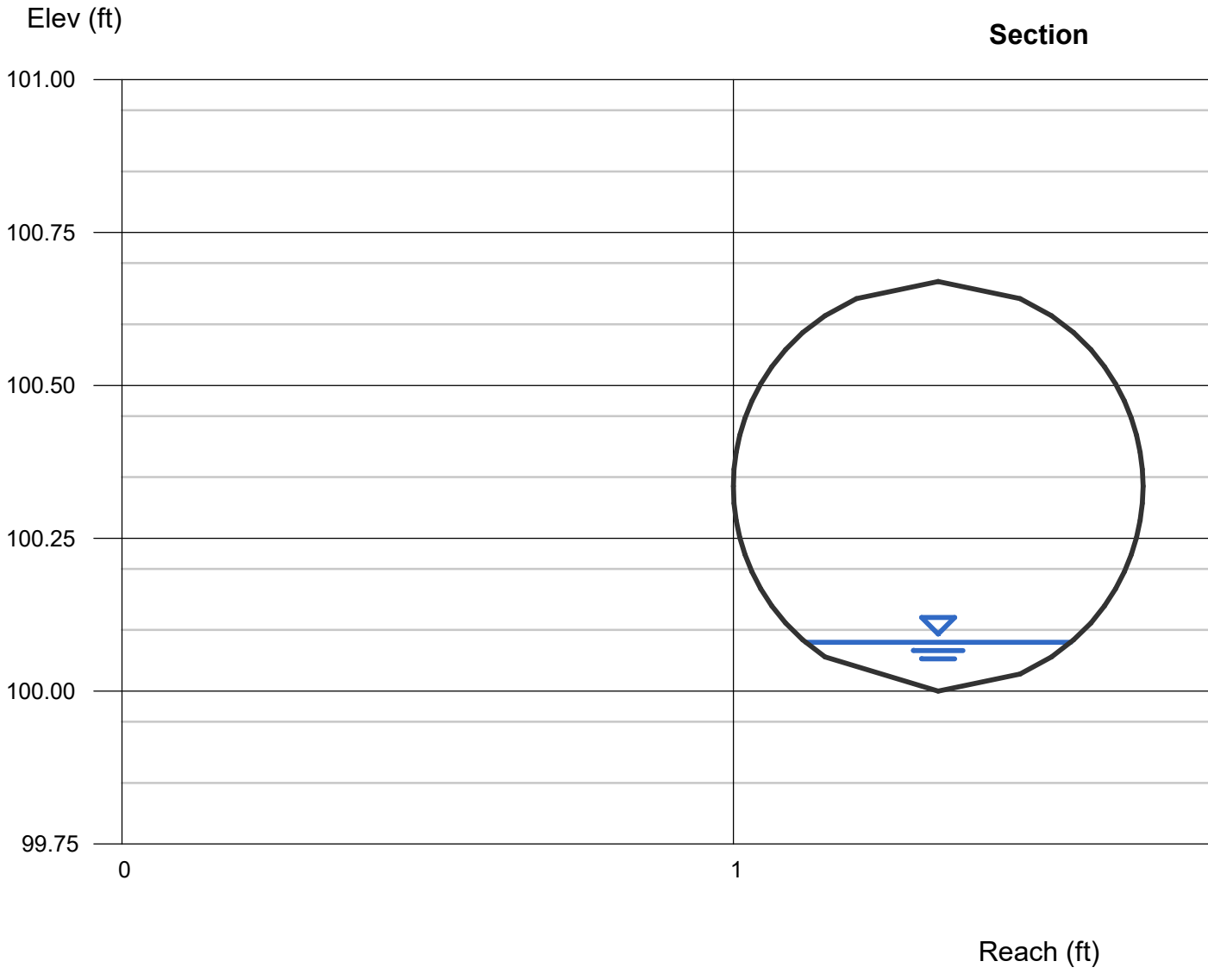
Diameter (ft)	= 0.67
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.011

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.04

Highlighted

Depth (ft)	= 0.08
Q (cfs)	= 0.040
Area (sqft)	= 0.02
Velocity (ft/s)	= 1.65
Wetted Perim (ft)	= 0.48
Crit Depth, Yc (ft)	= 0.09
Top Width (ft)	= 0.44
EGL (ft)	= 0.12



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jan 19 2022

DP 3

Circular

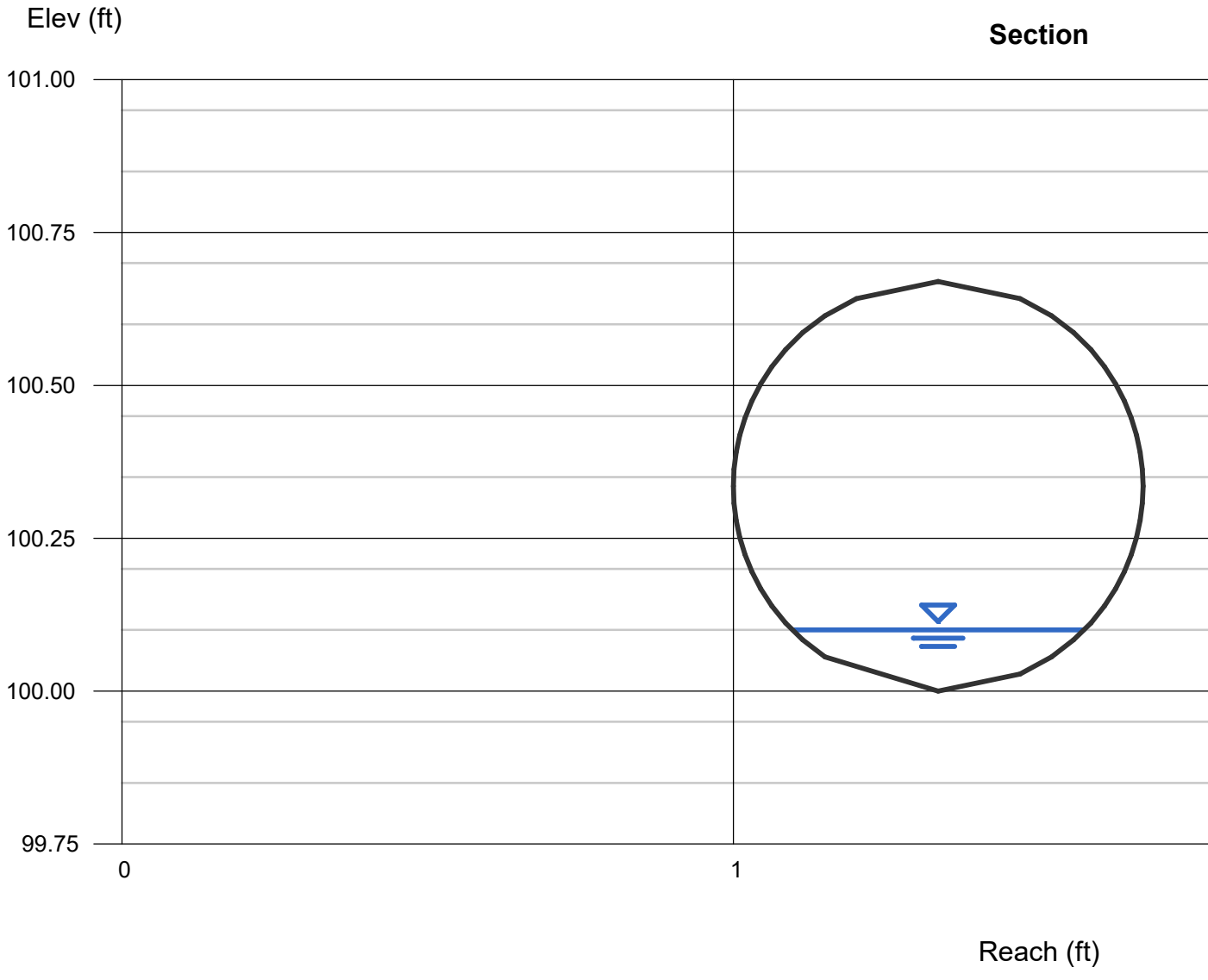
Diameter (ft)	= 0.67
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.011

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.06

Highlighted

Depth (ft)	= 0.10
Q (cfs)	= 0.060
Area (sqft)	= 0.03
Velocity (ft/s)	= 1.81
Wetted Perim (ft)	= 0.53
Crit Depth, Yc (ft)	= 0.12
Top Width (ft)	= 0.48
EGL (ft)	= 0.15



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jan 19 2022

DP 4

Circular

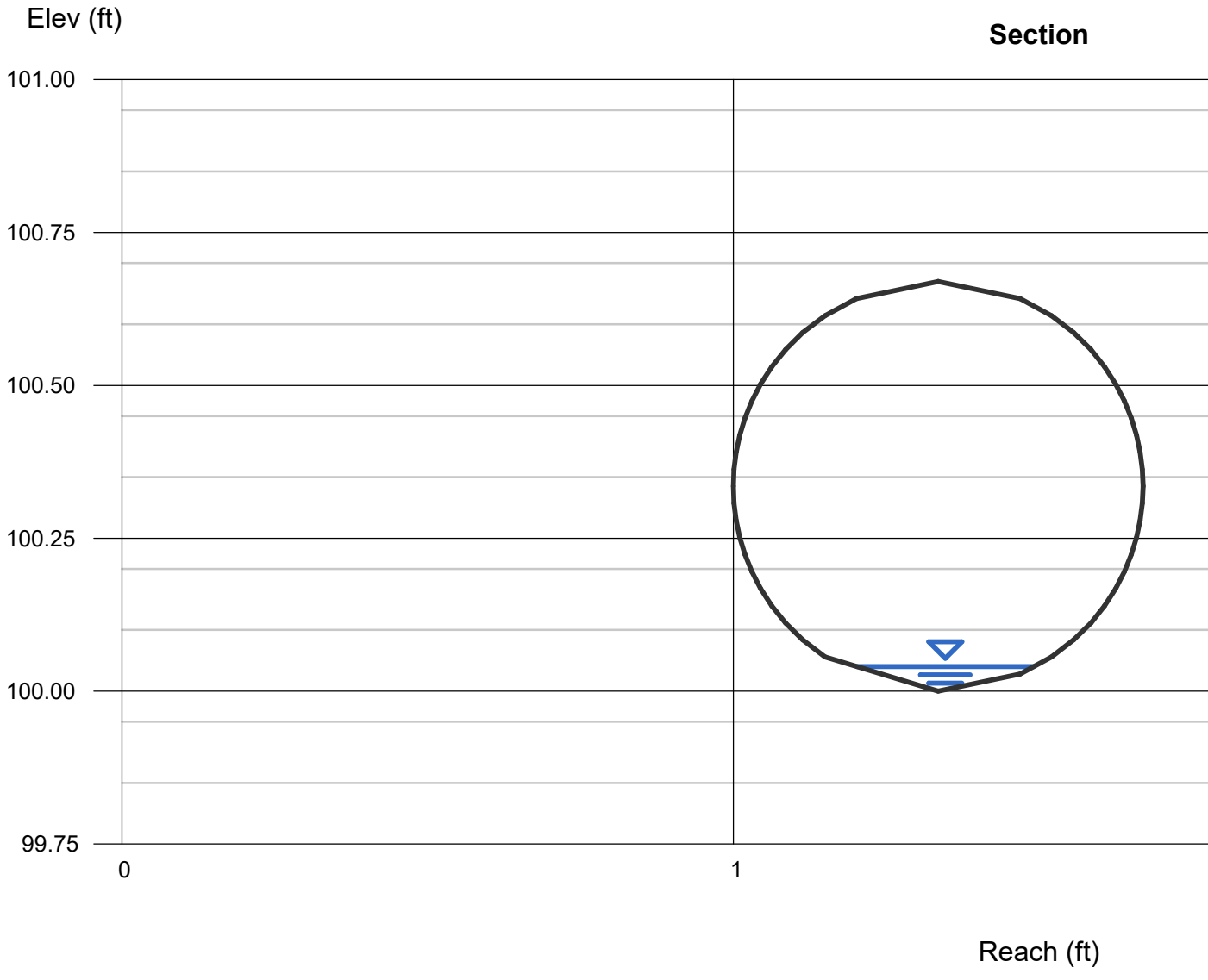
Diameter (ft)	= 0.67
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.011

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.01

Highlighted

Depth (ft)	= 0.04
Q (cfs)	= 0.010
Area (sqft)	= 0.01
Velocity (ft/s)	= 1.16
Wetted Perim (ft)	= 0.33
Crit Depth, Yc (ft)	= 0.05
Top Width (ft)	= 0.32
EGL (ft)	= 0.06



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jan 19 2022

DP 5

Circular

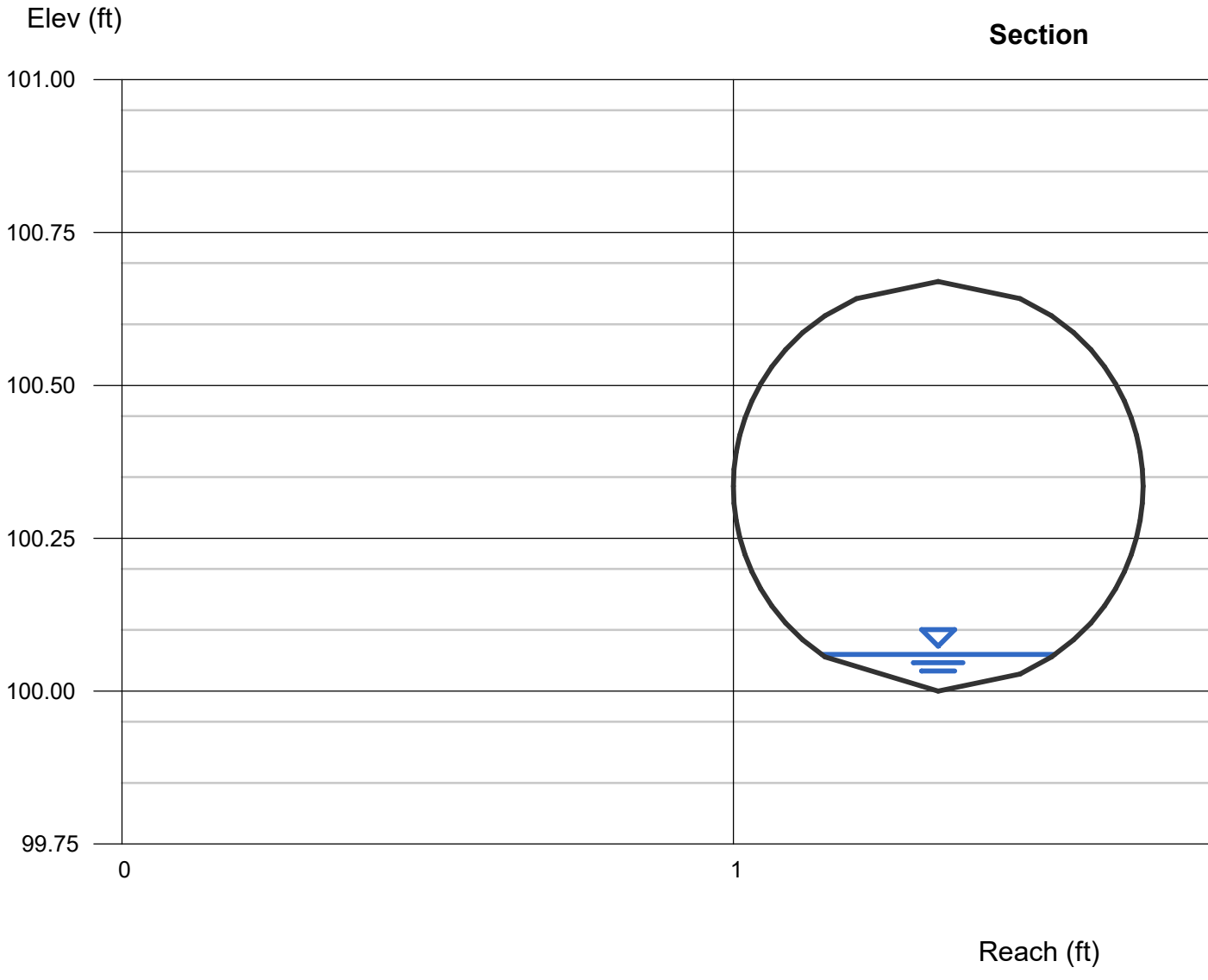
Diameter (ft)	= 0.67
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.011

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.02

Highlighted

Depth (ft)	= 0.06
Q (cfs)	= 0.020
Area (sqft)	= 0.02
Velocity (ft/s)	= 1.27
Wetted Perim (ft)	= 0.41
Crit Depth, Yc (ft)	= 0.07
Top Width (ft)	= 0.38
EGL (ft)	= 0.09



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jan 19 2022

DP 6

Circular

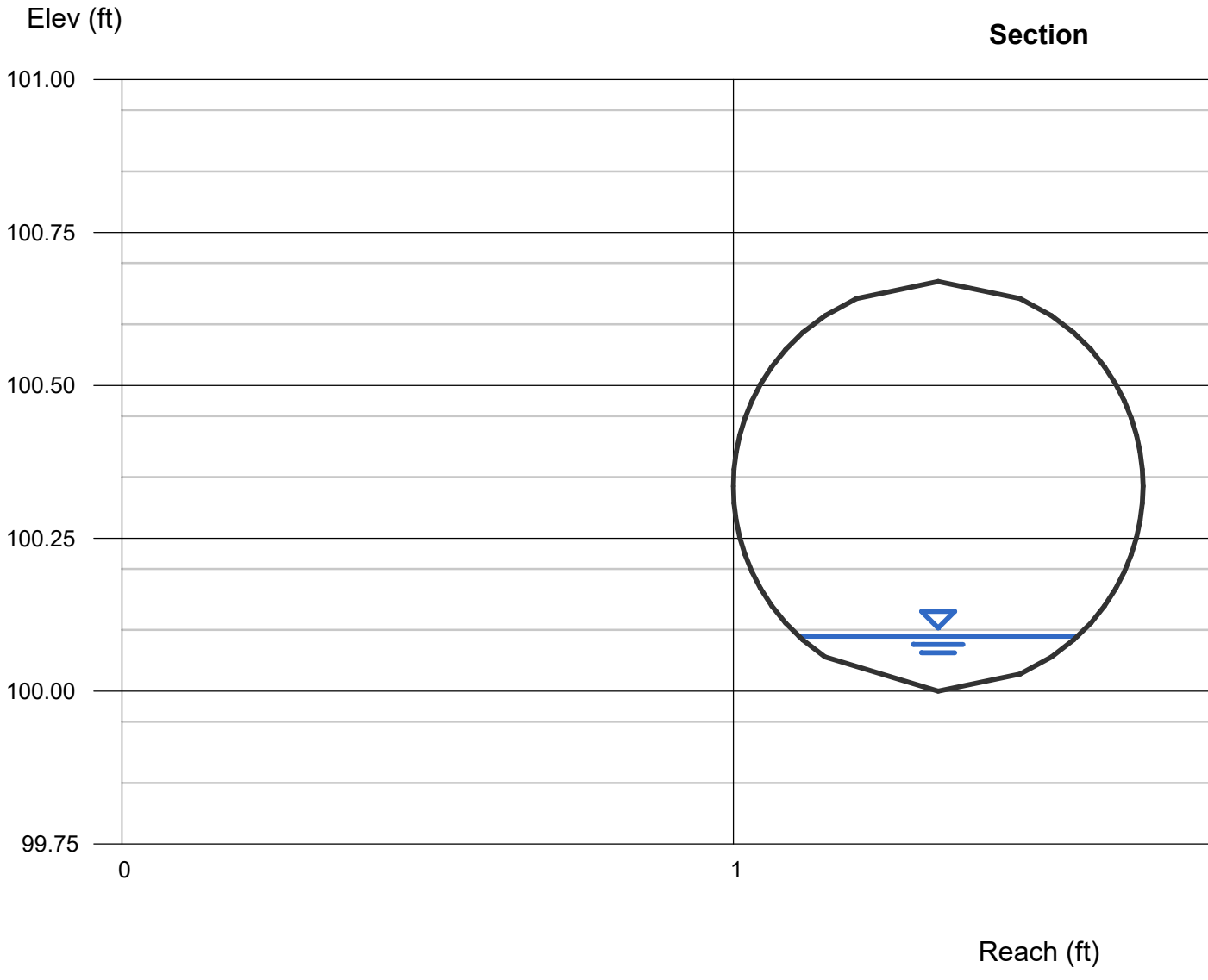
Diameter (ft)	= 0.67
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.011

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.05

Highlighted

Depth (ft)	= 0.09
Q (cfs)	= 0.050
Area (sqft)	= 0.03
Velocity (ft/s)	= 1.74
Wetted Perim (ft)	= 0.51
Crit Depth, Yc (ft)	= 0.11
Top Width (ft)	= 0.46
EGL (ft)	= 0.14



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jan 19 2022

DP 7

Circular

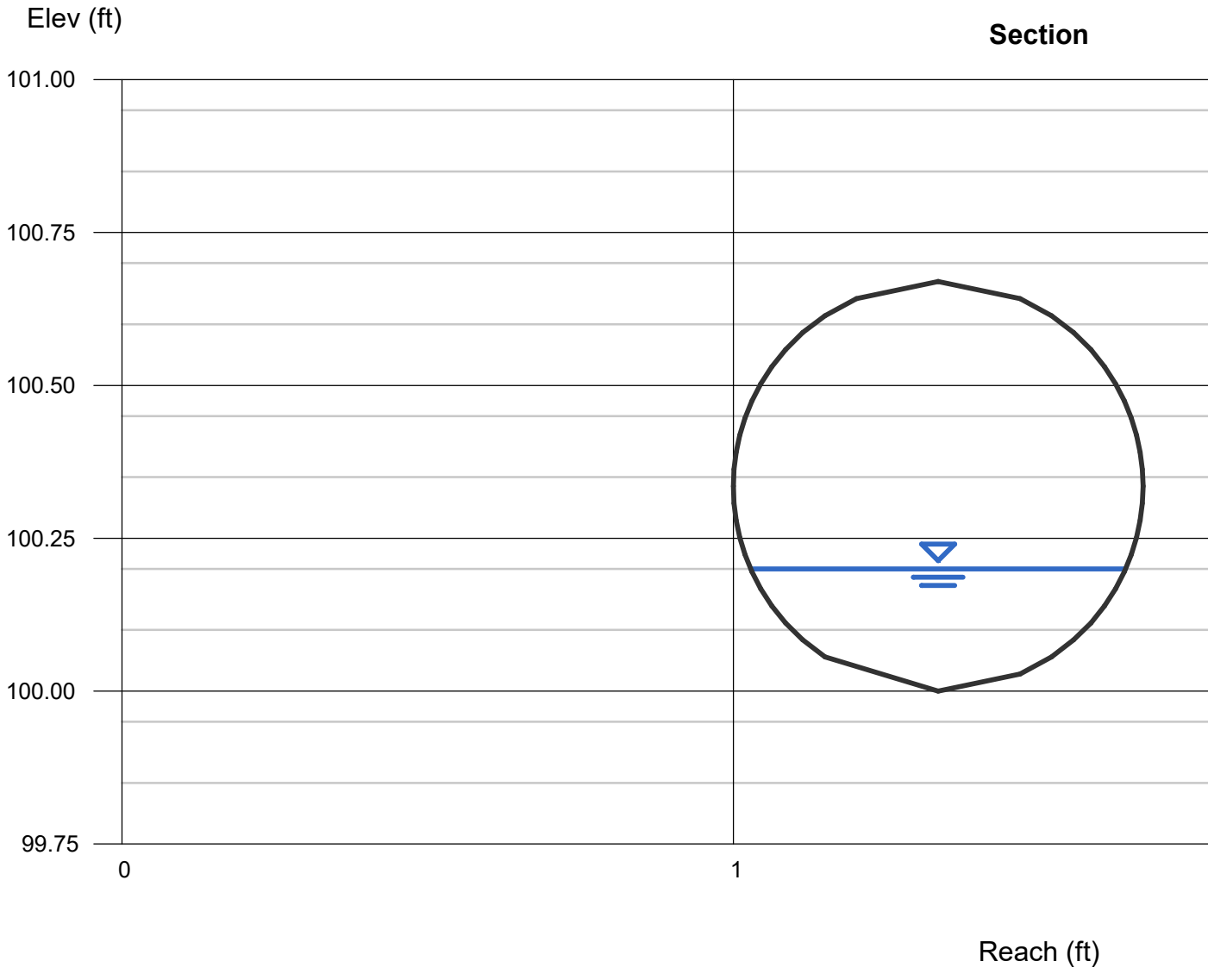
Diameter (ft)	= 0.67
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.011

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.27

Highlighted

Depth (ft)	= 0.20
Q (cfs)	= 0.270
Area (sqft)	= 0.09
Velocity (ft/s)	= 3.03
Wetted Perim (ft)	= 0.78
Crit Depth, Yc (ft)	= 0.24
Top Width (ft)	= 0.61
EGL (ft)	= 0.34



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jan 19 2022

DP 8

Circular

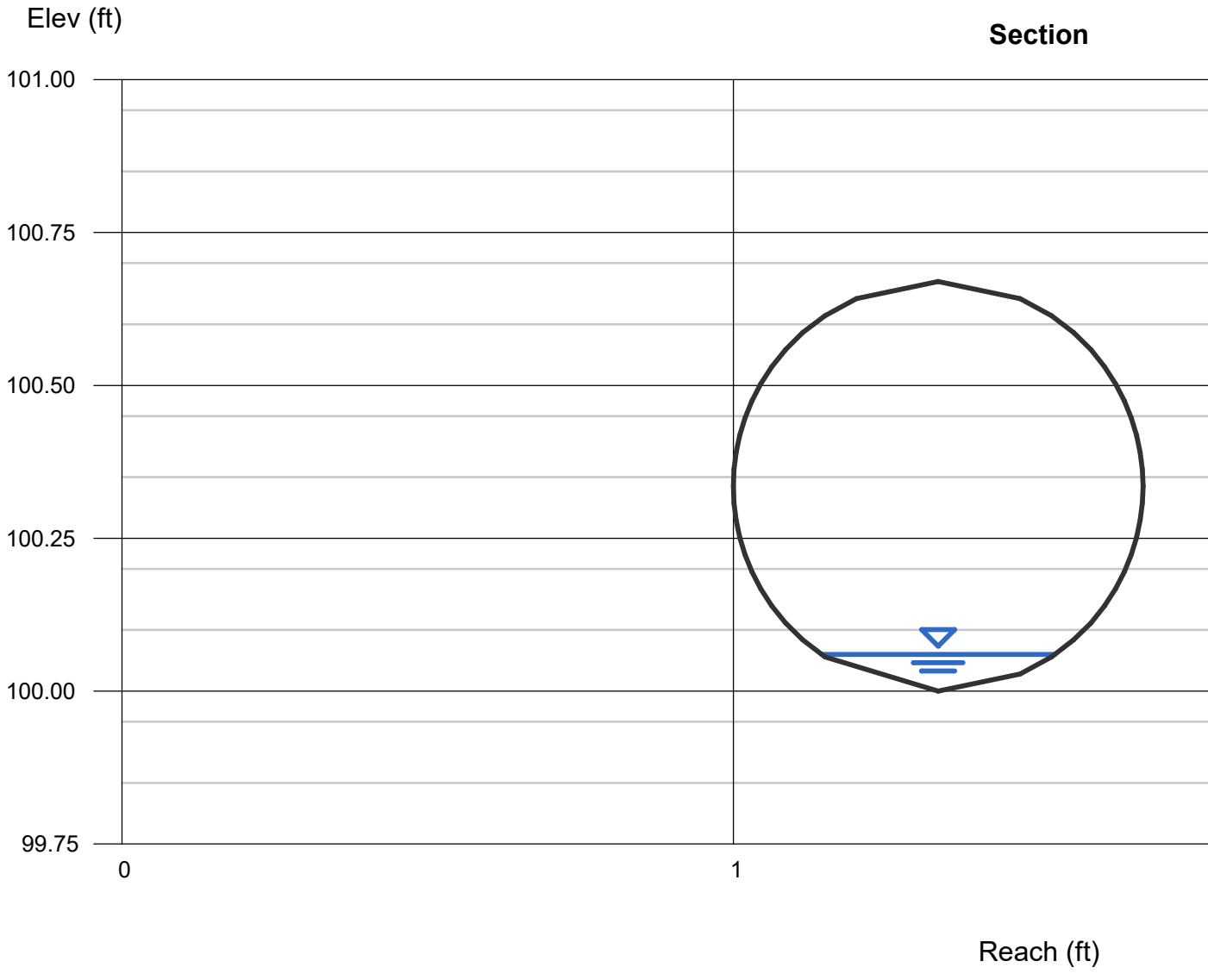
Diameter (ft)	= 0.67
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.011

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.02

Highlighted

Depth (ft)	= 0.06
Q (cfs)	= 0.020
Area (sqft)	= 0.02
Velocity (ft/s)	= 1.27
Wetted Perim (ft)	= 0.41
Crit Depth, Yc (ft)	= 0.07
Top Width (ft)	= 0.38
EGL (ft)	= 0.09



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jan 19 2022

DP 9

Circular

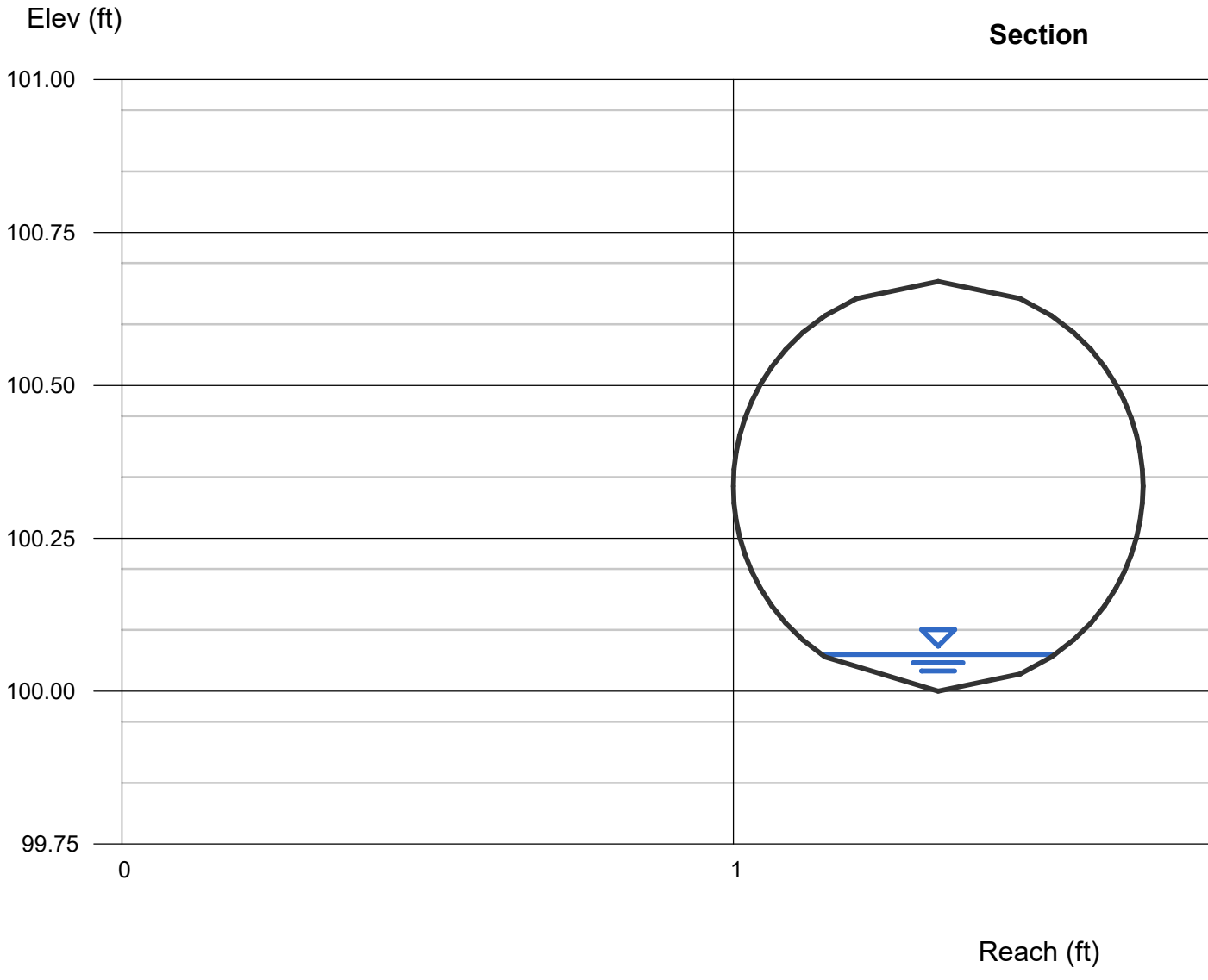
Diameter (ft)	= 0.67
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.011

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.02

Highlighted

Depth (ft)	= 0.06
Q (cfs)	= 0.020
Area (sqft)	= 0.02
Velocity (ft/s)	= 1.27
Wetted Perim (ft)	= 0.41
Crit Depth, Yc (ft)	= 0.07
Top Width (ft)	= 0.38
EGL (ft)	= 0.09



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jan 19 2022

DP 10

Circular

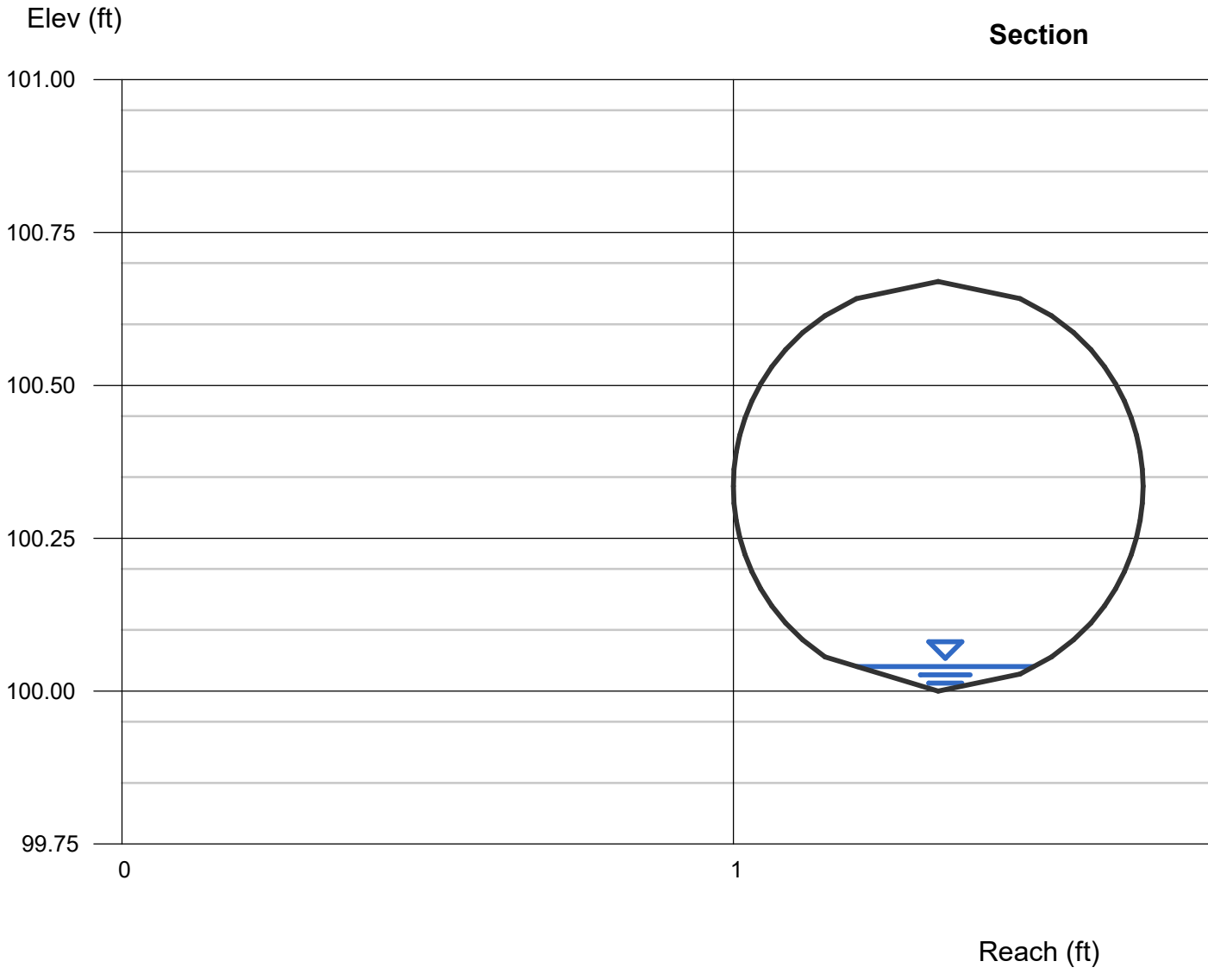
Diameter (ft)	= 0.67
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.011

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.01

Highlighted

Depth (ft)	= 0.04
Q (cfs)	= 0.010
Area (sqft)	= 0.01
Velocity (ft/s)	= 1.16
Wetted Perim (ft)	= 0.33
Crit Depth, Yc (ft)	= 0.05
Top Width (ft)	= 0.32
EGL (ft)	= 0.06



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jan 19 2022

DP 11

Circular

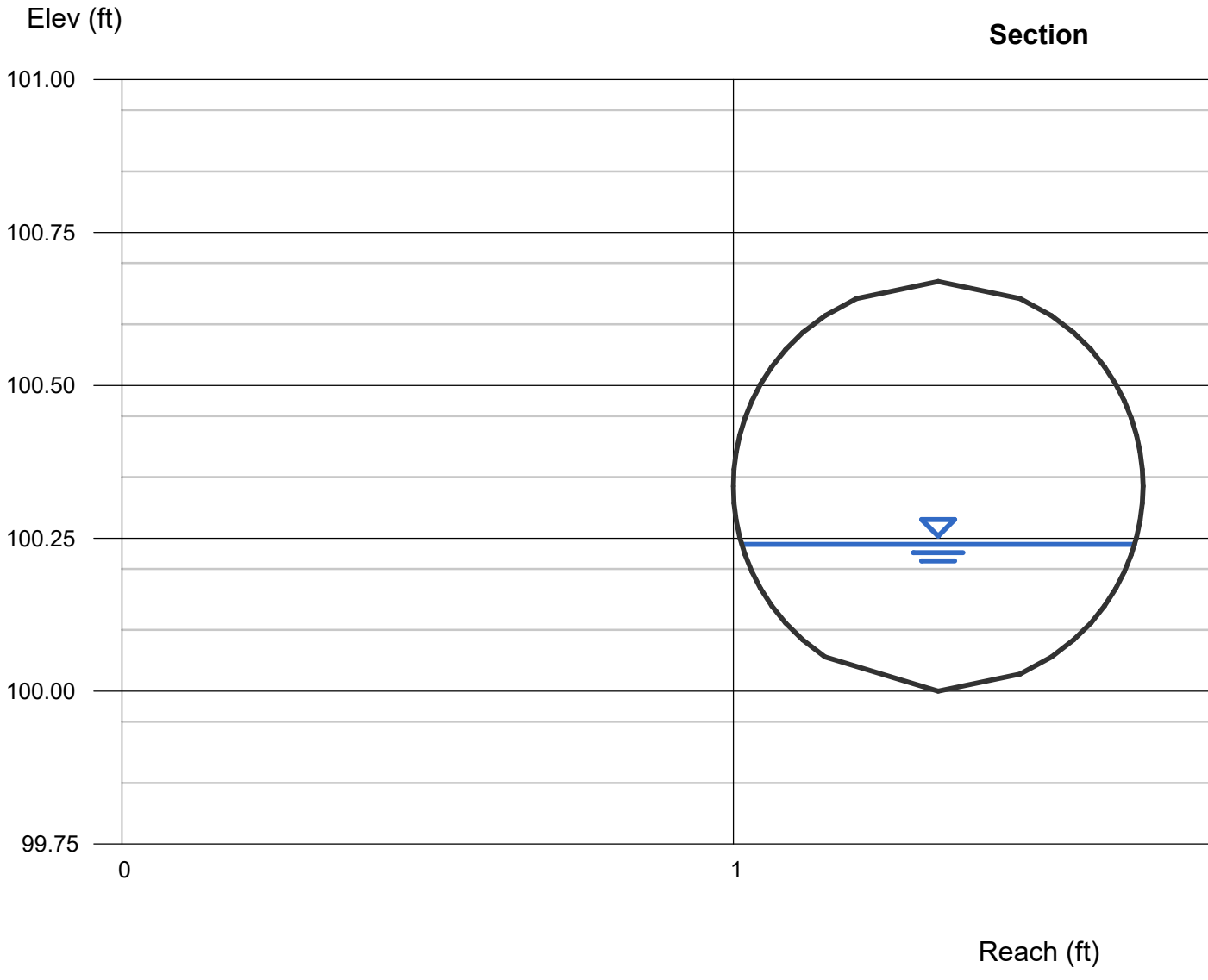
Diameter (ft)	= 0.67
Invert Elev (ft)	= 100.00
Slope (%)	= 0.83
N-Value	= 0.011

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.34

Highlighted

Depth (ft)	= 0.24
Q (cfs)	= 0.340
Area (sqft)	= 0.11
Velocity (ft/s)	= 2.99
Wetted Perim (ft)	= 0.86
Crit Depth, Yc (ft)	= 0.27
Top Width (ft)	= 0.64
EGL (ft)	= 0.38



APPENDIX D - REFERENCES

Aurora Water
City of Aurora
Planning and Engineering
15151 E. Alameda Parkway, Suite 3600
Aurora, Colorado 80012
303.739.7370
Worth Discovering • auroragov.org

Master Utility Design Criteria for Water and Sanitary Sewer

2020

Water System Design Criteria

Water Demand per Zoning Classification

Residential

The residential (single family and multifamily) water use demands will be calculated using the information in **Table 1**.

Table 1. Residential Water Use Criteria

Zoning	People per Unit	Average Day Per Capita Flow (gpd)
Residential	2.77	101

Peaking factors for residential are:

- Max Day/Average Day = 2.8
- Max Hour/Average Day = 4.5

Non-Residential

Water use criteria for commercial and industrial land use types and parks and greenbelts are shown in **Table 2**.

Table 2. Non-Residential Water Use Criteria

Zoning	Average Day (gpd/acre)	Max Day (gpd/acre)	Max Hour (gpd/acre)
Commercial	1,500	4,200	6,750
Industrial (including schools)	1,200	3,360	5,400
Parks & Greenbelts	1,800	5,040	N/A

Fire Flow Criteria

The system shall be analyzed to meet the maximum day plus fire flow demand (as determined by ISO criteria) with a residual pressure of no less than 20 psi at any point in the water distribution system. The fire flow demands by land use type are shown in **Table 3**.

Table 3. Fire Flow Demands

Use Classification	Fire Flow Demand
Residential	1,500 gpm for 2 hrs
Commercial/Multifamily	2,500 gpm for 2 hrs
Industrial	3,500 gpm for 3 hrs

Max Hour Velocity and Head Loss Criteria

The maximum pipe velocity and head loss criteria during peak hour conditions are shown in **Table 4**.

Table 4. Max Hour Head Loss and Velocity Requirements

Pipe Diameter (in)	Max Velocity (fps)	Head Loss Not to Exceed (ft / 1,000 ft)
6	2.5	5
8 to 12	3	5
16 to 24	4.5	5
>24	7.8	4

Sanitary Sewer System Design Criteria

Recommended Sewer Loading Rates for Different Types of Developments

Residential

The residential sewer loading rate that will be used in the Spec Book is shown in **Table 5** below.

Table 5. Residential Sewer Loading Criteria

Zoning	People per Unit	Loading Rate (gpcd)
Residential	2.77	68

Non-Residential

The commercial, industrial, and parks sanitary sewer loading criteria are shown in **Table 6**.

Table 6. Non-Residential Sewer Loading Criteria

Zoning	Average Day (gpd/acre)	Equivalent Population per Acre
Commercial	1,500	22
Industrial (including schools)	1,200	18

Peak Flow Calculations

Peak flow is determined by the following equation:

$$5 / p^{0.167} \text{ where } p = \text{population in thousands}$$

Maximum Peaking Factor= 4, Minimum Peaking Factor = 1.7

Velocities

Velocities shall not exceed 10 ft/s flowing full or 10 ft/s flowing half full using Manning's formula and (n_{PVC} = 0.011, n_{VCP} = 0.013, n_{RCP} = 0.013)

Minimum slope = 0.4% with a minimum velocity of 2 feet per second at least once per day

Depth of Flow

Depth of flow in pipes shall not exceed the following:

- 75% for pipes 12" and smaller
- 80% for pipes larger than 12"

Inflow and Infiltration

Add 10% Inflow and Infiltration to the average flow (do not peak).