Ward Engineering Group
Planning • Engineering • Surveying
231 West 800 South, Suite A Salt Lake City, UT 84101
Phone: 801.487.8040 Fax: 801.487.8668
www.wardeg.com

January 23, 2023

John Mackey, Engineering Manager
Utah Department of Environmental Quality,
Division of Water Quality
Multi – Agency State Office Building
195 North 1950 West
Salt Lake City, UT

Project: Sagewood Drive to Erda Way Trunk Sewer Line, Within the Erda Sewer Service Area – Served by Stansbury Park Improvement District

Attachments: Hydraulic Calculations
Growth Projections
Erda Area Sewer Master Plan, Sheet 01
Erda Area Sewer Master Plan (The Project), Sheet 02
Stansbury park-Erda-Tooele Boundaries, Sheet 03

Appendix A: Construction Permit for West Erda Regional Interceptor Sewer Line
Appendix B: Pipe Capacity Worksheets

Mr. Mackey:

Thank you for your review and consideration of this project. Below is a brief description of the project and the basis of the line sizes established in the construction plans submitted.

Background

In 2019, the Utah Division of Water Quality (DWQ) approved and permitted the Tooele County Regional Sewer Project, referred to as *West Erda Region Interceptor Sewer*. At the time, Tooele County initiated the sewer project to serve the anticipated needs of the Erda West and Central Regions. A copy of DWQ's construction permit, together with the Erda Area Sewer Master Plan, is provided as Appendix A. Due to annexation activity within the Erda West Region (i.e. multiple property owners have annexed and/or have active annexation applications with Grantsville City), Tooele County canceled the Interceptor Sewer Line Construction project, and no portion of it was constructed. Additionally, a significant land developer within the Erda Central Region withdrew its development permits with Tooele County, thus further diminishing the need to move forward with the approved construction project.

In 2022, Erda City incorporated within the "project area" of Tooele County, constituting a major portion of the master planned Erda Sewer Service Area. Sheet 01 shows the recently incorporated boundary of Erda City. Along with the City's incorporation came a new development application, and an annexation petition by Oquirrh Point Development (Developer) to Stansbury Park

Improvement District (SPID). SPID's Board of Trustees has authorized the Developer to proceed with the annexation process, and issued a Letter of Intent to serve. The Oquirrh Point development area consists of 73.88 acres, falling on the south end of both the East Erda Region and the Central Erda Region, consisting of an estimated 1,588 Equivalent Residential Units (ERUs). Sheets 01 and 02 illustrate the location and relative size of the Oquirrh Point development area.

As a condition of annexation, the Developer is required by SPID to upsize the Sagewood Drive to Erda Way Trunk Sewer Line (Project) in order to serve other future development and existing development within Erda City. Over the past several months SPID has worked together with Erda City and the Developer to establish a revised Erda Service Area (within Erda City), that is regional in nature, allowing future development to extend beyond the Oquirrh Point development area, and to provide for future growth and development within Erda City. Sheets 01 and 02 show the extents of the Erda Service Area, for which the Sagewood Drive to Erda Way Trunk Sewer Line Sewer is sized.

Sagewood Drive to Erda Way Trunk Line Sewer

The proposed trunk line, or project, (as designed by Ensign Engineering for construction) runs from the approximate intersection of Erda Way and SR-36 west along Erda Way to Tom's Lane, and north along Tom's Lane to Bates Canyon Road, and west along Bates Canyon Road to future 1200 West, and north on future 1200 West to a temporary connection point within SPID at the existing Sagewood Subdivision at Sagewood Drive (project beginning).

At the present time, sufficient capacity exists within SPID's existing system (at the Sagewood Subdivision Trunk Line No. 7) to permit a temporary connection for the initial phases of the Oquirrh Point development (see Sheet 03). However, this will be permitted by SPID only as a temporary condition.

Future Erda Area Outfall Sewer Line

In the future, an outfall sewer line will need to be constructed from Sagewood Drive to SPID's treatment facility, as was designed for construction under the previous construction permit issued by DWQ (dated April 1, 2019). This outfall sewer line is shown on Sheet 02. It is noted however, that the future outfall sewer line has been revised in diameter from a 36-inch pipeline to a 30-inch pipeline, reflecting a revised/reduced West Erda Region within the Erda Service Area. It is anticipated that the future outfall sewer line design will remain mostly the same and consistent with the construction plans permitted in April 1, 2019, except that the diameter will be revised (refer to Appendix A). At this time the outfall sewer design is not revised and not submitted for review, but will be at a future time. It is shown as part of this submittal for the purposes of master planning and for thoroughness.

Development Process

The Sagewood Drive to Erda Way Trunk Line Sewer project is instigated and paid for by Oquirrh Point Development, including the pipeline upsizing, as identified in the calculations and master plan sheets. The Developer is presently pursuing funding options for reimbursement of the system upsize costs, including a Public Infrastructure District (PID) with Erda City, as well as a conventional Reimbursement Agreement with SPID. At this time, SPID is not entertaining any option for district participation or financing for any portion of the project with future impact fees.

Once the project is constructed and accepted, SPID will own and maintain the sewer trunk line as part of its collection system, which will require annexation of the Oquirrh Point Development (under way), as well as other annexations into SPID as a condition of service within the Erda Service Area. SPID's board of trustees have issued a "will serve" letter to the Developer and continue to coordinate with the Developer and Erda City on the development application process.

Growth & Flow Projections

As depicted on the Service Area Maps (Sheets 01-03), the Erda Service Area and the corresponding sub-regions have been established based on anticipated current development activity and projected development known by Erda City. The sewer trunk line project (and the future outfall sewer line) are sized for the "build-out" conditions of the Erda Service Area. A population projection was calculated (as shown in the attached Population Projections Worksheet). An average growth rate of 2.5% compounded per year was used, typical of long-term growth in Tooele County, with a base density of 4,952 ERUs as a starting point (current population base of Stansbury Park). Build out (and full absorption of connections) within the Service Area is projected to occur in year 2058, or 36 years from the year ending in 2022. Therefore, a 50-year horizon was not considered.

Flow projections are based on current and planned land use and zoning, applying unit demands standard to SPID (300 gallons per day per Equivalent Residential Unit / or ERU).

- Zoning maps, Erda City's Draft General Plan, previous master planning reports, and additional coordination with key members of the Eder City Council were all used in concert to establish the development densities within the Service Area, which was the basis of determining the master planned peak flows.
- SPID's unit average day flow is well established in Stansbury Park Improvement District Adopted Master Plans, and was derived from past flow measurement at the treatment headworks facility.

At build-out conditions, it is projected that there will be a density of 12,450 ERUs within the overall Erda Service Area, with a peak flow of 9,337,500 gallons per day (14.45 CFS), as represented at node J in the attached plan sheets.

Pipe Capacities

Pipe capacity and hydraulic calculations are included. The following parameters and engineering criteria were used.

- Manning's "n" for both proposed PVC and future SaniTite HP pipe = 0.013 (as required by UAC R317-3-2)
- Minimum pipe slopes for the proposed trunk line are based on the design slopes in the submitted construction drawings prepared by Ensign Engineering.
- Minimum pipe slopes for future outfall sewer line are based on the construction drawings prepared by Ward Engineering Group and permitted by DWQ April 1, 2019.
- Peak Factor for the proposed trunk line and the future outfall sewer line = 2.5 (UAC R317-3-2)
- Verification of the proposed trunk line and future outfall sewer Peak Factor was made, applying a population-based equation: $\frac{Q_{ph}}{Q_{avg}} = \frac{18+\sqrt{P}}{4+\sqrt{P}}$, which yields a peak factor of 2.36, where:

  Q_{ph} = Peak Flow at the Peak Hour
  Q_{avg} = Average Flow
  P = Population in (1000x)

- Hydraulic capacity in all pipelines is based on Manning Equation, solving for a standard pipe diameter, using a depth to diameter ratio (d/D) of 0.67
  [Q = (1.49/n)(A)(R) ^ (2/3)(S) ^ (1/2)], where:
  n = manning's number (unitless)
  A = cross sectional area of flow in square feet
  R = hydraulic radius = area / wetted perimeter in ft
  S = pipe slope in ft/ft
- Future connection points (or points of inserted system demands in the capacity model) along the alignment of the sewer lines are estimated based on published topography and basin information as shown on the Service Area Maps, where nodes are identified as A through J. The nodes on the map are correlated to the calucations provided.

Thank you for your consideration and assistance on this project. Please let us know if you need any additional information (bthorpe@wardeg.com or 801-487-8040).

Respectfully,
WARD ENGINEERING GROUP

Brendan Thorpe, P.E.
District Engineer

Stansbury Park Improvement District

_____ _____
Date

By:_____

Erda City Corporation

_____ _____
Date

By:_____

Erda Service Area

Full Region flows

1/19/2023

Mannings (n) = 0.013
Peak Factor = 2.5

Proposed Trunk Lines - Sagewood Drive to Erda Way

Identifier	#ERU @ 300 gpd	Peak Flow (gpd)	Total Flow (cfs)	Designed Pipe Size	Min Pipe Slope Before Next Node	Pipe Flow Capacity (cfs)	ERU Capacity	ERUs Available
A	2500	1875000	2.90	15	0.25%	3.672	3164	664
B	1063	797250	1.23	NA	NA	NA	NA	NA
C	1000	750000	2.39	NA	NA	NA	NA	NA
D	385	288750	0.45	NA	NA	NA	NA	NA
E	1173	879750	4.26	18	0.36%	7.165	6174	2501
F	1173	879750	6.66	18	0.36%	7.165	6174	438
G	683	512250	7.90	21	0.37%	10.96	9445	2641
H	1326	994500	9.43	24	0.20%	11.50	9910	1780
I	2320	1740000	12.13	30	0.20%	20.86	17976	7526

NOTE: Nodes B, C & D corespond to the sewer basins in the service area that flow through trunk lines that have not been designed yet.

Mannings (n) = 0.013
Peak Factor = 2.5

Future Outfall Line

Identifier	#ERU @ 300 gpd	Peak Flow (gpd)	Total Flow (cfs)	Designed Pipe Size	Min Pipe Slope Before Next Node	Pipe Flow Capacity (cfs)	ERU Capacity	ERUs Available
J	2000	1500000	14.45	30	0.10%	14.75	12711	261

NOTE: The area outfall pipe is assumed to be a 30 inch pipe at 0.10% based on previous permitted designs.

ERDA Service Area

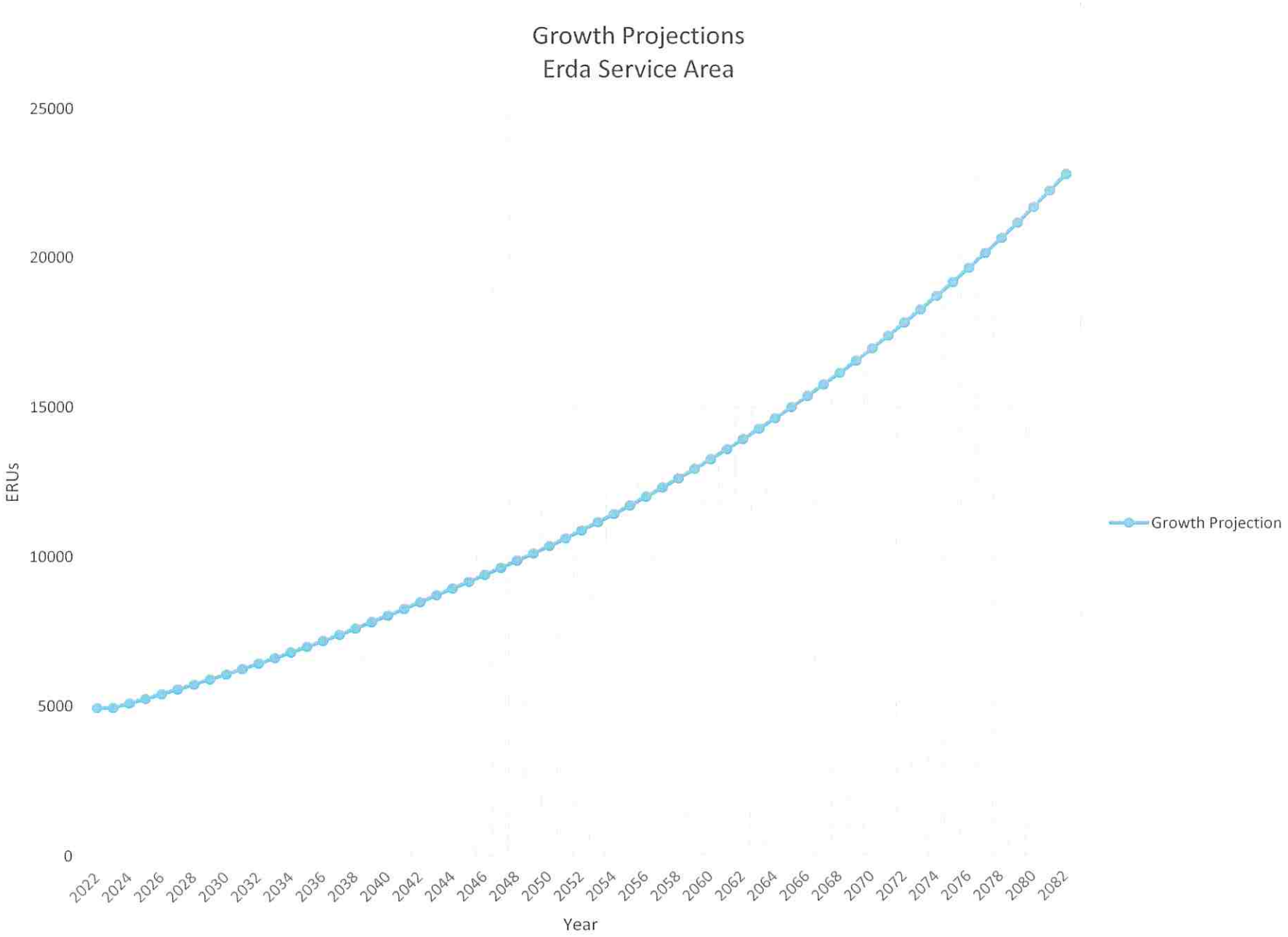
Population Projections

1/23/2023

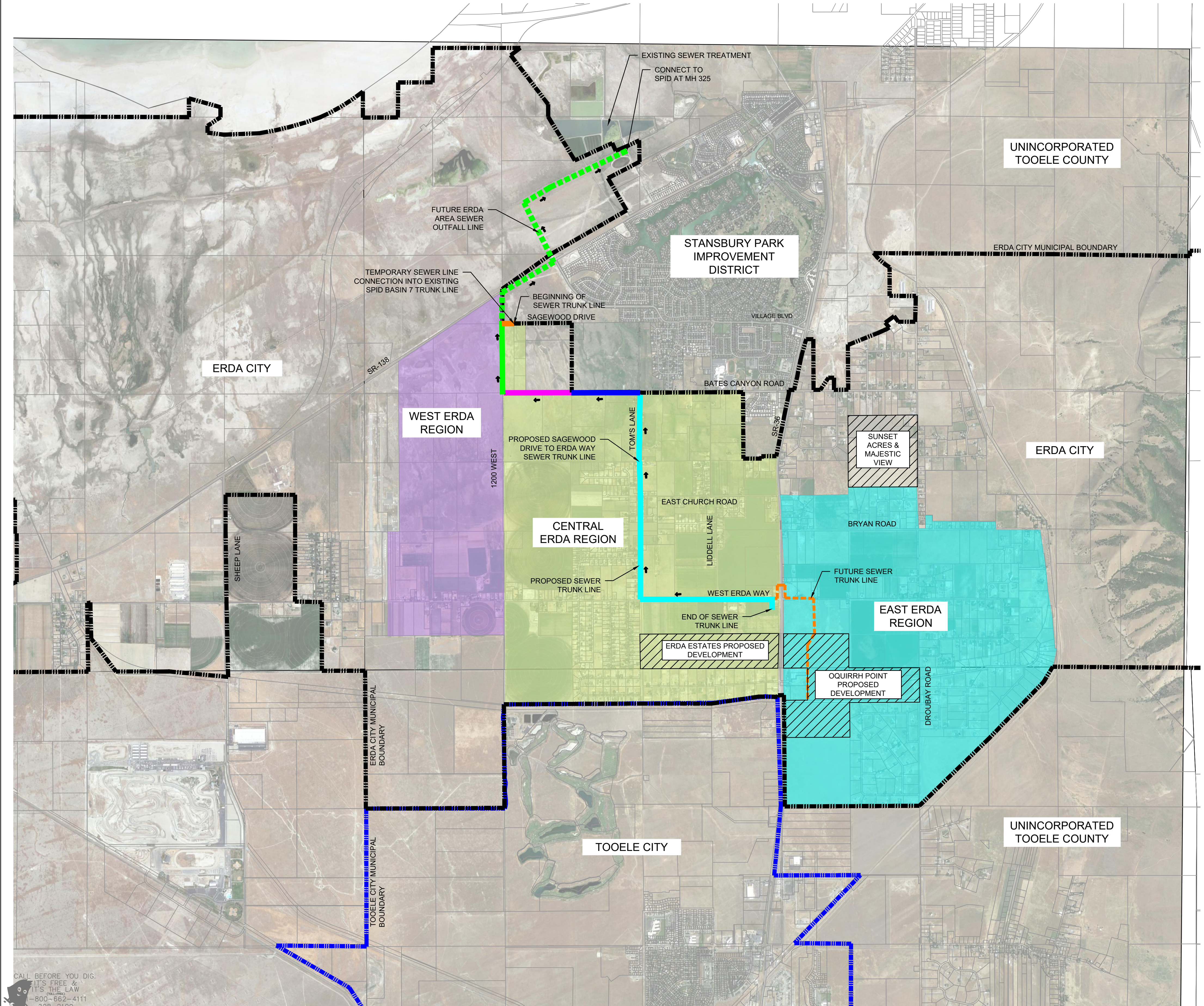
People Per ERU =	3.25
Base ERUs =	4952

Year	Growth Rate	Additional ERUs from Growth	Additional ERUs from Existing Resident Connection	Total ERUs	Equivalent Population
2022	0.00%	0	0	4952	16094
2023	0.00%	0	0	4952	16094
2024	2.50%	124	22	5098	16569
2025	2.50%	128	22	5248	17056
2026	2.50%	132	22	5402	17557
2027	2.50%	136	22	5560	18070
2028	2.50%	139	22	5721	18593
2029	2.50%	144	22	5887	19133
2030	2.50%	148	22	6057	19685
2031	2.50%	152	22	6231	20251
2032	2.50%	156	22	6409	20829
2033	2.50%	161	22	6592	21424
2034	2.50%	165	22	6779	22032
2035	2.50%	170	22	6971	22656
2036	2.50%	175	22	7168	23296
2037	2.50%	180	22	7370	23953
2038	2.50%	185	22	7577	24625
2039	2.50%	190	22	7789	25314
2040	2.50%	195	22	8006	26020
2041	2.50%	201	22	8229	26744
2042	2.50%	206	22	8457	27485
2043	2.50%	212	22	8691	28246
2044	2.50%	218	0	8909	28954
2045	2.50%	223	0	9132	29679
2046	2.50%	229	0	9361	30423
2047	2.50%	235	0	9596	31187
2048	2.50%	240	0	9836	31967
2049	2.50%	246	0	10082	32767
2050	2.50%	253	0	10335	33589
2051	2.50%	259	0	10594	34431
2052	2.50%	265	0	10859	35292
2053	2.50%	272	0	11131	36176
2054	2.50%	279	0	11410	37083

2055	2.50%	286	0	11696	38012	
2056	2.50%	293	0	11989	38964	
2057	2.50%	300	0	12289	39939	
2058	2.50%	308	0	**12597**	**40940**	**Service Area Build Out**
2059	2.50%	315	0	12912	41964	
2060	2.50%	323	0	13235	43014	
2061	2.50%	331	0	13566	44090	
2062	2.50%	340	0	13906	45195	
2063	2.50%	348	0	14254	46326	
2064	2.50%	357	0	14611	47486	
2065	2.50%	366	0	14977	48675	
2066	2.50%	375	0	15352	49894	
2067	2.50%	384	0	15736	51142	
2068	2.50%	394	0	16130	52423	
2069	2.50%	404	0	16534	53736	
2070	2.50%	414	0	16948	55081	
2071	2.50%	424	0	17372	56459	
2072	2.50%	435	0	**17807**	**57873**	**50-Year Time Fraime**
2073	2.50%	446	0	18253	59322	
2074	2.50%	457	0	18710	60808	
2075	2.50%	468	0	19178	62329	
2076	2.50%	480	0	19658	63889	
2077	2.50%	492	0	20150	65488	
2078	2.50%	504	0	20654	67126	
2079	2.50%	517	0	21171	68806	
2080	2.50%	530	0	21701	70528	
2081	2.50%	543	0	22244	72293	
2082	2.50%	557	0	22801	74103	


Growth Projections
Erda Service Area
25000
20000
15000
10000
5000
0
ERUs
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
2042
2044
2046
2048
2050
2052
2054
2056
2058
2060
2062
2064
2066
2068
2070
2072
2074
2076
2078
2080
2082
Year
Growth Projection

ERDA AREA SEWER MASTER PLAN



LEGEND

- 8" SEWER LINE
- 10" SEWER LINE
- 12" SEWER LINE
- 15" SEWER LINE
- 18" SEWER LINE
- 21" SEWER LINE
- 24" SEWER LINE
- 30" SEWER LINE
- FUTURE 30" SEWER LINE
- FUTURE 15" SEWER LINE
- ACTIVE ANNEXATION PETITIONS WITH SPID

SUMMARY OF ERUs	
EAST ERDA REGION	3,563
CENTRAL ERDA REGION	6,887
WEST ERDA REGION	2,000
TOTAL	**12,450**

NOTE: 1 ERU (EQUIVALENT RESIDENTIAL UNIT) = 300 GAL/DAY AVERAGE DAILY SEWER GENERATION.

N

2000 0 2000 4000 6000

Scale 1" = 2000'

STANSBURY PARK IMPROVEMENT DISTRICT
STANSBURY, UT
ERDA SEWER SERVICE MAP

231 West 800 South Salt Lake City, Utah 84101
Ward Engineering Group
Planning Engineering Surveying
PH: 801 . 487 . 8040

CLIENT: SPID
DWG: DEQ EXHIBITS.DWG
JOB No:
DO NOT SCALE THIS DRAWING DRAWING IS REDUCED IF LESS THAN 22-in x 34-in - DIMENSIONS AND NOTES TAKE PRECEDENCE

DRAWN BY: **AMD**
DESIGN BY: **AMD**
CHECKED BY: **BT**
DATE: **01/18/2023**

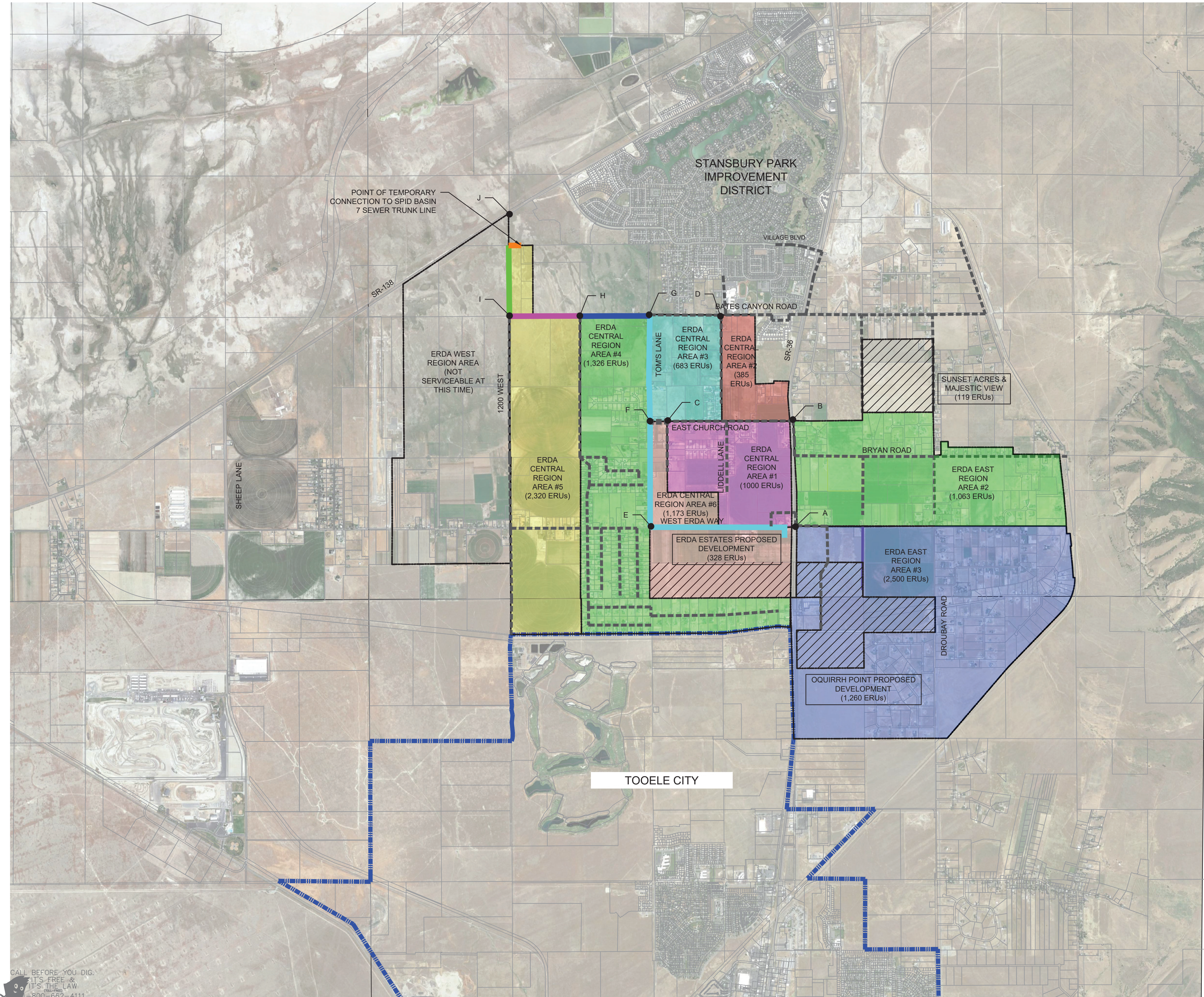
REVISIONS

1	01/18/2023	DEQ REPORT

SHEET **01**

FILENAME: W:\SPID\Erda West-Centeral-East Region Sewer Master Plan\Erda Sewer Trunk Line - East Region\Design\DEQ Exhibits.dwg TAB: EX-01 PLOT DATE AND TIME: 1/19/2023 3:59 PM

ERDA AREA SEWER MASTER PLAN
(SAGEWOOD DRIVE TO ERDA WAY TRUNK LINE SEWER PROJECT)



LEGEND

- 8" SEWER LINE
- 10" SEWER LINE
- 12" SEWER LINE
- 15" SEWER LINE
- 18" SEWER LINE
- 21" SEWER LINE
- 24" SEWER LINE
- 30" SEWER LINE
- 36" SEWER LINE
- OTHER PLANNED LOCAL SEWER LINES, NOT SIZED AT THIS TIME

N

2000 0 2000 4000 6000

Scale 1" = 2000'

STANSBURY PARK IMPROVEMENT DISTRICT
STANSBURY, UT
SEWER AREAS ERDA REGION

231 West 800 South Salt Lake City, Utah 84101
Ward Engineering Group
Planning Engineering Surveying
PH: 801 . 487 . 8040

CLIENT: SPID
DWG: DEQ - PROJECT MAP.DWG
JOB No:
DO NOT SCALE THIS DRAWING. DRAWING IS REDUCED IF LESS THAN 22-in x 34-in - DIMENSIONS AND NOTES TAKE PRECEDENCE

DRAWN BY: **MFAJ**
DESIGN BY: **MFAJ**
CHECKED BY: **BT**
DATE: **11/22/2022**

REVISIONS		
1	01/19/2023	DEQ REPORT

SHEET

02

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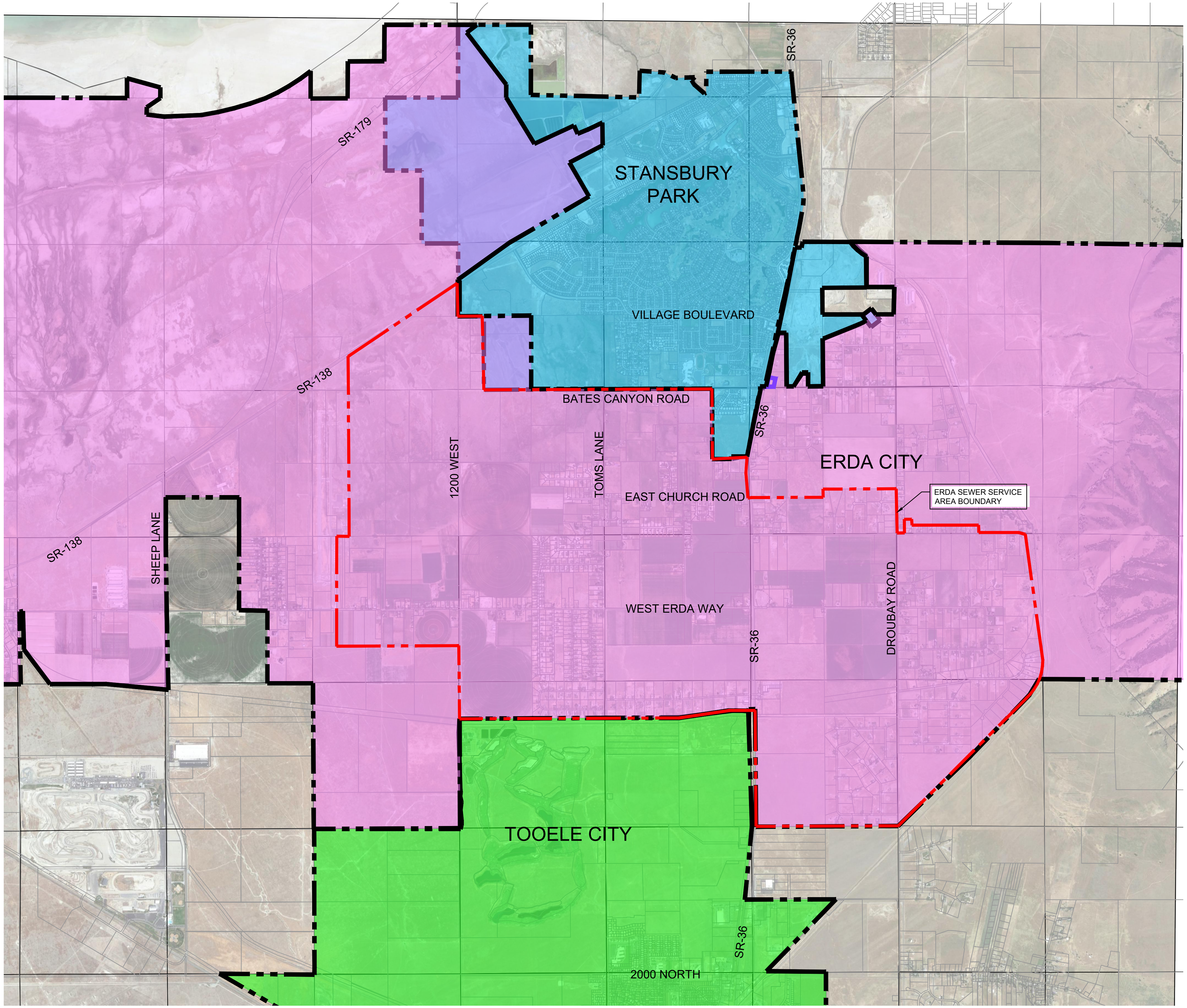
STANSBURY PARK - ERDA - TOOELE BOUNDARIES



LEGEND

- ERDA SEWER SERVICE AREA BOUNDARY
- ERDA CITY MUNICIPAL CORPORATION
- TOOELE CITY CORPORATION
- STANSBURY PARK IMPROVEMENT DISTRICT (SPID)
- AREA OVERLAPPING SPID & ERDA CITY

N

2000 0 2000 4000 6000

Scale 1" = 2000'

STANSBURY PARK IMPROVEMENT DISTRICT
STANSBURY, UT
CITY BOUNDARIES

231 West 800 South Salt Lake City, Utah 84101
Ward Engineering Group
Planning Engineering Surveying
PH: 801 . 487 . 8040

CLIENT: SPID
DWG: OVERALL CITY BOUNDARY MAP.DWG
JOB No:

DRAWN BY:
DESIGN BY:
CHECKED BY:
DATE:

REVISIONS

SHEET
03

FILENAME: W:\SPID\Erda West-Centeral-East Region Sewer Master Plan\Erda Sewer Trunk Line - East Region\Design\Overall City Boundary Map.dwg
TAB: EX-03
PLOT DATE AND TIME: 1/19/2023 3:57 PM

APPENDIX “A”

Construction Permit for West Erda Regional Interceptor Sewer Line

State of Utah
GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

Department of
Environmental Quality

Alan Matheson
Executive Director

DIVISION OF WATER QUALITY
Erica Brown Gaddis, PhD
Director

April 1, 2019

Rachelle Custer
Public Works Manager
Tooele County
47 South Main Street
Tooele, Utah 84074

Subject: **Construction Permit**
West Erda Regional Interceptor Sewer Line
Tooele County, Utah

Dear Mr. Custer:

After review of the plans and specifications for the West Erda Regional Interceptor Sewer Line project submitted by Ward Engineering on February 22, 2019, and stamped by Brenden Thorpe, P.E., on February 21, 2019, it has been determined that the plans and specifications comply with Utah Administrative Code R317, and is therefore approved. This letter hereby serves as a Construction Permit wherein the entities may proceed with construction of the sewer line subject to the following conditions:

1. Any revisions or modifications to the approved plans and specifications must be submitted to the Division for review and approval before construction or implementation thereof.

2. The permitted facility must not be placed in service until the Division has made a final inspection and has authorized you, in writing, to do so.

3. A Storm Water Permit is required for this project. Any construction activities that disturb one acre or more are required to obtain coverage under the Utah pollutant Discharge Elimination System (UPDES) Storm Water General Permit for Construction Activities. The permit requires the development of a storm water pollution prevention plan (SWPPP) to be implemented and updated from the commencement of any soil disturbing activities at the site until final stabilization of the project. For more information, or to obtain permit coverage online, please go to https://deq.utah.gov/legacy/permits/water-quality/utah-pollutant-discharge-elimination-system/storm-water-general-construction.htm.

4. Operations and maintenance of the West Erda Regional Interceptor Sewer shall be under the sponsorship of Stansbury Park Improvement District (SPID). The new system shall be maintained in a manner that is consistent with SPID's best management practices and the minimum standards of the Utah Sewer Management Program (UAC R317-801).

6. A 6-inch water line that crosses the sewer at station 10+14.19 must be 18 inches above the sewer line (UAC R309-550-7). Contact the Division of Drinking Water at (801) 536-4200 if a variance to this requirement becomes necessary.

The issuance of this permit does not relieve you in any way, from requirements to obtain applicable permits from local jurisdictions. You may contact Bryan Slade of Tooele County Health Department at (435) 277-2450 for assistance with compliance with any other local requirements.

The West Erda Sewer Line project consists of 5.7 miles of 36 inch, 30 inch, and 18 inch sewer line starting at connection to an existing interceptor (near to the SPID sewage lagoons). The new line then travels southwest along SR-138 to Sheep Lane where the line turns south, extending nearly to the Utah Motorsports Campus. Developing properties along the new line include the Utah Motor Sports Park, the Deseret Peak Complex, and a proposed 900 acre industrial park.

Flow projections for the project are based on current and projected land use and zoning, applying unit demands standard to SPID (300 gallons per day per Equivalent Residential Unit), as well as other projected unit demands from previous regional sewer master plans conducted by Tooele County. The sewer line is designed for a build out flow that is projected to occur in 2082.

The hydraulic design criteria are included in the Appendix 1. Erda population projections for the service area can be found in Appendix 2.

We are retaining one set of the submitted plans for our file, with an imprint of our construction permit stamp and returning one set to you. The stamped set must be kept available for examination and inspections to be conducted by the Division and the Health Department, or for resolution of any conflicts or discrepancies that may arise during construction or installation.

This construction permit will expire one year after the date of this permit, unless substantial progress is made in constructing the approved facilities or the plans and specifications have been resubmitted and the construction permit is reissued.

Please advise the Division regarding the commencement of construction activities so that we are able to schedule periodic inspections. We request a copy of "as built" drawings after construction is completed, the Division has completed the final inspection, and the project has been placed in service.

Rachelle Custer
Public Works Manager
West Erda Regional Interceptor Sewer Line

The Division values your feedback. Please help us improve the permitting process so that we can better meet your needs. Please go to http://www.waterquality.utah.gov/ and take a few minutes to complete our customer feedback form (submit your feedback using the link on the lower left side of the page).

We appreciate the cooperation of your consulting engineers and staff in the discussions we have had regarding the project. If we can be of further assistance, please contact Harry Campbell of my staff at (801) 536-4391.

Sincerely,

Kim Shelley
Acting Director

EG/KS/HC/ch

Enclosures: Contract Documents (Large Drawings – 1 volume, Small Drawings – 1 volume, Contract Documents – 1 volume)

cc: Brenden Thorpe, P.E., Ward Engineering, w/o enclosure
Bryan Slade, Tooele County Health Department w/o enclosure

DWQ-2019-002862

Rachelle Custer
Public Works Manager
West Erda Regional Interceptor Sewer Line

Appendix 1

			Mannings (n) =		0.013 (UAC R317-3-2)		
			Min Slope Sheep Lane =		0.75% (per design)		
			Min Slope SR-138 =		0.10% (per design)		
			Peak Factor =		2.5 (see letter dated 2-21-19)		
			Combined Calculation for both the Erda West and Central Region Service Area				
Identifier (Node)	#ERU @ 300 gpd (note 1)	#ERU @ 400 gpd (note 2)	Total ERUs (300gpd/ERU)	Total Peak Flow (gpd)	Cumulative Total Flow (cfs)	Required Pipe Diameter (in)	Pipe Size
A	1301	1938	3885	2913750	4.51	15.10	18
B	962	0	962	721500	5.62	16.41	18
C	319	0	319	239250	5.99	16.80	18
D	322	0	322	241500	6.37	25.08	30
E	1075.44	0	1075.44	806580	7.62	26.82	30
F	100	0	100	75000	7.73	26.97	30
G	7143	0	7143	5357250	16.02	35.45	36
Note 1: Flow per ERU established by SPID as defined in the 2018 Sewer IFFP study (applies to all projections except Note 2) Note 2: Flow per ERU established by developer's engineer (industrial use)							

Rachelle Custer
Public Works Manager
West Erda Regional Interceptor Sewer Line

Appendix 2

Tooele County
West Erda Region Interceptor Sewer
12/19/2018
Population Projections

People Per ERU 3.25

Base ERUs
1382

Year	Growth Rate	Growth (ERUs)	Future Connections Existing Homes (ERUs)	Equivalent Total ERUs	Population	
2018	0.00%	0	0	1382	4492	
2019	3.00%	42	65	1489	4839	
2020	3.00%	45	65	1599	5197	
2021	3.00%	48	65	1712	5564	
2022	3.00%	52	65	1829	5944	
2023	3.00%	55	65	1949	6334	
2024	3.00%	59	65	2073	6737	
2025	3.00%	63	65	2201	7153	
2026	3.00%	67	65	2333	7582	
2027	1.00%	24	65	2422	7872	
2028	1.00%	25	65	2512	8164	
2029	1.00%	26	65	2603	8460	
2030	1.00%	27	65	2695	8759	
2031	3.00%	81	65	2841	9233	
2032	3.00%	86	65	2992	9724	
2033	3.00%	90	65	3147	10228	
2034	3.00%	95	65	3307	10748	
2035	3.00%	100	65	3472	11284	
2036	1.00%	35	65	3572	11609	
2037	1.00%	36	65	3673	11937	
2038	1.00%	37	65	3775	12269	
2039	1.00%	38	0	3813	12392	(20 yr planning period)
2040	3.00%	115	0	3928	12766	
2041	3.00%	118	0	4046	13150	
2042	3.00%	122	0	4168	13546	
2043	3.00%	126	0	4294	13956	
2044	3.00%	129	0	4423	14375	
2045	3.00%	133	0	4556	14807	
2046	3.00%	137	0	4693	15252	
2047	3.00%	141	0	4834	15711	
2048	3.00%	146	0	4980	16185	
2049	3.00%	150	0	5130	16673	
2050	3.00%	154	0	5284	17173	
2051	3.00%	159	0	5443	17690	

Rachelle Custer
Public Works Manager
West Erda Regional Interceptor Sewer Line

Year	Future Connections Growth Rate	Growth (ERUs)	Existing Homes (ERUs)	Equivalent Total ERUs	Population	
3.00%	164	0	5607	18223		2052
2053	3.00%	169	0	5776	18772	
2054	3.00%	174	0	5950	19338	
2055	3.00%	179	0	6129	19919	
2056	3.00%	184	0	6313	20517	
2057	3.00%	190	0	6503	21135	
2058	3.00%	196	0	6699	21772	
2059	3.00%	201	0	6900	22425	
2060	3.00%	207	0	7107	23098	
2061	3.00%	214	0	7321	23793	
2062	3.00%	220	0	7541	24508	
2063	3.00%	227	0	7768	25246	
2064	3.00%	234	0	8002	26007	
2065	3.00%	241	0	8243	26790	
2066	3.00%	248	0	8491	27596	
2067	3.00%	255	0	8746	28425	
2068	3.00%	263	0	9009	29279	
2069	3.00%	271	0	9280	30160	
2070	3.00%	279	0	9559	31067	
2071	3.00%	287	0	9846	32000	
2072	3.00%	296	0	10142	32962	
2073	3.00%	305	0	10447	33953	
2074	3.00%	314	0	10761	34973	
2075	3.00%	323	0	11084	36023	
2076	3.00%	333	0	11417	37105	
2077	3.00%	343	0	11760	38220	
2078	3.00%	353	0	12113	39367	
2079	3.00%	364	0	12477	40550	
2080	3.00%	375	0	12852	41769	
2081	3.00%	386	0	13238	43024	
2082	3.00%	398	0	13636	44317	(Build out)

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Phone: 801.487.8040 Fax: 801.487.8668
www.wardeg.com

February 21, 2019

John Mackey, Engineering Manager
Utah Department of Environmental Quality,
Division of Water Quality
Multi – Agency State Office Building
195 North 1950 West
Salt Lake City, UT

Subject: Tooele County Regional Sewer Project,
West Erda Region Interceptor Sewer – Master Plan

Attachments: Hydraulic Calculations
Growth Projections
Service Area Map, Sheet 01
Service Area Map, Sheet 02

Mr. Mackey:

Thank you for your review and consideration of this project. Below is a brief description of the project and the basis of the line sizes established in the construction plans.

Background

Tooele County has initiated a sewer project in north Tooele County to serve the anticipated needs of the Erda West Region, and the future Erda Central Region. Transmitted is a service area map which has been created through continuous coordination with Tooele County and the Stansbury Park Improvement District. The proposed interceptor line runs along Sheep Lane north to SR-138, and east along SR-138 to Village Boulevard, and then south and east to a point where it will connect to a Stansbury Park Improvement District (SPID) sewer line that feeds the treatment headworks station. The sewer line consists of approximately 5.7 miles of 36-inch, 30-inch, and 18-inch gravity sewer lines.

The 36-inch and 30-inch lines are mostly specified as ADS SaniTite HP Triple Wall Sewer Pipe with "continuous flow" push-thru manholes. This approach (eliminating drops through manholes) allows the sewer line to maintain a constant slope and maximize a depth suitable for future connections along SR-138, while clearing multiple UNEV-high pressure petroleum pipelines, and to keep the pipeline below grade along the northern reaches of the alignment as it runs parallel to the existing Garfield Canal. The 18-inch lines run only along Sheep Lane and are not as restrictive, and are therefore specified as PVC, SDR-35 Sewer Pipe with conventional manholes having 0.2-foot drops.

The project is sponsored and paid for by Tooele County. The County intends to fund the project internally, without any G.O. bonds, loans, or grant requests. The County intends to structure a reimbursement process and connection fee to recoup the cost of the project. Once the project is constructed, SPID intends to accept, own, and maintain the sewer line as part of its collection system, which will require future annexations as development continues forward within the service area(s). SPID's board of trustees has formally agreed to take ownership and responsibility for the sewer line, and has entered into a "will serve" status with the County. SPID and County are currently negotiating a service agreement for the construction of, and transfer of the sewer line.

Flows Projections

As depicted on the Service Area Maps, The West Erda Region has been established based on anticipated current development activity and projected development known by the County, particularly near the south end of the service area, which includes Tooele County's existing Deseret Peak Complex, the existing UMC (motor sports park), a proposed 900-acre industrial park, and other developments. The sewer interceptor line is ultimately sized for the "build-out" conditions of both the West Erda Service Area, and the Central Erda Service Area. Flow projections are based on current and projected land use and zoning, applying unit demands standard to SPID (300 gallons per day per Equivalent Residential Unit / or ERU), as well as those other projected unit demands derived by previous regional sewer master plans conducted by Tooele County. Refer to the table on Service Area Map, Sheet 02 for the unit demands used in the wastewater generation calculations.

Although the line is sized for build-out conditions of the identified service areas, Tooele County will establish a reimbursement period of 20 years. Based on a growth projection model provided in the calculations, the 20-year planning growth is projected to be 3,818 ERUs, or a peak flow of 2,859,750 gallons per day (using a peak factor of 2.5, and 3.25 people per ERU. The growth projection is roughly equal to 2.14% per year with an existing base density of 1,382 ERUs.

At build-out conditions, it is projected that there will be a density of approximately 13,738 ERUs within both the West and Central Erda Service Areas (which will both feed the interceptor sewer line at build out conditions), with a peak flow of 10,303,500 gallons per day (16.02 CFS).

Pipe Capacities

Pipe capacity and hydraulic calculations are provided as attached. The following parameters were used.

- Manning's "n" for both PVC and SaniTite HP pipe = 0.013 (as required by UAC R317-3-2)
- Minimum pipe slopes for 36-inch and 30-inch pipe = 0.10% (based on design)
- Minimum pipe slopes for 18-inch pipe = 0.75% (based on design)
- Peak Factor for the interceptor sewer line = 2.5 (UAC R317-3-2)
- Peak Factor for the future Central Erda Region Sewer (which will ultimately feed the interceptor sewer) = 4. This future service area contains some uncertainty in the respect that there is potential for the area to expand in the future, possibly picking up flows from future development east of SR-36. Furthermore, a peak factor calculation using a population-based equation: $\frac{Q_{ph}}{Q_{avg}} = \frac{18+\sqrt{P}}{4+\sqrt{P}}$, yields a peak factor approximating 3. Therefore, this line more closely represents a major collector line and a peak factor of 4 is used.
- Hydraulic capacity based on Manning Equation solving for a standard pipe diameter using a depth to diameter ratio (d/D) of 0.67 [Q = (1.49/n)(A)(R) ^ (2/3)(S) ^ (1/2)], where:
    - n = manning's number (unitless)
    - A = cross sectional area of flow in square feet

R = hydraulic radius = area / wetted perimeter in ft
S = pipe slope in ft/ft

- Future connection points (or points of system demands) along the alignment of the sewer line are estimated based on topography and basin information as shown on Service Area Map, Sheet 1, where nodes are identified as A through G. The nodes on the map are correlated to the calucations provided.

Thank you for your assistance on this project. Please let us know if you need any additional information (bthorpe@wardeg.com or 801-487-8040)

Respectfully,
WARD ENGINEERING GROUP

Brendan Thorpe, P.E.

Tooele County

West Erda Region Interceptor Sewer

12/19/2018

Hyrdaulic Calculations

Mannings (n) = 0.013 (UAC R317-3-2)
Min Slope = 0.10% (per design)
Peak Factor = 2.5 (UAC R317-3-2)

Proposed Erda West Region Service Area

Identifier (Node)	#ERU @ 300 gpd (note 1)	#ERUs @ 400 gpd (note 2)	Total ERUs Converted to (300gpd/ERU)	Total Peak flow (gpd)	Cumulative Total Flow (cfs)	Required Pipe Diameter (in)	Pipe Size
A	1301	1938	3885	2913750	4.51	22.03	24
B	962	0	962	721500	5.62	23.94	24
C	319	0	319	239250	5.99	24.52	30
D	322	0	322	241500	6.37	25.08	30
E	1075.44	0	1075.44	806580	7.62	26.82	30
F	100	0	100	75000	7.73	26.97	30
G	2776	0	2776	2082000	10.95	30.74	36

Note 1: Flow per ERU established by SPID as defined in the 2018 Sewer IFFP study (applies to all projections except Note 2)
Note 2: Flow per ERU established by developer's engineer (industrial use)

Mannings (n) = 0.013 (UAC R317-3-2)
Min Slope = 0.50% (per design)
Peak Factor = 4 (UAC R317-3-2)

Future Erda Central Region Service Area

Identifier (Node)	#ERU @ 300 gpd (note 1)	#ERUs @ 400 gpd (note 2)	Total ERUs (300gpd/ERU)	Total Peak flow (gpd)	Cumulative Total Flow (cfs)	Required Pipe Diameter (in)	Pipe Size
J	1937	0	1937	2324400	3.60	14.97	18
I	740	0	740	888000	4.97	16.90	18
H	1690	0	1690	2028000	8.11	20.31	21
G	0	0	0	0	8.11	20.31	21

Note 1: Flow per ERU established by SPID as defined in the 2018 Sewer IFFP study (applies to all projections except Note 2)
Note 2: Flow per ERU established by developer's engineer (industrial use)

Mannings (n) =	0.013	(UAC R317-3-2)
Min Slope Sheep Lane =	0.75%	(per design)
Min Slope SR-138 =	0.10%	(per design)
Peak Factor =	2.5	(see letter dated 2-21-19)

Combined Calculation for both the Erda West and Central Region Servcie Areas

Identifier (Node)	#ERU @ 300 gpd (note 1)	#ERUs @ 400 gpd (note 2)	Total ERUs (300gpd/ERU)	Total Peak flow (gpd)	Cumulative Total Flow (cfs)	Required Pipe Diameter (in)	Pipe Size
A	1301	1938	3885	2913750	4.51	15.10	18
B	962	0	962	721500	5.62	16.41	18
C	319	0	319	239250	5.99	16.80	18
D	322	0	322	241500	6.37	25.08	30
E	1075.44	0	1075.44	806580	7.62	26.82	30
F	100	0	100	75000	7.73	26.97	30
G	7143	0	7143	5357250	16.02	35.45	36

Note 1: Flow per ERU established by SPID as defined in the 2018 Sewer IFFP study (applies to all projections except Note 2)

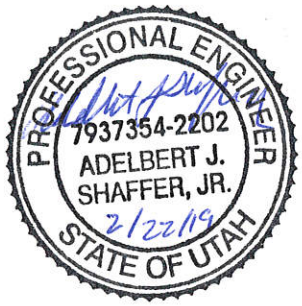
Note 2: Flow per ERU established by developer's engineer (industrial use)

Tooele County

West Erda Region Interceptor Sewer

12/19/2018

Population Projections



People Per ERU 3.25
Base ERUs = 1382

Year	Growth Rate	Growth (ERUs)	Future Connections Existing Homes (ERUs)	Total ERUs	Equivalent Population	
2018	0.00%	0	0	1382	4492	
2019	3.00%	42	65	1489	4839	
2020	3.00%	45	65	1599	5197	
2021	3.00%	48	65	1712	5564	
2022	3.00%	52	65	1829	5944	
2023	3.00%	55	65	1949	6334	
2024	3.00%	59	65	2073	6737	
2025	3.00%	63	65	2201	7153	
2026	3.00%	67	65	2333	7582	
2027	1.00%	24	65	2422	7872	
2028	1.00%	25	65	2512	8164	
2029	1.00%	26	65	2603	8460	
2030	1.00%	27	65	2695	8759	
2031	3.00%	81	65	2841	9233	
2032	3.00%	86	65	2992	9724	
2033	3.00%	90	65	3147	10228	
2034	3.00%	95	65	3307	10748	
2035	3.00%	100	65	3472	11284	
2036	1.00%	35	65	3572	11609	
2037	1.00%	36	65	3673	11937	
2038	1.00%	37	65	3775	12269	
2039	1.00%	38	0	3813	12392	(20 Planning Period)
2040	3.00%	115	0	3928	12766	
2041	3.00%	118	0	4046	13150	
2042	3.00%	122	0	4168	13546	
2043	3.00%	126	0	4294	13956	
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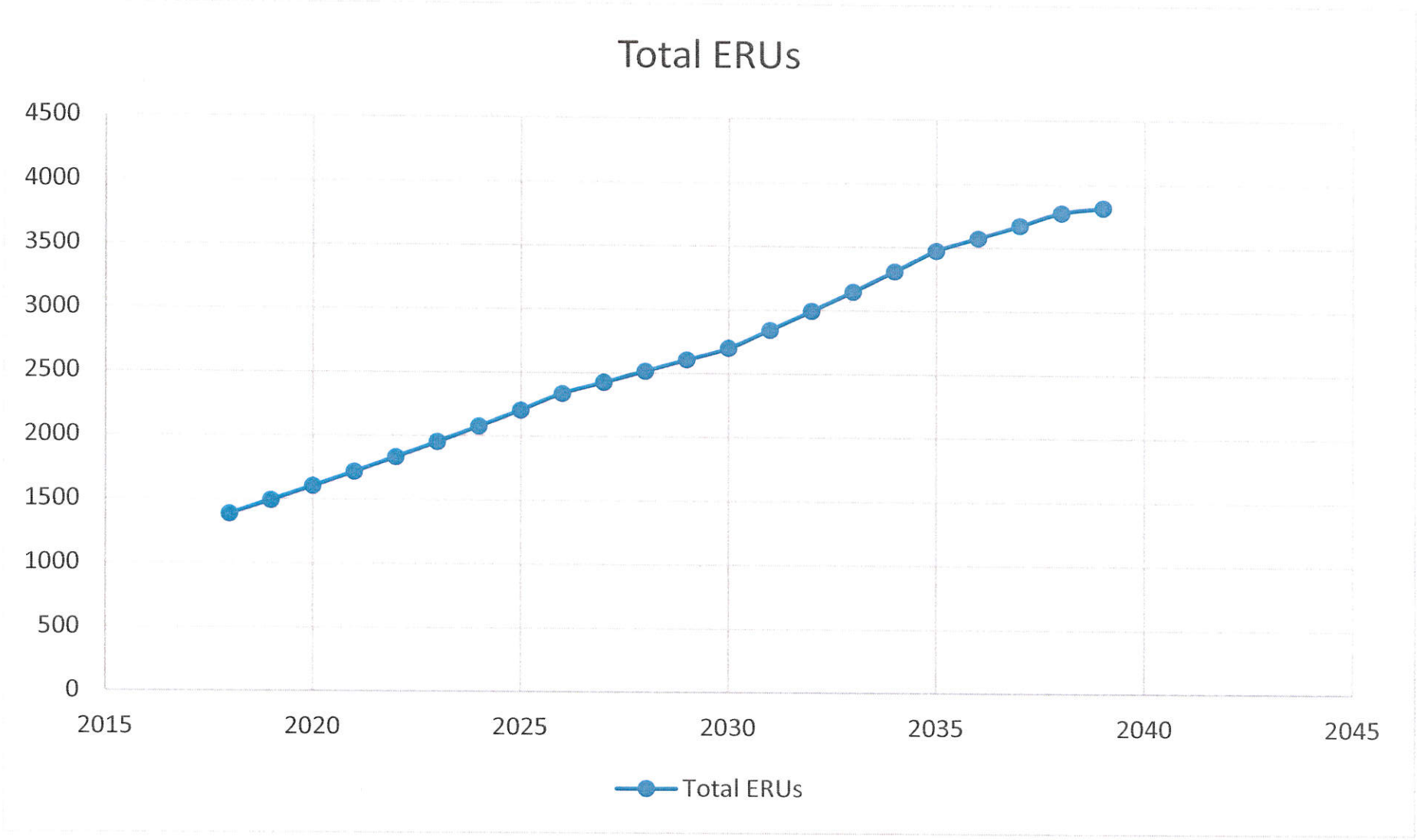
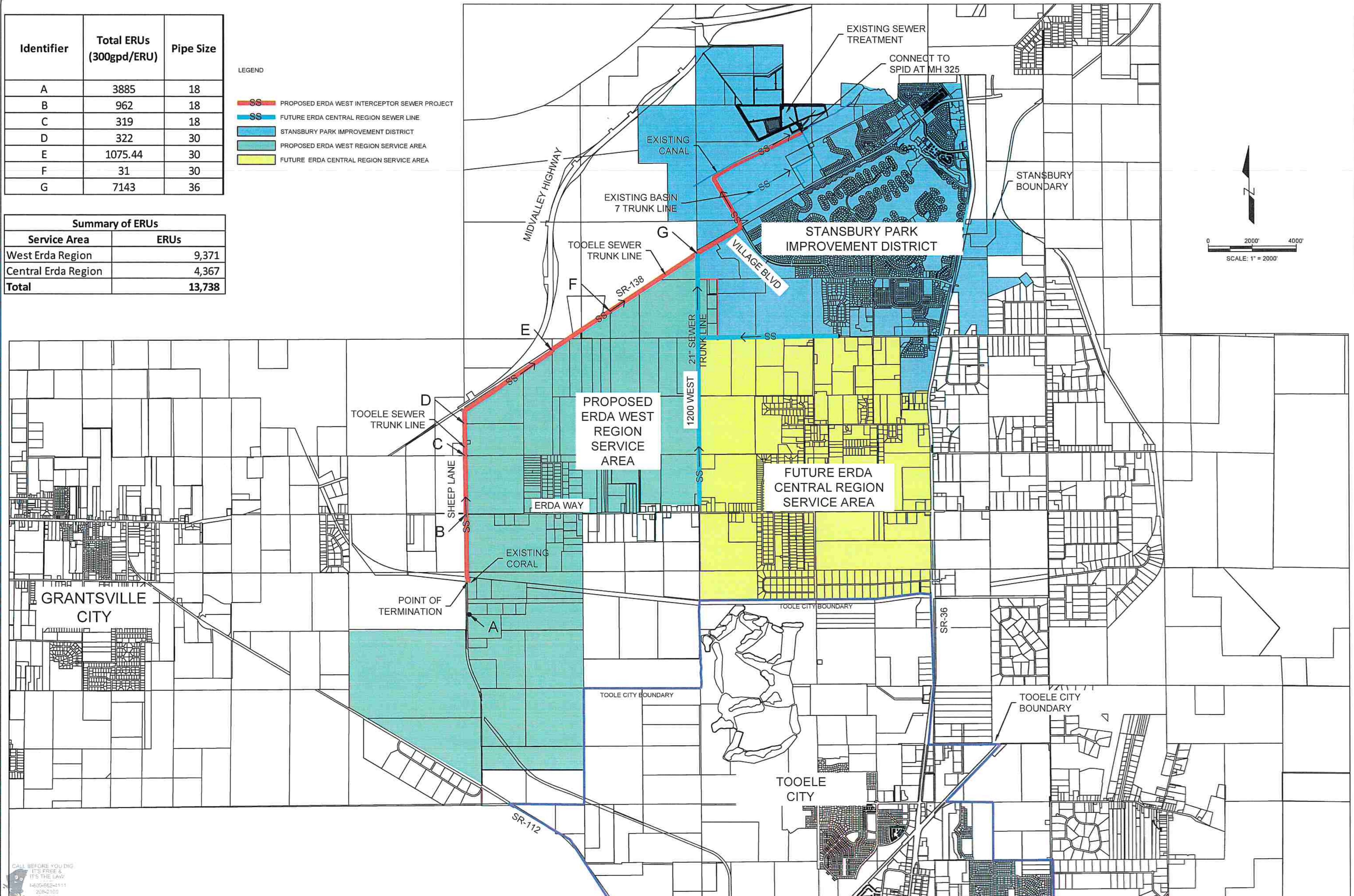
2050	3.00%	154	0	5284	17173	
2051	3.00%	159	0	5443	17690	
2052	3.00%	164	0	5607	18223	
2053	3.00%	169	0	5776	18772	
2054	3.00%	174	0	5950	19338	

2055	3.00%	179	0	6129	19919	
2056	3.00%	184	0	6313	20517	
2057	3.00%	190	0	6503	21135	
2058	3.00%	196	0	6699	21772	
2059	3.00%	201	0	6900	22425	
2060	3.00%	207	0	7107	23098	
2061	3.00%	214	0	7321	23793	
2062	3.00%	220	0	7541	24508	
2063	3.00%	227	0	7768	25246	
2064	3.00%	234	0	8002	26007	
2065	3.00%	241	0	8243	26790	
2066	3.00%	248	0	8491	27596	
2067	3.00%	255	0	8746	28425	
2068	3.00%	263	0	9009	29279	
2069	3.00%	271	0	9280	30160	
2070	3.00%	279	0	9559	31067	
2071	3.00%	287	0	9846	32000	
2072	3.00%	296	0	10142	32962	
2073	3.00%	305	0	10447	33953	
2074	3.00%	314	0	10761	34973	
2075	3.00%	323	0	11084	36023	
2076	3.00%	333	0	11417	37105	
2077	3.00%	343	0	11760	38220	
2078	3.00%	353	0	12113	39367	
2079	3.00%	364	0	12477	40550	
2080	3.00%	375	0	12852	41769	
2081	3.00%	386	0	13238	43024	
2082	3.00%	398	0	13636	44317	(Build out)


Total ERUs
4500
4000
3500
3000
2500
2000
1500
1000
500
0
2015
2020
2025
2030
2035
2040
2045
Total ERUs

Identifier	Total ERUs (300gpd/ERU)	Pipe Size
A	3885	18
B	962	18
C	319	18
D	322	30
E	1075.44	30
F	31	30
G	7143	36

Summary of ERUs	
Service Area	**ERUs**
West Erda Region	9,371
Central Erda Region	4,367
Total	**13,738**



TOOELE COUNTY
WEST ERDA REGION
INTERCEPTOR SEWER
SERVICE MAP

231 West 800 South Salt Lake City, Utah 84101
Ward Engineering Group
Planning Engineering Surveying
PH: 801.487.8040 FX: 801.487.8668

CLIENT:
DWG: Service Area Map pg 1 - DEQ
JOB No:

DRAWN BY: MFAJ
DESIGN BY: AJS
CHECKED BY: BT
DATE: 11/09/2018

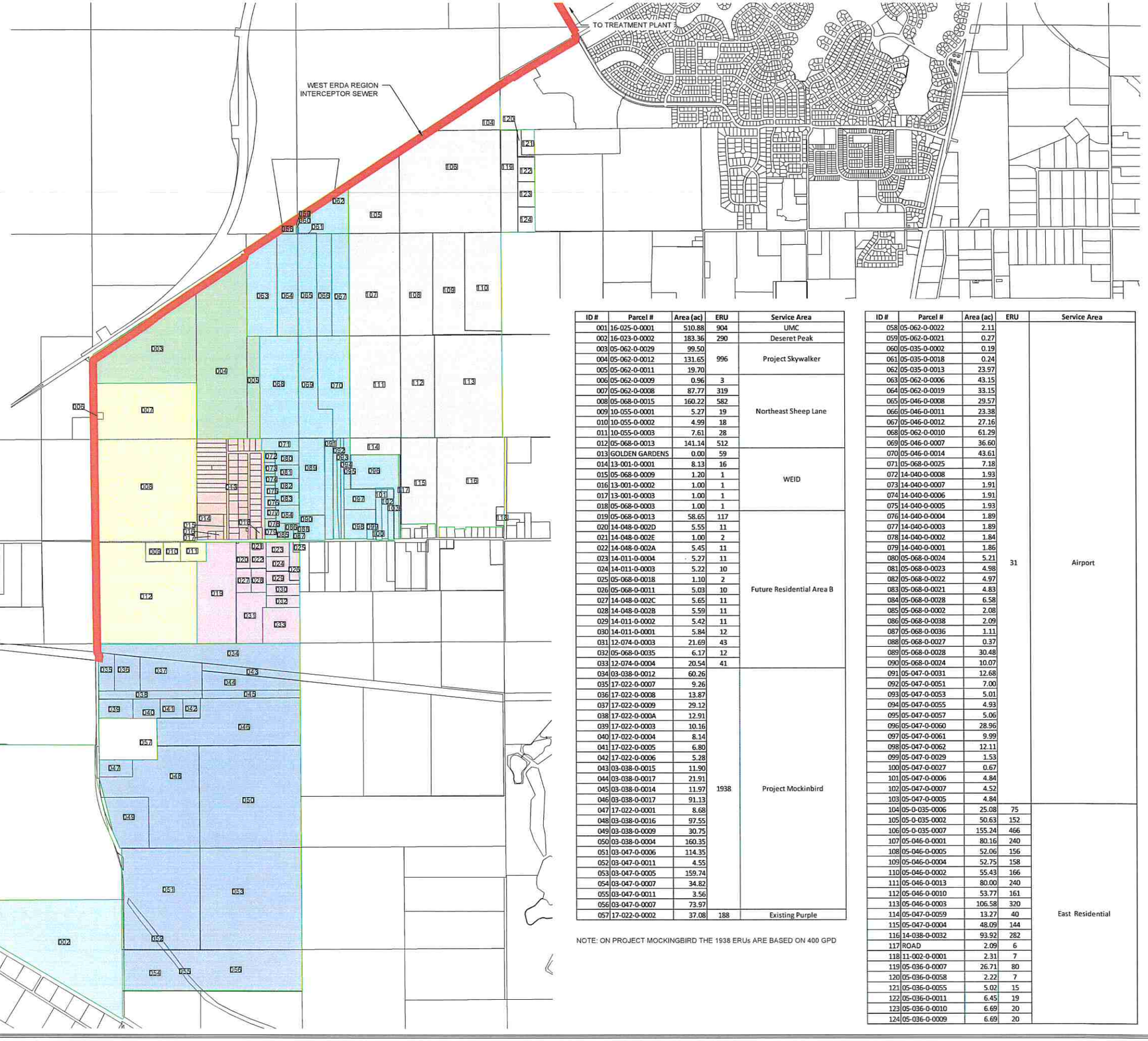
REVISIONS

SHEET 01

PLOT DATE AND TIME: 2/22/2019 11:19 AM
TAB: Service Area
FILENAME: O:\Tooele County\Sheep Lane utilities\engineering\Design\Base\Service Area Map pg 1 - DEQ.dwg

SERVICE AREA

- UMC
- DESERET PEAK COMPLEX
- PROJECT MOCKINBIRD
- EXISTING PURPLE
- AIRPORT
- PROJECT SKYWALK
- WEID
- EAST RESIDENTIAL
- NORTHEAST SHEEP LANE QUADRANT
- FUTURE RESIDENTIAL AREA B



Service Area	Source / Basis
UMC	Deseret Peak Special Service District Master Plan, published by Aqua (2010) = 904 ERU
Deseret Peak Complex	151 gpm buildout per Deseret Peak Special Service District Master Plan, published by Aqua (2010) = 290 ERU
Project Mockingbird	1938 ERUs or 775,200 gpd average day demand based on 400 gpd per ERU (indoor demand). Revised Romney Group Peservation (May 9,2018) and revised to eliminate Food Processor.
Existing Purple	563,400 sf 0.1 gpm/sf and 300 gpd/ERU = 188 ERUs
Airport	31 ERUs per Tooele Valley Airport Water and Sewer Master Plan Prepared by Bowen, Collins & Associates (2006) for Salt Lake City Department of Airports
Project Skywalk	996 ERUs by Skywalk Master Plan Dated 10/10/2018
WEID	79 ERU
East Residential	3 units per acre per Wastewater Regionalization Plan for Northern Tooele Valley, Hansen Allen and Luce (March 2017) = 2776 ERU
Northeast Sheep Lane Quadrant	Project mix of Hospitality / Comercial / Light industrial at 25% building footprint and 0.1 gpd/sf and 300 gpd/ERU = 1481 ERU
Future Residential Area B	2 units per acre per Wastewater Regionalization Plan for Northern Tooele Valley, Hansen Allen and Luce (March 2017) = 316 ERU

ID #	Parcel #	Area (ac)	ERU	Service Area
001	16-025-0-0001	510.88	904	UMC
002	16-023-0-0002	183.36	290	Deseret Peak
003	05-062-0-0029	99.50	996	Project Skywalker
004	05-062-0-0012	131.65		
005	05-062-0-0011	19.70		
006	05-062-0-0009	0.96	3	Northeast Sheep Lane
007	05-062-0-0008	87.77	319	
008	05-068-0-0015	160.22	582	
009	10-055-0-0001	5.27	19	
010	10-055-0-0002	4.99	18	
011	10-055-0-0003	7.61	28	
012	05-068-0-0013	141.14	512	
013	GOLDEN GARDENS	0.00	59	WEID
014	13-001-0-0001	8.13	16	
015	05-068-0-0009	1.20	1	
016	13-001-0-0002	1.00	1	
017	13-001-0-0003	1.00	1	
018	05-068-0-0003	1.00	1	
019	05-068-0-0013	58.65	117	Future Residential Area B
020	14-048-0-002D	5.55	11	
021	14-048-0-002E	1.00	2	
022	14-048-0-002A	5.45	11	
023	14-011-0-0004	5.27	11	
024	14-011-0-0003	5.22	10	
025	05-068-0-0018	1.10	2	
026	05-068-0-0011	5.03	10	
027	14-048-0-002C	5.65	11	
028	14-048-0-002B	5.59	11	
029	14-011-0-0002	5.42	11	
030	14-011-0-0001	5.84	12	
031	12-074-0-0003	21.69	43	
032	05-068-0-0035	6.17	12	
033	12-074-0-0004	20.54	41	
034	03-038-0-0012	60.26	1938	Project Mockinbird
035	17-022-0-0007	9.26		
036	17-022-0-0008	13.87		
037	17-022-0-0009	29.12		
038	17-022-0-000A	12.91		
039	17-022-0-0003	10.16		
040	17-022-0-0004	8.14		
041	17-022-0-0005	6.80		
042	17-022-0-0006	5.28		
043	03-038-0-0015	11.90		
044	03-038-0-0017	21.91		
045	03-038-0-0014	11.97		
046	03-038-0-0017	91.13		
047	17-022-0-0001	8.68		
048	03-038-0-0016	97.55		
049	03-038-0-0009	30.75		
050	03-038-0-0004	160.35		
051	03-047-0-0006	114.35		
052	03-047-0-0011	4.55		
053	03-047-0-0005	159.74		
054	03-047-0-0007	34.82		
055	03-047-0-0011	3.56		
056	03-047-0-0007	73.97		
057	17-022-0-0002	37.08	188	Existing Purple

NOTE: ON PROJECT MOCKINGBIRD THE 1938 ERUs ARE BASED ON 400 GPD

ID #	Parcel #	Area (ac)	ERU	Service Area
058	05-062-0-0022	2.11		
059	05-062-0-0021	0.27		
060	05-035-0-0002	0.19		
061	05-035-0-0018	0.24		
062	05-035-0-0013	23.97		
063	05-062-0-0006	43.15		
064	05-062-0-0019	33.15		
065	05-046-0-0008	29.57		
066	05-046-0-0011	23.38		
067	05-046-0-0012	27.16		
068	05-062-0-0010	61.29		
069	05-046-0-0007	36.60		
070	05-046-0-0014	43.61		
071	05-068-0-0025	7.18		
072	14-040-0-0008	1.93		
073	14-040-0-0007	1.91		
074	14-040-0-0006	1.91		
075	14-040-0-0005	1.93		
076	14-040-0-0004	1.89		
077	14-040-0-0003	1.89		
078	14-040-0-0002	1.84		
079	14-040-0-0001	1.86		
080	05-068-0-0024	5.21	31	Airport
081	05-068-0-0023	4.98		
082	05-068-0-0022	4.97		
083	05-068-0-0021	4.83		
084	05-068-0-0028	6.58		
085	05-068-0-0002	2.08		
086	05-068-0-0038	2.09		
087	05-068-0-0036	1.11		
088	05-068-0-0027	0.37		
089	05-068-0-0028	30.48		
090	05-068-0-0024	10.07		
091	05-047-0-0031	12.68		
092	05-047-0-0051	7.00		
093	05-047-0-0053	5.01		
094	05-047-0-0055	4.93		
095	05-047-0-0057	5.06		
096	05-047-0-0060	28.96		
097	05-047-0-0061	9.99		
098	05-047-0-0062	12.11		
099	05-047-0-0029	1.53		
100	05-047-0-0027	0.67		
101	05-047-0-0006	4.84		
102	05-047-0-0007	4.52		
103	05-047-0-0005	4.84		
104	05-0-035-0006	25.08	75	East Residential
105	05-0-035-0002	50.63	152	
106	05-0-035-0007	155.24	466	
107	05-046-0-0001	80.16	240	
108	05-046-0-0005	52.06	156	
109	05-046-0-0004	52.75	158	
110	05-046-0-0002	55.43	166	
111	05-046-0-0013	80.00	240	
112	05-046-0-0010	53.77	161	
113	05-046-0-0003	106.58	320	
114	05-047-0-0059	13.27	40	
115	05-047-0-0004	48.09	144	
116	14-038-0-0032	93.92	282	
117	ROAD	2.09	6	
118	11-002-0-0001	2.31	7	
119	05-036-0-0007	26.71	80	
120	05-036-0-0058	2.22	7	
121	05-036-0-0055	5.02	15	
122	05-036-0-0011	6.45	19	
123	05-036-0-0010	6.69	20	
124	05-036-0-0009	6.69	20	

TOOELE COUNTY
WEST ERDA REGION INTERCEPTOR SEWER
SERVICE AREA MAP

231 West 800 South Salt Lake City, Utah 84101
Ward Engineering Group
Planning Engineering Surveying
PH: 801 . 487 . 8040 FX: 801 . 487 . 8668

CLIENT
DWG: Service Area Map Pg 2 [DE]
JOB No.

DO NOT SCALE THIS DRAWING DRAWING IS RESIZED IF LESS THAN 22x34 - DIMENSIONS AND NOTES TAKE PRECEDENCE

DRAWN BY: MFAJ
DESIGN BY: AJS
CHECKED BY: BT
DATE: 11/09/2018

REVISIONS

SHEET
02

FILENAME O:\Tooele County\Sheep Lane utilities\engineering\Service Area Analysis\Service Area Map Pg 2 - DEQ.dwg TAB Service Area PLOT DATE AND TIME 2/21/2019 4:20 PM

APPENDIX “B”
Pipe Capacity Worksheets

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jan 4 2023

10in@0.5%

Circular

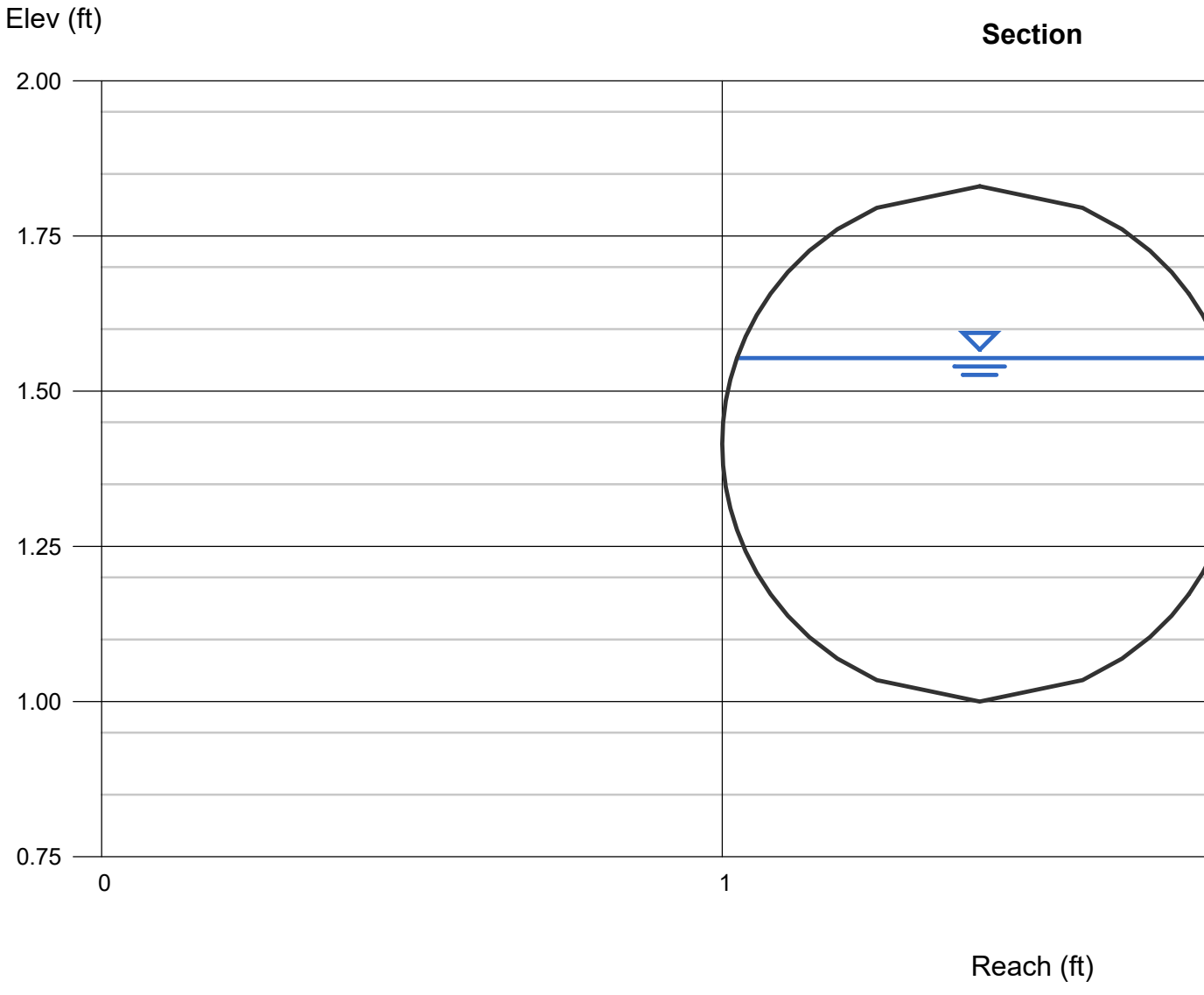
Diameter (ft)	= 0.83
Invert Elev (ft)	= 1.00
Slope (%)	= 0.50
N-Value	= 0.009

Calculations

Compute by:	Q vs Depth
No. Increments	= 3

Highlighted

Depth (ft)	= 0.55
Q (cfs)	= 1.742
Area (sqft)	= 0.38
Velocity (ft/s)	= 4.53
Wetted Perim (ft)	= 1.59
Crit Depth, Yc (ft)	= 0.60
Top Width (ft)	= 0.78
EGL (ft)	= 0.87



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jan 4 2023

12in@0.5%

Circular

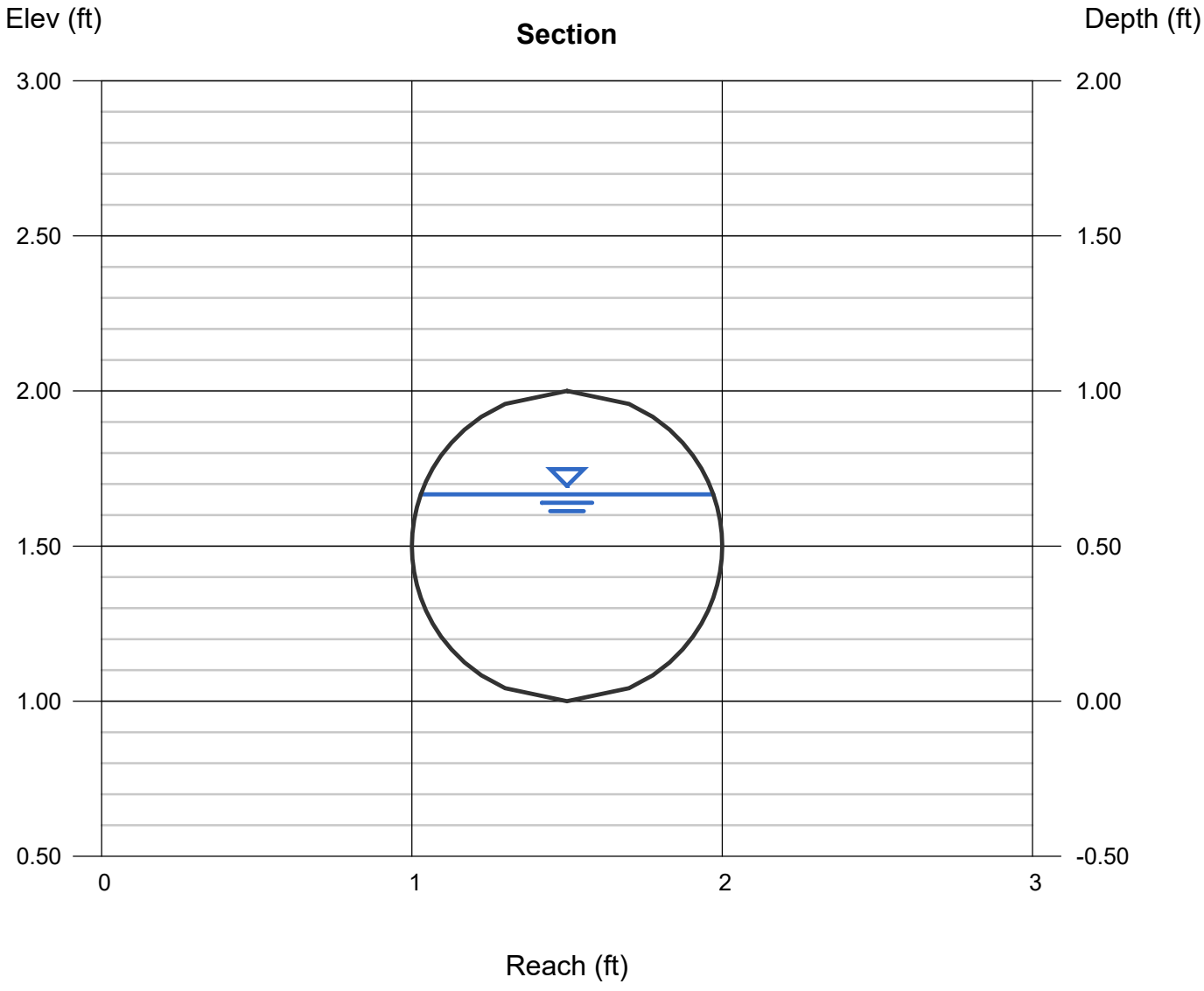
Diameter (ft)	= 1.00
Invert Elev (ft)	= 1.00
Slope (%)	= 0.50
N-Value	= 0.009

Calculations

Compute by:	Q vs Depth
No. Increments	= 3

Highlighted

Depth (ft)	= 0.67
Q (cfs)	= 2.864
Area (sqft)	= 0.56
Velocity (ft/s)	= 5.13
Wetted Perim (ft)	= 1.91
Crit Depth, Yc (ft)	= 0.73
Top Width (ft)	= 0.94
EGL (ft)	= 1.08



Channel Report

15in@0.5%

Circular

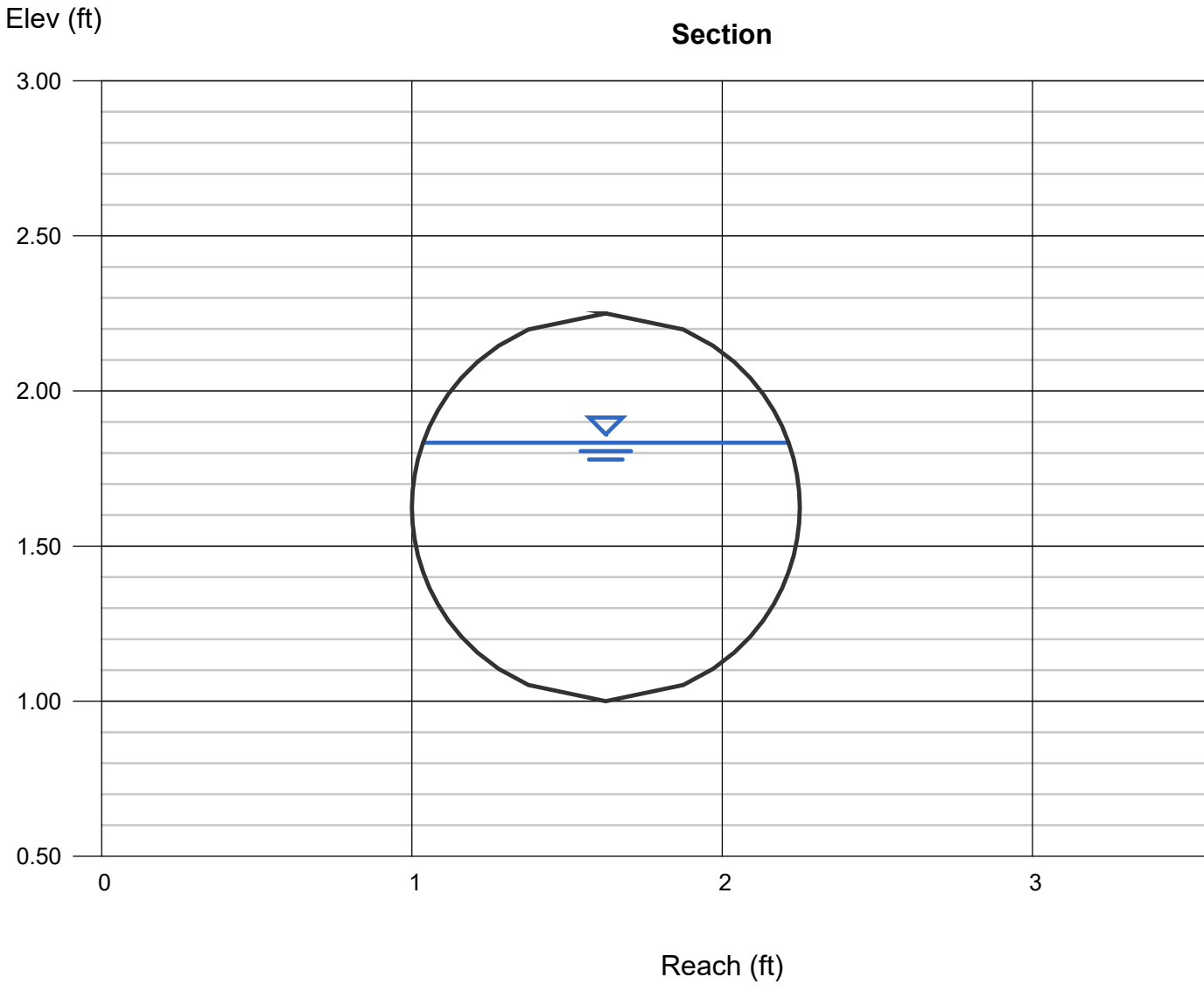
Diameter (ft)	= 1.25
Invert Elev (ft)	= 1.00
Slope (%)	= 0.50
N-Value	= 0.009

Calculations

Compute by:	Q vs Depth
No. Increments	= 3

Highlighted

Depth (ft)	= 0.83
Q (cfs)	= 5.192
Area (sqft)	= 0.87
Velocity (ft/s)	= 5.95
Wetted Perim (ft)	= 2.39
Crit Depth, Yc (ft)	= 0.93
Top Width (ft)	= 1.18
EGL (ft)	= 1.38



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Nov 28 2022

Ensign - 15in@0.15%

Circular

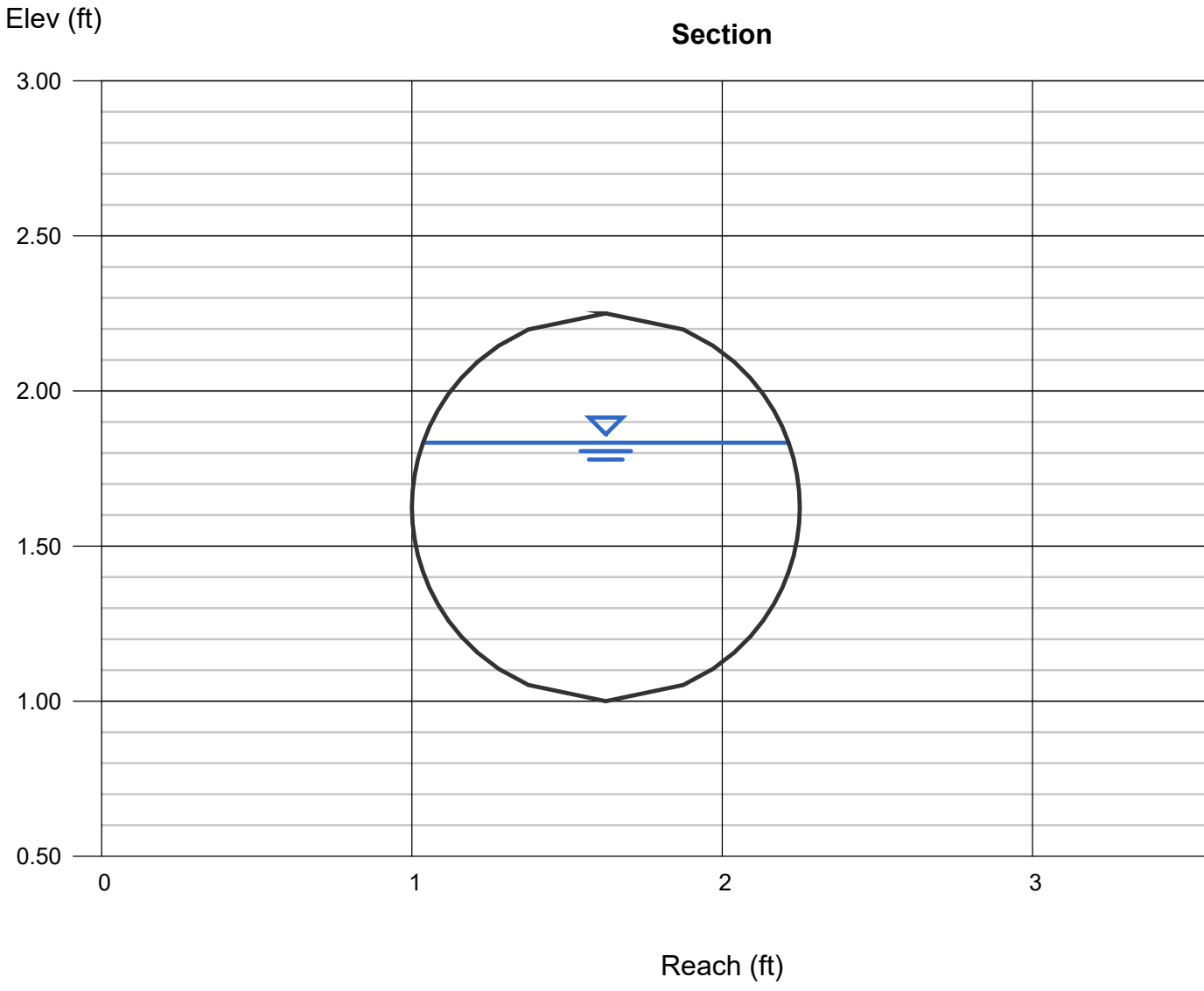
Diameter (ft)	= 1.25
Invert Elev (ft)	= 1.00
Slope (%)	= 0.15
N-Value	= 0.009

Calculations

Compute by:	Q vs Depth
No. Increments	= 3

Highlighted

Depth (ft)	= 0.83
Q (cfs)	= 2.844
Area (sqft)	= 0.87
Velocity (ft/s)	= 3.26
Wetted Perim (ft)	= 2.39
Crit Depth, Yc (ft)	= 0.68
Top Width (ft)	= 1.18
EGL (ft)	= 1.00



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Nov 28 2022

Ensign - 15in@0.25%

Circular

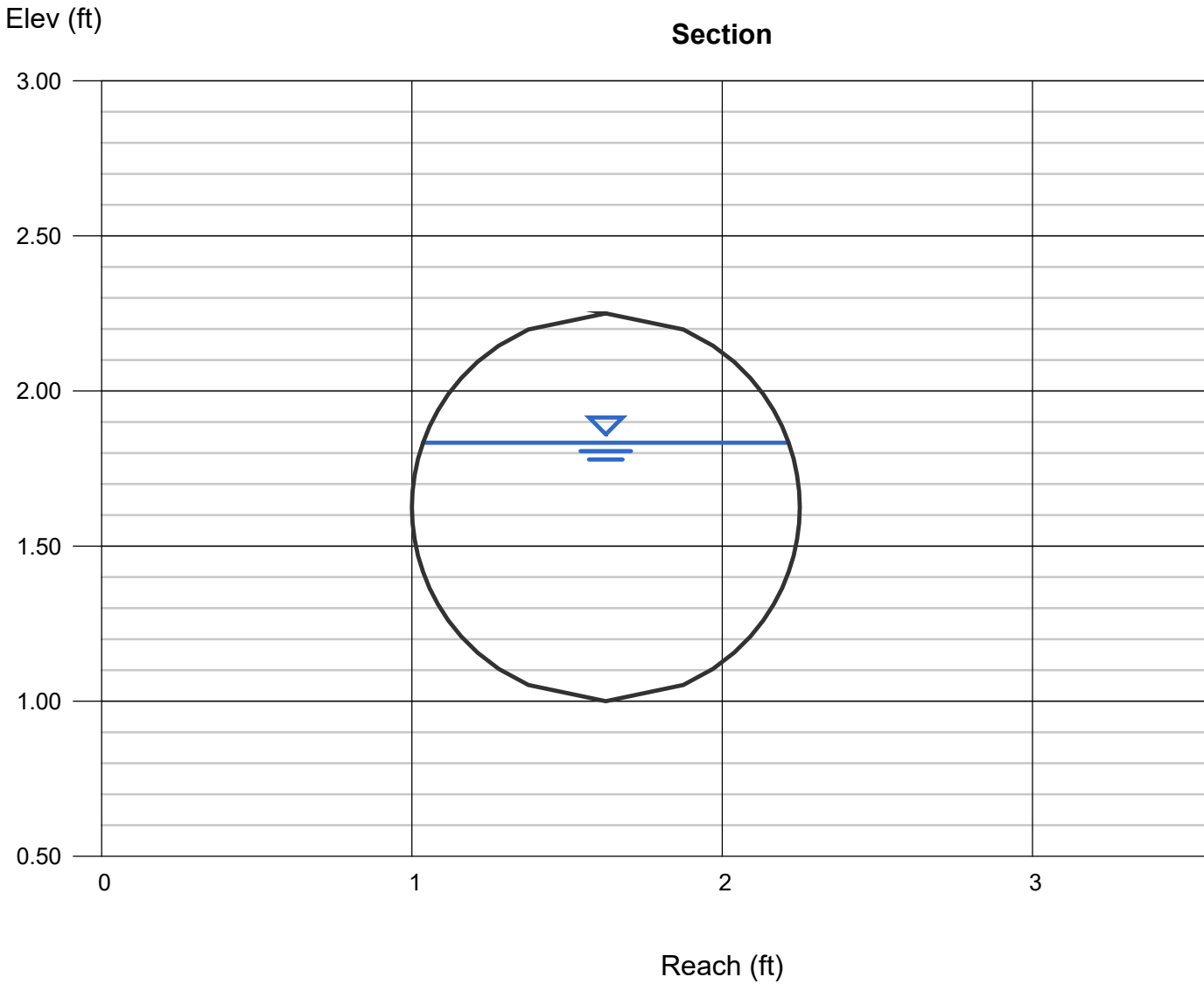
Diameter (ft)	= 1.25
Invert Elev (ft)	= 1.00
Slope (%)	= 0.25
N-Value	= 0.009

Calculations

Compute by:	Q vs Depth
No. Increments	= 3

Highlighted

Depth (ft)	= 0.83
Q (cfs)	= 3.672
Area (sqft)	= 0.87
Velocity (ft/s)	= 4.21
Wetted Perim (ft)	= 2.39
Crit Depth, Yc (ft)	= 0.78
Top Width (ft)	= 1.18
EGL (ft)	= 1.11



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Nov 28 2022

Ensign - 15in@0.39%

Circular

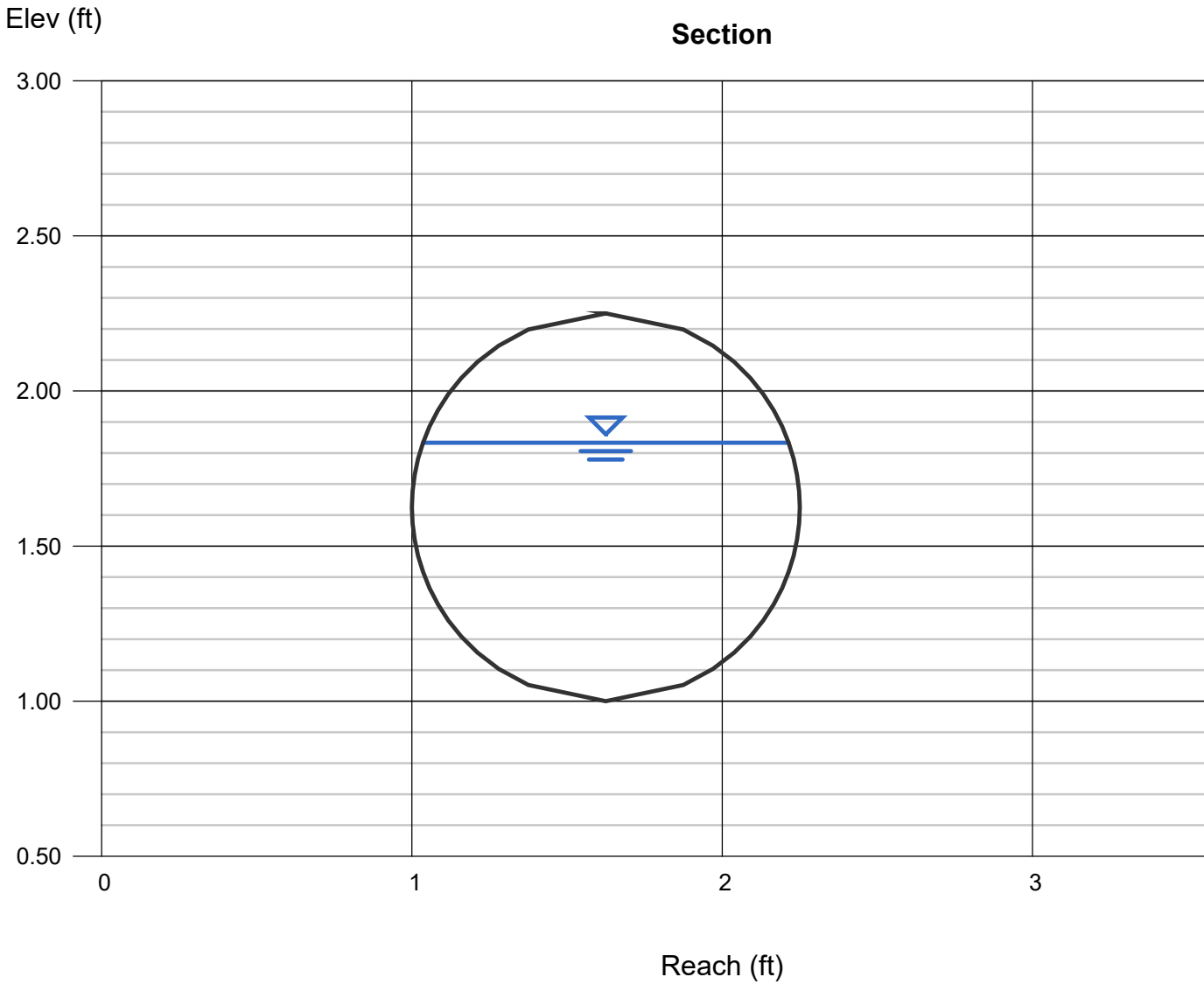
Diameter (ft)	= 1.25
Invert Elev (ft)	= 1.00
Slope (%)	= 0.39
N-Value	= 0.009

Calculations

Compute by:	Q vs Depth
No. Increments	= 3

Highlighted

Depth (ft)	= 0.83
Q (cfs)	= 4.586
Area (sqft)	= 0.87
Velocity (ft/s)	= 5.26
Wetted Perim (ft)	= 2.39
Crit Depth, Yc (ft)	= 0.87
Top Width (ft)	= 1.18
EGL (ft)	= 1.26



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Nov 28 2022

Ensign - 18in@0.36%

Circular

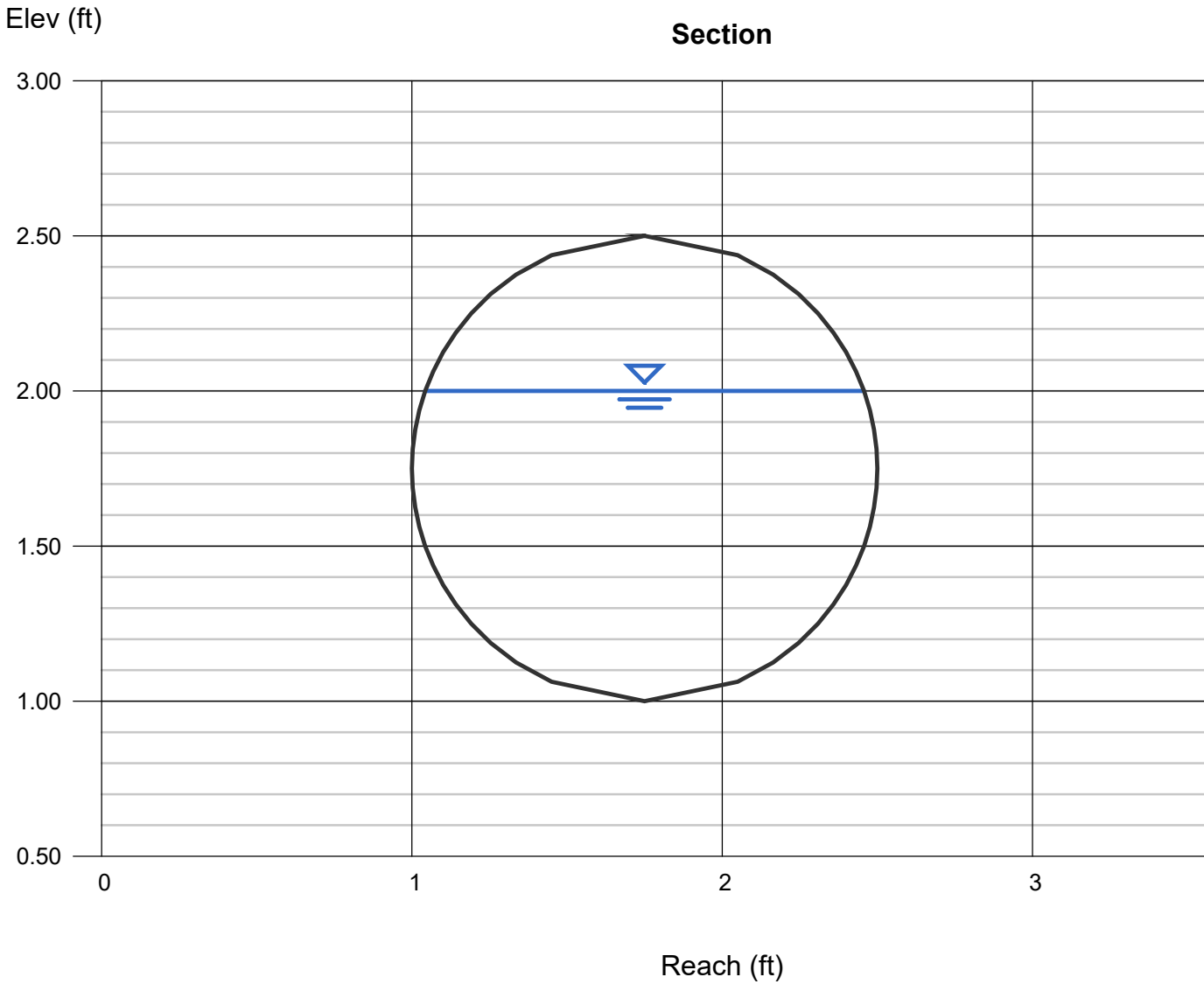
Diameter (ft)	= 1.50
Invert Elev (ft)	= 1.00
Slope (%)	= 0.36
N-Value	= 0.009

Calculations

Compute by:	Q vs Depth
No. Increments	= 3

Highlighted

Depth (ft)	= 1.00
Q (cfs)	= 7.165
Area (sqft)	= 1.26
Velocity (ft/s)	= 5.71
Wetted Perim (ft)	= 2.87
Crit Depth, Yc (ft)	= 1.04
Top Width (ft)	= 1.41
EGL (ft)	= 1.51



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Nov 28 2022

Ensign - 18in@0.37%

Circular

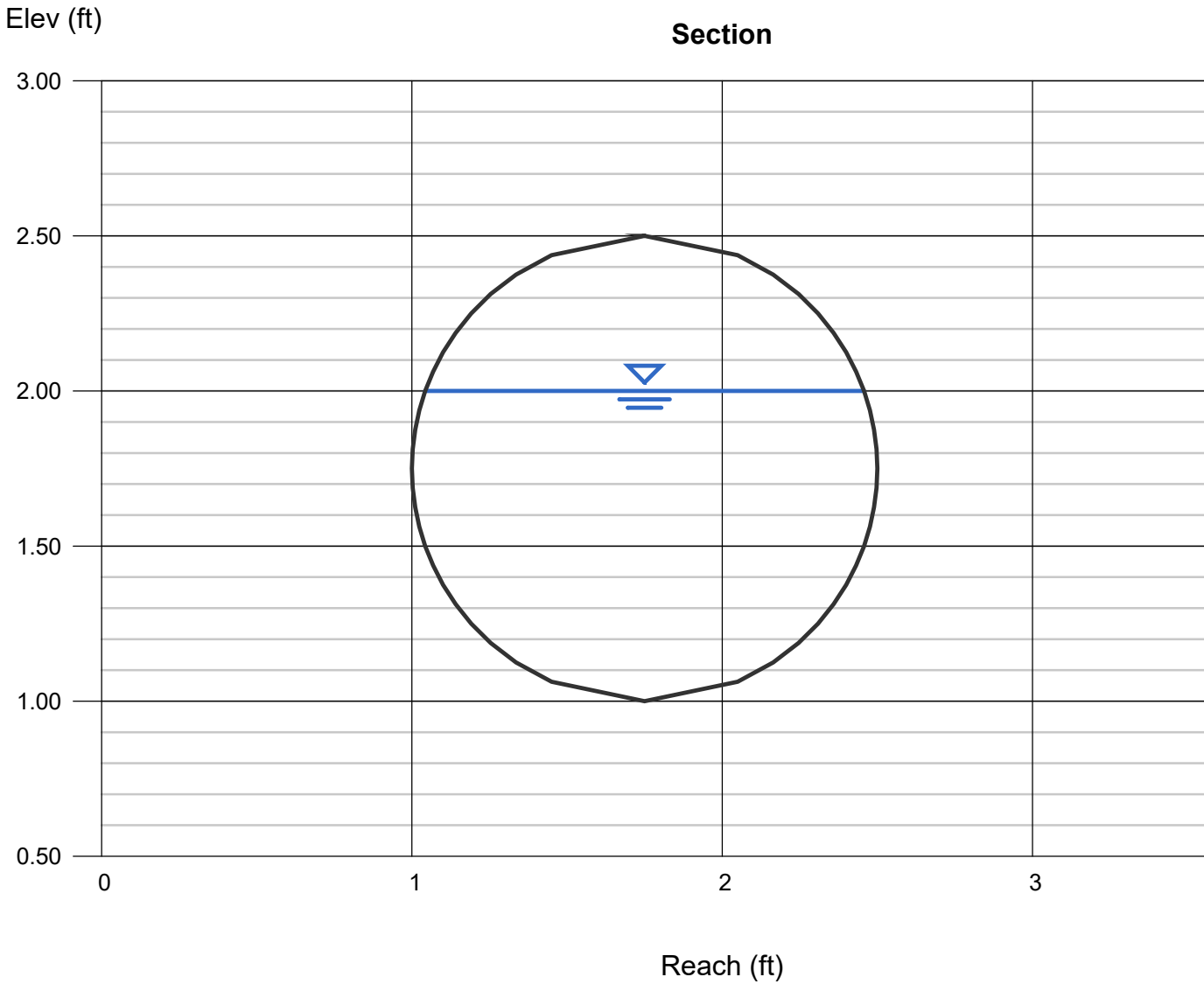
Diameter (ft)	= 1.50
Invert Elev (ft)	= 1.00
Slope (%)	= 0.37
N-Value	= 0.009

Calculations

Compute by:	Q vs Depth
No. Increments	= 3

Highlighted

Depth (ft)	= 1.00
Q (cfs)	= 7.264
Area (sqft)	= 1.26
Velocity (ft/s)	= 5.78
Wetted Perim (ft)	= 2.87
Crit Depth, Yc (ft)	= 1.05
Top Width (ft)	= 1.41
EGL (ft)	= 1.52



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Nov 28 2022

Ensign - 21in@0.20%

Circular

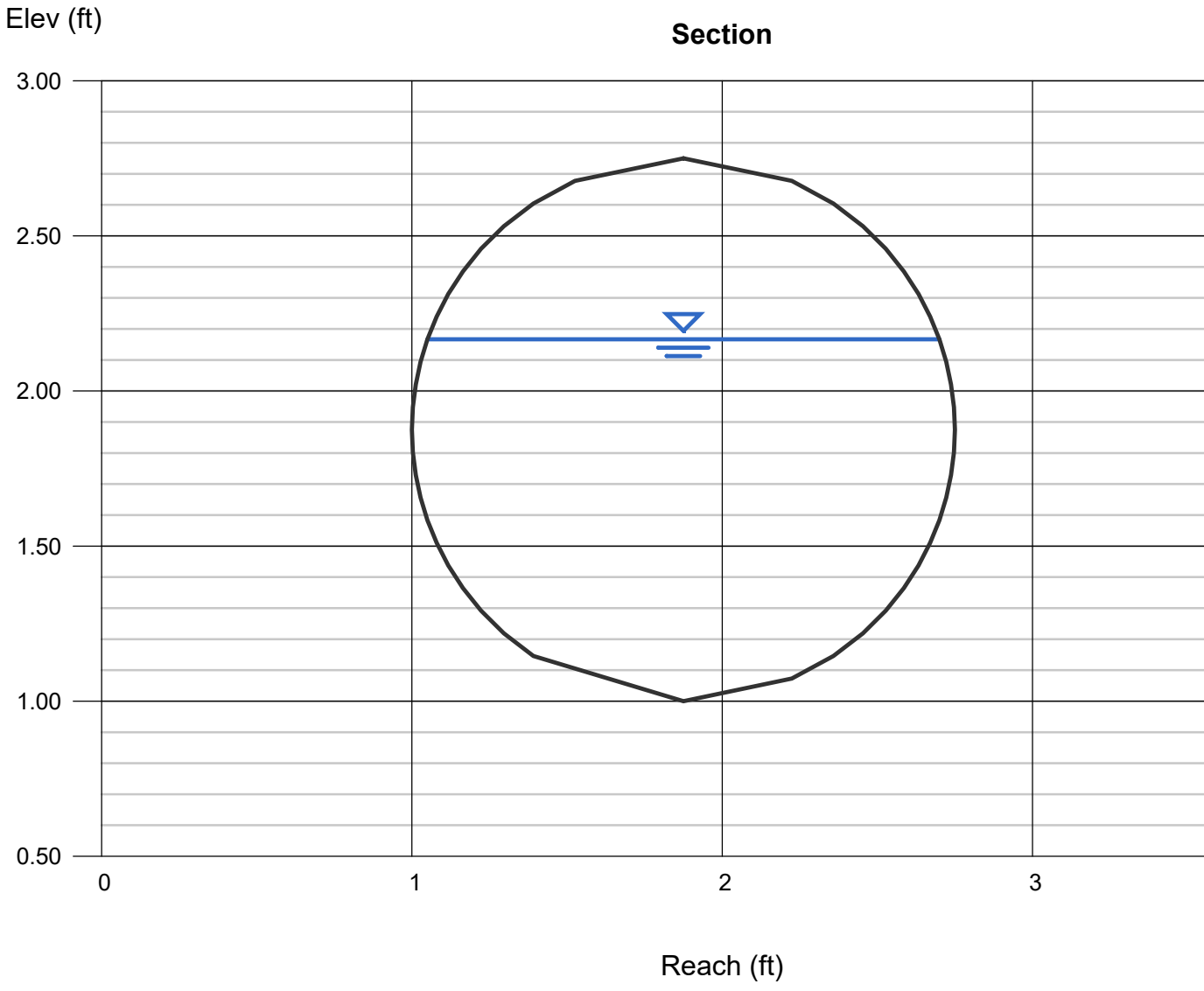
Diameter (ft)	= 1.75
Invert Elev (ft)	= 1.00
Slope (%)	= 0.20
N-Value	= 0.009

Calculations

Compute by:	Q vs Depth
No. Increments	= 3

Highlighted

Depth (ft)	= 1.17
Q (cfs)	= 8.056
Area (sqft)	= 1.71
Velocity (ft/s)	= 4.71
Wetted Perim (ft)	= 3.35
Crit Depth, Yc (ft)	= 1.06
Top Width (ft)	= 1.65
EGL (ft)	= 1.51



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jan 5 2023

21in@0.37%

Circular

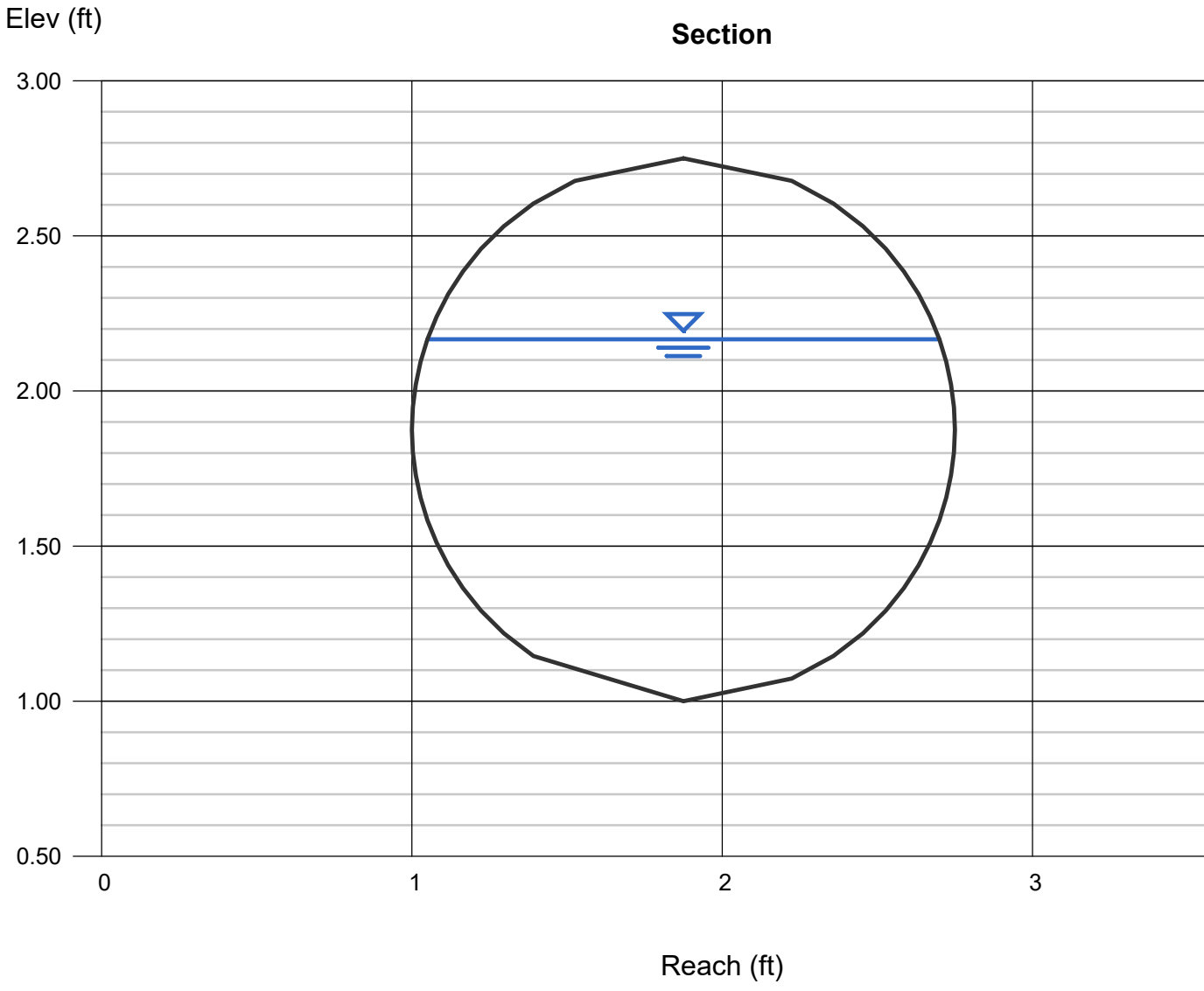
Diameter (ft)	= 1.75
Invert Elev (ft)	= 1.00
Slope (%)	= 0.37
N-Value	= 0.009

Calculations

Compute by:	Q vs Depth
No. Increments	= 3

Highlighted

Depth (ft)	= 1.17
Q (cfs)	= 10.96
Area (sqft)	= 1.71
Velocity (ft/s)	= 6.41
Wetted Perim (ft)	= 3.35
Crit Depth, Yc (ft)	= 1.24
Top Width (ft)	= 1.65
EGL (ft)	= 1.81



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jan 5 2023

24in@0.2%

Circular

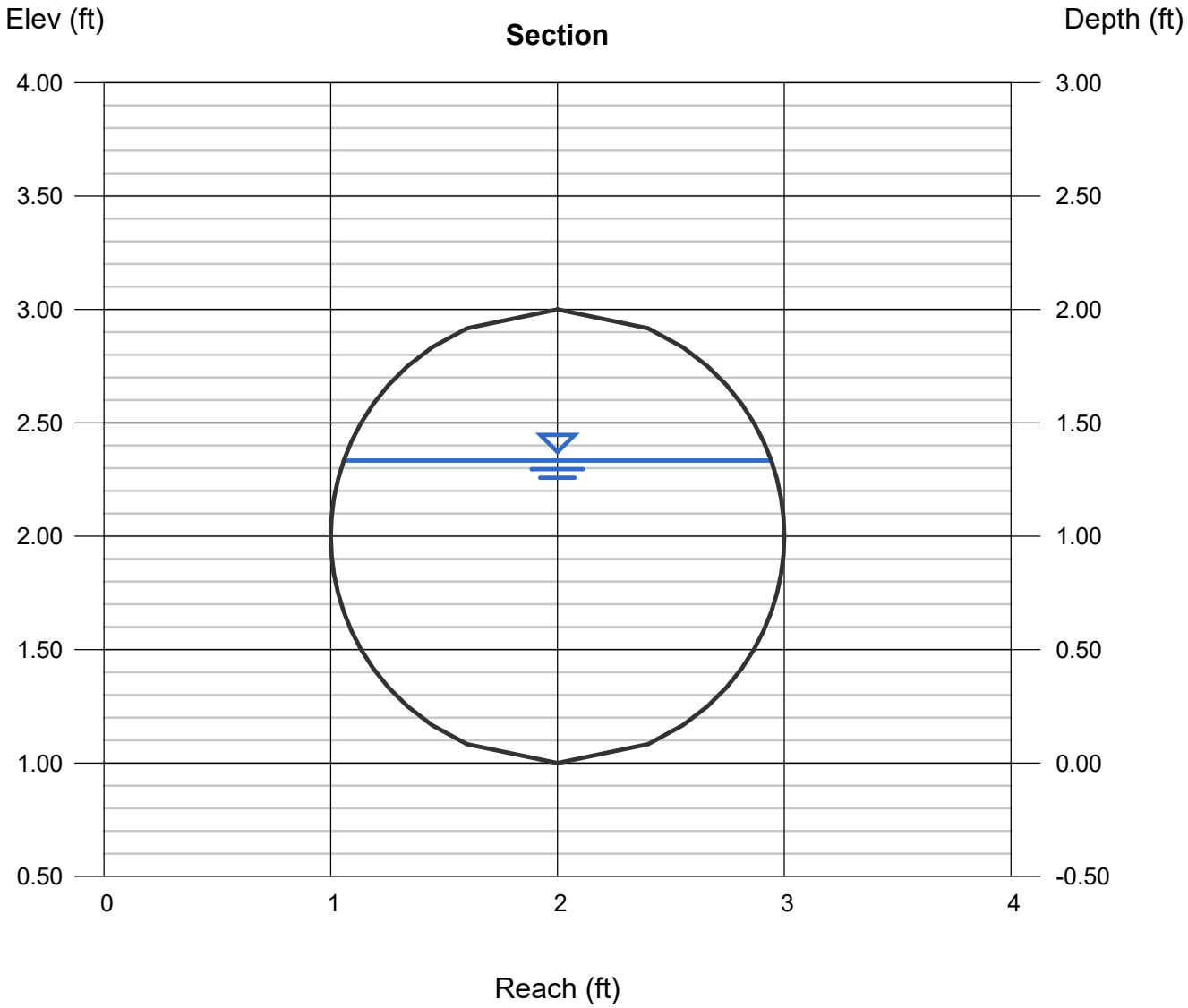
Diameter (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 0.20
N-Value	= 0.009

Calculations

Compute by:	Q vs Depth
No. Increments	= 3

Highlighted

Depth (ft)	= 1.33
Q (cfs)	= 11.50
Area (sqft)	= 2.23
Velocity (ft/s)	= 5.15
Wetted Perim (ft)	= 3.83
Crit Depth, Yc (ft)	= 1.22
Top Width (ft)	= 1.88
EGL (ft)	= 1.75



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jan 5 2023

27in@0.37%

Circular

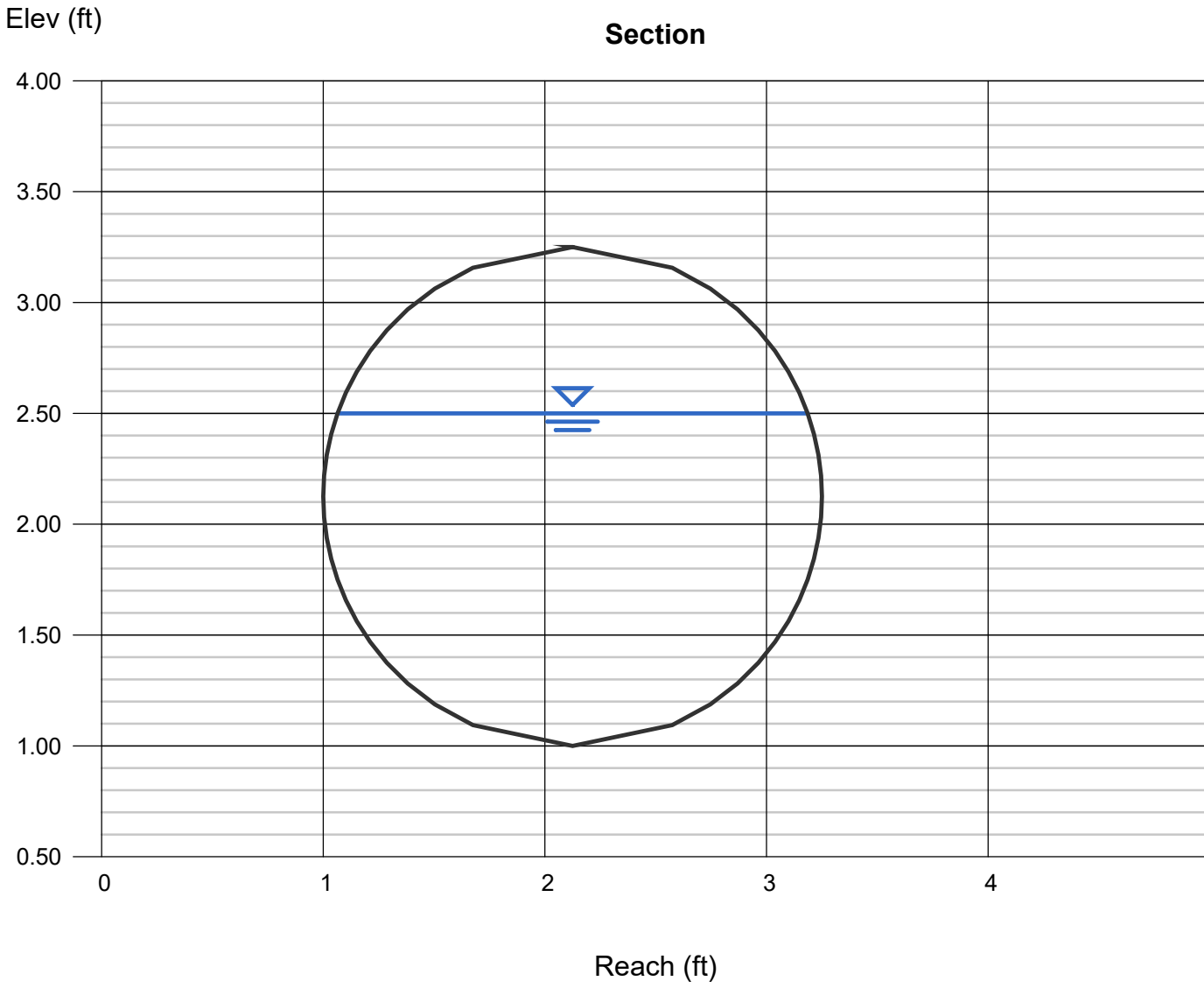
Diameter (ft)	= 2.25
Invert Elev (ft)	= 1.00
Slope (%)	= 0.20
N-Value	= 0.009

Calculations

Compute by:	Q vs Depth
No. Increments	= 3

Highlighted

Depth (ft)	= 1.50
Q (cfs)	= 15.75
Area (sqft)	= 2.83
Velocity (ft/s)	= 5.57
Wetted Perim (ft)	= 4.31
Crit Depth, Yc (ft)	= 1.39
Top Width (ft)	= 2.12
EGL (ft)	= 1.98



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jan 5 2023

30in@0.10%

Circular

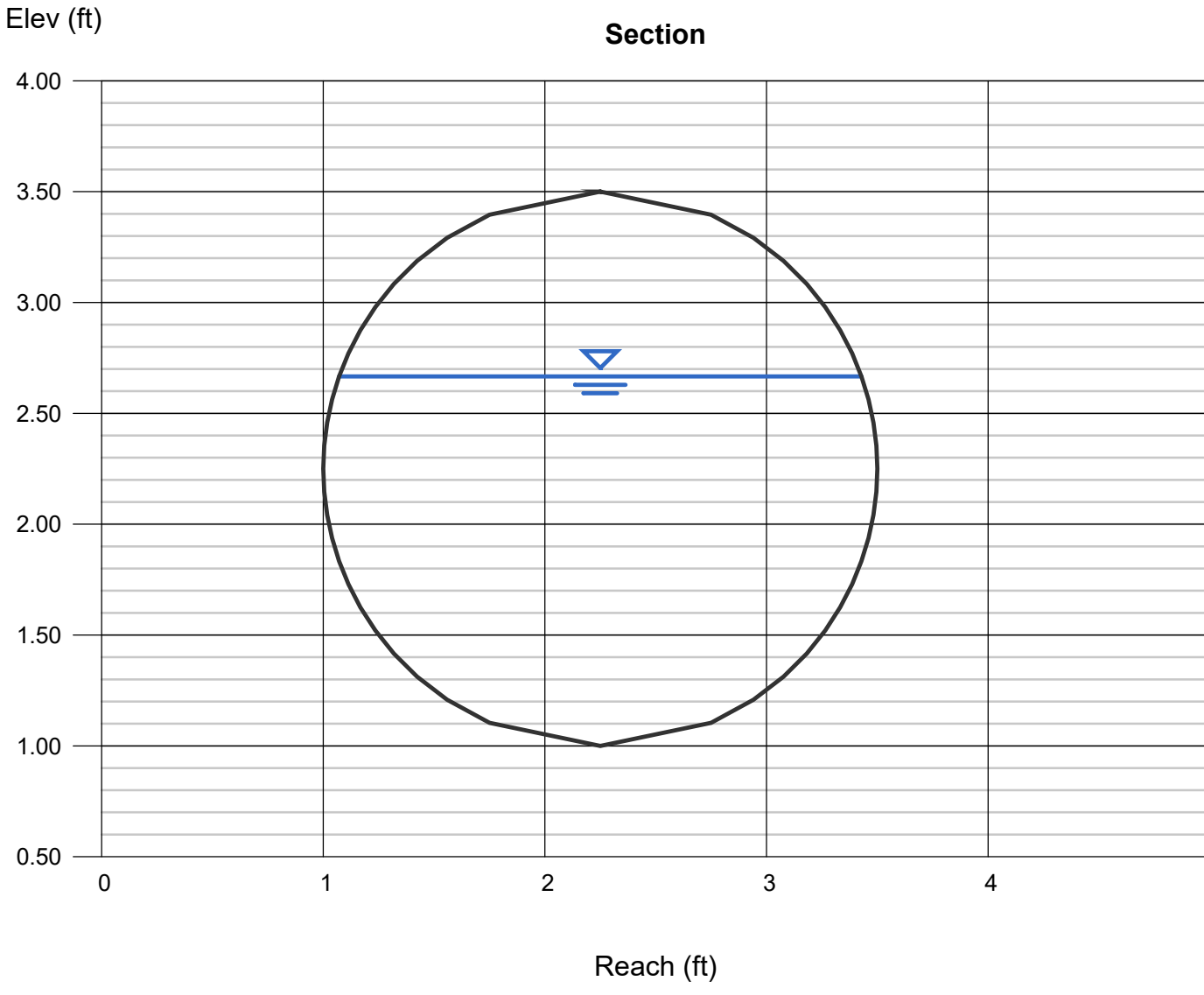
Diameter (ft)	= 2.50
Invert Elev (ft)	= 1.00
Slope (%)	= 0.10
N-Value	= 0.009

Calculations

Compute by:	Q vs Depth
No. Increments	= 3

Highlighted

Depth (ft)	= 1.67
Q (cfs)	= 14.75
Area (sqft)	= 3.49
Velocity (ft/s)	= 4.23
Wetted Perim (ft)	= 4.79
Crit Depth, Yc (ft)	= 1.30
Top Width (ft)	= 2.35
EGL (ft)	= 1.94



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jan 5 2023

30in@0.20%

Circular

Diameter (ft)	= 2.50
Invert Elev (ft)	= 1.00
Slope (%)	= 0.20
N-Value	= 0.009

Calculations

Compute by:	Q vs Depth
No. Increments	= 3

Highlighted

Depth (ft)	= 1.67
Q (cfs)	= 20.86
Area (sqft)	= 3.49
Velocity (ft/s)	= 5.98
Wetted Perim (ft)	= 4.79
Crit Depth, Yc (ft)	= 1.55
Top Width (ft)	= 2.35
EGL (ft)	= 2.22