CHRISTY
CORPORATION

MASTER SANITARY SEWER REPORT

5 Ridges

Prepared for:

5 Ridges Development Company, Inc.
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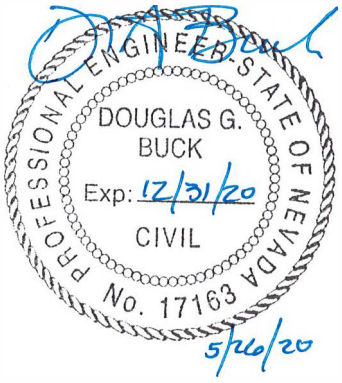
Reno, NV 89501



Prepared by:

Christy Corporation, Ltd.
1000 Kiley Parkway
Sparks, Nevada 89436

May 2020

Introduction

This report summarizes estimated wastewater generation analysis for buildout development for the 5 Ridges project and final design calculations for backbone infrastructure. The purpose of this report is to analyze the proposed sanitary sewer lines for the backbone infrastructure 5 Ridges project site to determine direction of flow, sizing of the sewer lines and to develop a framework for future sewer reports within the 5 Ridges development as well as to determine the anticipated sewage contribution to the Spanish Springs Sewer Interceptor.

The project is located in the foothills on the west side of Spanish Springs Valley, Section 9, Township 20 North, Range 20 East, within the Northern Sparks Sphere of influence (NSSOI), Sparks, Nevada. The proposed development site is north of Highland Ranch Parkway and west of Pyramid Highway. Please reference the attached vicinity map in the appendix.

The 5 Ridges project is a single family and townhome development that will be developed in multiple phases. There are 10 villages and a remainder parcel currently envisioned for the buildout of 5 Ridges.

The current land plan for 5 Ridges identifies a buildout of 1241 single family and townhome units. A total of 158 units are anticipated to be townhomes.

Previous Studies

Sewer Model Update for the City of Sparks, by Atkins, In Progress

Methodology

The City of Sparks does not have an official design criteria requirement for sanitary sewer design flow determination. The method proposed is to use the peak flow rates and occupancy rates, below. Sewer mains are analyzed at 50% flow depth. The following design criteria were used for the preparation of this report:

Manning's Equation: $Q=(1.49/n)AR^{2/3}S^{1/2}$	
Manning's Roughness Coefficient (n value)	0.014
Depth of flow pipe (d/D)	0.50
Main sewer lines (8" and 10")	300 gal/day/capita
Single Family Residential occupancy rate	3.0 capita/du
Multi-Family Residential occupancy rate	2.0 capita/du

The total sewer contribution in (gal/day) was converted to (MGD). Using this quantity sewer lines will be sized using the following Bentley Flow Master output:

8" diameter pipe at 0.4% minimum slope:	½ Full Pipe Discharge – 0.23 MGD
8" diameter pipe at 1%:	½ Full Pipe Discharge – 0.36 MGD
8" diameter pipe at 2%:	½ Full Pipe Discharge – 0.51 MGD
8" diameter pipe at 4%:	½ Full Pipe Discharge – 0.73 MGD
8" diameter pipe at 6%:	½ Full Pipe Discharge – 0.89 MGD
8" diameter pipe at 8%:	½ Full Pipe Discharge – 1.03 MGD
8" diameter pipe at 10%:	½ Full Pipe Discharge – 1.15 MGD
10" diameter pipe at 0.3% minimum slope:	½ Full Pipe Discharge – 0.36 MGD
10" diameter pipe at 1%:	½ Full Pipe Discharge – 0.66 MGD
10" diameter pipe at 2%:	½ Full Pipe Discharge – 0.93 MGD
10" diameter pipe at 4%:	½ Full Pipe Discharge – 1.31 MGD
10" diameter pipe at 6%:	½ Full Pipe Discharge – 1.61 MGD
10" diameter pipe at 8%:	½ Full Pipe Discharge – 1.86 MGD
10" diameter pipe at 10%:	½ Full Pipe Discharge – 2.08 MGD

Reference the appendix for all applicable calculations

Existing Sanitary Sewer System

The proposed site is located north and west of the existing 36" Spanish Springs Sewer Interceptor. The existing interceptor traverses the eastern boundary of the Kiley Ranch North development southeast of this site. Wastewater is conveyed to the Truckee Meadows Water Reclamation Facility (TMWRF) for treatment. The existing sewer network within Kiley Ranch extends from the interceptor through Kiley Ranch, and up Sparks Boulevard to the intersection of Sparks Boulevard, Pyramid Highway, and Highland Ranch Parkway and then up Highland Ranch Parkway terminating approximately 500 feet west of Pyramid Highway. The capacity of this infrastructure is discussed in the Exiting Sewer System section on following pages.

Wastewater Generation

The proposed 1241 units anticipated for buildout of 5 Ridges produce a peak flow of 1,070,000 gallons per day (gpd) or 1.07 million gallons per day (MGD). Project wastewater generation flows were calculated and are shown in the table below.

Table 1. 5 Ridges – Wastewater Generation

Land Use	Number of Units	Unit Flow (gal/unit/day)	Occupancy	Peak Flow (gpd)	Peak Flow (MGD)
Single Family Residential Villages 2, 3, 4, 5 6, 7, 8, 9, & 10	1083	300	3	947,700	0.948
Townhomes Villages 1A & 1B	158	300	2	94,800	0.095
Total	1241			1,069,500	1.070

Proposed Sanitary Sewer System

The proposed sanitary sewer system will consist of 8" and 10" PVC mains with minimum velocities of 2 fps and maximum velocities of 15 fps. Minimum anticipated 8" pipe slopes will be 0.4% to maintain minimum velocities. Sewer mains of 8" and 10" diameter will be utilized to convey buildout flows from the project. The primary sewer mains will be contained in the north-south backbone road, Five Ridges Parkway, and the west leg of Antelope Ridge Parkway, proposed with the project. Sewer mains will be constructed in these roadway to convey wastewater to Highland Ranch Parkway. New sewer will be constructed in Highland Ranch Parkway from Five Ridges Parkway to approximately 500 feet west of the intersection of Pyramid Highway and Highland Ranch Parkway/Sparks Boulevard where the sewer main will connect to an existing 10" sewer main.

Sewer mains proposed within the backbone infrastructure for the development are sized to collect anticipated flows for full buildout of the 5 Ridges development. The backbone infrastructure for the project will serve all Villages and facilities within the development. Backbone roadways include Five Ridges Parkway and Antelope Ridge Parkway. New sewer within Highland Ranch Parkway is also sized pursuant to these calculations. Table 2 and the Contributing Area Map in the Appendix identify the total wastewater generated by Villages at primary nodes in the backbone infrastructure. The flow (Q) in each row of the table in the Node column represents the total cumulative peak sewer flow anticipated in the proposed sewer system at that point. With this flow information and the pipe capacities presented in the Methodology section above, the sewer mains have been sized to flow at less than ½ full flow at buildout.

Table 2. 5 Ridges – Backbone Infrastructure Sewer Main Flows

Node #	Downstream Node	CONTRIBUTING AREA	DU	capita /DU	capita	Q ADD MGD	Q NODE MGD
A2	A1	VILLAGE 8	142	3	426	0.128	0.128
A1	F3	VILLAGE 6	148	3	444	0.133	0.261
F4	F3	VILLAGES 8 & 9 & 10	287	3	861	0.258	0.258
F3	F2						0.519
F2	F1	VILLAGES 2 & 4	102	3	306	0.092	0.611
F1	H2	VILLAGES 3 & 5 & 7	404	3	1212	0.364	0.975
H2	H1	VILLAGE 1B	70	2	140	0.042	1.017
H1	POC	VILLAGE 1A	88	2	176	0.053	1.070
		∑DU	**1241**			**∑Q**	**1.070**

The resultant sanitary sewer pipe network within the backbone infrastructure will consist of 8" sewer mains in Antelope Ridge Parkway and the portion of Five Ridges Parkway above Antelope Ridge Parkway and 10" sewer mains in Five Ridges Parkway below Antelope Ridge Parkway and in Highland Ranch Parkway.

Existing Sanitary Sewer System

Atkins is currently preparing an update to the City of Sparks Sewer Model. The sewer model addresses existing and buildout flows and pipe capacities for Sparks' existing public sewer system. The 5 Ridges development is identified in the buildout condition model being prepared by Atkins. Atkins has provided preliminary results of the sewer model that are included in the appendix to this report.

Atkins' Figure 1 (reference the appendix) presents the existing sewer pipe network that 5 Ridges will connect to. This system consists of 8" to 12" sewer mains in Sparks Boulevard. The main then turns and travels east on Kiley Parkway as a 15" main and is upsized to an 18" sewer interceptor at the intersection of David Allen Parkway and Kiley Parkway where it continues to Henry Orr Parkway where it turns south. The 18" interceptor terminates at the 36" Spanish Springs sewer interceptor.

Atkins' Figure 2 identifies contributory areas to buildout flows referenced in the appendix. These future flows incorporate groundwater infiltration in wet weather conditions as well as provide modeling of dry weather condition flows. In the analysis of new development, pipe capacity requirements for sewer mains and trunk mains (8" to 12") is typically limited to 50% full pipe flow and to 70% full pipe flow for sewer interceptors (pipe >15"). There is a single segment of 8" sewer main in Sparks Boulevard that is identified to be greater than 50% flow at buildout conditions during wet weather conditions. This section of 8" main is modeled to be at 37.9% full during dry weather conditions and 52.5% full during wet weather conditions. The slight exceedance of the 50% full design limit is relatively negligible in the wet weather peak flow condition and does not warrant upsizing of the existing sewer main for the development. As such all sewer mains, trunk mains, and interceptors identified in the model identify existing capacity for buildout of the 5 Ridges development.

Conclusion

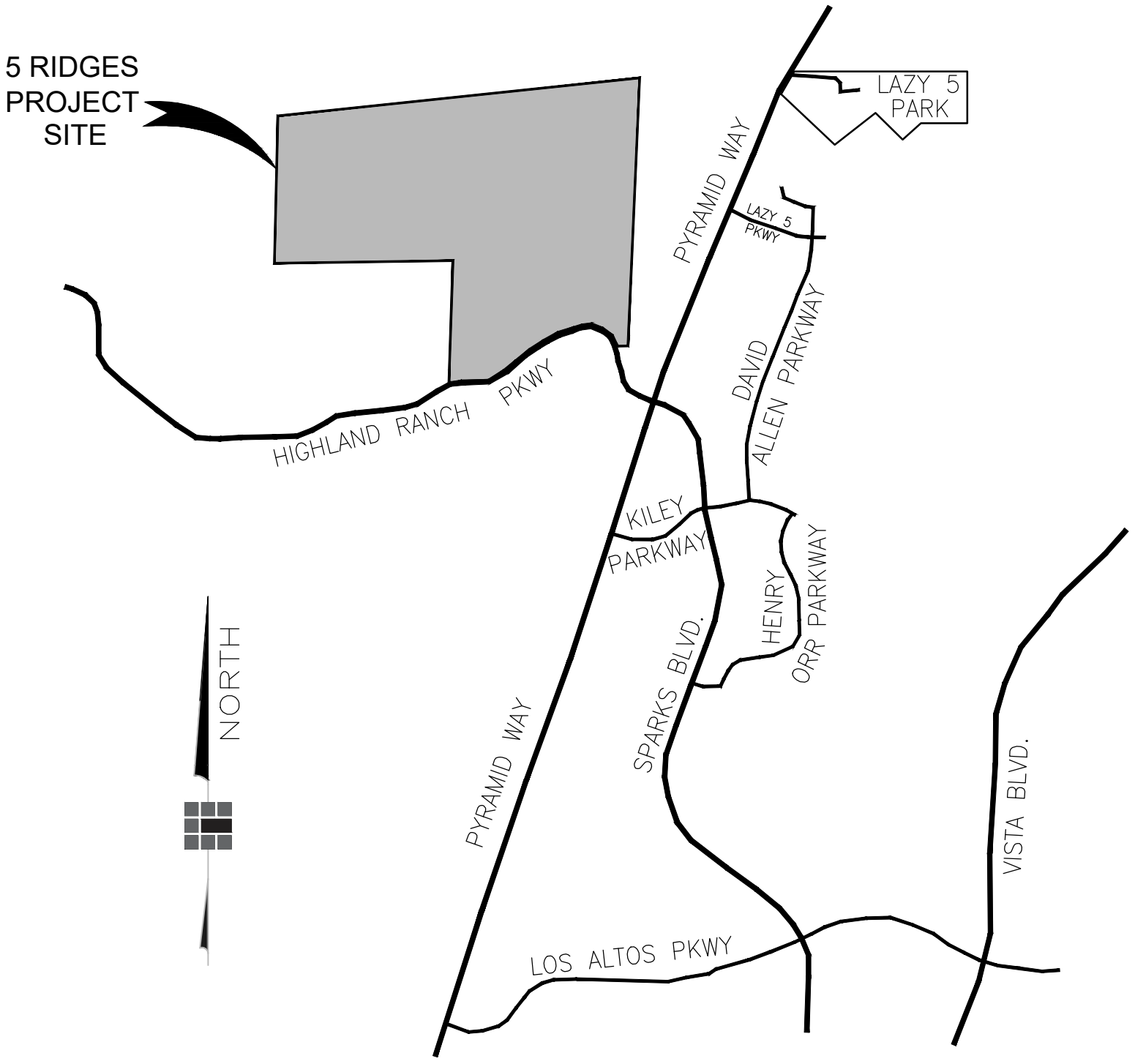
This master final sanitary sewer report defines the overall wastewater generation for 5 Ridges and provides sizing for sewer infrastructure within the backbone roadway system for the development. This study has been prepared in compliance with the existing Sparks sewer modeling and standard engineering practices. The project will not have a negative impact on existing sewer system conveyance capacities.

An individual Final Sanitary Sewer Study will be prepared for each of the Villages within the 5 Ridges development with each final map. As the site sewers to the Truckee Meadows Wastewater Reclamation Facility (TMWRF), each final map will be required to obtain sewer will serve letters from the City of Sparks to reserve treatment capacity prior to recordation or the creation of residential lots.

Appendices

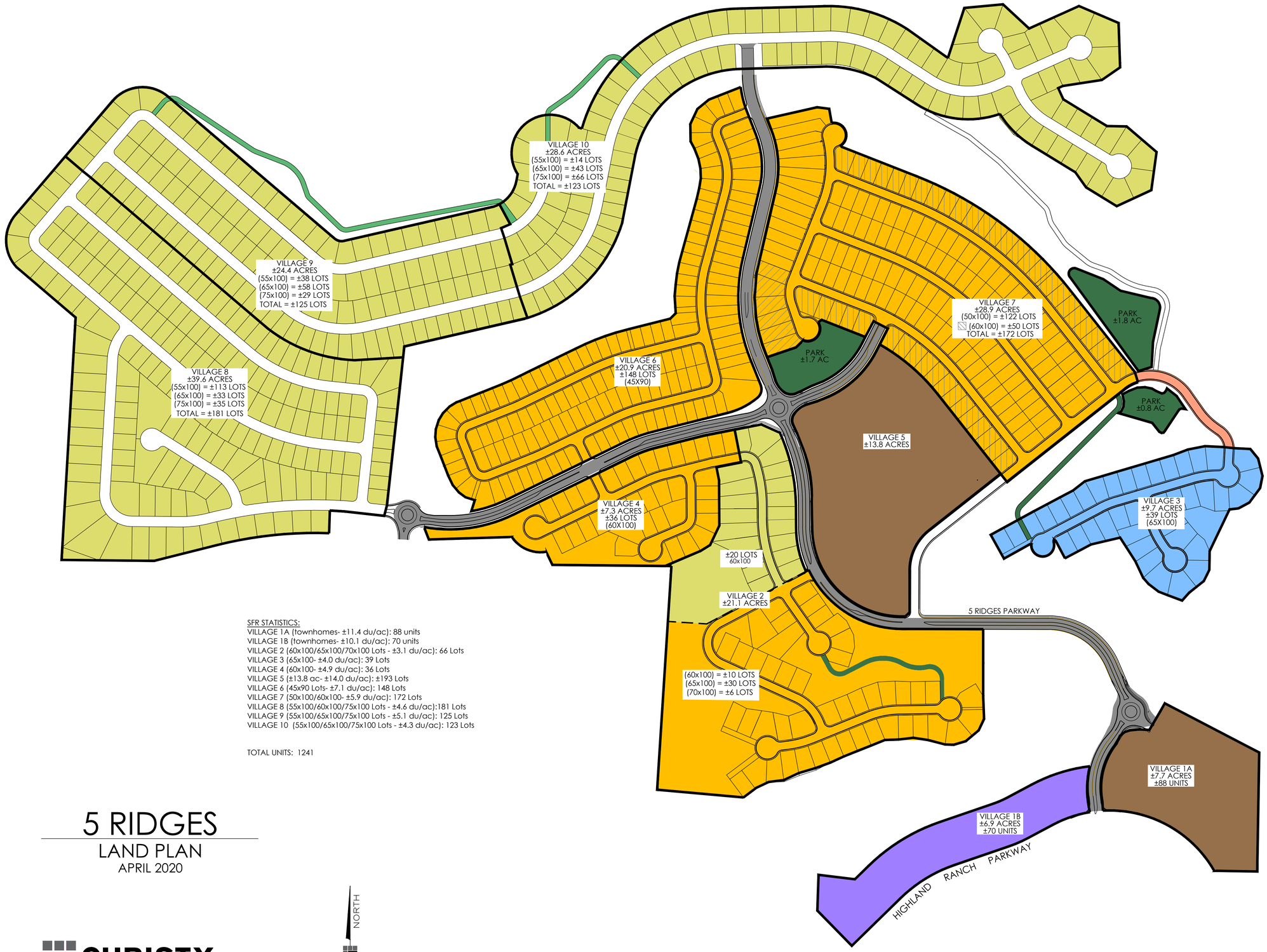
Vicinity Map
5 Ridges Land Use Plan
Variable Slope Pipe Capacities
City of Sparks Sewer Model (Preliminary), Atkins
- Figure 1, Kiley Ranch Area Sewer Network – Vicinity Map
- Figure 2, Kiley Ranch Area Parcels Map (Buildout Condition)
- Sparks Sewer Infrastructure Buildout Capacities

Contributing Area Map



VICINITY MAP

NOT TO SCALE



SFR STATISTICS:
VILLAGE 1A (townhomes- ±11.4 du/ac): 88 units
VILLAGE 1B (townhomes- ±10.1 du/ac): 70 units
VILLAGE 2 (60x100/65x100/70x100 Lots - ±3.1 du/ac): 66 Lots
VILLAGE 3 (65x100- ±4.0 du/ac): 39 Lots
VILLAGE 4 (60x100- ±4.9 du/ac): 36 Lots
VILLAGE 5 (±13.8 ac- ±14.0 du/ac): ±193 Lots
VILLAGE 6 (45x90 Lots- ±7.1 du/ac): 148 Lots
VILLAGE 7 (50x100/60x100- ±5.9 du/ac): 172 Lots
VILLAGE 8 (55x100/60x100/75x100 Lots - ±4.6 du/ac):181 Lots
VILLAGE 9 (55x100/65x100/75x100 Lots - ±5.1 du/ac): 125 Lots
VILLAGE 10 (55x100/65x100/75x100 Lots - ±4.3 du/ac): 123 Lots

TOTAL UNITS: 1241

5 RIDGES

LAND PLAN

APRIL 2020

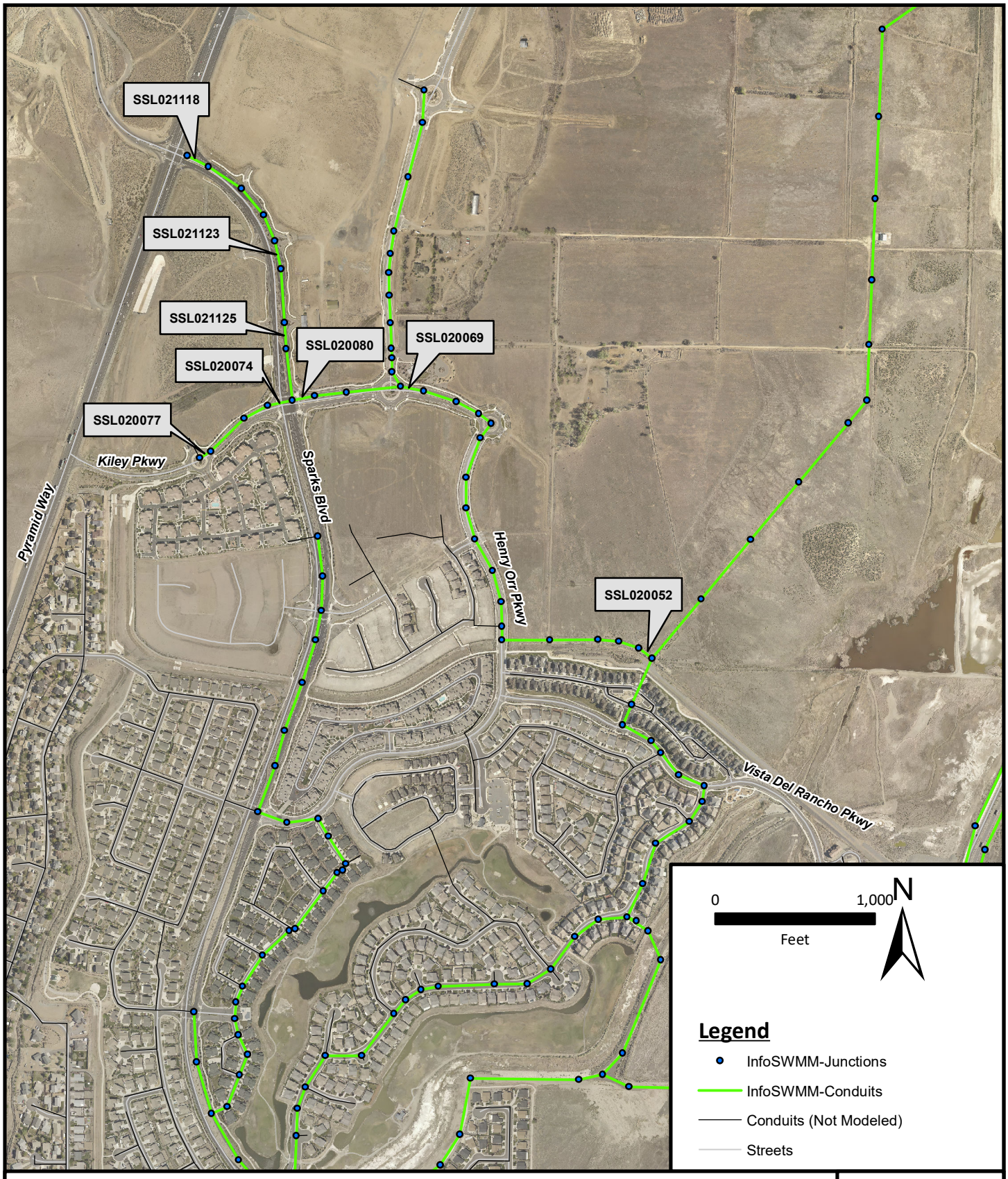
CHRISTY CORPORATION
1000 Kiley Pkwy | Sparks Nevada 89436
P 775.502.8552

NORTH

1"=200'

5 Ridges SS Analysis - Variable Pipe Size and Slope Report

Label	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Diameter (in)	Discharge (gal/day)	Percent Full (%)	Velocity (ft/s)
8in SS Main @ 10%	0.014	0.10000	4	8	1146628	50.0	10.16
8in SS Main @ 8%	0.014	0.08000	4	8	1025575	50.0	9.09
8in SS Main @ 6%	0.014	0.06000	4	8	888174	50.0	7.87
8in SS Main @ 4%	0.014	0.04000	4	8	725191	50.0	6.43
8in SS Main @ 2%	0.014	0.02000	4	8	512788	50.0	4.55
8in SS Main @ 1%	0.014	0.01000	4	8	362596	50.0	3.21
8in SS Main @ 0.40% Minimum Slope	0.014	0.00400	4	8	229326	50.0	2.03
10in SS Main @ 10%	0.014	0.10000	5	10	2078974	50.0	11.80
10in SS Main @ 8%	0.014	0.08000	5	10	1859491	50.0	10.55
10in SS Main @ 6%	0.014	0.06000	5	10	1610367	50.0	9.14
10in SS Main @ 4%	0.014	0.04000	5	10	1314859	50.0	7.46
10in SS Main @ 2%	0.014	0.02000	5	10	929746	50.0	5.27
10in SS Main @ 1%	0.014	0.01000	5	10	657429	50.0	3.73
10in SS Main @ 0.30% Minimum Slope	0.014	0.00300	5	10	360089	50.0	2.04



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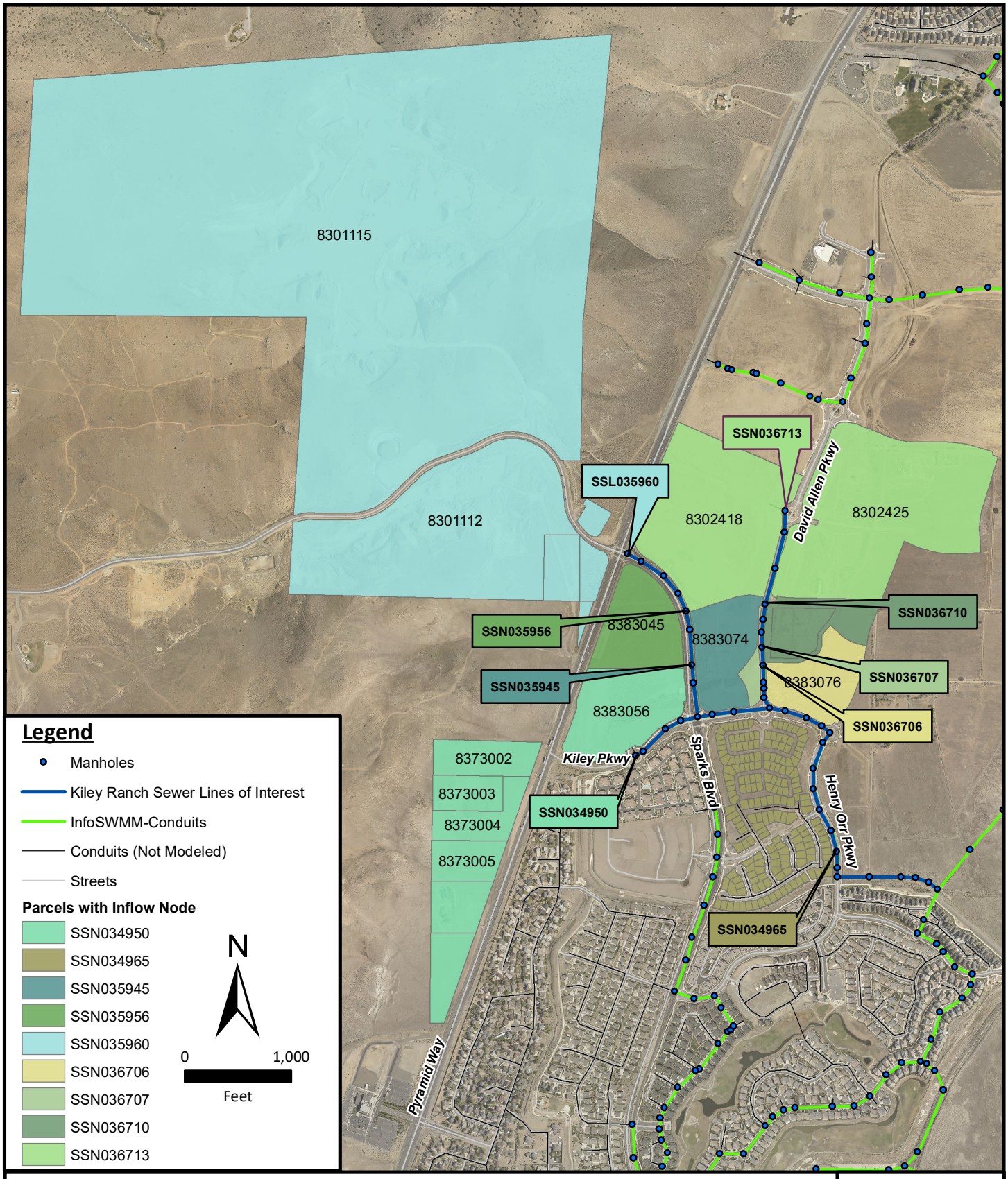
City of Sparks

Sewer Model Update

Kiley Ranch Area Sewer Network - Vicinity Map

Figure 1



ATKINS

City of Sparks

Sewer Model Update

Kiley Ranch Area Sewer Parcels Map (Buildout Condition)

Figure 2

2016 SSMP d/D Values

Kiley Ranch Area

			d/D Values			
MOID	Pipe Size (ft)	Slope	EX_DWF	EX_WWF	FUT_DWF	FUT_WWF
From SSL021118 to SSL020052						
SSL021118	0.67	0.022	0.000	0.055	0.321	0.432
SSL021119	0.67	0.026	0.000	0.070	0.315	0.426
SSL021120	0.67	0.027	0.000	0.077	0.297	0.403
SSL021121	0.67	0.041	0.000	0.110	0.379	0.525
SSL021123	0.83	0.006	0.000	0.096	0.310	0.428
SSL021124	0.83	0.027	0.000	0.087	0.257	0.350
SSL021125	1.00	0.016	0.000	0.071	0.201	0.273
SSL021126	1.00	0.046	0.000	0.097	0.230	0.320
SSL020080	1.25	0.005	0.000	0.105	0.229	0.325
SSL020073	1.25	0.005	0.000	0.108	0.226	0.321
SSL020072	1.25	0.004	0.015	0.124	0.270	0.359
SSL020069	1.50	0.005	0.026	0.118	0.270	0.342
SSL020068	1.50	0.004	0.027	0.125	0.286	0.363
SSL020067	1.50	0.005	0.024	0.111	0.248	0.314
SSL020066	1.50	0.013	0.023	0.110	0.239	0.303
SSL020065	1.50	0.005	0.026	0.124	0.268	0.341
SSL020064	1.50	0.005	0.025	0.123	0.263	0.337
SSL020063	1.50	0.007	0.021	0.103	0.216	0.276
SSL020062	1.50	0.030	0.022	0.108	0.220	0.281
SSL020061	1.50	0.004	0.026	0.134	0.273	0.352
SSL020060	1.50	0.004	0.026	0.135	0.273	0.352
SSL020059	1.50	0.005	0.028	0.134	0.271	0.352
SSL020058	1.50	0.005	0.032	0.142	0.287	0.373
SSL020056	1.50	0.003	0.034	0.151	0.299	0.388
SSL020055	1.50	0.003	0.035	0.159	0.314	0.409
SSL020054	1.50	0.004	0.028	0.129	0.254	0.331
SSL020053	1.50	0.035	0.019	0.085	0.161	0.207
SSL020052	1.50	0.056	0.148	0.263	0.451	0.594
From SSL020077 to SSL020074 (SSL020078 not modeled)						
SSL020077	0.83	0.005	0.000	0.061	0.093	0.165
SSL020076	0.83	0.004	0.000	0.080	0.094	0.175
SSL020075	0.83	0.005	0.000	0.094	0.094	0.182
SSL020074	0.83	0.004	0.000	0.129	0.223	0.342

Notes:

EX_DWF: Existing Condition Dry Weather Flow Scenario

EX_DWF: Existing Condition Wet Weather Flow Scenario

FUT_DWF: Buildout Condition Dry Weather Flow Scenario

FUT_WWF: Buildout Condition Wet Weather Flow Scenario

SSL020078 was not modeled in the 2016 SSMP

5 Ridges SS Analysis - Variable Pipe Size and Slope Report

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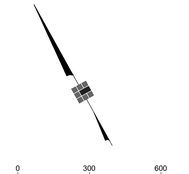

CHRISTY CORPORATION
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775.502.8552 christynv.com

REV.	DATE	DESCRIPTION	BY

CONTRIBUTING AREA MAP
5 RIDGES DEVELOPMENT
SANITARY SEWER MASTER STUDY
5 RIDGES DEVELOPMENT COMPANY, INC. — SPARKS, NEVADA

Date:	05/26/2020
Designed by:	DGB
Checked by:	DLM
Job No.	1532.007

SS-1

SHEET 1 OF 1

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