Sewer Basis of Design
Prepared: October 2016

STORYROCK Phase 1B

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1.0 INTRODUCTION

1.1 Project Description

The purpose of this sewer report is to support the proposed StoryRock Phase 1B residential development. StoryRock Phase 1B (Phase 1B) is part of the StoryRock Master Planned Community (formerly named Cavalliere Ranch), a development consisting of 462-acres of single family residential construction. A Conceptual Wastewater Master Plan was approved October 2014 with the project Zoning Case (13-ZN-2014) and amended October 2016.

StoryRock Phase 1B is a proposed 83-acre single family residential subdivision consisting of 96 single family residential units. Phase 1B is zoned for R1-18, R1-35, and R1-43 development.

1.2 Project Location

StoryRock is located within Section 12 of Township 4 North, Range 5 East of the Gila and Salt River Base and Meridian, Maricopa County, Arizona. The site is bound to the north by the Happy Valley Road Alignment and to the west by 128th Street. The Pinnacle Peak Road Alignment borders the site to the south. The McDowell Sonoran Preserve borders the site to the east and portions of the site to the north and south. Phase 1B is located in the northern half of the site, south of Phase 1A and bisected by Ranch Gate Road. See **Figure 1: Vicinity Map.**

1.3 Scope of Sewer Plan

The Conceptual Master Wastewater Plan for StoryRock established sewer design parameters, criteria and a general plan for sewer collection and conveyance. The report presented a conceptual layout of sewer lines, lift station locations and force mains. The master plan established lift station service areas and provided preliminary lift station design and force main sizing. Finally, the report analyzed the downstream system, including the proposed gravity line in 128th Street and the connection to the existing lift station at 128th Street and Ranch Gate Road.

This report presents the basis of design criteria that will be used for the engineering design of the proposed Phase 1B development. This report will establish the final sewer system demands for the project and the sewer system infrastructure required to serve the development. Finally, the report will show the development of Phase 1B is in conformance with the approved master plan.

All design criteria that is presented in this report will conform to the City of Scottsdale Design Standards & Polices Manual (DS&PM).

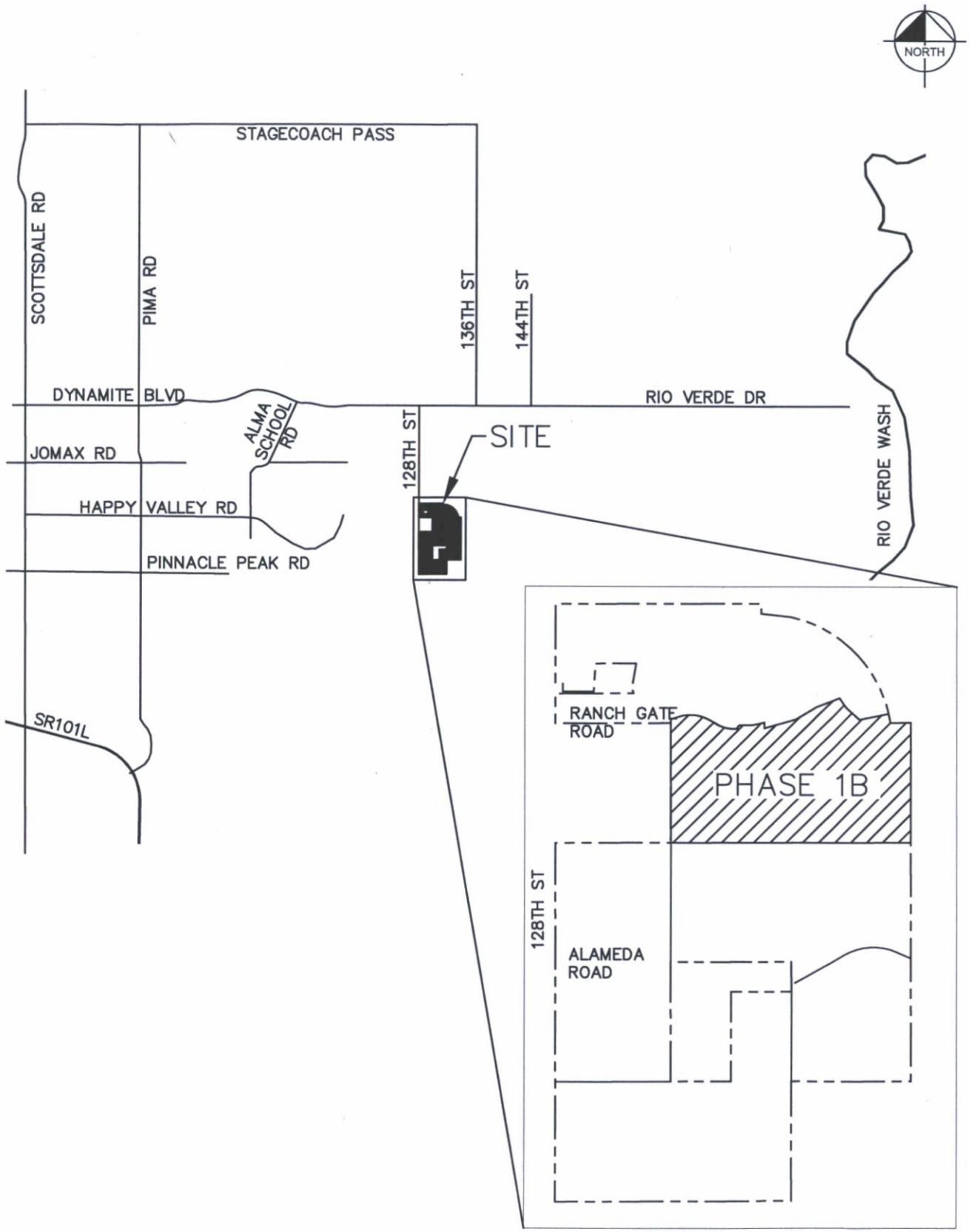

FIGURE 1
VICINITY MAP
STORYROCK

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2.0 EXISTING SITE CONDITIONS AND SEWER SYSTEMS

2.1 Site Conditions

The project is undeveloped natural desert. Based on a review of City Quarter Section maps; no city water infrastructure exists on-site. The site is characterized by many washes and rock features of varying sizes. The on-site washes vary in size and depth, but generally flow from the southwest to the northeast or east through the site. Phase 1B is bordered to the east by The McDowell Sonoran Preserve. Multiple ridgelines run though the site, in the general direction of southwest to northeast. Elevations range from approximately 2630' in the southwest to 2530' in the northeast.

2.2 Adjacent Sanitary Systems

The Sereno Canyon development is located directly west of the project. A majority of the infrastructure for Sereno Canyon has been constructed, though none of the lots have been developed. Wastewater generated by a large portion of Sereno Canyon is conveyed by gravity sewer to an existing lift station located on the east side of 128th Street approximately 350' north of Ranch Gate Road. This lift station is located on the western boundary of the proposed StoryRock Development. From the lift station, wastewater flows are conveyed through an existing 6-inch force main west along the Happy Valley Road alignment. Flows are ultimately conveyed to the City of Scottsdale treatment facility located at Pima Road and Hualapai Drive.

2.3 Phasing and Existing StoryRock Development

As discussed within the approved master plan, the development of StoryRock is divided into three (3) major phases. Phase 1 is intended to be the first phase of development and is further divided into three (3) sub-phases: 1A, 1B and 1C. All major phases require offsite infrastructure installment in 128th Street. Furthermore, Phase 1A and 1B sub-phases require offsite infrastructure installment in Ranch Gate Road. Due to its proximity to the existing infrastructure at the intersection of 128th Street and Ranch Gate Road, Phase 1A has the highest feasibility of initial development. It is possible, however, that Phase 1B will be constructed prior to Phase 1A. As such, all phases of development will be required to construct the necessary infrastructure to serve their development, including onsite and offsite sewer lines and force mains. At this time all phases of the project are concurrently proceeding through preliminary plat applications. If other phases move ahead to final engineering and construction prior to this phase, portions of the offsite system may be already designed or constructed and would no longer be developed with this phase. Payback or other agreements may be in place to reimburse the cost of construction for shared offsite infrastructure.

3.0 PROPOSED WASTEWATER PLAN

3.1 General Discussion

Per the approved master plan, the sewer system for Phase 1B of StoryRock consists of the installment of an 8-inch gravity sewer main in 128th Street from Alameda Road to Buckskin Trail as well as collection lines internal to the development of Phase 1B.

3.2 Phase 1B Proposed Collection System

The Phase 1B proposed onsite collection system will consist of 8-inch SDR 35 sewer lines, routed through the project to serve all lots in Phase 1B. The gravity sewer lines will convey flows to two lift stations, one at the northeast corner and one at the southeast corner of the site. At the northeast corner, the proposed lift station (LS #2) will pump flows through a proposed force main routed back through the development and Ranch Gate Road to 128th Street. At the southeast corner, the proposed lift station (LS #1) will pump flows through a force main routed back along Ranch Gate Road to 128th Street. The force mains will run parallel in Ranch Gate Road and will discharge into the proposed 8-inch gravity line in 128th Street. This gravity line conveys flows to the existing lift station located at 128th Street and Ranch Gate Road.

See **Figure 2: Sewer System Layout** for sewer line and lift station location.

4.0 METHODOLOGY AND CALCULATIONS

4.1 Design Criteria

Peak wet weather design flows for Lift Station #1 Service Area and Lift Station #2 Service Area are determined in the approved master report. A summary of the design flows for Phase 1B and the lift station service areas is included in the table below:

	Average Day Flow (GPD)	Peak Wet Weather Flow (GPD)	Peak Wet Weather Flow (GPM)
Phase 1B	**8,772**	**N/A**	**N/A**
Lift Station #1 Service Area	**46,096**	**147,507**	**102**
Lift Station #2 Service Area	**29,240**	**100,147**	**70**

Per the DS&PM, proposed sewer lines were designed to achieve a full flow velocity between 2.5 and 10 feet per second and maintain a maximum d/D ratio of 0.65 when calculated with a Manning's "n" value of 0.013. To satisfy these requirements the proposed 8-inch sewer will be designed with a minimum slope of 0.0052 ft/ft (0.52%) and a maximum slope of 0.0833 ft/ft (8.33%). See **Appendix A** for pipe slope calculations.

4.2 Wastewater System Analysis

To determine the capacity of the proposed wastewater collection system, the peak design flow was analyzed using the minimum design pipe slope. At the minimum design slope of 0.0052 ft/ft, an 8-inch line has the capacity to convey approximately 563,000 gallons per day. An 8-inch line at the minimum design slope can convey the proposed peak design flow of 147,507 gallons per day at a normal depth of 0.23' or a d/D ratio of 0.35, at a velocity of 2.10 ft/s. See **Appendix A** for pipe capacity calculations.

4.3 Lift Station and Force Main Design

Lift Station #1, Lift Station #2 and the associated force mains are designed to convey the peak flow produced by Phase 1B and the rest of the service areas as identified in the approved master plan. See the supplemental reports "Preliminary Engineering Report for StoryRock – Lift Station #1" and "Preliminary Engineering Report for StoryRock – Lift Station #2" for further information on the design of the proposed lift stations and the associated force mains.

5.0 CONCLUSIONS

1) The proposed Phase 1B wastewater collection system is in conformance with the approved Conceptual Master Wastewater Plan for Cavalliere Ranch (StoryRock).

2) Gravity sewer will convey flows generated by Phase 1B to a proposed Lift Station #1 and Lift Station #2.

3) Lift Station #1 and Lift Station #2 will convey flows to a proposed 8-inch sewer within 128th, which will convey flows to the existing lift station.

4) Design criteria establish by the City of Scottsdale DS&PM and the Arizona Administrative Code was used as the basis of design.

5) The proposed Lift Station #1, Lift Station #2 and associated force mains have been preliminarily designed, see the supplemental reports "Preliminary Engineering Report for StoryRock – Lift Station #1" and "Preliminary Engineering Report for StoryRock – Lift Station #2".

6.0 REFERENCES

City of Scottsdale, *Design Standards and Policies Manual*, January 2010.

Arizona Administrative Code, *Title 18, Chapter 9,* September 2005.

Conceptual Master Wastewater System Report for Sereno Canyon, Wood Patel and Associates, September, 2005.

Sereno Canyon Amended Master Wastewater Report, LVA, February 2014.

Facility Payback Agreement for Sewer System Improvements in the Sereno Canyon Service Area, City of Scottsdale, 12/21/2010.

Conceptual Master Wastewater Plan for Cavalliere Ranch (StoryRock), Kimley-Horn and Associates, Amended October 2016.

Preliminary Engineering Report for StoryRock – Lift Station #1, Kimley-Horn and Associates, October 2016.

Preliminary Engineering Report for StoryRock – Lift Station #2, Kimley-Horn and Associates, October 2016.

Appendix A – Sewer Capacity Calculations

Worksheet for 8-Inch Full - Min

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00520	ft/ft
Normal Depth	0.67	ft
Diameter	0.67	ft
Discharge	563167.59	gal/day

Results

Discharge	563167.59	gal/day
Normal Depth	0.67	ft
Flow Area	0.35	ft²
Wetted Perimeter	2.09	ft
Hydraulic Radius	0.17	ft
Top Width	0.00	ft
Critical Depth	0.44	ft
Percent Full	100.0	%
Critical Slope	0.00857	ft/ft
Velocity	2.50	ft/s
Velocity Head	0.10	ft
Specific Energy	0.76	ft
Froude Number	0.00	
Maximum Discharge	0.94	ft³/s
Discharge Full	0.87	ft³/s
Slope Full	0.00520	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for 8-Inch Full - Min

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.67	ft
Critical Depth	0.44	ft
Channel Slope	0.00520	ft/ft
Critical Slope	0.00857	ft/ft

Worksheet for 8-Inch Full -Max

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.08330	ft/ft
Normal Depth	0.67	ft
Diameter	0.67	ft
Discharge	2254023.72	gal/day

Results

Discharge	2254023.72	gal/day
Normal Depth	0.67	ft
Flow Area	0.35	ft^2
Wetted Perimeter	2.09	ft
Hydraulic Radius	0.17	ft
Top Width	0.00	ft
Critical Depth	0.66	ft
Percent Full	100.0	%
Critical Slope	0.07763	ft/ft
Velocity	9.99	ft/s
Velocity Head	1.55	ft
Specific Energy	2.22	ft
Froude Number	0.00	
Maximum Discharge	3.75	ft^3/s
Discharge Full	3.49	ft^3/s
Slope Full	0.08330	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for 8-Inch Full -Max

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.67	ft
Critical Depth	0.66	ft
Channel Slope	0.08330	ft/ft
Critical Slope	0.07763	ft/ft

Worksheet for 8-Inch Capacity

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00520	ft/ft
Diameter	0.67	ft
Discharge	147507.00	gal/day

Results

Normal Depth	0.23	ft
Flow Area	0.11	ft²
Wetted Perimeter	0.84	ft
Hydraulic Radius	0.13	ft
Top Width	0.64	ft
Critical Depth	0.22	ft
Percent Full	35.0	%
Critical Slope	0.00645	ft/ft
Velocity	2.10	ft/s
Velocity Head	0.07	ft
Specific Energy	0.30	ft
Froude Number	0.90	
Maximum Discharge	0.94	ft³/s
Discharge Full	0.87	ft³/s
Slope Full	0.00036	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	34.95	%
Downstream Velocity	Infinity	ft/s

Worksheet for 8-Inch Capacity

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.23	ft
Critical Depth	0.22	ft
Channel Slope	0.00520	ft/ft
Critical Slope	0.00645	ft/ft