

**TALKING ROCK RANCH
PHASE 8**

**SEWER SYSTEM
DESIGN REPORT**

Prepared for:

Talking Rock Land, L.L.C.
7600 East Doubletree Ranch Road, Suite 220
Scottsdale, Arizona 85258
Job # 03404



Prepared By:

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February 2004

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Introduction

General Description

The Talking Rock Ranch Subdivision consists of residential and recreational facilities. This planned area development (PAD) was approved by the Yavapai County Board of Supervisors on October 6, 1999 and Amended on May 8, 2000.

The site encompasses about 3500 acres of undeveloped and newly developed land that slopes towards Inscription Canyon. The site is divided by Williamson Valley Road. The site consists of forested areas with slopes ranging from gentle to near vertical.

Project Location

The project site (Phase 8) is located in portions of Section 22, Township 16 North, Range 3 West, Gila and Salt River - Meridian, Yavapai County, Arizona. The project is generally located in the Southern portion of Williamson Valley and lies to the east of Williamson Valley Road. See Appendix "A" for site map.

Objective

This report will address the low-pressure and gravity sewer system design for Phase 8. Lots connecting into the low pressure sewer system within Phase 8 will require a homeowner installed and operated grinder pump station (see Appendix D for grinder pump information). All low pressure sewer pipe will be schedule 40 PVC, meeting AWWA standards. Gravity sewer pipe will be SDR-35 PVC.

The sewer system for Phases 8A and 8B will consist entirely of a low pressure sewer system. The low pressure system for phases 8A and 8B will need to function properly with phase 8A standing alone and with phase 8A and 8B functioning together. The outfall for Phases 8A and 8B will be the gravity sewer main along Three Forks Road, built in Phase 2 of Talking Rock. Phase 8C will consist of both a low pressure sewer system and a gravity system and will also connect in the gravity main along Three Forks Road. An exhibit of the sewer collection system for Phase 8 is located in Appendix E

System Analysis

The low-pressure sewer piping analysis was performed using computer design software developed by Environment One Corporation (E-ONE) of Niskayuna, New York. The software calculates velocity and friction head loss for pumps in simultaneous operation within the system. The output is based on the Hazen-Williams formula for determining pipe sizes to create minimum flow velocities of 3.0 feet per second or higher as required by ADEQ. At these velocities, scouring is assured. The analysis uses a design flow of 250 gallons/day/unit and maximum flow rate of 11 gallons/minute/unit. A C-Value of 140 was used for the low pressure sewer system pipe.

Phase 8A and 8B contains fifty-four (54) E-ONE GP 2010-58 pump stations. Below is a summary of the Phase 8A and 8B low-pressure sewer system (mainline).

Road	Units	1-1/2" PS	2" PS	2-1/2" PS
Sandia Lane	12	-	1,253 ft	-
Three Sisters Drive	12	-	-	1,493 ft
Simmons Peak Road	14	-	-	1,381 ft
Palace Place	10	-	1,061 ft	-
Soza Mesa Lane	6	-	623 ft	-

Table 1: Phase 8A and 8B mainline LPS summary

Phase 8C includes a total of fifteen (15) E-ONE GP 2010-58 pump stations. Below is a summary of the Phase 8C low-pressure sewer system (mainline).

Road	Units	1-1/2" PS	2" PS	2-1/2" PS
Gun Fury Drive	8	-	442 ft	-
Johnny Guitar Road	4	-	459 ft	-
Billy Jack Way	3	355 ft	-	-

Table 2: Phase 8C mainline LPS summary

The Phase 8A system was analyzed for pipe velocity and total dynamic head as a stand alone system and then analyzed while functioning with phase 8B.

The highest total dynamic head encountered within the entire Phase 8 low pressure system is 132 feet (zone 4), which is below the recommended limit of 138 feet set by E-ONE. The highest total retention time in the system is 3.4 hours (zone 3), low enough to eliminate odor concerns at the discharge point.

Flushing connections for the low pressure system will be located at the terminal end of each main, at intersections, at changes in pipe diameter, and at any sharp changes in direction. Intermittent spacing of inline flushing stations will be a maximum of 1500 feet per the manufacture. Air release valves will be placed at high points in the system to prevent air build-up.

Lots 55 through 57 and lot 66 along the west side of Centennial Drive will require E-ONE GP 2010-58 pump stations. These low pressure sewer services will connect to the proposed gravity main along Centennial Drive.

Lots 74 through 80 along the east side of Centennial Drive will have 4" PVC (SDR-35) gravity sewer services and connect to the proposed gravity sewer main along Centennial Drive.

The proposed gravity sewer main along Centennial Drive will consist of an 8" PVC (SDR-35) pipe per the minimum requirement by ADEQ Bulletin No. 11. A design check for minimum and maximum flow velocities in the gravity sewer main is located in Appendix D. The design criteria for the gravity sewer main along Centennial Drive are as follows:

Total number of residential connections = 26

Average flow rate per connection = 250 gal/connection/day

Average flow rate per connection =
(250 gal/connection/day) x (1/1440 day/min) = 0.174 gpm/connection

Total system average flow rate =
(0.174 gpm/connection) x (26 connections) = 4.53 gpm

Max. daily flow w/ peak factor of 2 = 2 x 4.53 gpm = 9.06 gpm (0.02 cfs)

Max. hourly flow w/ peak factor of 3.62 = 3.62 x 4.53 gpm = 16.4 gpm (0.04 cfs).

The maximum pipe slope for the 8" gravity sewer is 15% to avoid abrasive action caused by high flow velocity. The minimum slope is 0.80% based on a full flow velocity of greater than 3 feet per second.

Conclusion

The combination low-pressure sewer and gravity sewer system chosen for the project is the preferred system based on the mountainous terrain characteristics of the site. An all gravity system would not be a viable system due to the extreme depths required for minimum slope criteria and impacts to open space land.

This system will serve 80 single-family lots with a combination low-pressure and gravity sewer, maintaining the balance between economics, operation and maintenance.

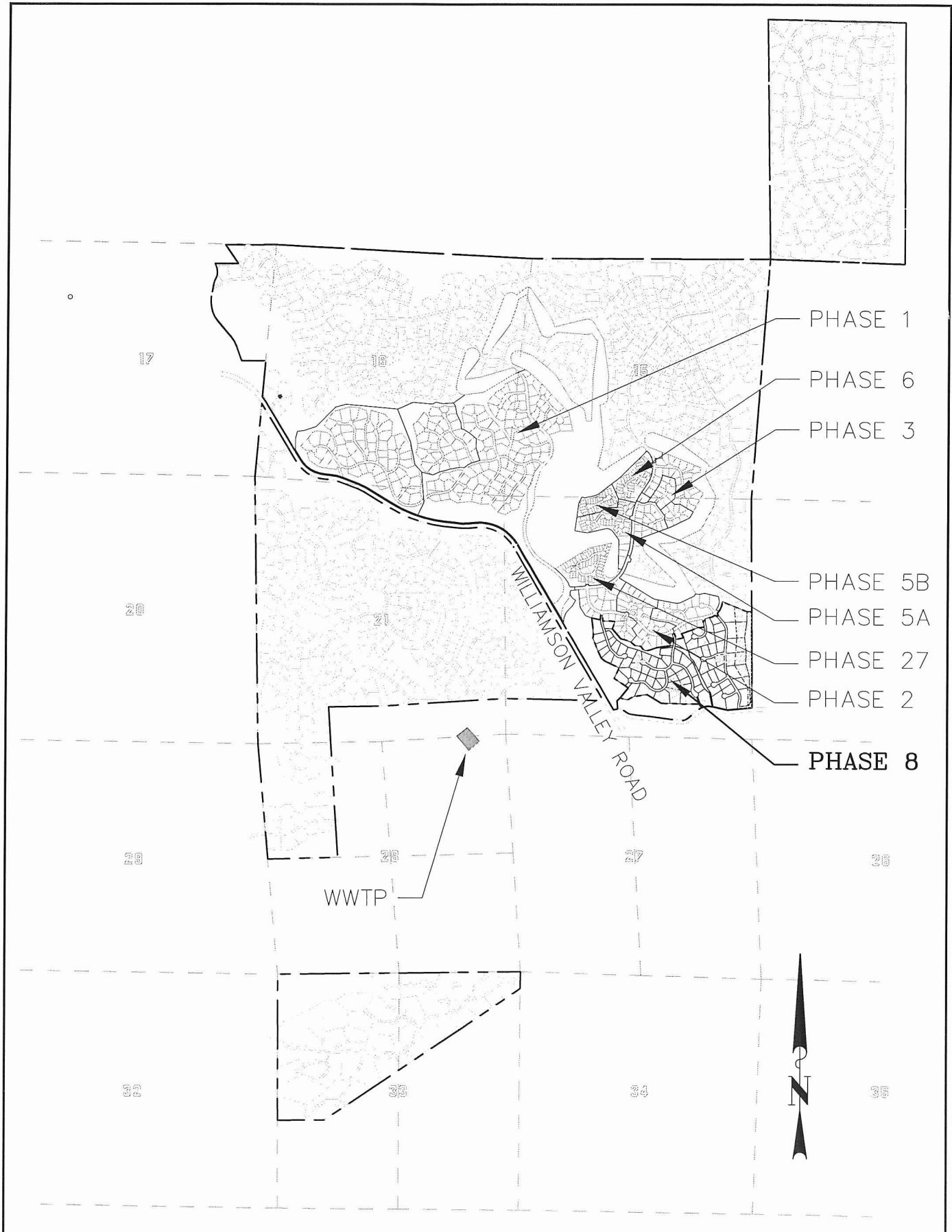
References

ADEQ Bulletin No. 11: Minimum Requirements for Design, Submission of Plans and Specifications of Sewage Works.

Flowmaster, Haestad Methods, v6.1

E-One Low Pressure Sewer System Design Assistant, v.5.0

APPENDIX A
SITE MAP



SHEPHARD - WESNITZER, INC. CIVIL ENGINEERING AND SURVEYING 221 N. MARINA ST., SUITE 102 PRESCOTT, AZ 86301 (928) 541-0443	JOB NO:	03404	TALKING ROCK RANCH PH. 8 YAVAPAI COUNTY ARIZONA	SHEET	1 OF 1
	DATE:	FEB 2004			
	SCALE:	1"=3000'	APPENDIX A SITE MAP		
	DRAWN:	BBH/MWB			
	DESIGN:	BBH			
CHECKED:	SFH				

APPENDIX B

LOW PRESSURE SEWER ANALYSIS

PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Talking Rock Phase 8A

February 12, 2004

Prepared By:
M Brown

Zone Number	Pumps to Zone	Number of Cores in Zone	Accum Cores in Zone	Gal/Day per Core	Max Flow per Core	Max Flow per Core	Max Sim Ops	Max Flow (GPM)	Pipe Size (Inches)	Max Velocity (FPS)	Length of Main this Zone	Friction Loss Factor (ft/100ft)	Friction Loss this Zone	Accumulated Friction Loss (Feet)	Max Main Elevation	Minimum Pump Elevation	Static Head (Feet)	Total Dynamic Head (ft)
his spreadsheet was calculated using pipe diameters for: SCH40PVC																		
1.00	1.00	12	12	250.00	11.00	4	44.00	2.00	4.21	1,253.00	3.61	45.23	45.23	5,013.00	4,991.00	22.00	67.23	
2.00	2.00	12	12	250.00	11.00	4	44.00	2.50	2.95	1,493.00	1.52	22.70	22.70	5,055.00	5,017.00	38.00	60.70	
5.00	5.00	6	6	250.00	11.00	3	33.00	2.00	3.15	623.00	2.12	13.20	13.20	5,079.00	5,053.00	26.00	39.20	

PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME (HR)
Talking Rock Phase 8A

February 12, 2004

Prepared By:
M Brown

Zone Number	Pumps to Zone	Accumulated Total of Cores this Zone	Existing Pipe Size	Gallons per 100 Lateral Feet	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
his spreadsheet was calculated using pipe diameters for: SCH40PVC										
1.00	1.00	12	2.00	17.43	1,253.00	218.42	3,000	13.74	1.75	1.75
2.00	2.00	12	2.50	24.87	1,493.00	371.33	3,000	8.08	2.97	2.97
5.00	5.00	6	2.00	17.43	623.00	108.60	1,500	13.81	1.74	1.74

PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Talking Rock Phase 8A and 8B

February 12, 2004

Prepared By:
M Brown

Zone Number	Pumps to Zone	Number of Cores in Zone	Accum Cores in Zone	Gal/Day per Core	Max Flow per Core	Max Sim Ops	Max Flow (GPM)	Pipe Size (Inches)	Max Velocity (FPS)	Length of Main this Zone	Friction Loss Factor (ft/100ft)	Friction Loss this Zone	Accumulated Friction Loss (Feet)	Max Main Elevation	Minimum Pump Elevation	Static Head (Feet)	Total Dynamic Head (ft)
his spreadsheet was calculated using pipe diameters for: SCH40PVC																	
1.00	1.00	12	12	250.00	11.00	4	44.00	2.00	4.21	1,253.00	3.61	45.23	45.23	5,013.00	4,991.00	22.00	67.23
2.00	2.00	12	36	250.00	11.00	6	66.00	2.50	4.42	1,493.00	3.22	48.10	48.10	5,055.00	5,017.00	38.00	86.10
3.00	2.00	14	14	250.00	11.00	4	44.00	2.50	2.95	1,381.00	1.52	21.00	69.09	5,058.00	5,008.00	50.00	119.09
4.00	2.00	10	10	250.00	11.00	4	44.00	2.00	4.21	1,061.00	3.61	38.30	86.39	5,093.00	5,047.00	46.00	132.39
5.00	5.00	6	6	250.00	11.00	3	33.00	2.00	3.15	623.00	2.12	13.20	13.20	5,079.00	5,053.00	26.00	39.20



PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME (HR)
Talking Rock Phase 8A and 8B

February 12, 2004

Prepared By:
M Brown

Zone Number	Pumps to Zone	Accumulated Total of Cores this Zone	Existing Pipe Size	Gallons per 100 Lineal Feet	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
his spreadsheet was calculated using pipe diameters for: SCH40PVC										
1.00	1.00	12	2.00	17.43	1,253.00	218.42	3,000	13.74	1.75	1.75
2.00	2.00	36	2.50	24.87	1,493.00	371.33	9,000	24.24	0.99	0.99
3.00	2.00	14	2.50	24.87	1,381.00	343.47	3,500	10.19	2.36	3.35
4.00	2.00	10	2.00	17.43	1,061.00	184.95	2,500	13.52	1.78	2.77
5.00	5.00	6	2.00	17.43	623.00	108.60	1,500	13.81	1.74	1.74

PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS
Talking Rock Phase 8C

February 12, 2004

Prepared By:
M Brown

Zone Number	Pumps to Zone	Number of Cores in Zone	Accum Cores in Zone	Gal/Day per Core	Max Flow per Core	Max Sim Ops	Max Flow (GPM)	Pipe Size (Inches)	Max Velocity (FPS)	Length of Main this Zone	Friction Loss Factor (ft/100ft)	Friction Loss this Zone	Accumulated Friction Loss (Feet)	Max Main Elevation	Minimum Pump Elevation	Static Head (Feet)	Total Dynamic Head (ft)
his spreadsheet was calculated using pipe diameters for: SCH40PVC																	
6.00	6.00	8	8	250.00	11.00	3	33.00	2.00	3.15	442.00	2.12	9.36	9.36	5,094.00	5,053.00	41.00	50.36
7.00	7.00	4	4	250.00	11.00	3	33.00	2.00	3.15	459.00	2.12	9.72	9.72	5,104.00	5,067.00	37.00	46.72
8.00	8.00	3	3	250.00	11.00	2	22.00	1.50	3.47	355.00	3.16	11.22	11.22	5,125.00	5,085.00	40.00	51.22

PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME (HR)
Talking Rock Phase 8C

February 12, 2004

Prepared By:
M Brown

Zone Number	Pumps to Zone	Accumulated Total of Cores this Zone	Existing Pipe Size	Gallons per 100 L' metal Feet	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
his spreadsheet was calculated using pipe diameters for: SCH40PVC										
6.00	6.00	8	2.00	17.43	442.00	77.05	2,000	25.96	0.92	0.92
7.00	7.00	4	2.00	17.43	459.00	80.01	1,000	12.50	1.92	1.92
8.00	8.00	3	1.50	10.58	355.00	37.54	705	18.78	1.28	1.28

APPENDIX C
GRAVITY SEWER ANALYSIS

Talking Rock Phase 8 - Gravity Sewer Main Design Worksheet for Circular Channel

Project Description	
Worksheet	Maximum Velocity Calculations for 8" Gravity Sewer
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Mannings Coefficient	0.013
Slope	0.150000 ft/ft
Diameter	8 in
Discharge	0.04 cfs

Results	
Depth	0.04 ft
Flow Area	9.7e-3 ft ²
Wetted Perimeter	0.35 ft
Top Width	0.33 ft
Critical Depth	0.09 ft
Percent Full	6.6 %
Critical Slope	0.007067 ft/ft
Velocity	4.11 ft/s
Velocity Head	0.26 ft
Specific Energy	0.31 ft
Froude Number	4.21
Maximum Discharg	5.03 cfs
Discharge Full	4.68 cfs
Slope Full	0.000011 ft/ft
Flow Type	Supercritical

Talking Rock Phase 8 - Gravity Sewer Main Design Worksheet for Circular Channel

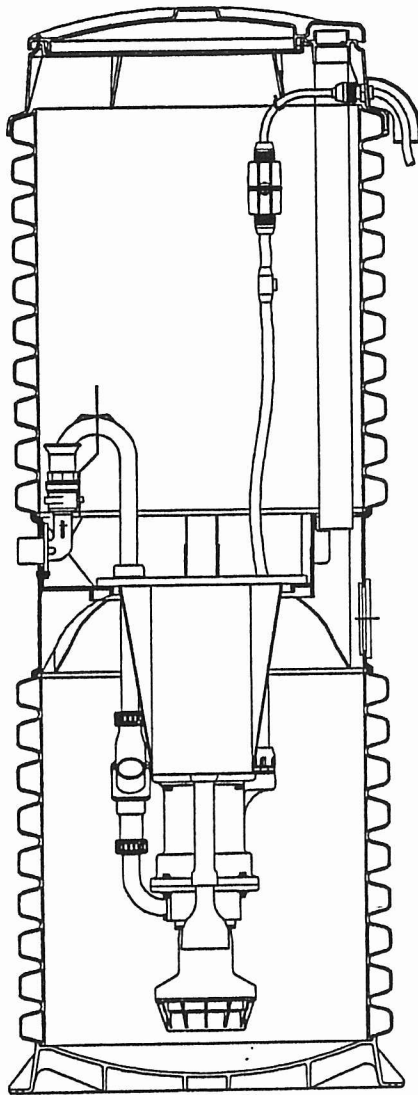
Project Description	
Worksheet	Minimum Slope Calculations for 8" Gravity Sewer
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Capacity

Input Data	
Mannings Coefficient	0.013
Slope	0.008000 ft/ft
Diameter	8 in

Results	
Depth	0.67 ft
Discharge	1.08 cfs
Flow Area	0.3 ft ²
Wetted Perimeter	2.09 ft
Top Width	0.00 ft
Critical Depth	0.49 ft
Percent Full	100.0 %
Critical Slope	0.009933 ft/ft
Velocity	3.10 ft/s
Velocity Head	0.15 ft
Specific Energy	0.82 ft
Froude Number	0.00
Maximum Discharg	1.16 cfs
Discharge Full	1.08 cfs
Slope Full	0.008000 ft/ft
Flow Type	N/A

APPENDIX D
GRINDER PUMP INFORMATION

GP2010



General Applications

The size, efficiency and operating economy of the GP 2010 make it your best choice for single dwellings, waterfront property, subdivision developments and marinas. The GP 2010 is ideally suited for both new and existing communities.

Features

The GP2010 Grinder Pump is a complete unit that includes: the grinder pump, check valve, HDPE (high density polyethylene) tank and controls. The GP2010 is packaged into a single complete unit, ready for installation.

All solids are ground into fine particles, allowing them to pass easily through the pump, check valve, and small diameter pipe lines. Even objects that are not normally found in sewage, such as plastic, rubber, fiber, wood, etc. are ground into fine particles.

The 1-1/4" inch discharge connection is adaptable to any piping materials, thereby allowing us to meet your local code requirements.

The tank is made of tough corrosion resistant HDPE. The optimum tank capacity of 70 gallons is based upon computer studies of water usage patterns. A single GP 2010 can accommodate the sewage flow from two single family homes or 700 gallons per day.

The internal check valve assembly, located in the Grinder Pump, is custom designed for non-clog, trouble-free operation.

The Grinder Pump is automatically activated. It runs infrequently for very short periods. The annual energy consumption is typically that of a 40 watt light bulb.

Units are available for indoor and outdoor installations. Outdoor units are designed to accommodate a wide range of depths.

Operational Information

Motor

1 HP, 1,725 RPM, high torque, capacitor start, thermally protected, 120/240 V / 60 Hz, one phase

Inlet Connections

4" inlet grommet standard for DWV pipe. Other inlet configurations available from the factory.

Discharge Connections

Pump discharge terminates in 1-1/4" NPT female thread. Can easily be adapted to 1-1/4" PVC pipe or any other material required by local codes.

Discharge*

15 gpm at 0 psig
11 gpm at 40 psig
9 gpm at 60 psig

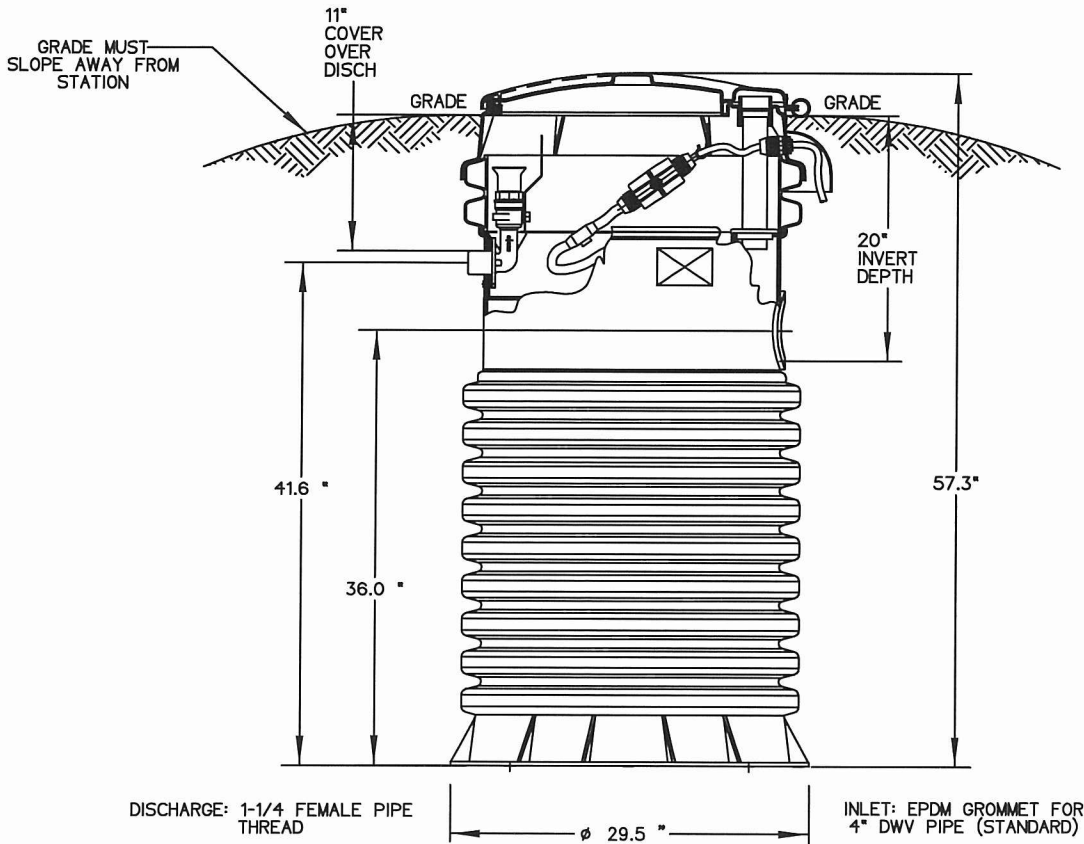
Overload Capacity

The maximum pressure that the pump can generate is limited by the motor characteristics. The motor generates a pressure well below the rating of the piping and appurtenances. The automatic reset feature does not require manual operation following overload.

Patent Numbers: 5,752,315 5,562,254
5,439,180

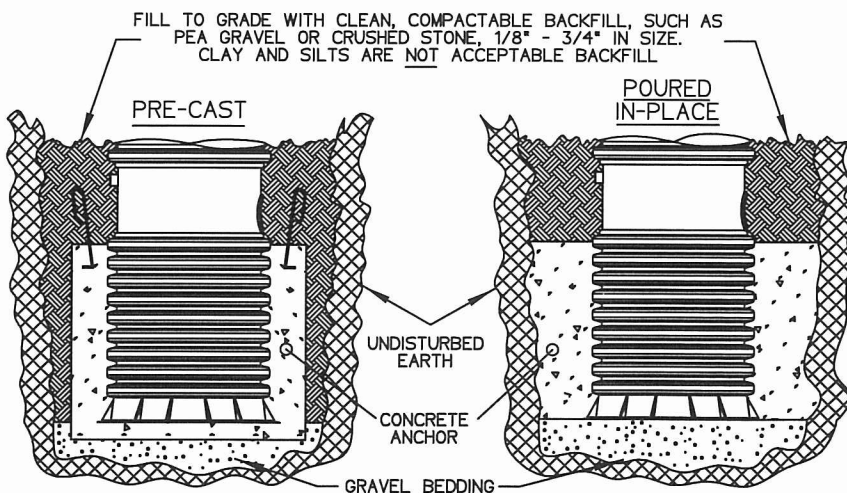
* Discharge data includes loss through check valve, which is minimal.

Printed in USA, on Recycled Paper
PA1346P01 Rev. B, 1/99



**SEE INSTALLATION INSTRUCTIONS FOR FURTHER DETAILS

NOTE: A CONCRETE ANCHOR OF 1500 lbs (9.8 cu ft) IS REQUIRED ON ALL MODEL 2010 58" STATIONS.



SGS	CAH	01/21/99	A	1/16
DR BY	CHK'D	DATE	ISSUE	SCALE



MODEL 2010-58

PA 0856 P02

APPENDIX E

PHASE 8 SEWER COLLECTION SYSTEM EXHIBIT