Sewer Modeling of Near-Term Development Technical Memorandum

City of Reedley, CA

March 8, 2018

Page Intentionally Blank

hdrinc.com
2365 Iron Point Road, Suite 300, Folsom, CA 95630-8709
T: (916) 817-4700 **F:** 916.817.4747

The City of Reedley (City) is anticipating near-term developments to the north of the City's currently developed areas. These developments will contribute additional sewer flow to the City's existing sewer collection system, and may result in hydraulic deficiencies in the system due to the increased volume of sewer loading.

1. Introduction

The purpose of this technical memorandum (TM) is to provide an analysis of the impacts of near-term development on the City's sanitary sewer system. For this modeling effort, scenarios were used to evaluate potential hydraulic issues resulting from the near-term developments to the north of the City. A second set of scenarios was used to determine the facility upsizing required to convey flows down Manning Avenue and via the Reed Avenue Lift Station to the treatment plant at buildout. Buildout flows were used to verify the recommended facility upsizing will not encounter capacity issues resulting from further development before the facilities reach their useful lives.

2. Background

HDR previously completed the City's Sanitary Sewer Master Plan (Master Plan) in 2014. As part of the Master Plan effort, a hydraulic model of the City's sewer collection system was developed using the modeling software package InfoSWMM®, developed by Innovyze®. As part of the model development, sewer loading estimates were developed for the collection system based on flow meter data and current land use. Future loadings were projected based on planned land use types and were divided into two phases:

- Phase 1: projected flows through 2020.
- Phase 2: projected flows from 2020 through buildout.

The Master Plan recommended changing the existing system's configuration to route future flows from the north of the City south, down Reed Avenue, to the treatment plant. This strategy would convey the majority of flows to the treatment plant using gravity and limit the flows conveyed via the Reed Avenue Lift Station. However, the costs and disruption associated with installing new pipe on Reed Avenue may make this option unfeasible. Therefore, for this analysis, the alternative option of maintaining the current system configuration is assumed. This alternative will continue to route flows from the north of the City to the west, down Manning Avenue, and south down Kingswood Parkway to the Reed Avenue Lift Station. The proposed modeling task addresses this alternative option for conveying projected future flows to the treatment plant.

3. Model Scenarios and Assumptions

As part of this analysis, four scenarios were added to the hydraulic model. Both dry and wet weather scenarios were developed for each of the following:

- Existing flows plus near-term development flows loaded onto the existing system.
- Existing flows plus near-term development flows with system upgrades, as needed.

- Projected buildout flows loaded onto the existing system.
- Projected buildout flows with system upgrades, as needed.

The following assumptions were used in the model update and analysis:

- Existing sewer flows were assumed to be the existing loads developed as part of the Master Plan. Historical treatment plant records may be used to validate the existing flow volumes in the model.
- Flows for the near-term developments north of the City were estimated based on land use sewer generation rates developed in the Master Plan and the planned land use types.
- Projected buildout flows were also based on planned land use types.
- As in the Master Plan, wet weather flow scenarios were based on rainfall derived inflow and infiltration for a 10-year, 24-hour storm event.
- Evaluation and development criteria were based on the criteria included in the Master Plan.

4. Near-Term Developments and Projected Flows

Since June 2017, two development projects have been submitted to the City. It is anticipated that these projects will be constructed within 6 months to three years from January 2018. The locations of these projects are shown in Figure 1.

The first project, VSTM 6196, is a subdivision located at the northeast corner of Reed and Aspen Avenues. 161 single family homes are proposed, with construction for this project expected to start in 2018. A planning map for this development is included in Appendix A.

The second project, Frankwood Commons, is a proposed subdivision and commercial area located at the northeast corner of Frankwood and South Avenues. The project is currently not within City limits and will need to be annexed before map approval and construction begins. The proposed subdivision is 161 lots and the commercial area is estimated at 15,000 SQFT. A planning map for this project is included in Appendix B.

Near term flows were projected based on the land use associated with the planned developments and the duty factors developed in the 2014 Master Plan. Duty factors, acreage per land use type, and projected flows are shown in Figure 1. Based on the calculations it is estimated that the developments will result in average dry weather flow (ADWF) of approximately 85,400 gallons per day (gpd).

Peak wet weather flows (PWWF) for the developments were projected based on a wet weather peaking factor of three (3) developed as part of the 2014 Master Plan. Resulting PWWF for each of the developments is shown in Table 2. A total of 256,000 gpd for PWWF is projected for the developments.

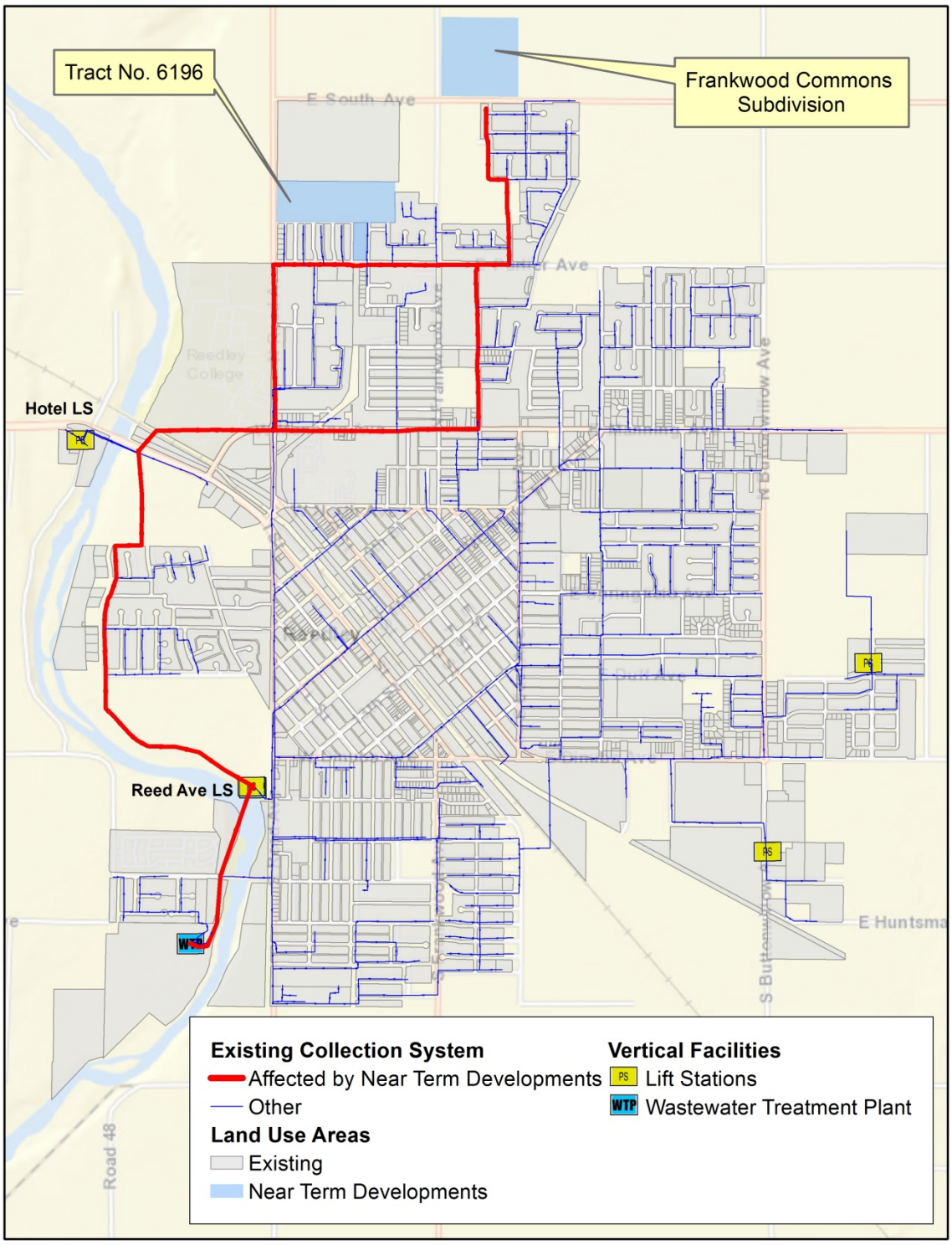

Figure 1 - Near Term Developments and Affected Collection System

Table 1 - Near-Term Development Projected Average Dry Weather Flows

General Plan Land Use	Duty Factor (gpd/acre)	Development Area (acres)		Projected Sewer Flows (gpd)	
		Frankwood Commons	VSTM 6196	Frankwood Commons	VSTM 6196
Low Residential	1,520		30.8		46,800
Medium Residential	1,480	23.3		34,500	
Neighborhood Commercial	1,280	3.2		4,100	
Open Space	-	1.5			
Totals		28.0	30.8	38,600	46,800
Total Additional Near Term Average Dry Weather Flow				85,400	

Table 2 - Near Term Development Projected Peak Wet Weather Flows

Development	Average Dry Weather Flow (gpd)	Peak Wet Weather Flow (gpd)
Frankwood Commons	38,600	116,000
VSTM 6196	46,800	140,000
Total	85,400	256,000

5. Model Update and Analysis

Model analysis was conducted by running the updated model scenarios and comparing the results with the evaluation criteria from the 2014 Master Plan, shown in Table 3. Evaluation criteria for gravity sewers include a peak depth to diameter ratio (d/D) of at most 0.5 for peak dry weather flow (PDWF) and 1.0 for PWWF. Based on results of the 2014 Master Plan, the PWWF criteria dominates in the Reedley collection system. If a gravity main was found to be undersized based on the evaluation criteria, an upsized main was recommended based on the design criteria of a PWWF d/D not to exceed 0.75. Additionally, lift stations are evaluated based on their ability to convey their design flow with the largest pump out of service. For the purposes of this analysis, design flow was assumed to be the PWWF experienced at the lift station.

Table 3 - Planning and Evaluation Criteria

Parameter		Value
Evaluation Criteria for Gravity Sewers	PDWF	d/D < 0.5
	PWWF	d/D <= 1.0
Design Criteria for New Gravity Sewers	PWWF	d/D <= 0.75
Evaluation Criteria for Lift Stations	Design Flow	Pump design flow with largest pump out of service

Source: 2014 Reedley Sewer Master Plan

Although the gravity main evaluation criteria is based on d/D values, high water levels in pipes are often the result of hydraulic bottlenecks in the collection system. To evaluate locations where hydraulic bottlenecks may occur in the collection system due to near term development, hydraulic grade line (HGL) profiles of the flow paths of the near term development flows were evaluated for PWWF condition. The locations of the two HGL profiles are shown in Figure 2, and the resulting HGL profiles are shown in Figure 3 and Figure 4.

Both HGL profiles indicate surcharging at various points in the pipe reaches. Analysis of the model results indicated that the surcharging seen in HGL Profile 2 is the result of backflow conditions in pipes in Manning Avenue, a bottleneck illustrated in HGL Profile 1. Therefore, the only significant hydraulic constraints in the collection system as a result of the near term development flows are experienced by pipes in HGL Profile 2.

The Reed Avenue Lift Station was also evaluated based on model results. Model results indicate a PWWF inflow to the lift station of 2.73 mgd. The lift station includes three pumps each with a rated capacity of 0.79 mgd. With one pump out of service, the PWWF to the lift station exceeds the capacity of the pumps based on the evaluation criteria.

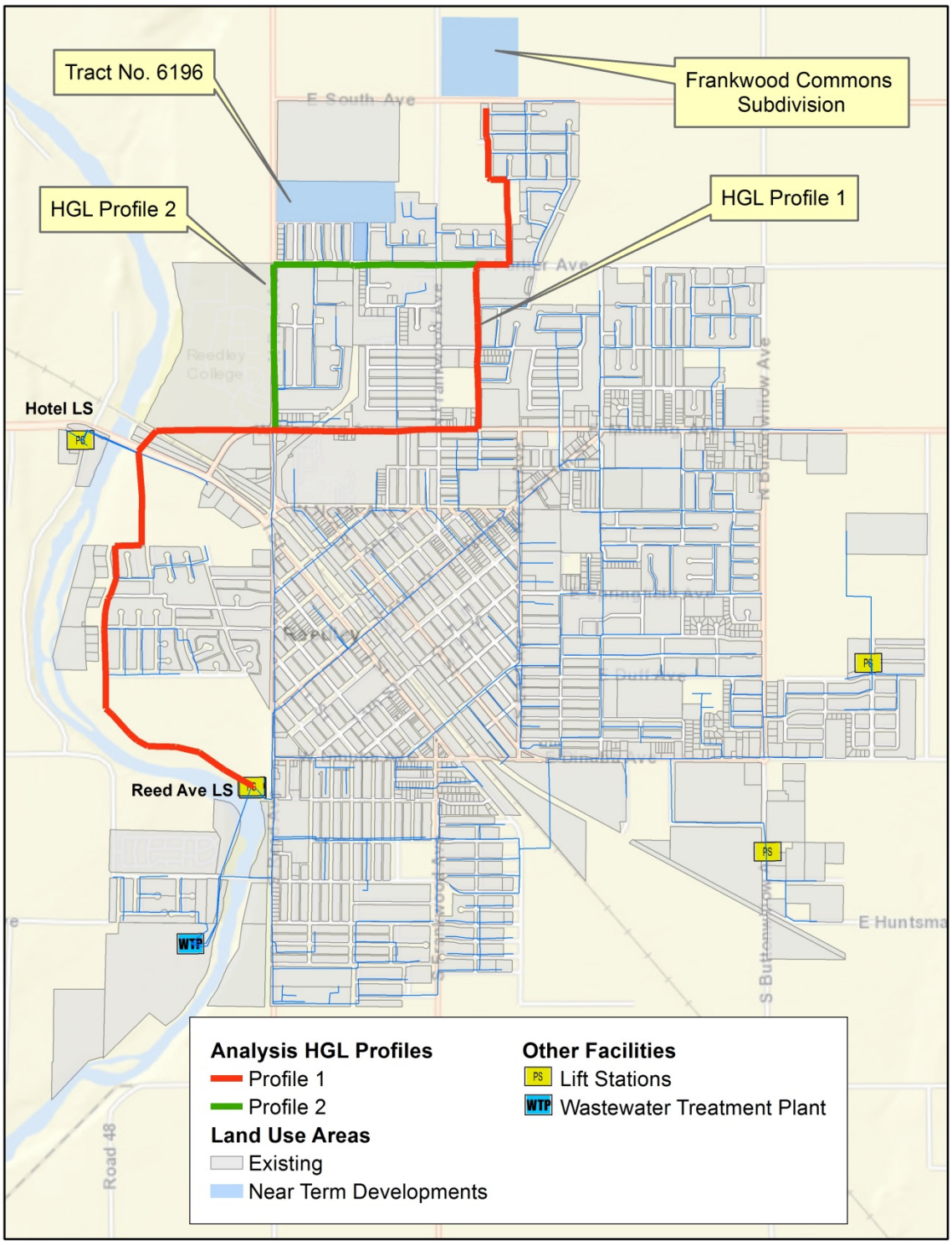

Figure 2 - Location of Hydraulic Grade Line Profiles used for Model Analysis

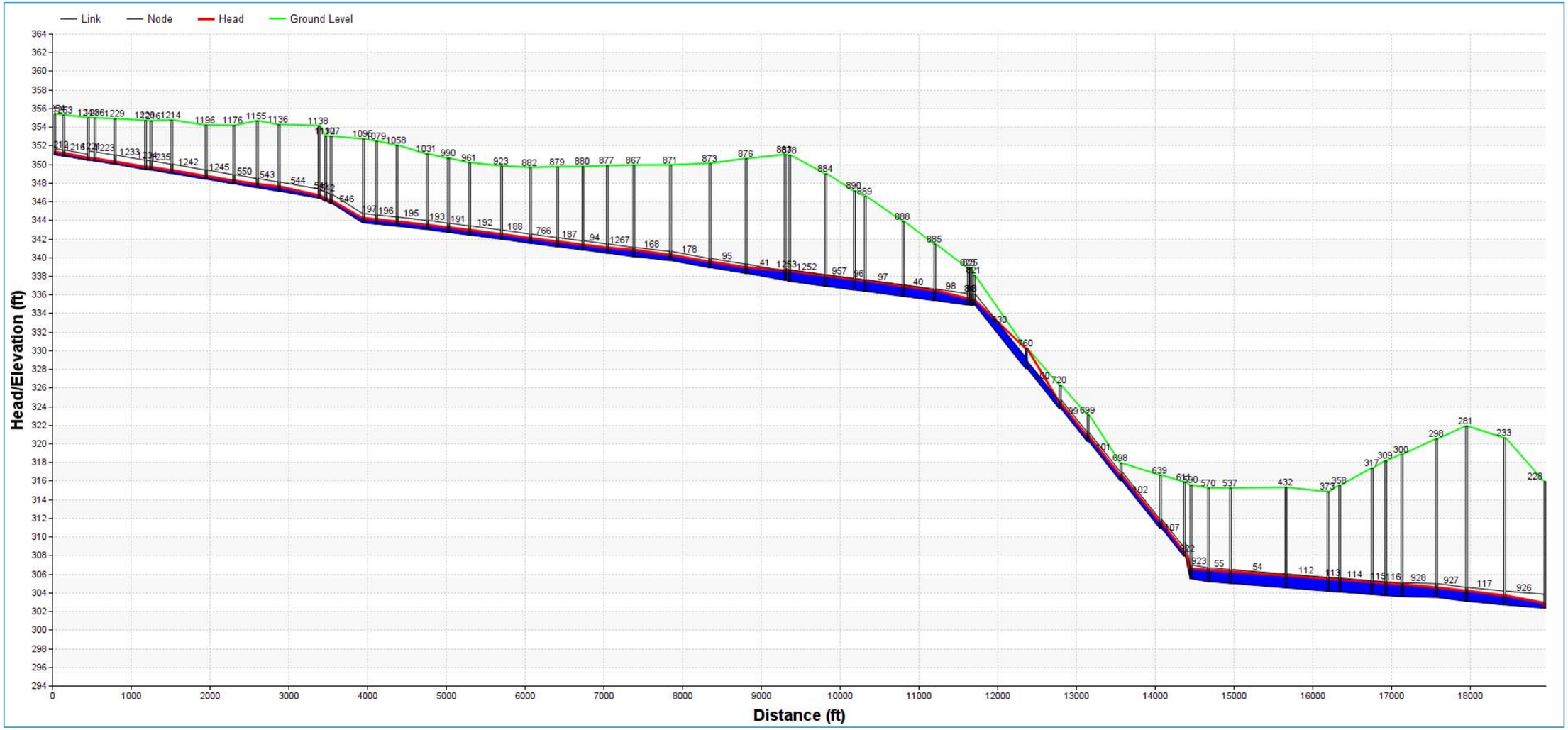

Figure 3 - Existing System plus Near Term Development Flows PWWF HGL Profile 1

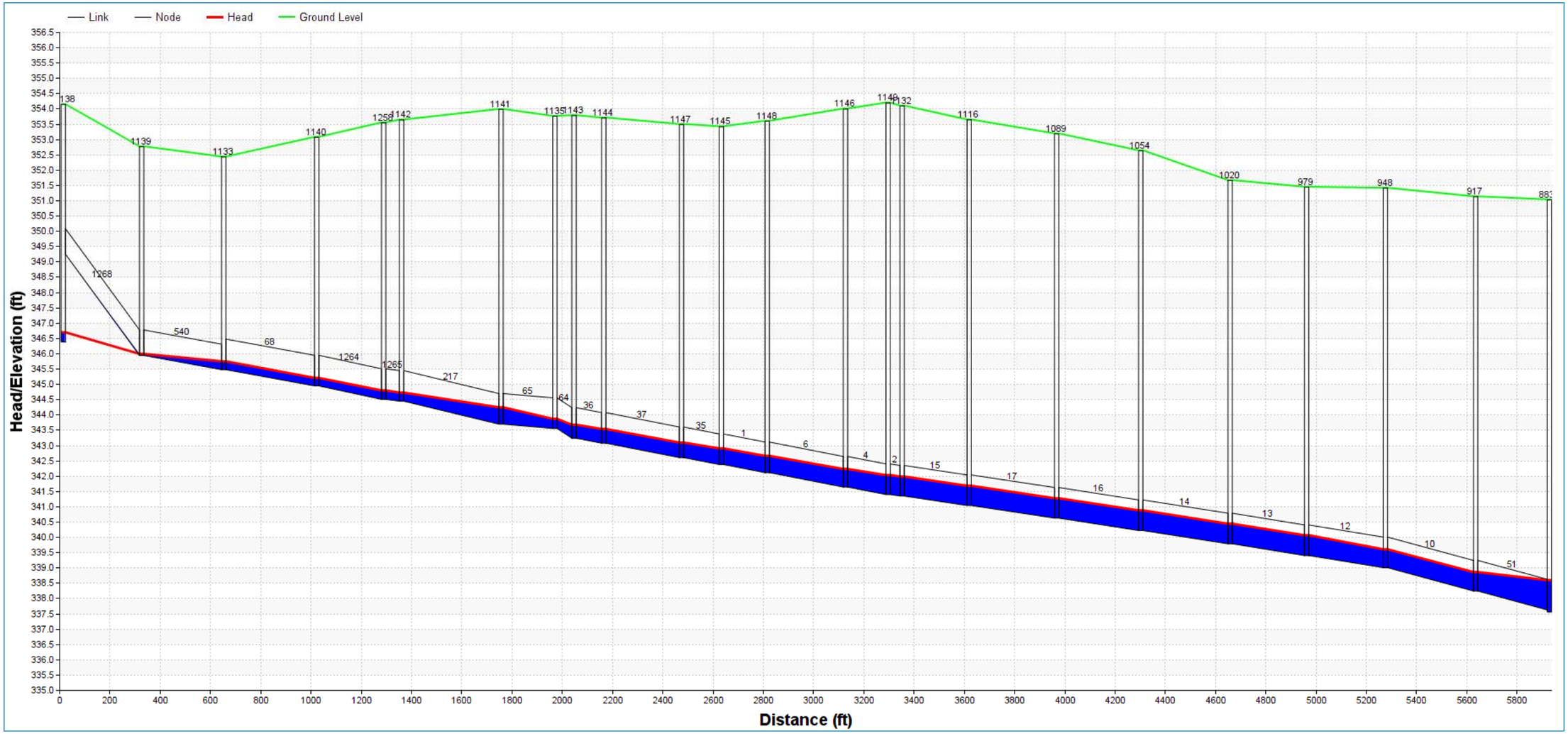

Figure 4 - Existing System plus Near Term Development Flows PWWF HGL Profile 2

6. Recommended Upgrades

As discussed in the Background section of this TM, the 2014 Master Plan assumed the collection system would be upgraded to allow flows from the north of the City to be routed down new gravity mains in Reed Avenue. However, for this analysis, it is assumed that future flows will continue to be routed west down Manning Avenue and south down Kingswood Parkway to the Reed Avenue Lift Station, as is done in the existing collection system. Therefore, new buildout scenarios were developed in the model to identify possible capacity constraints associated with this alignment and to estimate the gravity main diameters required to convey buildout flows. Installing gravity mains sized to convey buildout flows will help the City avoid replacing mains due to capacity issues before the mains reach the end of their useful lives.

Based on the model results, it is recommended that approximately two miles of gravity main be upsized on Manning Avenue and in the Kingswood Parkway alignment which conveys flows to the Reed Avenue Lift Station. The recommended upgrades are summarized in Table 4 and shown in Figure 5. The resulting HGL profiles for the recommended upsized pipes under PWWF are shown in Figure 6 and Figure 7.

In addition to the gravity main upgrades, it is recommended that a capacity analysis of the Reed Avenue Lift Station be performed. Based on the evaluation criteria, the lift station should convey design flow using two pumps each rated at 0.79 mgd. For the buildout scenario used in the model analysis, model results indicate an inflow of 6.17 mgd at PWWF.

Table 4 - Recommended Gravity Main Upgrades by Length

Diameter (inches)	Length (feet)
15	1,898
18	2,112
21	65
24	2,297
27	1,776
30	2,769
Total	10,918

Figure 5 - Recommended System Upgrades

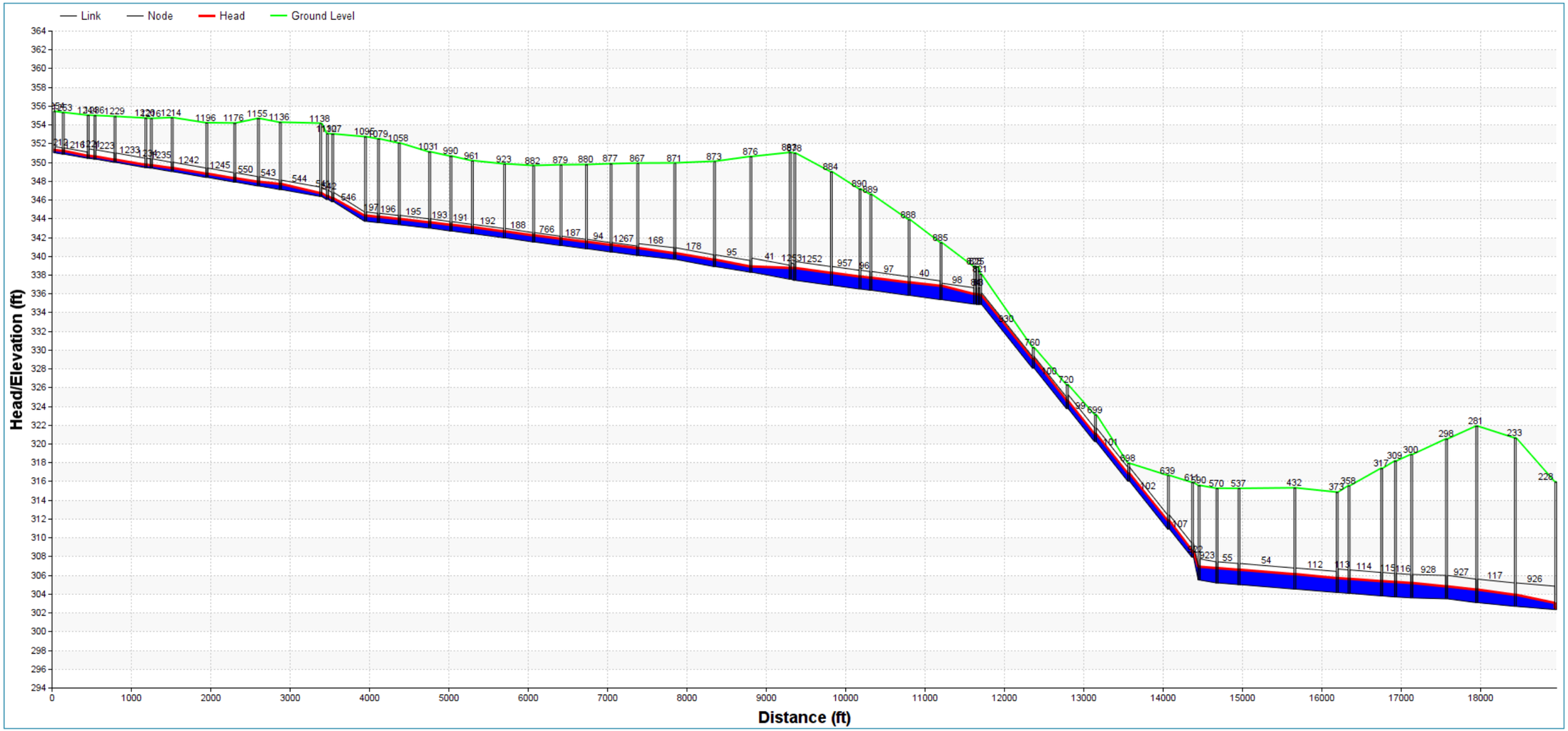

Figure 6 - Buildout System Flows PWWF HGL Profile 1

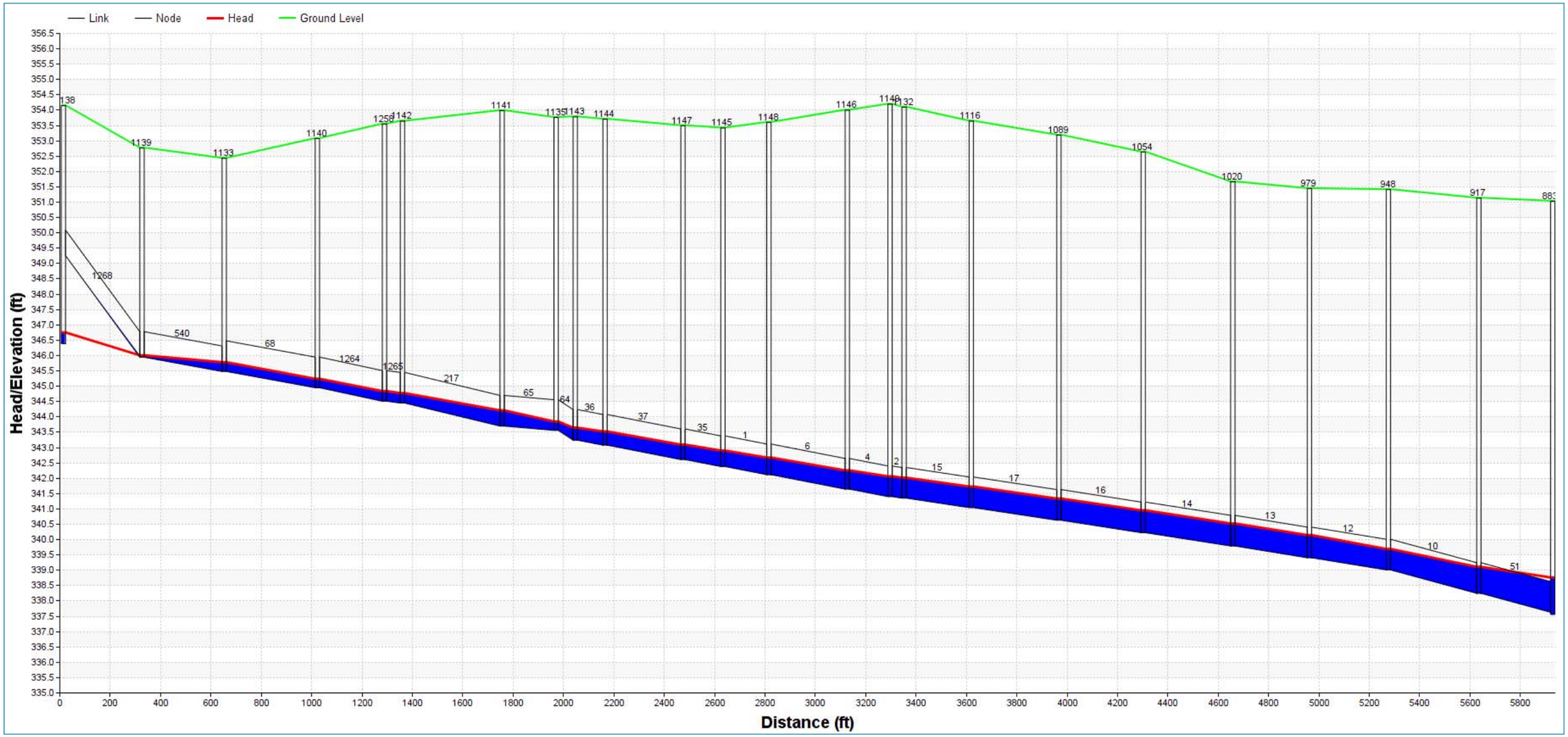

Figure 7 - Buildout System Flows PWWF HGL Profile 2