EPANET Technical Report – Vaquero Village Water System

1. System Overview

The Vaquero Village water distribution system is modeled using EPANET and Python-based simulation frameworks. The system consists of: - A single 20 GPM well feeding two 2900-gallon storage tanks (total 5800 gallons). - Two 320-gallon pressure maintenance bladder tanks (640 gallons total). - A booster pump (20 GPM capacity) activating at 38 psi. - Transmission and service lines modeled as 2.5” and 1.5” PVC respectively. - Critical connection nodes (CN41, CN81, CN89, CN90, CN91, CN92) monitored for pressure and flow.

2. Simulation Framework

Hydraulic analysis is based on the Darcy-Weisbach equation for head loss, the Bernoulli equation for energy balance, and continuity principles. Simulation steps include: - Sequential use of pressure tanks, then storage tanks and well. - Booster pump supplying additional flow during demand surges. - Pressure decay mapped to critical CNs.

3. Scenarios Modeled

Baseline and upgrade scenarios have been evaluated: 1. Baseline: 20 GPM well, 640 gallons pressure maintenance. 2. Booster pump engagement at 38 psi. 3. Additional booster pump (20 GPM) engaging at 30 psi. 4. Demand variations: 1.25, 1.0, 0.75, 0.5, 0.125 GPM per active CN. 5. System upgrade proposal: additional well (not implemented), extra 640 gallons pressure maintenance, network loops (SN89-SN71, SN90-SN41), removal of CN91/92.

4. Critical Node Monitoring

Simulation tracks pressures at: - CN41 (no flow, reference node) - CN81 (active consumer node) - CN89 (no flow, priority for tracking) - CN90 (no flow, priority for tracking) - CN91, CN92 (removed in upgrade scenario)

5. Results Summary

Outputs include system-wide pressure, volume, and flow rate data over time. CSV exports provide detailed time-step data for all CNs, with emphasis on the six critical nodes. Key findings: - Pressure tanks provide initial demand coverage until depletion. - Booster pump maintains minimum pressure until demand exceeds 20 GPM. - Optimal activation of second booster pump prevents under-pressurization.

6. Next Steps

Recommended actions: - Continue refining EPANET input file (.inp) for Vaquero Village. - Generate visualization plots of pressure decay and flow distribution. - Package Python scripts and CSV outputs into reproducible ZIP archives. - Maintain rolling checkpoint PDFs/Word docs to safeguard against chat collapse.