City of Portland - Environmental Services
Systems Planning Program

System Plan Update

# TECHNICAL MEMORANDUM 5.6A

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| Date: | March 5, 2007 |
| Task: | 7900 |
| Subject: | Fanno Pump Station Influent Flow and Capacity |

## Purpose

The purpose of this memorandum is to provide estimated peak flow and volume discharged to the Clean Water Services collection system from the Fanno Basin Pump Station service area during a 5-year recurrence interval storm.

## Background

The Fanno Basin Pump Station (FABA) pumps sanitary sewage from Portland Bureau of Environmental Services (BES) and Clean Water Services (CWS) service areas. During wet season wet weather, rainfall derived infiltration and inflow causes flow to significantly increase to FABA. If peak inflows exceed FABA capacity, an overflow to the CWS collection system will occur.

Both CWS and BES are in the process of performing facilities plan updates. CWS has requested an estimate of peak flow at FABA influent, FABA capacity, and an estimate of volume that would discharge to CWS during a 5-year storm event.

BES' staff is in the process of characterizing the ability of the system to convey existing flows for a 5-year 24-hour winter design storm. The approach for generating future flows is currently being tested. Therefore, this memo provides results for existing conditions only. The existing flows in this memorandum should be regarded as draft pending review from BES management.

## Summary of Results

Two pumping scenarios were performed for the 5-year winter design storm with different assumptions made for pumping capacity at FABA and Cambridge Village (CAVI) pump stations. The "Firm Capacity" scenario assumed the installed spare was out of service at both pump stations; FABA with three pump sets available and CAVI with one pump available. The "Full Capacity" simulation assumed all pumps operational in both stations.

The results for the 5-year winter design storm are summarized in Table 1 below and in Figures 1 and 2 for operating with firm and full capacity at pump stations, respectively

**Table 1: 5-year Winter Design Storm Modeling Results Summary**

| | Peak Flow Rate (cubic feet per second) | | | | Volume (million gallons) |
|---|---|---|---|---|---|
| | Upstream of CWS diversion | Fanno Pump Station Inflow | Fanno Pump Station Effluent | Overflow to CWS system | Overflow to CWS system |
| **Firm Capacity** | 39 | 28 | 24 | 15 | 3.5 |
| **Installed Capacity** | 39 | 31 | 28 | 11 | 2.1 |

## Overview of Technical Approach

This section gives an overview of the model calibration and verification efforts in support of the results.

### Hydrologic and Hydraulic Model Calibration

The Fanno sanitary basin models consist of both hydrologic and hydraulic models. The Fanno sanitary basin models were developed and calibrated as part the on-going Sanitary Sewer System Plan Update by the BES System Planning Section. Hydrologic models were developed using DHI MOUSE and were used to quantify dry weather flow and Rainfall Dependent Infiltration and Inflow (RDII) that enter the sewer system. The hydraulic models, developed using XP-SWMM, were used to convey flows generated by hydrologic models through sanitary system to the Fanno Pump Station.

The input data for the MOUSE hydrologic models were developed based on the characteristics of sanitary catchments and monitoring flow data collected at thirty flow monitoring stations in the Fanno basin. The input data for the XP-SWMM hydraulic models were based on the conveyance system's characteristics, such as pipe length, pipe inverts and other applicable factors.

Pumping rates at FABA were verified and fine-tuned in the model based on the review of 1-minute average effluent flow data collected at the pump station during large storm events. The Fanno pump station flow rates used in the hydraulic model are given in Table 2. This indicates the firm capacity of the FABA is 24 cubic feet per second (cfs) or 10,800 gallons per minute (gpm)

| Table 2: Fanno Basin Pump Station Flow Rates | | | | |
|---|---|---|---|---|
| **# Pumps in Operation** | **1** | **2** | **3** | **4** |
| **Model Flow Rate (cfs)** | 11.5 | 19 | 24 | 28 |
| **Model Flow Rate (gpm)** | 5,200 | 8,500 | 10,800 | 12,600 |

The Fanno sanitary model calibration was completed by adjusting the input data for the hydrologic models until a reasonable fit between modeled flow and measured flow was achieved at all flow meter locations. After calibration, model verification was performed using effluent flow collected at the Fanno Pump Station in January 2003 and in the 2005-2006 winter season. The model development and calibration effort is documented in Technical Memorandum 5.3A of the 2006-2007 Sanitary Sewer System Plan Update Project.

The calibrated model was also verified most recently using the large storms that occurred in November and December of 2006. The measured flow and modeled flow at the Fanno Pump Station for 2006 November and December storms are shown in Figures 3 and 4.

Fanno sanitary basin model calibration and verification results indicate that the Fanno sanitary basin models were able to reproduce the system response to rainfall during wet season storm events and provide reasonably accurate estimates of timing and peak flows for various storm events at most flow meter locations in the basin, including the Fanno Pump Station effluent meter.

## Application of Design Storm

The calibrated Fanno sanitary basin models will be used in basin characterization for conveyance system capacity evaluation. A 5-year winter design storm was recently developed by the System Analysis Section based on a statistical analysis of long-term precipitation data collected at various City rain gauges. The design storm is a 72-hour hyetograph with hourly intensities that match rainfall depths developed for various 5-year durations using data from the Portland Hydra Network. Table 3 gives the 5-year recurrence interval rainfall depths calculated for various durations.

| Table 3: Fanno 5-year Precipitation Depths | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Duration** | **5 Min** | **15 Min** | **30 Min** | **60 Min** | **90 Min** | **2 Hour** | **3 Hour** | **6 Hour** | **12 Hour** | **24 Hour** | **2 Day** | **3 Day** |
| **Depth (in)** | 0.14 | 0.26 | 0.33 | 0.42 | 0.54 | 0.66 | 0.87 | 1.27 | 1.85 | 2.52 | 3.33 | 4.08 |

This 5-year winter design storm was used in the calibrated Fanno sanitary basin models to quantify flow at the Fanno Pump Station and overflow into the Clean Water Services (CWS) collection system.

This 5-year design storm has not been reviewed by the BES Standards and Practices Committee and may be subject to modification in future.

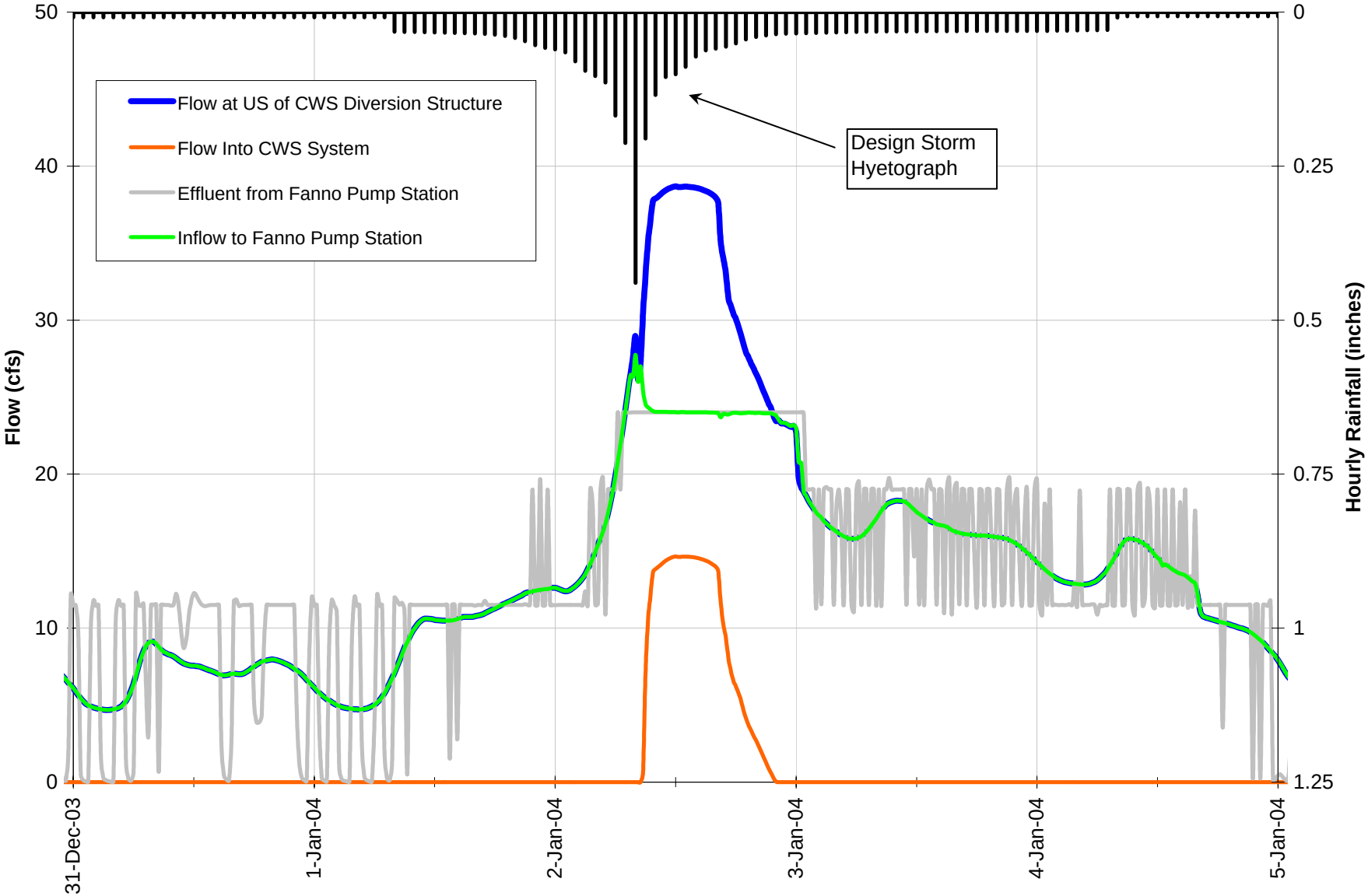


**Figure 1: 5-Year Winter Design Storm Model Simulation Results**
**Fanno and Cambridge Pump Station at Firm Capacity (one pump as spare)**

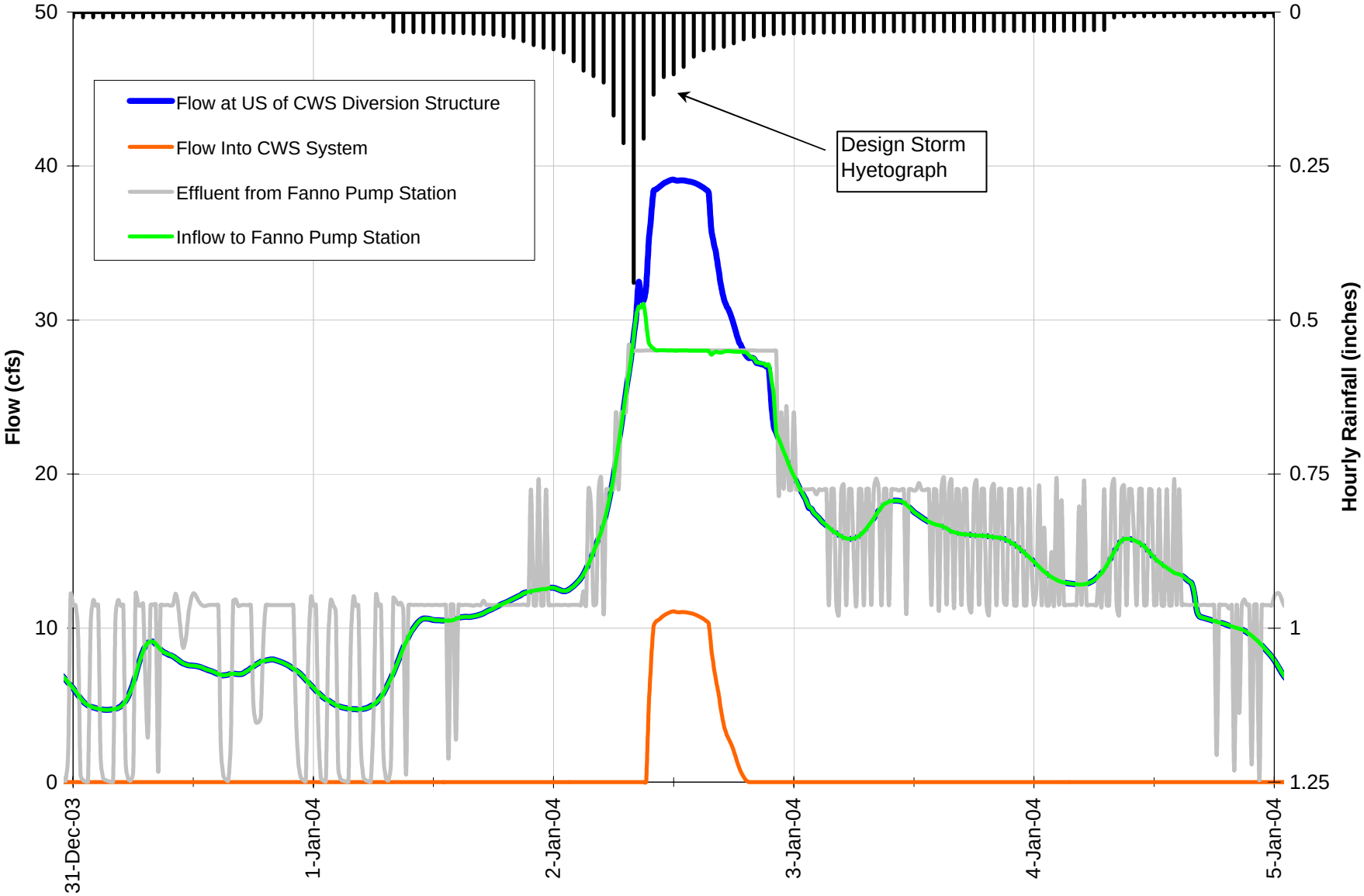


**Figure 2: 5-Year Winter Design Storm Model Simulation Results**
**Fanno and Cambridge Pump Station at Full Capacity (all pumps operational)**

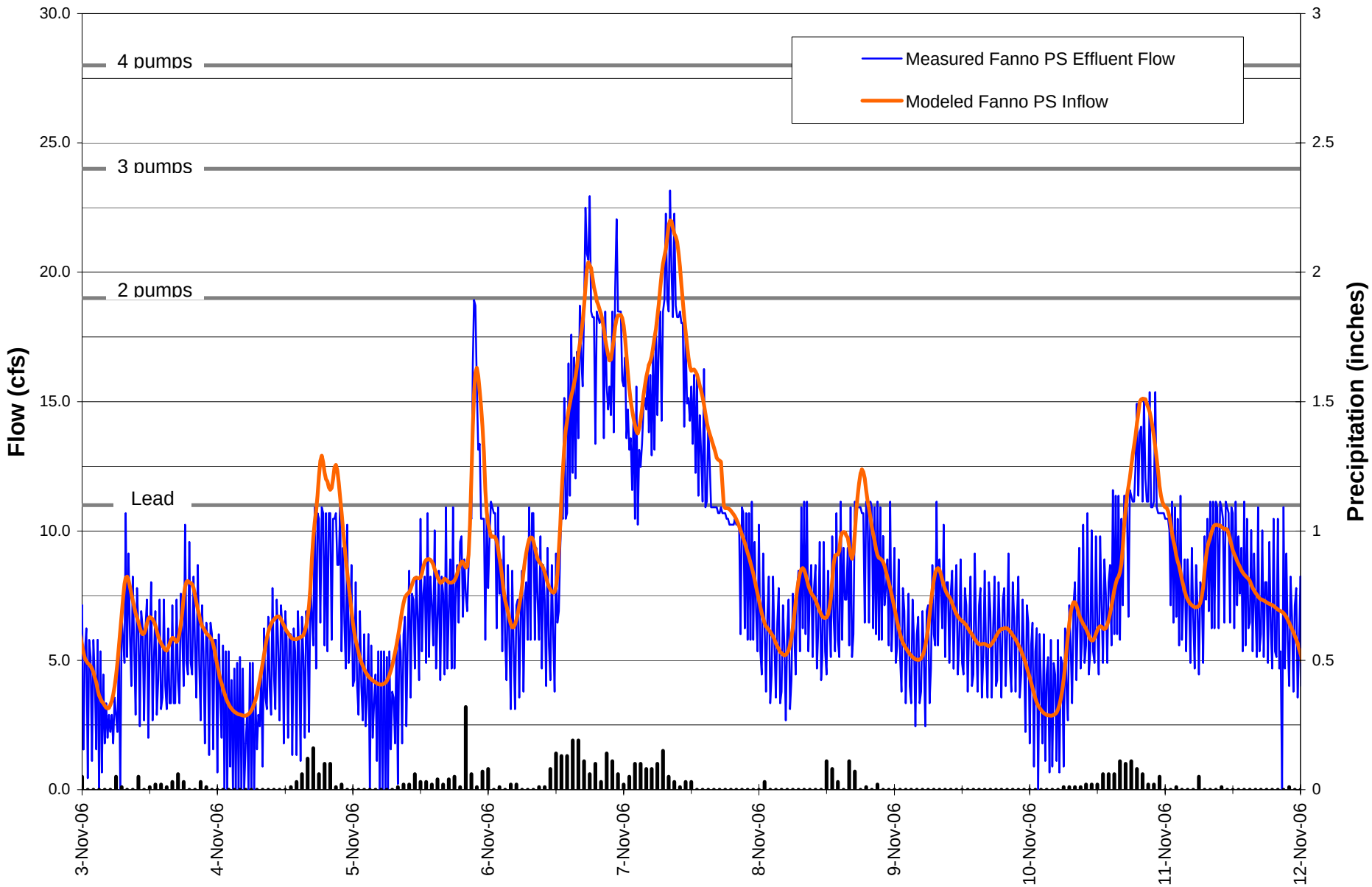


**Figure 3 Measured and Modeled Flow Comparison for Fanno Pump Station (November 2006)**

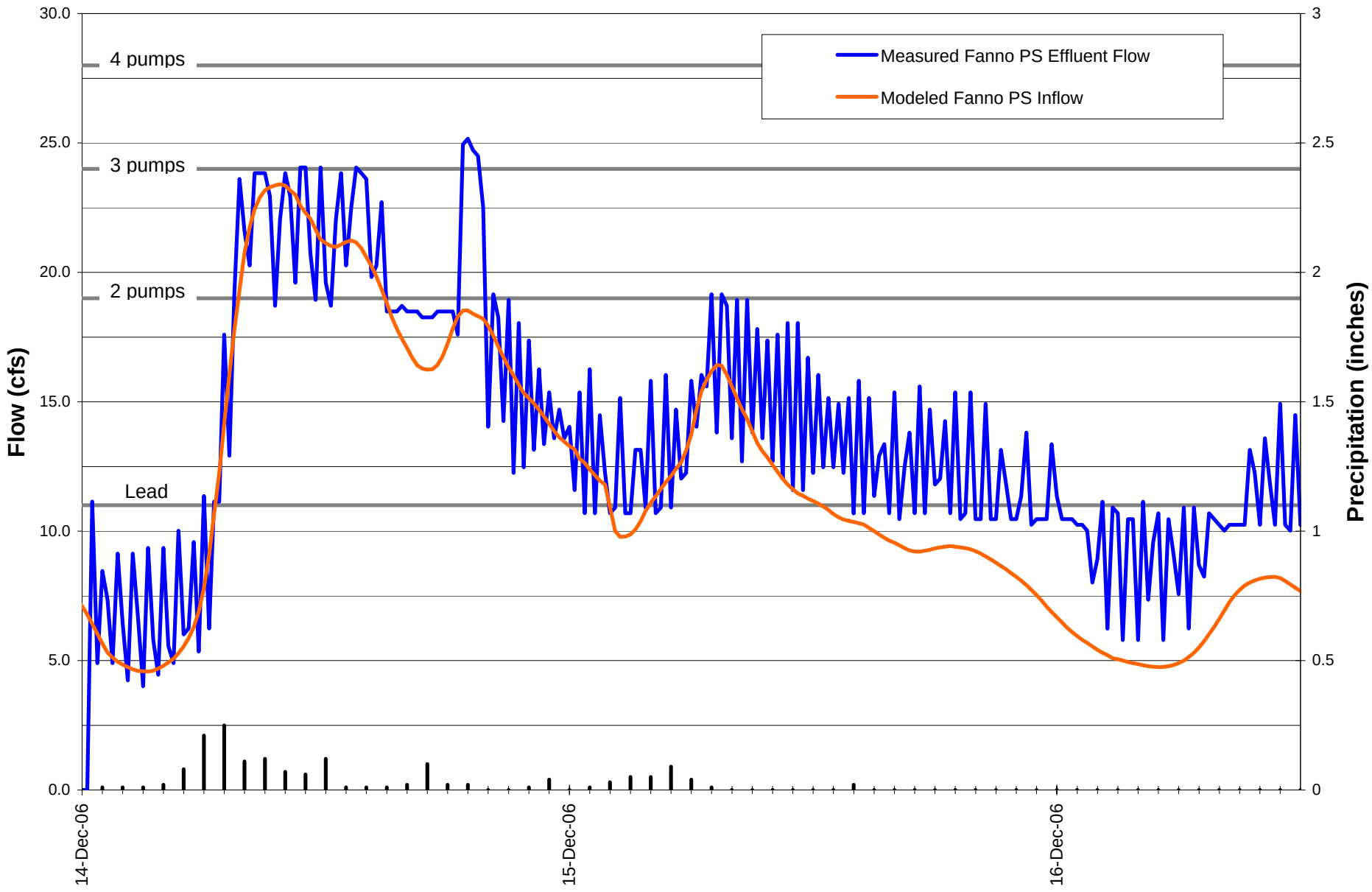


**Figure 4 Measured and Modeled Flow Comparison for Fanno Pump Station (December 15, 2006)**