TECHNICAL MEMORANDUM

DATE: October 30th, 2017

PROJECT: On-Call Modeling, Wastewater Collection

TO: City of Bend, Oregon

FROM: Shad Roundy, P.E,
Sven MacAller, EIT
Murraysmith

RE: Drake Lift Station Analysis

Background

Murraysmith conducted a lift station analysis for the Drake Lift Station. The lift station was identified for condition upgrades in the 0 to 5-year timeframe in the 2014 Collection System Master Plan (CSMP). Based on increasing development pressure in the lift station service area, a capacity analysis was performed to evaluate potential capacity upgrades that may also be required. The purpose of this on-call analysis was to confirm existing and build-out flows and to identify the timeframe of potential capacity deficiencies. In addition, as-built drawings for the lift station were reviewed to evaluate potential upsizing options for the force main. A preliminary recommendation for pump replacement and force main upsizing are provided.

Drake Lift Station Service Area

The Drake Lift Station service area is approximately 225 acres, with a mix of residential, commercial and mixed-use parcels. The service area includes both the Box Factory and the KorPine site which are high growth areas with continued development potential and interest. These developments are estimated to contribute 1,500 equivalent dwelling units at build-out. The lift station service area is shown in Figure 1 and the lift station site is shown in Figure 2.

Figure 1
Lift Station Service Area

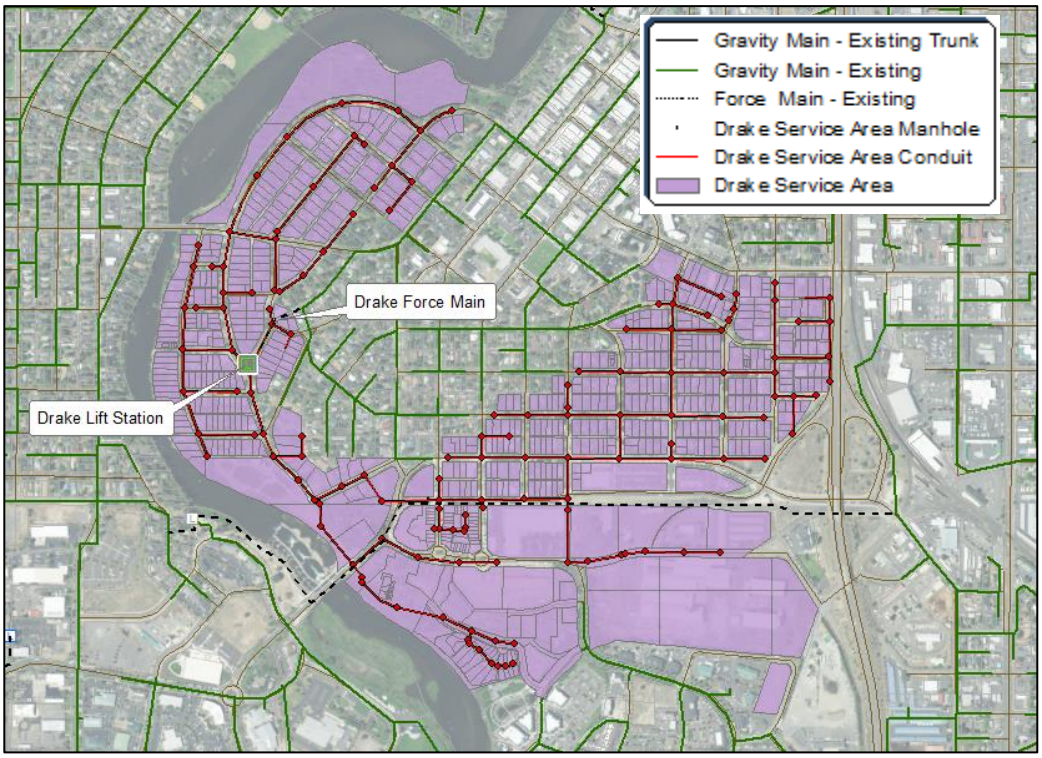
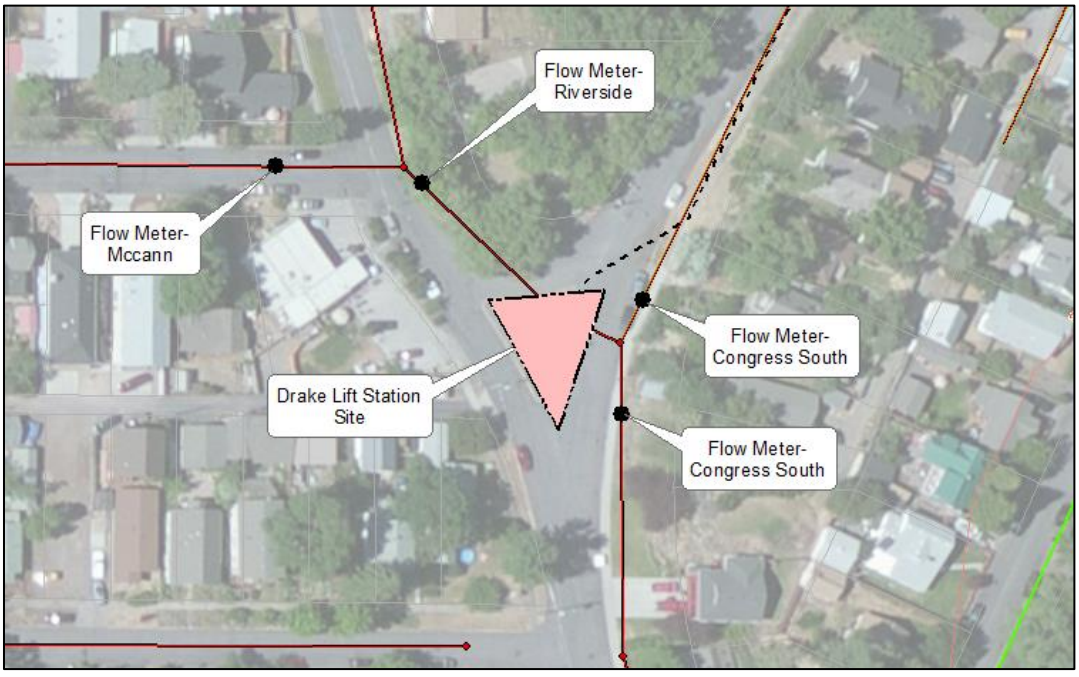


Figure 2
Lift Station Site



Flow Monitoring Data Review

Four flow meters were installed, as shown on Figure 2, to collect pump station inflow data. Meter data was used to validate model flow and peaking factors and to establish an existing flow that reflects development that has occurred after the last model calibration. Flow data was provided from April 18th, 2017 to June 1, 2017 at 15 minute intervals for all four flow meters. There are some gaps in the data, especially for the Congress North and Mccan meters, however there was sufficient data to establish an existing flow into the lift station.

Precipitation data for the flow monitoring period was also evaluated, however there were only three rainfall measurements during this time, all less than 0.03 inches. This did not provide enough information to establish an existing wet weather flow response. As a result, wet weather peaking factors from recent modeling efforts were assumed for the lift station service area (average to peak wet peaking factor is 4).

Lift Station Capacity and Condition

The existing lift station has three pumps that discharge into a 6-inch, 584-foot long force main. Based on an evaluation of the pump station system curve, existing firm capacity (largest pump out of service, two pumps operating) is approximately 780 gallons-per-minute (gpm). At this flow rate, the force main velocity is approximately 9 feet per second (fps). During dry conditions (one pump operating) the force main velocity is approximately 7 fps.

Two of the Drake Lift Station pumps were installed approximately 45 years ago. The third pump and additional drywell, were added in 1996. There are several condition and operational challenges at the Drake Lift Station including the vacuum priming system for the original pumps, and ragging and solids issues. Maintenance reports that they are at the lift station almost daily, and the wet well requires cleaning with a vactor truck monthly. A backup generator was added when the third pump and additional drywell were added at the site in 1996.

Existing and Future Flow Analysis

Based on flow monitoring data as-well as the existing calibrated model, the existing average flow into the Drake Lift Station is approximately 100 gpm, and peak wet plus dry weather flow is approximately 400 gpm. The existing plus permitted flows other than the Box Factory site are estimated at 110 gpm and 440 gpm for dry average and peak flow respectively. Full development of the KorPine and Box Factory sites increase dry average flow to approximately 250 gpm (1,000 gpm peak wet plus dry flow). By build-out of the entire service area, the flow into the pump station increases to 300 gpm average (1,200 gpm peak wet plus dry weather flow). The existing and future flows are summarized in Table 1.

Table 1
Flow Summary

Flow Component	Flow (gpm)	EDUs[1]
Existing + Permitted Average Dry Weather Flow	110	1,200
Existing + Permitted Peak Dry + Wet Weather Flow	440	1,200
KorPine, Box Factory Development + Existing + Permitted, Average Dry Weather Flow	250	2,670
KorPine, Box Factory Development + Existing + Permitted, Peak Dry + Wet Weather Flow	1,000	2,670
Build Out Average Dry Weather Flow (full service area)	300	3,150
Build Out Peak Dry + Wet Weather Flow (full service area)	1,200	3,150

Note 1. EDUs = Equivalent Dwelling Units, where 1 EDU = 135 gallons-per-day

Lift Station Evaluation

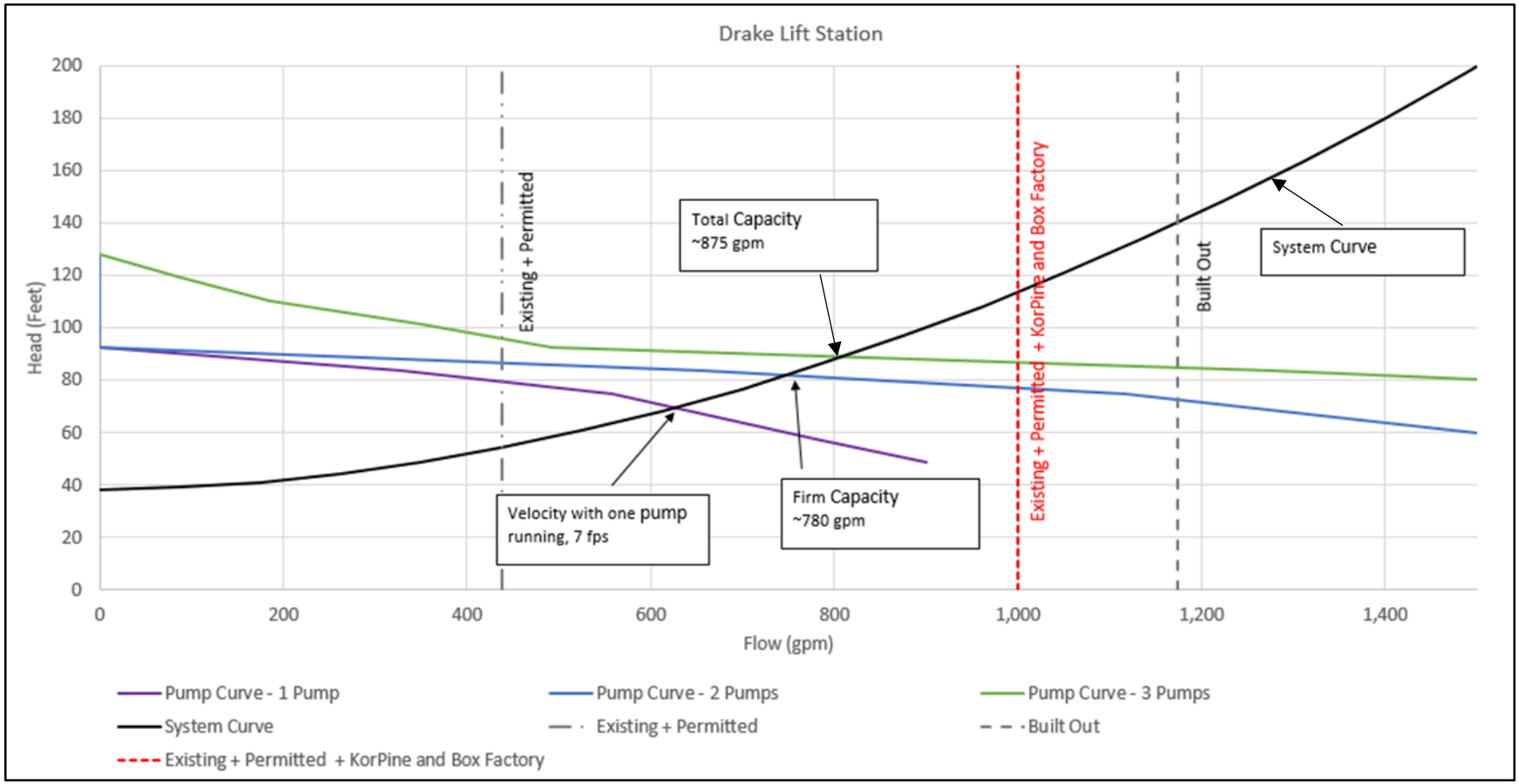
The existing pump curves and system curves relative to existing and future flows are shown in Figure 3. Force main velocities with the existing 6-inch force main are shown in Table 2. The existing lift station configuration has capacity for existing flow + permitted flow + approximately 900 EDUs within the KorPine and Box Factory sites. Based on the full development of the KorPine and Box Factory sites, the Drake Lift Station will be capacity deficient by a minimum 200 gpm or 500 EDUs.

The lift station was identified for condition based improvements in the 0-5-year time frame in the CSMP. Based on additional discussions with Operation and Maintenance staff, this condition based improvement is required in the near-term to minimize operational risk and reduce the number of visits to the site to addresses vacuum suction and priming.

Table 2
Force Main Velocity

Planning Horizon	Velocity at Peak Flow (fps)	Velocity at Peak Dry Flow (fps)
Existing Operations	9.0 (2 pumps)	7.0 (1 pump)
Existing + KorPine + Box Factory	11.3	5.1
Build Out	13.3	6.0

Figure 3
Lift Station Evaluation



Downstream Impacts

Discharge flows from the Drake Lift Station force main contribute to flows in the Central Interceptor. The Central Interceptor has been identified as a capacity limited prior to construction of the North and East Interceptors. Increasing flow through the Drake Pump station will contribute to deficiencies in the Central Interceptor and this interaction should be considered if the pump station capacity is increased in the near-term. Implementing a variable frequency drive (VFD) would reduce the downstream impact as peak dry flow is significantly less than peak wet weather flows at the lift station.

Alternate Service for Box Factory and KorPine

An alternative configuration where some or all the flow from the Box Factory and KorPine are conveyed under Highway 97 via a pipeline adjacent to Crux has been discussed as a potential alternative to Drake Lift Station upsizing.

Both the KorPine and Box Factory sites are downhill from the pipeline connection, with the highest point of the KorPine site approximately 5 to 10-feet lower than the invert of the pipe connection. Based on topography, a local pump station is required to convey enough of the flow from the site to significantly reduce future flows to the Drake Lift Station. There are also approximately six pipe segments in the downstream gravity system that exceed full flow capacity. These deficiencies would be in addition to capacity limitations downstream of the existing Drake Lift Station discharge in the Central Interceptor System. Considering pumping and gravity capacity improvements, the alternate service route is not recommended.

Force main Sizing

At greater than current firm capacity (780 gpm, 9 fps), a force main improvement is recommended. An 8-inch force main sizing results in a maximum velocity of 7.5 fps (build-out flow of 1,200 gpm). Utilizing VFD's allows for some flexibility in terms of achieving scouring velocity in a new force main.

Recommendation

To improve system condition and provide adequate capacity for the KorPine and Box Factory development, a new Drake Lift Station and force main are recommended. The firm capacity of the new pump station is recommended at approximately 1,200 gpm and the new force main is recommended at a minimum 8-inch diameter. These two development sites account for approximately 50 percent total future peak flow in the lift station service area. As a result, the timing of these projects is the main driver of lift station capacity deficiencies.

The existing pump station configuration includes an older wet well, and a newer dry pit with an additional back-up pump. There are limited options for retrofitting the existing pump configuration to improve capacity and reliability. The existing wet well limits flexibility of pump selection due to size constraints. Additionally, bypass pumping during construction may be challenging due to the multiple inflow conduits into the existing wet well.

A new wet pit and submersible pumps are recommended with VFDs. There is some space available on the existing site where a new wet well could be built utilizing either a duplex or triplex submersible pump configuration. If this alternative is used, the existing pump station can be used during construction and bypass pumping would only be required temporarily for final connection of the new wet well. In addition to simplification of bypass pumping, the inflow configuration of a new wet well reduces risk of sedimentation and ragging. The existing backup generator is likely sufficient even for larger pumps, however this would need further evaluation.