TECHNICAL MEMORANDUM

Executive Summary – West Point Flood Investigation *Findings Report*

PREPARED FOR: King County WTD

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DATE: March 7, 2017

This summary provides an update on circumstances and information known regarding the incident at the West Point Treatment Plan on February 9, 2017. Ongoing testing and data analysis continues to define the root cause(s); this summary will be updated as more information is gathered.

Timeline

On the morning of February 9, 2017, an intense wind and rain storm in Seattle produced an extremely high influent flow to the West Point Treatment Plant. Plant records show that at 2:12AM, electrical switchgear feeding two of four Effluent Pumping Station (EPS) pumps failed. The EPS is the final hydraulic element of the plant that delivers flow to the outfall, which is located 220 feet under Puget Sound. At the time, Pump 1 was in standby mode and Pumps 2, 3, and 4 were operating at full speed. Because Pumps 1 and 2 are fed from the electrical switchgear that opened, Pump 2 stopped and was not operational. Because Pumps 3 and 4 are fed from a different switchgear than Pumps 1 and 2, these were operational until 2:14AM, when they also failed due to high vibration.

The closely-coupled hydraulic elements of the treatment plant are protected by a series of float switches and hydraulically-actuated gates. When the EPS pumps fail, the system is designed such that an EPS wet well high-level float switch should prevent continued flow into secondary treatment. At 2:15AM, the EPS wet well float switch tripped, and gates automatically closed to stop primary effluent (PE) flow from the primary treatment tanks.

Primary treatment occurs at the front-end of the plant, and consists of two extremely large tanks meant to slow the velocity of the sewage; this allows solids to settle and scum to float. Under normal operation, the solids and scum are removed as the PE moves onto secondary treatment and then onto EPS. Similar to the EPS float switch, the primary treatment system has float switches designed to detect high wastewater levels. The float switches' safety circuit function is programmed to automatically stop the entry of wastewater into the plant from raw sewage pumps (RSPs). During this event, eight float switch circuits failed to engage, and the RSPs did not automatically shut-down. As a result, the two primary treatment tanks began to overtop at 2:25AM, causing extensive damage to components located in galleries beneath the tanks.

At 3:03AM operators manually stopped the RSPs, and the level in the influent control structure (ICS) upstream of the pumps began to rise. At 3:04AM the ICS float switches performed their intended function and caused the emergency bypass (EB) gate to open, which allowed flow to automatically bypass the plant and divert into the emergency marine outfall. At 3:05AM the level in the primary tanks began to subside and fell below the overflow point, stopping the flooding of the facility.

Once the decision was made to stop the RSPs, the by-pass mode was achieved in 12 minutes (3:15AM). This resulted in over 180 million gallons of untreated stormwater mixed, with small amounts of sewage, to be discharged into Puget Sound through the emergency marine outfall.

Preliminary Root Cause Observations

Between 2:12AM and 3:15AM, operators were focused on three primary goals: protecting onsite crew located throughout the facility; responding to 2,155 alarms to keep the facility operational; and mitigating by-passing untreated discharges to Puget Sound as long as possible.

Three minutes passed between when electrical failure occurred in the EPS, and when PE flow automatically stopped leaving the primary treatment system. Ten minutes passed between when PE flow was prevented from leaving the primary treatment system, and when the primary tanks first started to overflow. Based on information known at this time, these first 13 minutes of this event (between 2:12AM and 2:25AM) were a critical time period that resulted in extensive damage to the underground electrical and mechanical components of the plant.

Tests and data analysis are ongoing to determine the root cause of the electrical failure that precipitated the loss of power to EPS Pumps 1 and 2. We do know that EPS Pumps 1 and 2 failed because their hydraulically-actuated discharge control valves lost their power. Although Pumps 3 and 4 had power, their discharge valves did not, and could not be opened. To mitigate the potential for a by-pass event, the operators repeatedly tried to bring EPS Pumps 3 and 4 back online following the 2:12AM power failure, to no avail. Operators reacted to place the RSPs under manual control within two minutes (at 2:14AM).

Upstream from the EPS pumps, the failure of the primary treatment float switches is believed to be due to bending of the float support rods. There are two float switches in each of the two primary tanks. The float is a 4-1/2 inch stainless steel ball that is supported by a rod that travels within a guide tube. The entire assembly is mounted within a 6-inch pipe, which acts as a stilling well. The floats are set to actuate the safety circuit when the level in the tanks rises to an elevation of 1-foot below the overflow point.

These floats, although wired into the plant's Distributed Control System (DCS) for alarming purposes, act completely independently of the DCS using hard wired relays. These safety circuits are supplied with 125-VDC battery back-up power. When examined post-event, the float rods were observed to have been bent to such a degree that the 4-1/2 inch ball would have been in contact with the inner surface of the 6-inch stilling well; this would cause friction on the float and between the rod and guide tube. It appears that this impingement inhibited free travel of the float, which then caused the safety circuit to fail. This appears to be the reason that the RSPs did not stop pumping, even though the level was rising in the primary treatment tanks.

The following report provides more detail into the forensics of this incident, and will be updated as testing and data analysis concludes.