

Kearl Drainage Pond 4 (DP4) Overflow – Investigation Results

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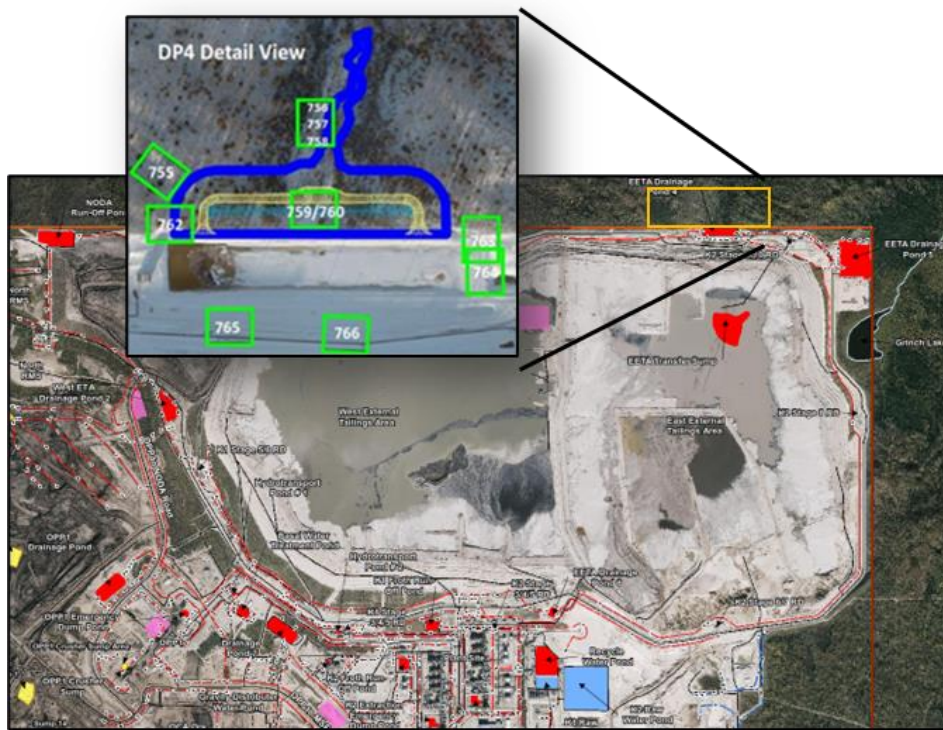
Background

Imperial’s Kearl asset utilizes a system of ditches and ponds to collect process affected water from various on lease sources, including surface water runoff and the External Tailings Area (ETA) dyke drain system. Water from these ditch systems collects in drainage ponds, where it is pumped back into on-lease infrastructure, such as the ETA, for storage and use in production processes.

Drainage Pond 4 (DP4) is one of these collection ponds. It collects process affected water from the Kearl lease area via the interconnected closed ditch system and is designed to manage those fluids by recycling them back to the ETA.

Between January 30th and January 31st, 2023, an estimated 5300m3 of water flowed through the spillway of DP4. The pond is situated on the North lease boundary for Kearl and consequently the released fluids flowed to both on and off lease areas following the natural topography of the area. The release was discovered on February 4th when impacted snow was observed, indicating that fluids had overflowed the pond via the existing overflow spillway and flowed north towards the Kearl lease boundary.

An investigation team was assembled consisting of technical, operations, and maintenance functional representatives to identify root causes of the overflow, and to ensure mitigations are put in place for DP4 and other ponds in the water collection system.



DP4 Release Area

Investigation Findings

The DP4 overflow Root Cause Failure Analysis (RCFA) identified several causes that contributed to this event including level reliability and understanding, pond operation, pond design, risk identification and management, and human performance.

Level Reliability and Understanding

Level instrumentation in the DP4 wet well remotely indicates pond level to the control room. The Level system is impacted by several factors; it relies on sediment levels remaining below design, scaling is not correlated with pond elevation, and sediment causes a rapid level rise resulting in very short start-stop intervals, which also affects pump reliability. These factors contributed to loss of confidence in the level reading with the control room operators.

System Operated in Manual Mode

DP4 is designed to operate with automatic pump control logic for level control, allowing either automatic or manual mode to start the level control pump. At the time of the event, DP4 was operating in manual level control.

Factors contributing to manual operation include:

- Lack of confidence in level reading
- Additional winter operation impacts (pond ice, line draining, freeze protection)
- Motor Operated Drain Valve reliability (required to operate in conjunction with the level control pump)
- Higher setpoints to protect pump reliability

Sediment Accumulation

The design of DP4 was to maintain sediment levels below a height of 0.5m. Sources of sediment include natural erosion of the East ETA slopes and tailings pipeline discharge. Progressive accumulation of sediment has led to higher sediment levels, impacting level reliability (as noted above) and pump reliability, causing control room operators to increase the operating level in the pond.

DP4 was dredged twice to remove sediment, however past dredging was shown to be inefficient and there was a decision made to pause dredging in 2022 to evaluate more effective options.

Risk Identification and Management

In 2019, a risk assessment was completed that assessed the risk of overflowing drainage ponds at the lease boundary. The risk scenario identified multiple initiating events including; weather, equipment failure, procedural. The risk assessment process relies on the experience of the team to identify potential outcomes. The risk assessment concluded the risk was driven by a 1-in-100 year storm event.

It is evident the 1-in-100 year storm risk was the primary focus for risk management.

Pond Design

DP4 was constructed with an overflow spillway to manage volumes and protect the pond structure in the event of a 1-in-100 year storm. The area topography, spillway orientation and pond proximity to the lease boundary results in wastewater reaching off lease if the pond height reaches the spillway.

An Operating, Maintenance, and Surveillance manual was published in 2014 and most recently updated in 2017 based on the designed operation of the pond. The manual was not sufficiently integrated into Imperial's operations integrity management systems (OIMS).

People (Human Performance)

The reliance on field operator surveillance and manual intervention (i.e. operating in manual) increased over time. In the few days prior to the level reaching the spillway, environmental factors such as the surface of the pond being covered with snow and ice, snow build-up around the spillway, and low lighting at night made it difficult to verify level.

Solutions to Prevent Recurrence

Instrumentation:

Given the design discrepancy between the level instrumentation in the DP4 wet well and the elevation of the engineered spillway, level indication has been re-scaled to manage the difference.

Alarms:

To better alert control room operators of elevated pond levels, a high-high-level critical alarm has been added to the control panel for DP4.

Automatic Pump Operation

Operation of the DP4 level control pumps has been changed from Manual to Automatic, eliminating the need for control room operators to start the level control pumps.

Surveillance and Monitoring:

Operator surveillance rounds have been updated for the ponds.

Pond level readings and trends have been added to regular engineering surveillance processes for tracking and reporting.

The Operating, Maintenance and Surveillance Manual will be updated and integrated into Imperial's OIMS.

Human Performance

Training has been and will continue to be provided to Operations personnel including a discussion of the overflow risk and consequence, and expectations for surveillance rounds.

Imperial will be following its internal progressive discipline process.

Sediment Removal and Mitigation

A dredging program is planned to start in Spring 2023 to remove sediment from DP4.

Mitigations to prevent sediment build-up in DP4 is being considered for implementation.

Risk Assessment and Risk Management Process

Risk assessments are being updated for each drainage pond to consider efficacy of mitigations in place, including design, operation, and reliability.

Imperial's risk assessment worksheet will be updated to consider the reliability, effectiveness, and history of safeguard / mitigations in the assessment process.

Spillway Design

Alternate spillway designs are being assessed for DP4.