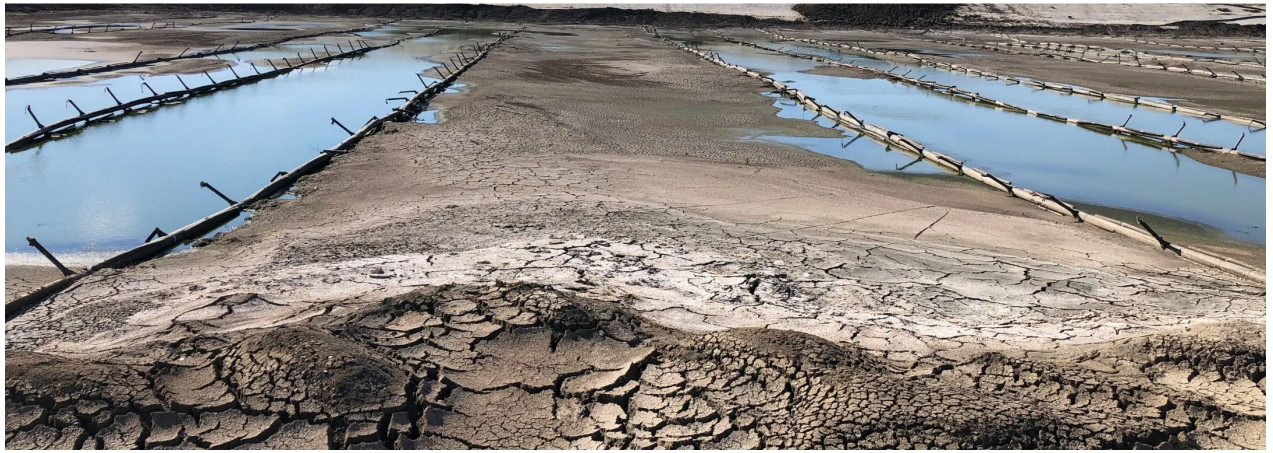


Regina Wastewater Treatment Plant

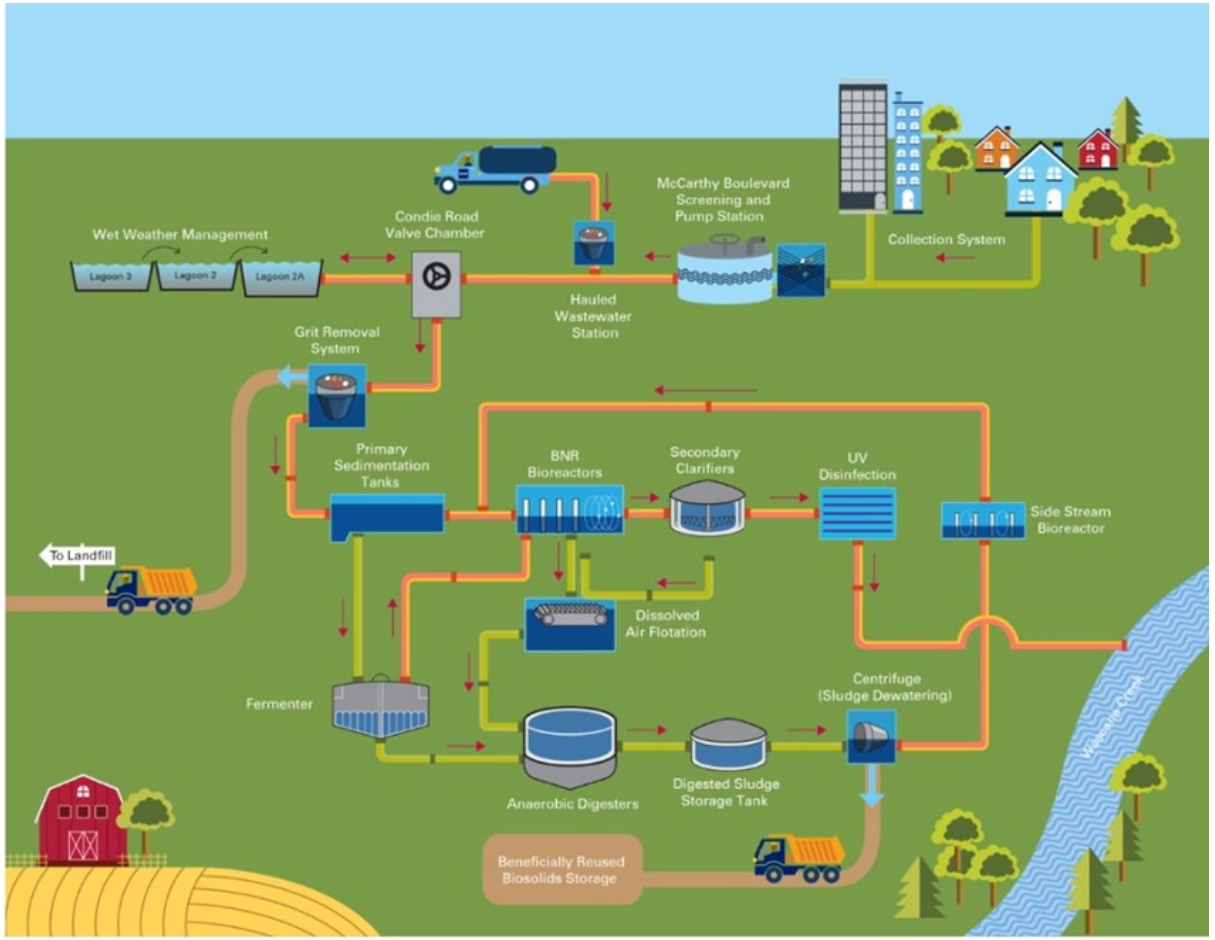
Clean-up of a Hydrocarbon Spill at a WWTP

EPCOR: Alec Mackenzie, P.Eng.

November 2023

Regina WWTP System

System Overview



The Event

Emergency Response

- May 22, 2020: the City of Regina's operators called to inform that they were seeing tar in the influent and to be alert as it was on its way to the WWTP through the 5km forcemain.

May 22 & 23, 2020

- EPCOR Operators reduced the flow to the WWTP to limit the impact. The remainder of the raw wastewater was diverted to Cell 2A.
- Throughout the morning the impacts of the contamination started to become clear:
    - Testing throughout the plant and effluent resulted in cause for alarm
    - Bioreactors began to foam significantly
    - Flow to the digesters was reduced to prevent further contamination and foaming
    - All flow was diverted to the lagoons
    - One bioreactor was isolated to preserve any good bacteria
- The City contract representative and Water Security Agency were notified. The City contacted the industrial user.

Cell 2A

- Cell 2A is used as the primary wet weather storage cell the WWTP.
- Existing aeration system from the lagoon-based treatment plant is still in place and used to maintain aerobic conditions as needed.
- Was part of the old WWTP aerated cell configuration.
- Cell 2A had approximately 33,000 m^3 of sludge prior to the event (important issue for later on).

The Oil Slick

- May 22 & 23, 2022 – Impacts seen on Cell 2A

The Initial Clean-up Attempts

Initial Cleanup Attempt

- May 22 – 29, 2022 – attempted to clean using Hydrovac

Need to Review Additional Solutions

- Associated was contacted in May to provide an environmental assessment and further remediation recommendations as to how to clean the contaminated sludges and mitigate the other damages that were possibly caused by the incident.

Investigation and Options

Initial Steps

- AE conducted a visual assessment in June.
- It was observed that the oil was seen on the surface, floating within the water column and settling on the sludge.
- Water and sludge samples were collected to assess the general concentrations as a starting point.
- Initial results showed F2 – F4 concentrations in the sludge ranged from 20,000 mg/kg to 40,000 mg/kg
- F1 fraction was minimal – very heavy hydrocarbon chain

Step 1 - Dewatering

- Water column held very little oil
- Majority found in sludge
- Decision to pump Cell 2A dry – oil boom used and floated around the intake
- Attempt to dry sludge

Oops - Sludge did not dewater

- Track hoe was used to remove the surficial sludge and pile it onto the bank.
- Dried contaminated sludge would then be transported to the designated disposal facility.
- The approach did not work out as:
  - Sludge was too moist to be able to stay on the bank.
  - The natural drying process did not work as efficiently as expected.
  - Did not have sufficient temporary storage space onsite for the estimated quantity.
  - Delays caused by rainy weather.

Step 2 - Freeze and Scrape

- Ultimate solution was to let the sludge freeze and remove the top 300 mm.
- Frozen sludge allowed for heavy equipment use
- Hope for a late spring

Analytical

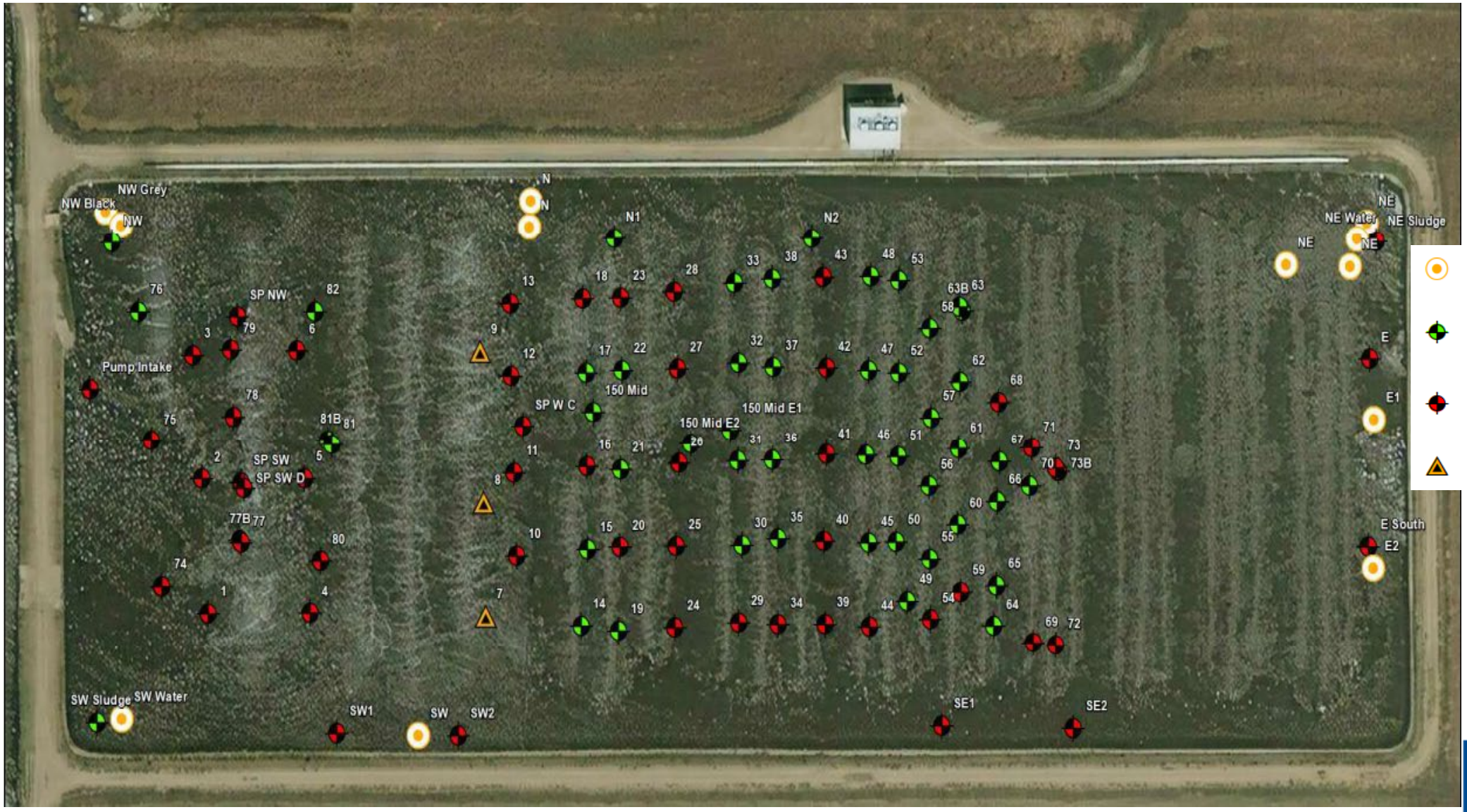
Depth of Oil

- A trackhoe was used to collect samples in a grid pattern to determine the extent of the hydrocarbon impacts.
- Confirmatory samples were collected from the most affected areas (east and southwest side) at different depths to try and delineate how deep the oil might have penetrated into the organic sludge.
    - Collected from the top 50mm, medium 100-150mm and the bottom 300mm
    - The results confirmed the decreasing of the concentration by depth, which provided an indication of roughly 300mm of surficial materials were contaminated.
    - With some areas that had shallower water level, a potential of deeper contamination was observed.
- Further confirmatory samples were collected from the central area when the sludge bed was more solidified.

Cut-off Objective Determined

- Based on the concentration trends developed during the initial confirmatory sampling program, it was determined that a reasonable total PHC (C_6-C_{50}) concentration of 5,000mg/kg was used as a cut-off objective for determining the depth of the excavation program.
- The determination of the cut-off concentration is also based on the sludge samples collected from other old aeration Cells and the literature reviews of the carbon content within the organic sludges of this type.
- In addition, it was deemed as a reasonable concentration based on the review of the current land use and receptors in comparison with the Saskatchewan Environmental Quality Guidelines.
- In order to confirm the vertical depth of potential contamination and ensure that the contaminated sludge was removed as much as possible to the depth of the original sludge bed, 82 sludge samples (included duplicates) were collected during the removal excavation.

Sample Locations



General Logistic Issues

Could not just dig all the sludge out

- Only sludges that were confirmed to be contaminated through this event would be removed for final disposal.
- Sludges deemed not impacted would remain in Cell 2A
- Had an independent consultant collecting samples to confirm process.
- No concerns over approach used was raised by the independent consultant.

Mother Nature

- Weather
  - Major thunderstorms and power failure in July and August affected the normal plant operation which resulted in adding additional volume to Cell 2A while dewatering. These issues created the need for additional dewatering time.
  - Early spring thaw: by late March it was determined that the soft cell bottom conditions made it nearly impossible to move equipment around the cell and effectively remove any further materials.

Integrity of Lagoon

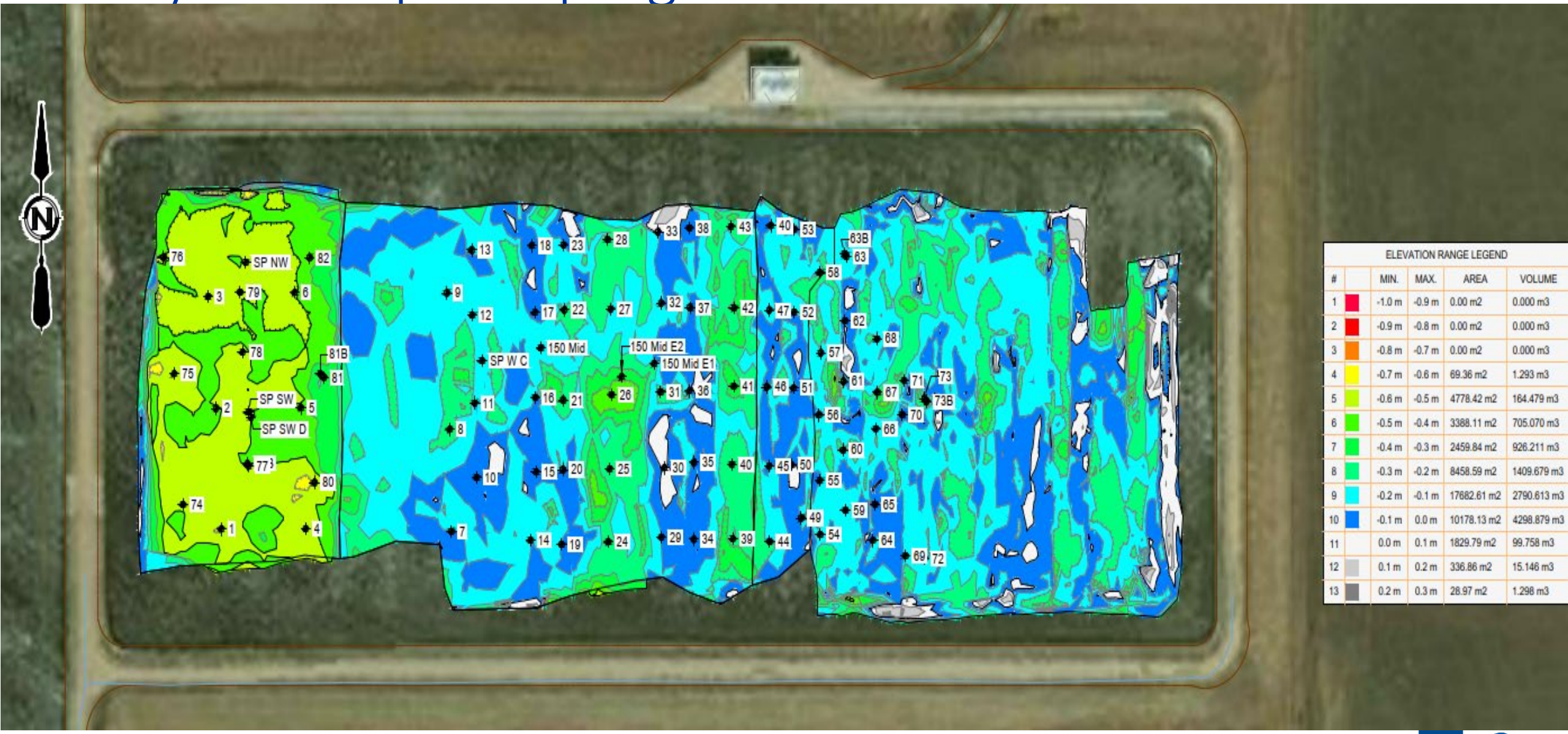
- Maintaining the integrity of the clay lined bottom was critical
- The excavation depth – only to the point where PHC concentrations reached an acceptable level.
- Excavation between the aeration lines – made excavation more difficult in some areas. Some in-situ materials were left under the aeration lines.

Remediation

Survey for Volume Removed

- Based on Cell 2A's dimensions and actual excavation extents approximately 56,000 m^2 of the initial impacted footprint area of 68,000 m^2 was removed. This equated to over 80% of the initial area being remediated.
- A progress survey was conducted in the excavation approximately twice a week to verify volume removed and to compare with material weighed at the disposal facilities.
- By late March 2021, it was determined that the soft cell bottom condition made it nearly impossible to move the equipment around the cell and effectively remove any additional sludge at the remaining eastern portion of Cell 2A, leaving an estimated 2,000m^3 of contaminated sludge in place.
- Total 44,800m^3 of material was removed and disposed of (96% of contaminated sludge).

Survey – example of progress



ELEVATION RANGE LEGEND					
#		MIN.	MAX.	AREA	VOLUME
1		-1.0 m	-0.9 m	0.00 m2	0.000 m3
2		-0.9 m	-0.8 m	0.00 m2	0.000 m3
3		-0.8 m	-0.7 m	0.00 m2	0.000 m3
4		-0.7 m	-0.6 m	69.36 m2	1.293 m3
5		-0.6 m	-0.5 m	4778.42 m2	164.479 m3
6		-0.5 m	-0.4 m	3388.11 m2	705.070 m3
7		-0.4 m	-0.3 m	2459.84 m2	926.211 m3
8		-0.3 m	-0.2 m	8458.59 m2	1409.679 m3
9		-0.2 m	-0.1 m	17682.61 m2	2790.613 m3
10		-0.1 m	0.0 m	10178.13 m2	4298.879 m3
11		0.0 m	0.1 m	1829.79 m2	99.758 m3
12		0.1 m	0.2 m	336.86 m2	15.146 m3
13		0.2 m	0.3 m	28.97 m2	1.298 m3

Final Comments

- The clean up took 9 months (from initial event to final cleanup).
- The City was pleased with the effort and supported the approach.
- The City worked with the party who discharged the oil.
- Source control issues in the City have since improved.
- EPCOR and the City have a better linkage with each other and downstream user needs. New contact protocols are now in place.


EPCOR
QUESTIONS?

Approval of Disposal Sites

- Lab analyses of the sludge was provided to determine if the proposed disposal facilities (industrial landfills) were permitted to accept this material.

- Water Security Agency and Ministry of Environment were informed about the situation and process. No concerns were raised about the approaches that had been taken place.