

Spills from the Oil and Gas Industry in Saskatchewan

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Summary

In Western Canada, several thousand oil and high-salinity wastewater spills have been recorded. These spills have occurred both at the well sites and from pipelines. These incidents pose threats to groundwater sources and constitute a risk for ecosystems and public health.

Here, an exploratory quantitative multivariate analysis using the publicly available spills dataset derived from Saskatchewan Ministry of Energy and Resources is conducted.

The long-term goal study will provide deeper insights into the legacy impacts to soils and groundwaters, effectiveness of existing remediation efforts, and the strength of the regulatory regimes in SK.

Workflow

This research seeks to identify cause-effect relationships associated with oilfield spills in Saskatchewan. This is achieved through a time series analysis of spill data for the period of 1990 to 2019, in order to map relevant input/output variables including location, source, volume etc. Analysis will be conducted on a large-scale data set developed and provided by Saskatchewan Ministry of Energy and Resources. The dataset documents the number of spills and leaks, occurrence date, spill location information, spilled and recovered volumes, spill type, pathways involved, and underlying causal factors. The data was compiled to enable trend analysis using descriptive statistics, examine spill rates, and identify the most prominent pathways to support development of robust monitoring and mitigation strategies.

Preliminary Results

Since 1990, there have been 20,736 incidents reported to Energy and Resources totalling 19,115,012.57 m³ substances, of which 319,866.282 m³ were recovered. This includes 91,819 m³ of crude oil and 316,771.17 m³ of produced water. Water bodies were impacted 793 times.

Assessing brine spill data from 1990 through 2019, the median volume for yearly reported pipeline spills (5,693m³) is larger than the median for facility related spills (2,444 m³) and well spills (2,003 m³). As for crude oil, the largest median for yearly volumes is recorded for facility induced spills (1014,9 m³), followed by well spills (976.6 m³) and pipeline spills (504.4 m³).

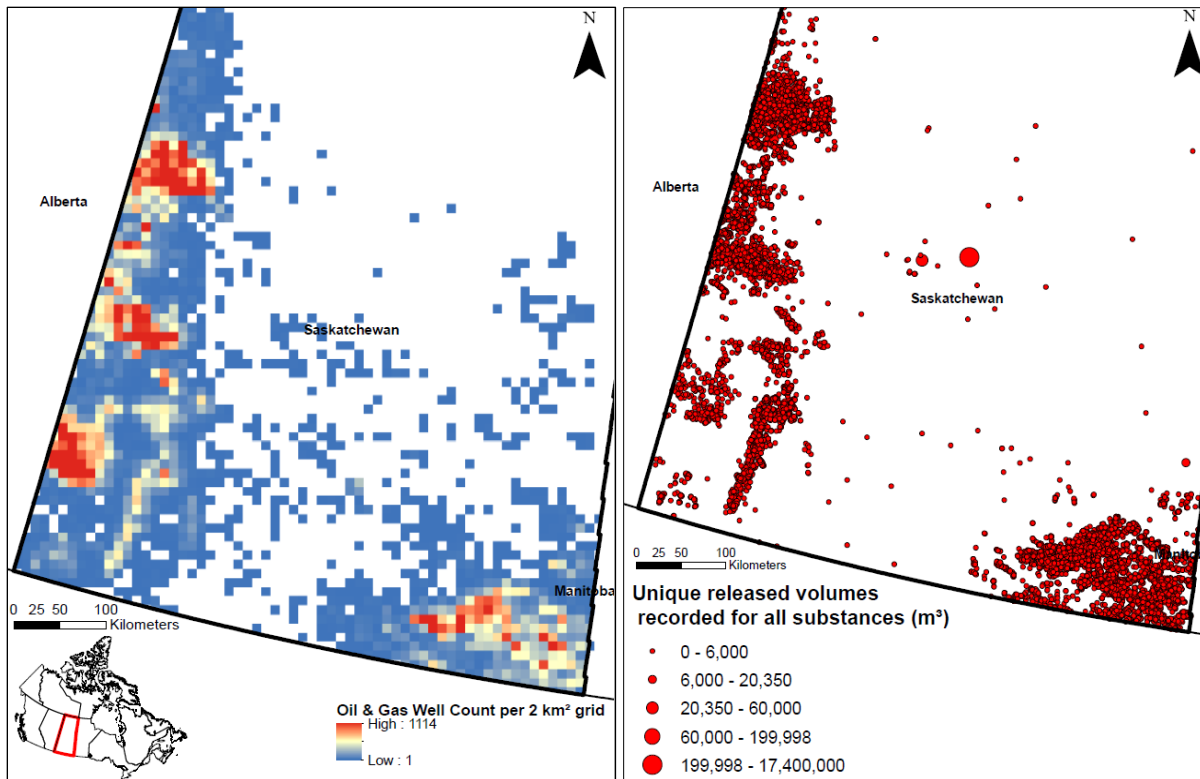


Figure 1: Oil & Gas well density and incident distribution in Saskatchewan

Analysis of the ~12,937 documented brine spills shows that they had reported unique records ranging from 0.001 to 5,075 m³ during the study period. The reported volumes are low compared to the large quantities of produced and injected waters which experienced a sharp increase in the past two decades. As of 1990, 724,770,427.8 m³ of wastewater was produced and 836,361,294.4 m³ of produced water was injected across the province.

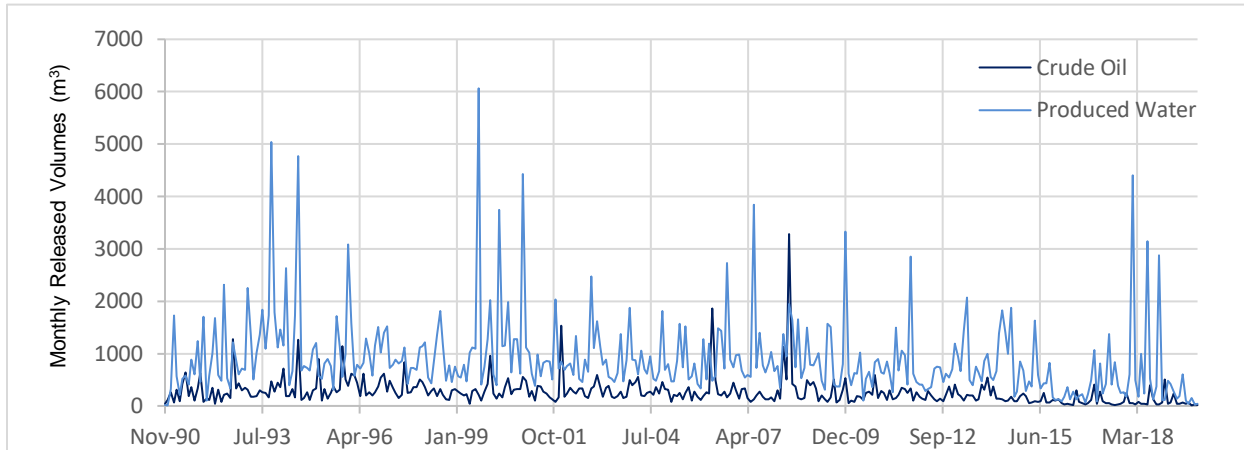


Figure 2: Monthly spilled produced water and crude oil volumes from 1990 to 2019

Figure 2 reveals that, throughout the study period, monthly brine spill volumes show a downward trend in the peaks and a positively skewed time series. As for crude oil, monthly spilled volumes are relatively low, peaked in June 2008 and decreased in the recent period.

The period with the most incidents was 2006-2015, with numbers ranging between 1500 and 1550 incidents and the number of incidents has decreased since that time. The frequency of incidents since 1990 coincides with an increase in the level of production.

The spill/leak distribution map (Figure 1) geolocates all the incidents that occurred from 1990 through 2019. Areas of west central SK where surficial sands are present are more vulnerable to groundwater contamination. Other areas might be of less concern because underlying aquifers are protected by glacial till aquitards.

Conclusions and Future Work

Preliminary analyses indicated that substantial amounts of oil and brines have been spilled in Saskatchewan. The extent of legacy impacts to soils and groundwater are currently unclear. There appears to be no decrease in the rate of spills, suggesting that this will continue to be an issue into the future.

To develop a full picture of oilfield spills in Saskatchewan:

- Look at individual variables in more details (Set the focus on specific types of wells such as injection wells and volumes of injected wastewater)
- Correlate that with spilled brine volumes and brine spill count

- Merge the incidents dataset to the Oil & Gas well dataset by identifying the nearest wells to the spill and identify the producing formations and modes in which the well was operating when the incident occurred.
- Look at the drilling patterns and assess whether oilfield spills increase simply due to the increase in drilling or due to the unconventional development of the Bakken formation.
- Assess the changes in regulations for how spills are reported in Saskatchewan and how that shaped the data collected.

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