CASE STUDY

1950's Wellsite Remediation

Introduction

The subject site is a wellsite drilled in the late 1950's to a depth of approximately 3,700 metres below ground surface (mbgs) and re-entered in the 1960's to approximately 4,800 mbgs. The well produced condensate, gas, and water and was later used as an injection well. A Phase 1 Environmental Site Assessment (ESA) identified a flare pit, above ground infrastructure, and drilling waste disposal areas (DWDAs) as Areas of Potential Environmental Concern (APECs). Three Phase 2 ESAs identified petroleum hydrocarbons, polycyclic aromatic hydrocarbons, and metals as Contaminants of Potential Concern (CoPCs).

Problem

Old well sites are known to frequently be highly contaminated and expensive to clean up. The example site had a flare pit, two drilling waste disposal areas and several other pits were discovered that were impacted with petroleum hydrocarbons (PHCs), polycyclic aromatic hydrocarbons (PAHs), and metals above Tier 1 guidelines. The total volume of soil recommended for remediation to meet guidelines was >16,000 m^3 and a large volume of that soil did not meet Class II landfill criteria resulting in elevated anticipated costs for transportation and disposal.

Methodology

A mix of Tier 1 and Tier 2 guidelines were identified as appropriate for the site. The domestic use aquifer was excluded for benzene, toluene, ethylbenzene, and xylenes (collectively referred to as BTEX) and the ecological direct soil contact pathway was excluded for petroleum hydrocarbon fractions F1 to F4. The remediation was conducted in two phases: the first addressing the flare pit and northeast DWDA and the second addressing the southwest DWDA.

Solution & Implementation

During the first phase of the remediation, lower-level impacted soils from the DWDA were identified through field screening and laboratory analysis for confirmation and segregated from more highly impacted soils. Low level impacted soils were treated on site with a Reterra soil recycler which pulverizes and homogenizes soils enhancing natural attention and degradation. More highly impacted soils and soils with identified metals concentrations greater than applicable guidelines were hauled to a nearby landfill for disposal.

In the second phase of the remediation program the drilling waste disposal area in the southwest portion of the lease was remediated. This southwest DWDA had soils with high concentrations of BTEX and petroleum hydrocarbon fractions F1 to F4 and soils analyzed for landfill criteria failed to meet the standards for disposal at a Class II landfill. As the costs for disposal and the distance for hauling to a Class I landfill were considerably higher than a Class II landfill, all soils were treated on site with the Reterra soil recycler until they met Class II landfill criteria. Approximately 8,800 m^3 of soils were treated to meet Class II criteria resulting in a significant cost savings. Further, the soils treated by the Reterra from the first phase of the remediation project were confirmed by laboratory analysis to meet Tier 2 guidelines at depths below 3.0 m and were used as backfill for the southwest DWDA resulting in savings for disposal, backfill and hauling.

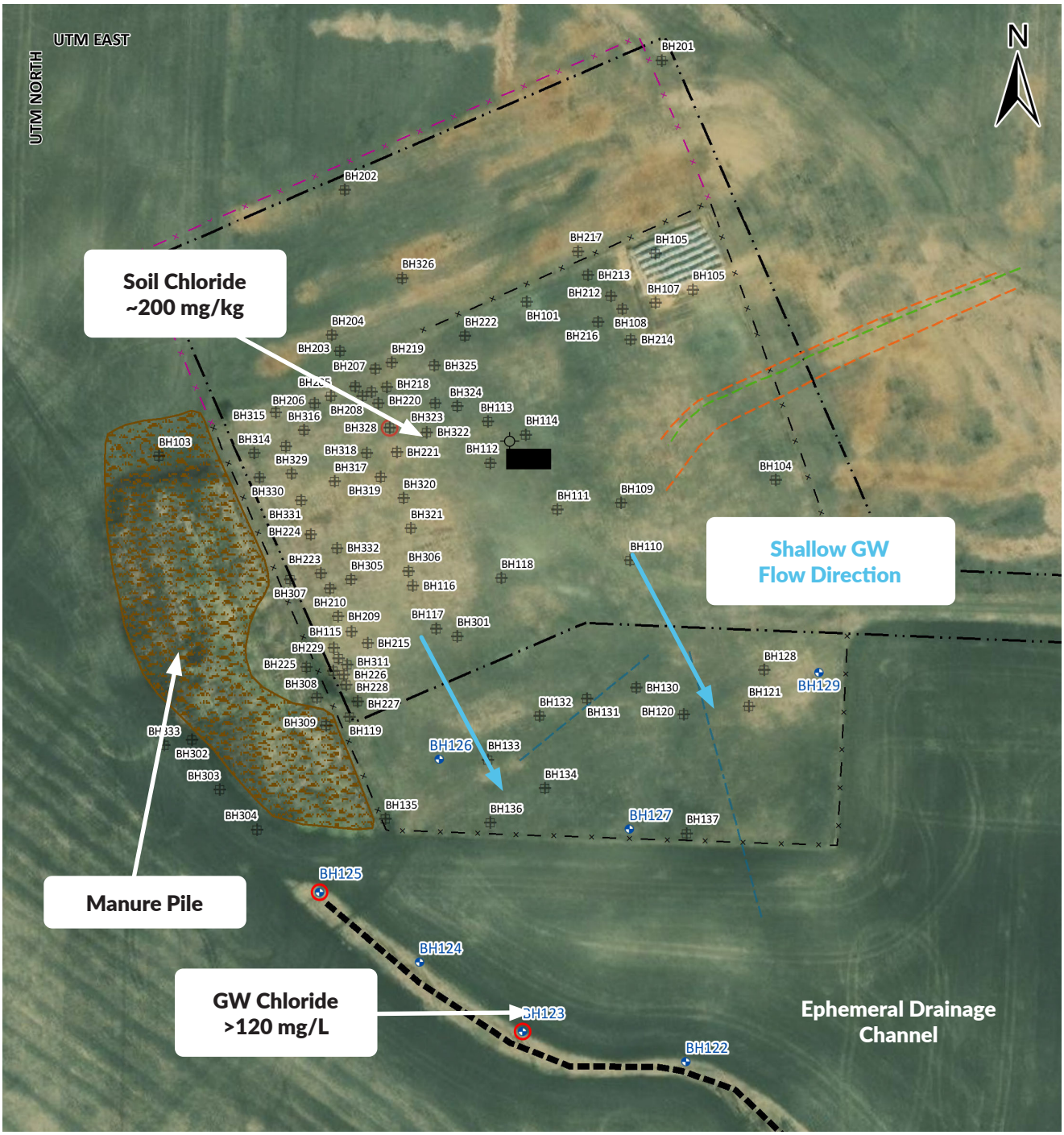
Results & Discussion

After the two phases of remediation soils at the site were shown to meet all applicable guidelines however, the Alberta Energy Regulator (AER) returned the Record of Site Condition (ROSC) with concerns regarding slightly elevated chloride in shallow groundwater. A small number of groundwater monitoring wells had chloride concentrations of up to 400 mg/L observed during monitoring events from 2018 to 2023. As chloride was generally not observed in soils during the three Phase 2 ESAs (with one minor exception) it was not considered a CoPC for the site. The exception was one sample from a borehole that had a soil chloride concentration of approximately 200 mg/kg at 1.5 to 2.5 m. The only other potential source of chloride at the site was a large manure pile along the west side of the lease that had been present (and growing) for >10 years.

A threefold approach was taken to show the AER that the elevated chloride was not a result of historical oil and gas activities at the site. First, groundwater parameters (i.e., depth, velocity, direction) and chemistry trends showed that there was no trend in chloride concentrations as would be expected from a salinity plume originating from the site. The impacted monitoring wells were at the south portion of the site downgradient from the manure pile. Second, multiple samples were obtained from the manure pile and analysis confirmed that chloride concentrations of up to approximately 400 mg/kg were present indicating the manure was the likely source of the elevated chloride. Lastly, preliminary Tier 2 groundwater guidelines were calculated using the Subsoil Salinity Tool (SST) and all historical groundwater chloride concentrations were less than the calculated guideline indicating no risk to the groundwater receptors at the site. Our approach proved successful, and the AER approved the ROSC and the site has moved on to reclamation and closure.

In Summary:

- 2,500 m^3 impacted soil to Class II landfill.
- 5,100 m^3 low level impacted soil remediated on site and used as backfill.
- 8,800 m^3 highly impacted soil treated on site to meet Class II landfill criteria and hauled to landfill.
- Additional data showed the minor elevated chloride observed in a small number of shallow groundwater wells was not associated with historical oil and gas activities at the site.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UTM NORTH
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Soil Chloride
~200 mg/kg
Shallow GW
Flow Direction
Manure Pile
GW Chloride
>120 mg/L
Ephemeral Drainage
Channel
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BH202
BH326
BH217
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