Case Studies

Rapid Soil Analysis System
(RSAS)

Maapera Analytics Inc.

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Maapera Analytics Case Studies

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1. Introduction

Maapera Analytics (Maapera) has developed innovative data products for the environmental industry by combining reflectance spectroscopy with machine learning and automated data visualization. Our flagship product is a rapid soil analysis system (RSAS) that measures soil petroleum hydrocarbons, soil texture, and soil water content using reflectance spectroscopy. RSAS delivers magnitudes more data than methods that rely on wet extraction analyses from a laboratory and delivers them in minutes rather than days.

Maapera has taken the next step by automating data management and the creation of figures such as borehole logs and 3D site models. The high data volumes possible via reflectance spectroscopy can be managed efficiently in a data pipeline that leads to the creation of all the 2D and 3D figures needed in your report with the click of a mouse.

2. Overall Build in Canada Innovation Program Results

Maapera's RSAS technology has been tested successfully in numerous operational environments. This includes environmental site assessments (ESAs) in upstream and down-stream oil & gas sites, phase III excavations, and ESAs on properties administered by the federal government.

From September 2017 to March 2018, Maapera Analytics completed 15 projects for the Federal Government as part of a Build in Canada Innovation Program. Each of these sites had 15 samples collected and analyzed using Maapera's technology along with conventional laboratory methods for comparison.

The CCME (2016a) provides guidance for the evaluation of emerging field analytical methods for soil. Results from alternative field analytical methods must show a strong correlation with laboratory testing results. The number of paired samples needs to be sufficient to satisfy rigorous statistical analysis.

A comparison of RSAS and standard wet extraction results using leave-one-out cross-validation methods show the model had a strong ability to predict PHC levels, with R^2 values of: 97%, 98%, 99%, 98% for F1, F2, F3 and F4 PHCs, respectively. Assessment of the incremental improvement to the analytical results of the RSAS by each addition of a site-specific calibration sample shows the model stops improving after the addition 8-10 samples. This is well below CCME's suggestion of 15 site-specific calibration samples.

Figures illustrating the correlation between RSAS results and standard wet extraction results are provided below.

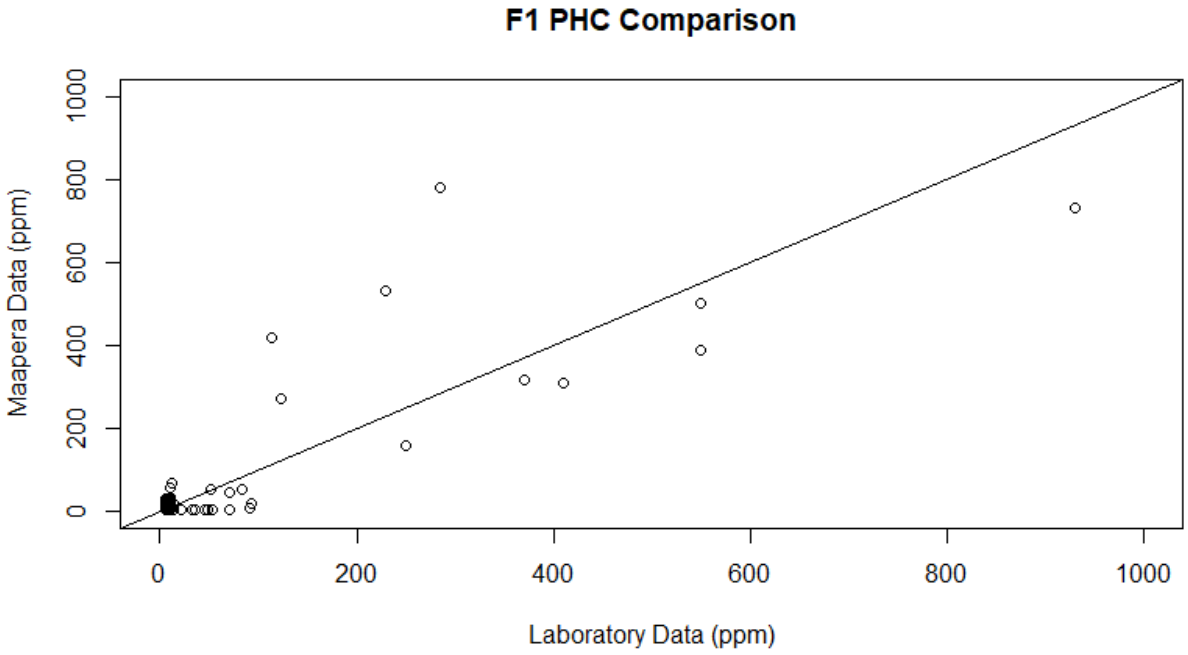

Figure 1. Predicted versus observed results for F1 Petroleum Hydrocarbon data obtained during the Build in Canada Innovation Program.

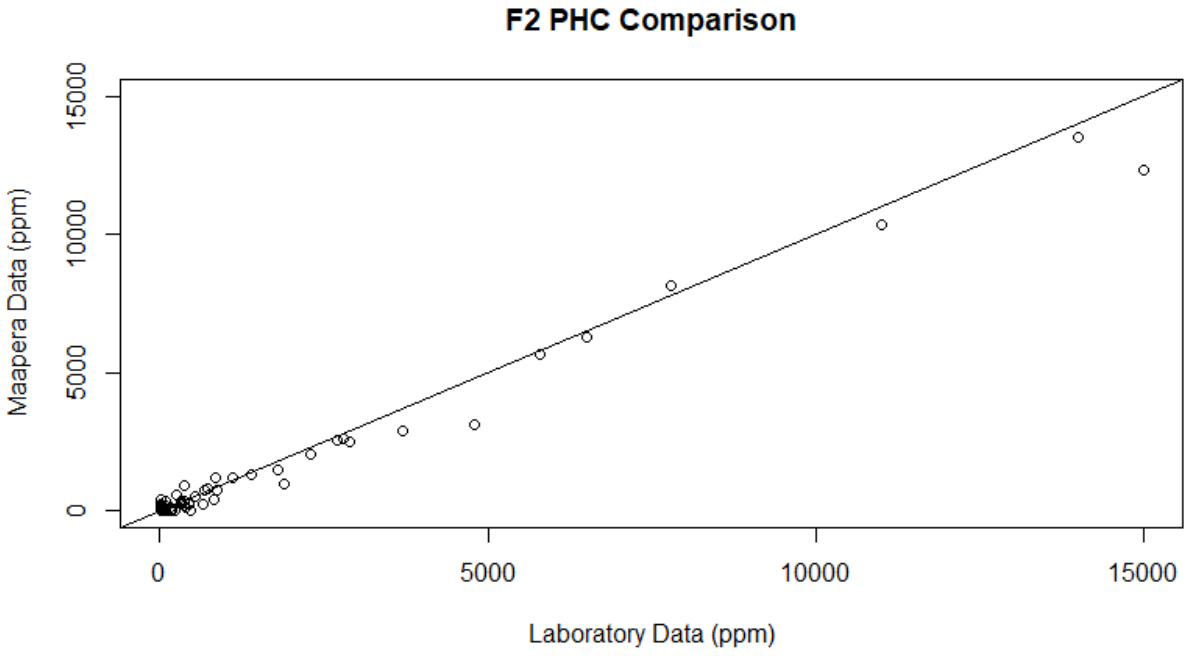

Figure 2. Predicted versus observed results for F2 Petroleum Hydrocarbon data obtained during the Build in Canada Innovation Program.

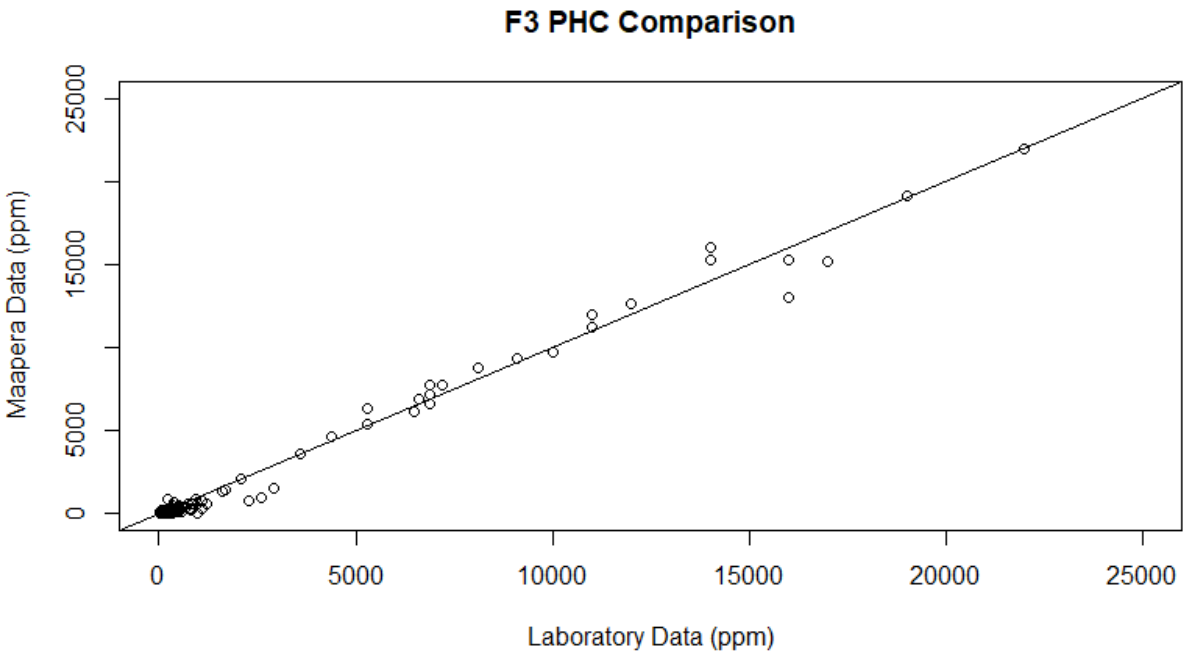

Figure 3. Predicted versus observed results for F3 Petroleum Hydrocarbon data obtained during the Build in Canada Innovation Program.

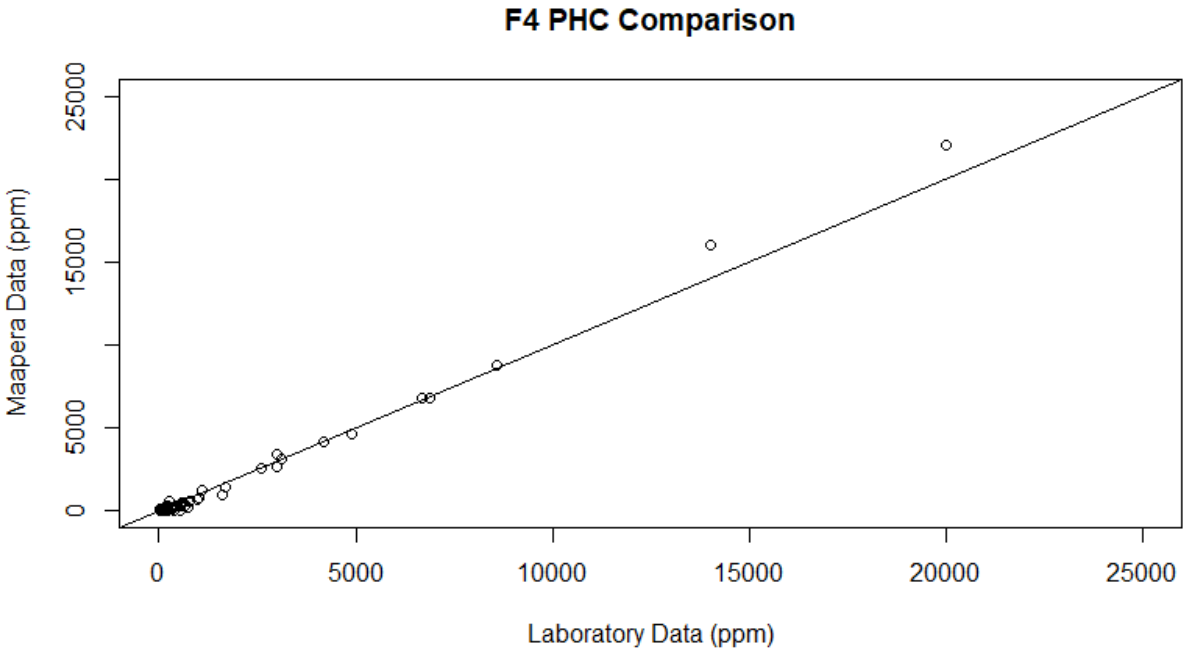

Figure 4. Predicted versus observed results for F4 Petroleum Hydrocarbon data obtained during the Build in Canada Innovation Program.

Table 1. Model Performance by Hydrocarbon Fraction for Build in Canada Innovation Program

PHC Fraction	R2	Ratio of Performance to Deviation[1]
F1	0.97	6.1
F2	0.98	7.0
F3	0.99	11.8
F4	0.98	8.5

[1] Values above 2 indicate good predictive capability

3. Surface contamination investigation

As part of projects with the Federal Government, Maapera Analytics completed a surface audit of a diesel fuel storage facility at a remote site. Field analysis encompassed 148 sample locations and focused of two main areas-of-concern. RSAS results delineated the extent of the impact around the refueling area (I) and cleared the auxiliary area (II) of impacts. Field work for this assessment was completed in four hours. The environmental coordinator for this jurisdiction used the results of this investigation in a funding application to manage the impacts.

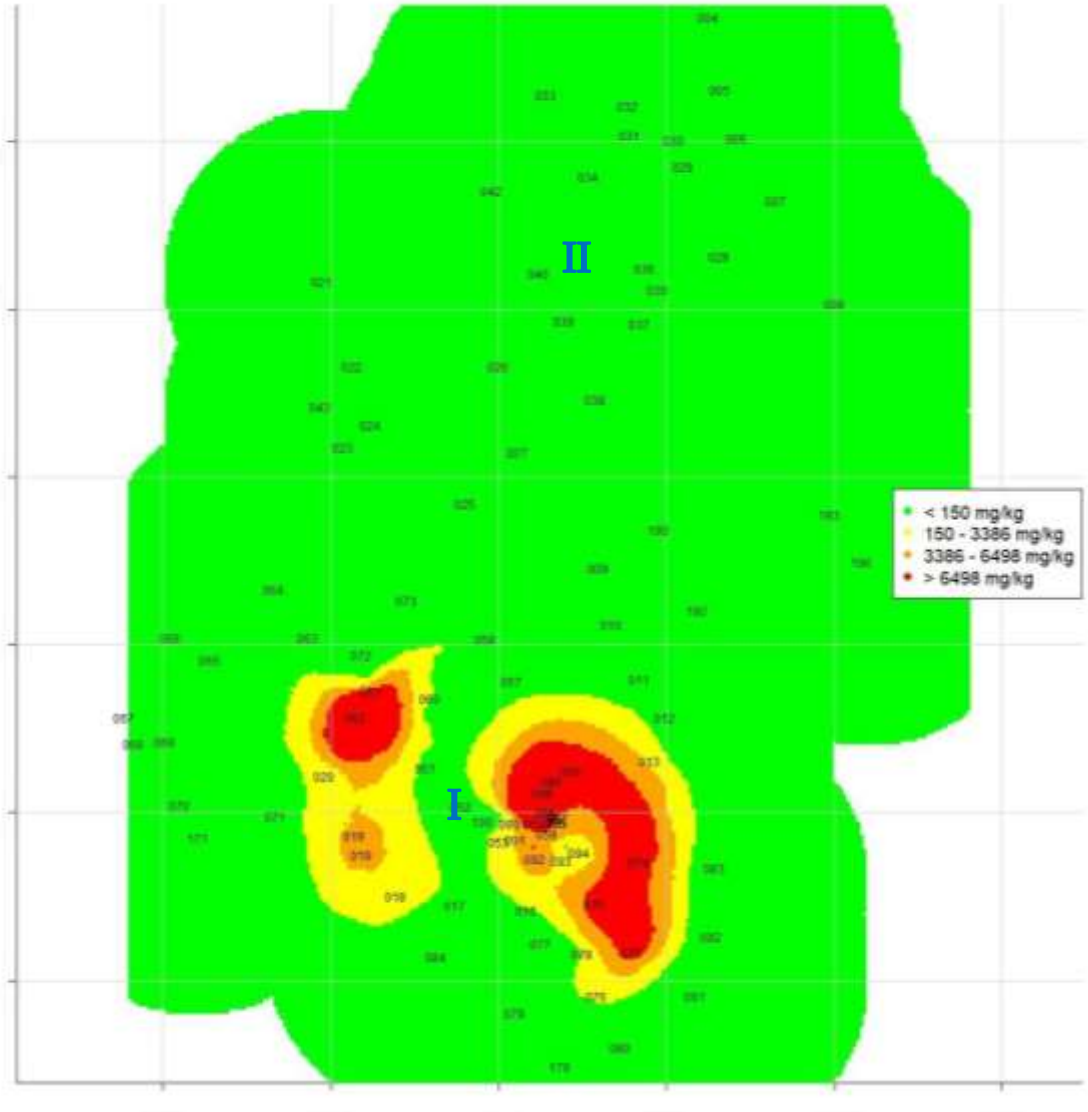

Figure 5. Surface audit contamination assessment F2 Petroleum Hydrocarbon Contamination Map

4. Site Assessment

Maapera completed an assessment of industrial storage yard for the Federal Government in December 2018. In total, 34 boreholes were completed to 3 m with measurements taken approximately every 10 cm over two days of drilling. In total, measurements were taken at 429 separate locations. At each location replicate measurements were taken and averaged, leading to a total of 2149 individual measurements at this site. As 9 separate parameters were reported for each measurement, there were a total of 19,341 data points generated for this site.

The environmental coordinator for this jurisdiction used the results of this investigation to guide decommissioning of the site.

Management and analysis of the data was supported by the data pipeline created by Maapera and was performed without manual manipulation of the data. The process was entirely automated and was completed in approximately 20 minutes. Among the many data products delivered, the following conceptual site model (CSM) was generated that distills all the parameters measured by the RSAS into one figure.

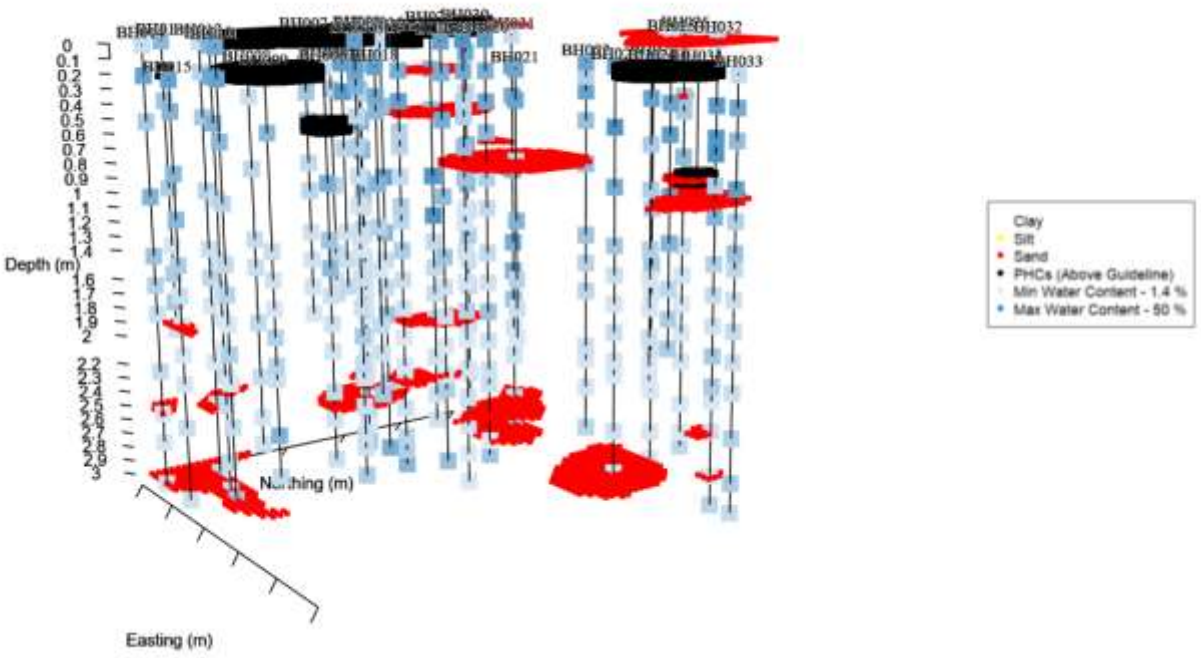

Figure 6. Conceptual Site Model Example.

CSM.html

5. Excavation

Maapera provided field analyses for a Phase III Excavation in February of 2018. After approximately 1,100 m^3 of soil was excavated from the site, Maapera scanned the walls and floor of the excavation. Results confirmed PHC impacts extended off-site in some areas and showed vertical closure had not been achieved. The primary contractor used this information to get a change-of-scope from the client and extend the excavation depth another 0.5 m. Follow-up scanning, after the removal of more floor material, showed the floor material met the relevant guidelines.

Maapera's services provided the primary contractor with needed evidence to get a scope-change from the client and save the client money by reducing equipment standby time while waiting for laboratory results.

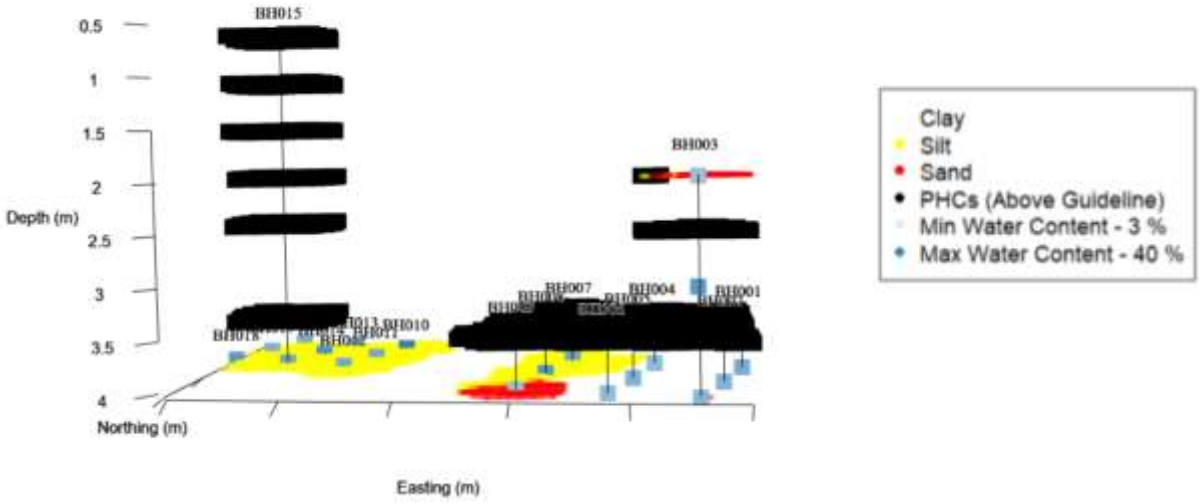

Figure 7. Conceptual Site Model from Phase III Excavation.

Phase III.html