BioNorth Solutions

Hydrocarbon Contamination Remediation of a Machinery Oil Leak

A BioNorth Solutions Case Study

Client Problem: As a result of mineral exploration, hydrocarbon contamination has accumulated at a project site located outside of Armstrong, Ontario. While drilling the site, oil leaked out of the machinery. The site cannot be excavated due to the nature of the project.

Solution: An evaluation of the suitability of Microbiate SG™ was undertaken. BioNorth Solutions and the client determined that an in-situ remediation would be best.

For this site, bore holes were dug out within a grid of holes 1 meter apart and the microbe/nutrient mix was added to fill each hole to the top. Special care was given to application to areas of high TPH (total petroleum hydrocarbons) concentration. Samples were to be tested for BTEX and PHC concentrations to determine the rates of application for a second application in the spring.

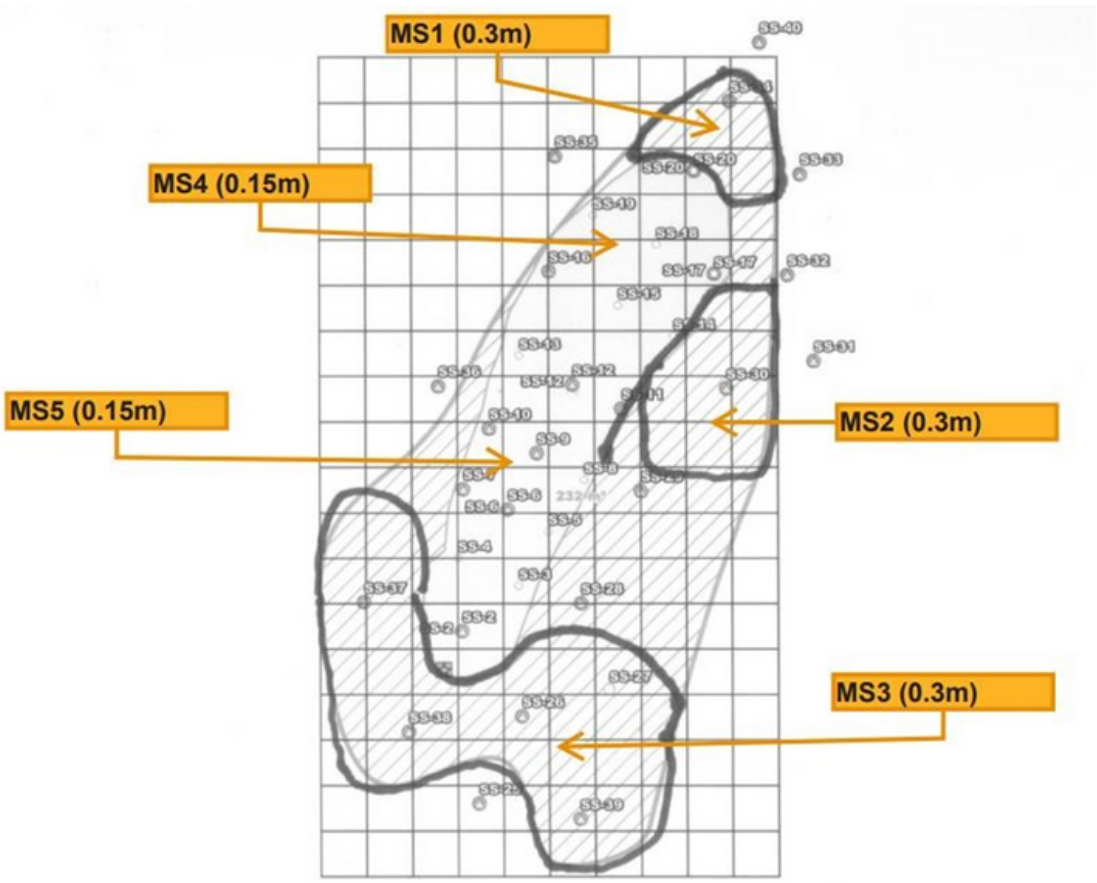

Figure 1. Drawing of the project site. Areas that require remediation are striped; areas with high contamination levels are circled. Samples sites are labeled. Deeper sample sites are labeled in orange.

Treatment: Bore holes approximately 1 inch in diameter and 1 meter in depth were dug out at a 1-meter distance from each other, then filled completely with a homogenous microbe/nutrient mix. Bore holes in less contaminated areas were filled half full. The application of Microbiate SG™ took place in November 2021, with snow on the ground. Soil samples were taken and analyzed in June 2021 before application. Sampling took place each month until the final sampling in August 2022.

Contamination Levels Pre-Application of Microbiate SG™

Parameter	Units	MOE Table 2	SS-1	SS-2	SS-6	SS-7	SS-9	SS-21	SS-10	SS-11	SS-12	SS-16
F1 (C6-C10) - BTEX	µg/g	55	-	*<100*	*<100*	*<100*	*<100*	*<100*	*<100*	*<100*	*<100*	*<100*
Extra Silica Gel F2 (C10-C16)	µg/g	98	74,000	21	46	11,000	58	300	55	32	33	4,900
F2 (C10-C16)	µg/g	98	52,000	23	46	5,900	45	360	<20	<30	<20	3,600
Extra Silica Gel F3 (C16-C34)	µg/g	300	57,000	130	110	7,100	<150	300	150	170	110	13,000
F3 (C16-C34)	µg/g	300	46,000	380	210	6,600	340	620	200	160	150	5,100
Extra Silica Gel F4 (C34-C50)	µg/g	2,800	320	<100	<100	<100	<150	<100	<100	<150	<100	330
F4 (C34-C50)	µg/g	2,800	300	<100	<100	150	<150	<100	<100	<150	<100	160

Table 1. BTEX and PHC concentration levels in soil samples taken in June 2021. A considerable number of samples had concentration levels above the acceptable MOE Table 2 criteria levels (highlighted in yellow).

Contamination Levels Post-Application of Microbiate SG™

Parameter	Units	MOE Table 2	1.0 SS2	1.0 SS6	1.0 SS12	1.0 SS17	1.0 SS20	SS26	SS28	SS29	SS30	SS32
F1 (C6-C10) - BTEX	µg/g	55	<100	<100	<50	<100	<100	<100	<100	<100	<100	<100
Extra Silica Gel F2 (C10-C16)	µg/g	98	<10	<10	<10	<10	<10	<10	<10	<10	11	<10
Extra Silica Gel F3 (C16-C34)	µg/g	300	<50	<50	65	53	60	470	86	<50	100	67
Extra Silica Gel F4 (C34-C50)	µg/g	2,800	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50

Parameter	Units	MOE Table 2	SS33	SS34	SS35	SS36	SS37	SS38	SS39	SS41	SS40	SS BG
F1 (C6-C10) - BTEX	µg/g	55	<70	<100	<70	<70	<100	<50	<50	<50	<100	<100
Extra Silica Gel F2 (C10-C16)	µg/g	98	<10	34	<10	<10	25	42	<10	10	-	<10
Extra Silica Gel F3 (C16-C34)	µg/g	300	<50	110	<50	<50	74	170	360	610	-	<50
Extra Silica Gel F4 (C34-C50)	µg/g	2,800	<50	<50	<50	<50	<50	<50	<50	<50	-	<50

Table 2. BTEX and PHC concentration levels in soil samples taken in August 2022. Most samples had concentration levels below the acceptable MOE Table 2 criteria levels. Levels still above the acceptable concentrations are highlighted in yellow.

Results: Soil quality is assessed based on the Ontario Ministry of the Environment (MOE) Soils, Groundwater, and Sediment Standards (2011) Table 2 Criteria. Pre-application of Microbiate SG™, contamination levels at the site were well above acceptable levels (shown in Table 1). 9 months after application, the contamination levels were well below acceptable MOE criteria levels. As shown in Table 2, a few sample sites still had high concentrations of PHCs, but an overall contamination reduction is seen. A spot application of Microbiate SG™ will be necessary at these locations to further remediate these sites.

Conclusion: Overall, the application of Microbiate SG™ was effective at reducing hydrocarbon contamination in the soil, thereby improving soil quality. This was revealed through the analysis of BTEX and PHCs in the soil before and after application of the product. After the application, soil sampling once a month revealed a decrease in the concentration levels of BTEX and PHCs to below the acceptable MOE levels. Thus, Microbiate SG™ has proven to be an effective solution for in-situ remediation, even when applied later in the remediation season, due to the cold-adapted microbes.

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