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 microbe/nutrient mix was added to fill each hole to the top. Residual product remaining after filling the core holes was spread over the site, especially in areas of high TPH (total petroleum hydrocarbons) concentration. Samples were to be tested for bacterial cell counts and BTEX and PHC concentrations before a second application. This evaluation would allow for BioNorth to adjust the concentration of the Microbiate SG™ used in certain areas of the site for the second application in the spring, if necessary.

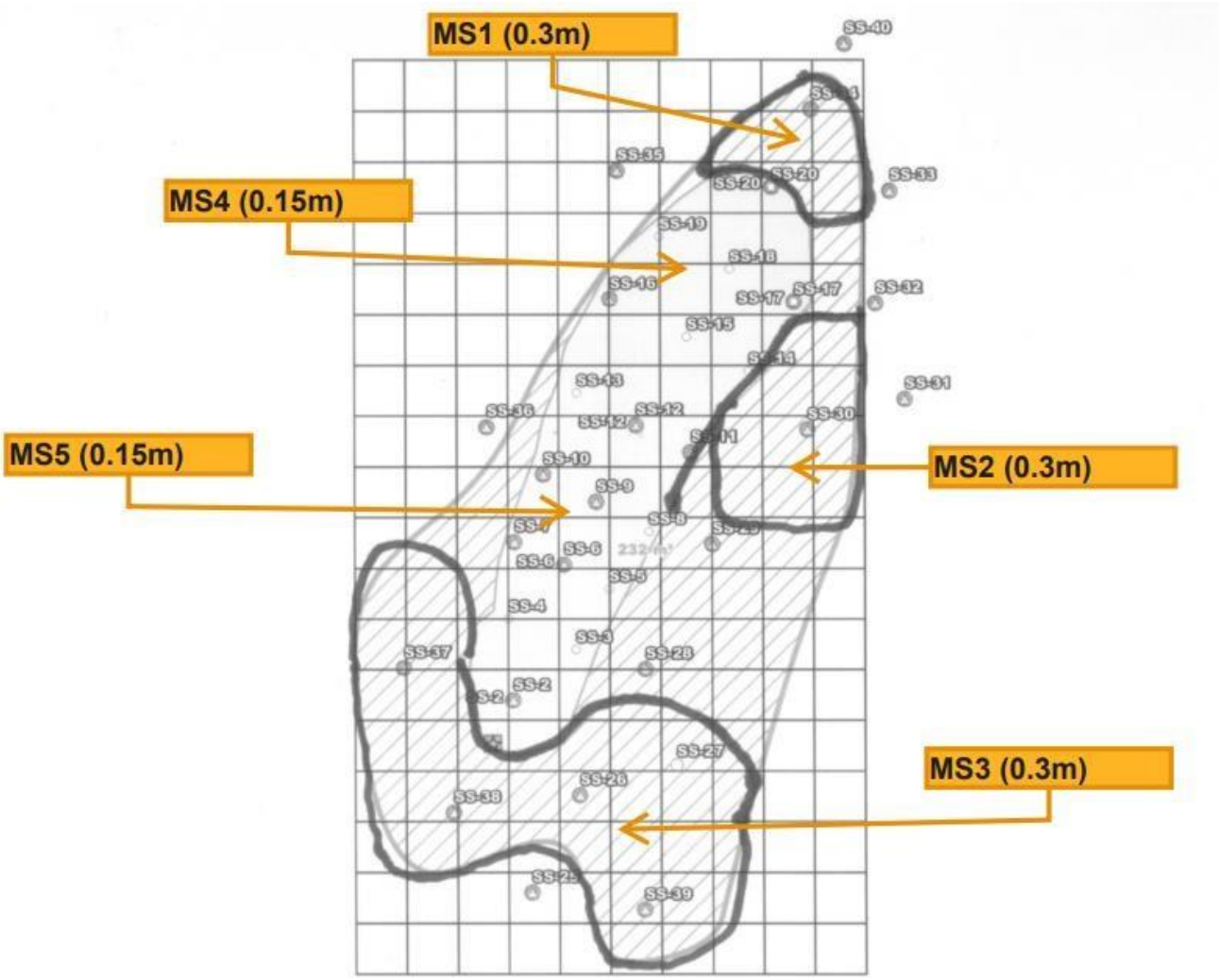

Figure 1. Drawing of the project site. Areas that require remediation are striped; areas with the highest concentrations of TPH are circled. Sample sites are marked with circles. Deeper sample sites are marked with orange arrows.

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. Samples of BTEX and PHCs as well as bacterial cell counts were taken in June 2022 and August 2022. The site was remediated by the end of August 2022.

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).

Analysis of Soil Samples After Microbiate SG™ Application

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 2021. 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. As shown in Table 1, the concentration levels of BTEX and PHCs F1-F4 exceeded acceptable MOE criteria levels for the soil type (peat) at multiple sample sites. These sites were sampled in June 2021, before the initial application of Microbiate SG™.

When the site was sampled again in August 2021, the concentrations of BTEX and PHCs were well below acceptable MOE criteria levels. As shown in Table 2, a few sample sites still had high concentrations of PHCs, but these excess concentrations are much closer to acceptable levels than those concentrations exceeding acceptable levels before the application. A spot application of Microbiate SG™ will be necessary at these locations to further remediate these sites. Bacterial cell counts were taken from samples at deeper depths in areas of higher contamination as well, which determined that the bacteria were still active within the remediation site and targeting the hydrocarbon contamination.

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 of hydrocarbon contamination in peat soil types.

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