



Advisian

WorleyParsons Group

Advisian
Suite 500, 151 Canada Olympic Rd SW
Calgary, AB T3B 6B7 CANADA
Phone: +1 403 247 0200
Toll-Free: 1 800 668 6772
Facsimile: +1 403 247 4811

A business of WorleyParsons Canada
Services Ltd.
www.advisian.com

02 April 2018

Proj. No.: 307031-00048

Shaun Sabourin, P.Eng, M.A.Sc, Project Manager
Community & Government Services
Government of Nunavut
PO Box 1000 Stn 620, 4th Floor W.G Brown Bldg
Iqaluit NU X0A 0H0

Dear Mr. Sabourin:

RE: 2017 Phase II ESA For Arviat Tank Farm Hydrocarbon Impacted Soil Volumes and Treatment Options

This cover letter is intended to be read in conjunction with the report entitled "2017 Phase II Environmental Site Assessment, Arviat Tank Farm – Arviat, NU" dated April 2, 2018 (the Report). The Report describes the activities, results and limitations associated with the Phase II ESA conducted in October 2017 at the Arviat Tank Farm and associated facilities (the Site). This letter is intended to provide additional information related to contaminated soil volume contingencies, remediation options and local considerations.

1. Contaminated Soil Volume Contingency

It is important that the Government of Nunavut understand the uncertainty of estimated volumes of potentially contaminated soil described in this Report. The Report provides estimated volumes of petroleum hydrocarbon (PHC) contaminated soil based on available laboratory analytical results and conservative assumptions where unresolved data gaps exist.

Based on the findings of the Phase 1 ESA (Appendix 1 of the Report) a tank farm was present at the site prior to construction of the existing facility. Available documentation cannot confirm if an environmental liner was included in the original tank farm construction nor if any environmental impacts existed from the initial tank farm operation prior to the upgrades in 1994/1995.

As such, it is recommended that PPD carry a contingency for the management of an additional 10,000 m³ of PHC-impacted soils based on the calculation in Table A and plan to delineate and segregate soils during earthworks at the tank farm. Without further intrusive environmental investigations in the area, Advisian is unable to provide a margin of error for this volume estimate; however, it is atypical for entire area under a facility to have contaminant concentrations exceeding the applicable guideline. The risk in volume uncertainty could be mitigated by selecting remediation methods and schedules that carry the smallest per unit remediation cost.



Table A: Contingency Volume of Contaminated Soil Below the Existing Tank Farm Liner

	Min Depth (m below liner)	Max depth (mbgs)	Net depth (m)	Area (m ²)	Volume (m ³)
Tank Farm Footprint	0	1.5	1.5	6,755	10,132

2. Remediation Options

Soils contaminated with PHCs like gasoline or diesel can often be efficiently excavated and treated ex-situ (e.g. above ground) at the source site or a nearby location subject to permitting and engineering controls. Once the residual hydrocarbon concentrations meet those acceptable for the intended land use and/or zoning, the remediated soil can then be reused locally with minimal additional transportation costs. This approach can be beneficial in terms of conservation of usable fill material, reduction of greenhouse gas emissions and overall cost.

The majority of the anticipated hydrocarbon contaminated soil at the Arviat site appears to be amenable to bioremediation based on the laboratory analytical results and the coarse-grained soils identified during the site assessment. There are three practical methods of bioremediating hydrocarbon contaminated soil in Northern climates such as Arviat:

- **Biopiles** can be used to treat a large volume of soil in the least amount of space but typically requires infrastructure to aid aeration of the pile and can take a longer period of time to achieve remediation success.
- **Landfarms** can be used if there is a large area available to spread the contaminated soil over and may not be as successful in locations with extremes of rainfall. Specialized tillage equipment and machines to propel them may be required to be brought to an area.
- **Windrows** of soil undergoing treatment take up less space than landfarms and can be set up to manage water runoff more easily. Aeration of windrows typically employs the use of specialized attachments attached to locally available excavators.

It is also possible to remediate locations by removing the contaminated soil to a licensed off-site landfill; however, the cost to transport soil from northern Canada to southern disposal locations is typically cost prohibitive. The selected method depends upon a number of factors including the site setting, contaminant characteristics, acceptable residual concentrations, timelines and regulatory requirements.

In our experience, frequent aeration of windrows using devices similar to an Allu bucket has been a successful strategy for treating petroleum hydrocarbon contaminated soils in remote Arctic environments and is typically our first choice to remediate soil similar to that found at the Arviat tank farm. Our company and staff have been involved in successfully permitting, planning and/or executing soil remediation using aeration of windrows for tens of thousands of cubic meters of soil. The locations for these projects covers a wide range of



the western and central Arctic including; Norman Wells, Johnson Point (Banks Island), Camp Farewell logistics base (Mackenzie Delta), Tuktoyaktuk, and numerous DEW Line sites (BAR-C, PIN-B, PIN-D).

3. Local Considerations

We recommend that the Government of Nunavut consider ex-situ bioremediation of the hydrocarbon impacted soil either on-site or at a nearby location. If this option is a desired approach for the Government, the local community should be consulted to describe the process, determine an acceptable location for a treatment area and discuss the final location where treated soil could be used. Treating the soil to a standard suitable for interim cover or capping material for the Arviat landfill may be an acceptable approach.

Development of a soil treatment facility may represent a local business opportunity which would require discussions the community, regulators such as the Nunavut Water Board and the Government of Nunavut. Potential owners or operators of a treatment facility may wish to offer treatment and disposal services to other owners of hydrocarbon contaminated soil. These services could potentially be provided to owners outside of the community depending on the desires of the local community. The methods and price structure the theoretical owners/operators use to develop such a service are beyond the scope of this report.

4. Closing

We trust this additional information meets your needs. Please contact either of the undersigned should you need additional information.

Sincerely,

Sam Bird, B.Sc.
Environmental Scientist

Masten Brolsma, B.Sc., P.Eng. (NT)
Principal Environmental Engineer

Advisian, Americas



Disclaimer

The information presented in this document was compiled and interpreted exclusively for the purposes stated in Section 2 of the attached document. WorleyParsons Canada Services Ltd., operating as Advisian (Advisian) provided this report for The Government of Nunavut solely for the purpose noted above.

Advisian has exercised reasonable skill, care, and diligence to assess the information acquired during the preparation of this report, but makes no guarantees or warranties as to the accuracy or completeness of this information. The information contained in this report is based upon, and limited by, the circumstances and conditions acknowledged herein, and upon information available at the time of its preparation. The information provided by others is believed to be accurate but cannot be guaranteed.

Advisian does not accept any responsibility for the use of this report for any purpose other than that stated in Section 2 of the attached report and does not accept responsibility to any third party for the use in whole or in part of the contents of this report. Any alternative use, including that by a third party, or any reliance on, or decisions based on this document, is the responsibility of the alternative user or third party.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior permission of Advisian.

Any questions concerning the information or its interpretation should be directed to Sam Bird, or Masten Brolsma.