

APPENDIX A

Statement of Work, Consultant Services, Oil Disposal Pit, Royal Roads
Landfill, PFC Removal Technology Demonstration for Contaminated
Groundwater and Stormwater, Dated July 2015





Canada

**STATEMENT OF WORK
CONSULTANT SERVICES**

Oil Disposal Pit
Royal Roads Landfill

PFC Removal Technology Demonstration
for Contaminated Groundwater
and Stormwater

July 2015

4 Wing CFB / Cold Lake, Alberta

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ANNEX

Annex 1 Recommended Format for the Field Demonstratoin Report

1.0 PURPOSE

This Statement of Work (SOW) has been developed on behalf of the Department of National Defence (DND) to solicit professional environmental services from qualified firms or joint venture partners, composed of environmental and engineering specialists with the capability and expertise to conduct a PFC Removal Technology Demonstration for Contaminated Groundwater and Stormwater at the Oil Disposal Pit (hereafter referred to as the 'Site') which is located within the Royal Roads Landfill, CFB Cold Lake, Alberta (Figure 1).

2.0 SITE INFORMATION

The Royal Roads Landfill is located in the northwestern section of 4 Wing Cold Lake and was historically used as the main landfill for the Base. The Oil Disposal Pit is approximately 40 m by 60 m. It was used mainly for disposal of waste oil, waste fuel and degreasers. The Site appears to have been used for uncontrolled dumping as far back as 1955, as determined through aerial photograph interpretations, and is known with certainty that it was operational from 1977 to 1985.

The Oil Disposal Pit is adjacent to a Hazmat Compound to the east and a runway to the south (Figure 2). The Site is also adjacent to a Firefighter Training Area (FTA) (Figure 2). A bog is located to the north of the disposal pit. Marie Creek is approximately 650 m north of the Site.

The soil of the Site is characterized as a layer of sand, silt, gravel or clay-fill or organic material overlying variable sand to silty-sand layer. The sand to silty-sand layer extends from 0.7 to 3 m below ground surface (bgs). A clay or clay-till layer resides below the sand layer, extending to a minimum of 9 m bgs (the maximum depth of investigation). The sand and sandy-silt layers have been confirmed as coarse-grained material, while the clay layer consists of fine-grained soils.

In the area of the Oil Disposal Pit, natural groundwater movement is generally believed to be towards the northeast. However, a large underground stormwater pipe system that exerts a significant influence on groundwater flow is present. The section of stormwater pipe that runs through the Oil Disposal Pit area discharges at the edge of the forest to the northeast (Figure 2). The discharge is significant and creates a flooded section of forest before reaching Marie Creek.

According to EC's Climate Normals database, during the period of 1981-2010, the mean annual precipitation was 421 mm, of which 319.2 mm was received as rain and 101.8 mm was received as 128.6 cm of snow. Snowfall >1 cm can begin in November and end in April, with an average of 140 days per year receiving this accumulation. July is generally the warmest month, with an average temperature of 23.3°C, and January is generally the coldest, averaging -20.1°C.

Environmental Site Investigations at the Site began in 1989 following a discovery of hydrocarbon contamination in a drainage ditch in 1988. Numerous investigations have been undertaken between 1989 and 2014, which have attempted to delineate the contamination, characterize the surface and subsurface conditions and detail the contaminant pathways associated with the Site.

The contaminants of concern identified during the period of 1989 to 2012 include petroleum hydrocarbons (PHCs), benzene, toluene, ethylbenzene and xylene (BTEX), 1,1-Dichloroethane, 1,1,1-trichloroethane), phenols, and metals. In the past two years, perfluorinated compounds (PFCs) were investigated as emerging contaminants and widespread perfluorooctane sulfonate (PFOS)/perfluorooctanoate (PFOA) exceedances of the drinking water guidance values (i.e., 0.3 and 0.7 µg/L for PFOS and PFOA, respectively) across the site were observed. The highest PFOS concentration in groundwater was found to be 120 µg/L, exceeding the Federal Environmental Quality Guideline (FEQG) for PFOS in groundwater (60 µg/L). In addition, PFCs were detected from the stormwater pipe system. This is likely due to infiltration of PFC-contaminated groundwater into the stormwater drain pipe that traverses the adjacent (upgradient) Fire Fighting Training Area (Figure 2). The content of the stormwater pipe consists of surface water runoff from the runway as well. The stormwater drain pipe acts as a conduit which discharges into a flooded area and then forms a small stream that enters Marie Creek. The PFOS concentrations in the pipe, the flooded area and the small stream are in the order of 13-36 µg/L.

Various remedial activities have been recommended and implemented for the conventional contaminants. Some studies inferred that the conditions were suitable for intrinsic bioremediation (i.e., monitored natural attenuation) at the Site. However, bioremediation is known to be ineffective for treating PFC-contaminated groundwater and soil.

In 2012, Environment Canada (EC)'s Emergencies Science and Technology Section (ESTS) launched a technology feasibility study for the remediation of PFC-contaminated sites under the Canadian Federal Contaminated Sites Action Plan (FCSAP). Since then, ESTS has investigated different technologies and recently recommended to FCSAP that pump and treat (P&T) with carbon adsorption is a promising treatment approach for PFC-contaminated groundwater.

3.0 REQUIREMENT

In order to address the PFC contamination issues found in both groundwater and the stormwater pipe system at the Site, a field trial on P&T with carbon adsorption is needed.

4.0 OBJECTIVES

The Objective of this project is to determine whether P&T with granular activated carbon (GAC) is a practical approach for removing PFCs from contaminated groundwater and stormwater.

The P&T systems used in the field trials will also be evaluated for the effectiveness of reducing the concentrations of other contaminants in the water samples. Ideally, the quality of treated water will meet the criteria for discharging or re-injecting.

For this purpose, DND is seeking the services from a Consultant with the following qualifications:

- i. Experience in groundwater P&T
- ii. Experience in environmental site assessment

Note:

- Preference may be given to candidates who have experience/expertise in treating PFC-contaminated groundwater and/or wastewater using P&T system with GAC
- Preference may be given to candidates who have previous experience conducting environmental site assessment at the Site

5.0 FIELD TRIAL LOCATIONS

Two locations (i.e., Location A and Location B) have been selected for the field trials on PFC-contaminated groundwater and stormwater, respectively (Figure 2). The Location A is in the area BH13-06 (Figure 3) and Location B is at the stormwater pipe discharge point (Figure 4).

6.0 REFERENCES

The following is not an all-inclusive list; therefore, ensure that all applicable references are used. Should more current versions become available during the life of the contract; they shall take precedence and be referred to in subsequent work/reports.

- i. 2013 Supplementary Site Investigation, Oil Disposal Pit Site - 4 Wing CFB Cold Lake, Cold Lake, Alberta. October 2013, DCC Project No. AC 149514 (*Prepared by EGE Engineering Ltd. for Defence Construction Canada*)
- ii. 2014 Environmental Site Assessment of the Oil Disposal Pit, 4 Wing CFB Cold Lake, Cold Lake, Alberta. February 2015 (*Prepared by Environmental Sciences Group, Royal Military College. for Department of National Defence*)
- iii. Human Health Risk Assessment of the Oil Disposal Pit. February 2015 (*Prepared by Environmental Sciences Group, Royal Military College. for Department of National Defence*)

7.0 SCOPE OF WORK

7.1 General

This project is to consist of two Tasks. Task I will involve the field trial on P&T for PFC-contaminated groundwater using GAC. Task II will involve the implementation of the field trial on P&T with GAC for PFC-contaminated stormwater collected from the stormwater pipe discharge point. An outline of the expectations of the tasks is provided herein to help the Consultant understand the context for, and guide the completion of the field trials.

7.2 Task I: Field Trial on P&T System for PFC-contaminated Groundwater

7.2.1 Field Trial Workplan Development

The Consultant is asked to review pertinent historical documentation related to the Site for getting an understanding of the site contamination issues regarding PFCs and other

contaminants (i.e., PHCs, volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and metals).

Copies of previous studies (as outlined in Section 6.0) will be made available to Bidders during the tender stage, in order for the Bidders to determine the anticipated effort to conduct the field work.

After award of the contract, the Consultant is to conduct a site reconnaissance to note any changes since the time of the earlier reports, identify anomalies, gather additional information, and identify possible health and safety hazards, all to help develop a Field Trial Workplan for Task I.

The Field Trial Workplan for Task I is to address:

- All required field trial components;
- All analytical requirements; and
- All data analysis and reporting requirements.

At a minimum, the Field Trial Workplan is to consist of:

- Proposed P&T system with GAC for groundwater treatment
- Proposed extraction and monitoring well locations, installation methodology, construction details and instrumentation;
- Proposed approach for looking into the baseline chemistry of the PFC plume;
- Proposed field trial and monitoring procedures;
- Proposed analytical parameters, including PFCs (i.e., PFBA, PFBS, PFPeA, PFHxA, PFHxS, PFHpA, PFOSA, PFOA, PFOS, PFNA, PFDA, PFUnA and PFDoA), PHCs, VOCs, PAHs, metals, total organic carbon (TOC), and pH);
- Proposed approach for evaluating post-test groundwater chemistry;
- Proposed approach for monitoring off-site PFC movement;
- Proposed Quality Assurance/Quality Control (QA/QC) Plan; and
- Proposed site-specific Health and Safety Plan

7.2.2 *P&T System Design*

The Consultant is required to propose a P&T system that could be obtained through rental for the field trial. The design should be based on but not limited to the system concept shown in Figure 5.

7.2.3 *Establishment of Extraction and Monitoring Well Network*

The Consultant is to establish an extraction and monitoring well network at Location A prior to groundwater treatment. The network should consist of approximately 24 extraction wells and 14 monitoring wells (8 monitoring wells cover the on-site source area for evaluating source removal and another 6 monitoring wells are to be located at the site boundary for monitoring off-site PFC movement).

There are some existing monitoring wells around the area that can possibly be used in the field trial. The Consultant should discuss the possibility with DND/PWGSC during or after the reconnaissance.

7.2.4 *Establishing Baseline Chemistry of the Plume*

The Consultant is to undertake two monitoring and surveying (M&S) events to evaluate seasonal effects. 8 samples per event will be collected from the 8 monitoring wells located in source area and 6 samples per event will be collected from the 6 monitoring wells located at site boundary for PFC analysis.

7.2.5 *Field Trial and Monitoring*

The Consultant is to conduct the groundwater P&T trial for a one-month period. An infiltration gallery for treated water disposal will be constructed. Daily system monitoring and system optimization will be performed during the trial. 4 samples (2 pre-treatment and 2 treated samples) per day will be collected for PFC, TOC and pH analyses to evaluate the removal efficiency of PFCs by GAC. Additionally 4 samples (2 pre-treatment and 2 treated samples) will be collected on the last day of each week for analyses of other target contaminants (i.e., PHCs, VOCs, PAHs and metals) to evaluate their removal efficiencies. It is assumed that a total of 2,000 kg of GAC will be used in the groundwater P&T trial (i.e., one change out of carbon during the field trial). The waste carbon will be destroyed via incineration.

7.2.6 *Sample Analysis*

All analytical laboratories used shall be accredited by the Canadian Association for Laboratory Accreditation (CALA) or has the equivalent laboratory certification under ISO 17025 (General Requirements for the Competence of Testing and Calibration Laboratories) for the parameters to be analyzed.

7.2.7 *Evaluating Post-test Groundwater Chemistry*

The Consultant is to undertake two M&S events to evaluate the post-test groundwater chemistry. 8 samples per event will be collected from the 8 monitoring wells located in the source area and 6 samples per event will be collected from the 6 monitoring wells located at the site boundary for PFC analysis.

The results from the monitoring wells in the source zone will be used to evaluate source removal.

7.2.8 *Off-site PFC Movement Monitoring*

The results from the monitoring wells at the site boundary will be used to evaluate off-site PFC migration.

7.2.9 *Data Analysis and Reporting*

Based on the results of the field trial, the Consultant is to:

- Produce a tabular summary of the analytical results in comparison to applicable standards and guidelines, which is to be included in the report;
- Submit data generated from this Task electronically, ensuring that the laboratory has analytical data available in a native file format with the following fields (as a minimum):
 - a) Chain of Custody Number,
 - b) Lab ID,
 - c) Sample ID,
 - d) Date sampled,
 - e) Date tested,
 - f) Matrix,
 - g) Result,
 - h) MDL,
 - i) Units,
 - j) Parameter description,
 - k) Laboratory parameter code (if used by the lab).

Additional fields can include: Sampling Method and Report Number. If further information regarding file format is required by the lab, then questions should be directed to the PWGSC Project Manager;

- Highlight any numeric exceedance of the relevant federal and/or provincial standards and guidelines in the data summary; and
- Interpret the data to determine the effectiveness of the P&T system for removing PFCs and other target co-contaminants from contaminated groundwater.
- Interpret the data to evaluate the source removal and off-site movement of PFCs at the Location A.

7.3 Task II: Field Trial on P&T System for PFC-contaminated Stormwater

7.3.1 Field Trial Workplan Development

As described in 7.2.1, the Consultant is to develop a Field Trial Workplan for Task II.

The Field Trial Workplan for Task II is to address:

- All required field trial components;
- All analytical requirements; and
- All data analysis and reporting requirements.

At a minimum, the Field Trial Workplan is to consist of:

- Proposed P&T system with GAC for stormwater treatment
- Proposed stormwater pool location, construction details and instrumentation;
- Proposed field trial and monitoring procedures;
- Proposed analytical parameters (i.e., PFCs, PHCs, VOCs, PAHs, metals, TOC, and pH);
- Proposed QA/QC Plan; and
- Proposed site-specific Health and Safety Plan

7.3.2 P&T System Design

The Consultant is to propose a P&T system that could be obtained through rental for the field trial. The design should be based on but not limited to the system concept shown in Figure 5.

7.3.3 Construction of Stormwater Pool

The Consultant is to construct a barrier to pool the stormwater as it discharges from the pipe. The water could then be pumped into the treatment system.

7.3.4 Field Trial and Monitoring

The Consultant is to conduct the stormwater P&T trial for a one-month period. An infiltration gallery for treated water disposal will be constructed. Daily system monitoring and system optimization will be performed during the trial. 4 samples (2 pre-treatment and 2 treated samples) per day will be collected for PFC, TOC and pH analyses to evaluate the removal efficiency of PFCs by GAC. Additionally 4 samples

(2 pre-treatment and 2 treated samples) will be collected on the last day of each week for analyses of other target contaminants (i.e., PHCs, VOCs, PAHs and metals) to evaluate their removal efficiencies. It is assumed that a total of 2,000 kg of GAC will be used in the stormwater P&T trial (i.e., one change out of carbon during the field trial). The spent carbon will be destroyed via incineration.

7.3.5 *Sample Analysis*

Same as described in Section 7.2.6.

7.3.6 *Data Analysis and Reporting*

See detailed requirements described in Section 7.2.9. Based on the results from the field trial, the Consultant is to interpret the data to determine the effectiveness of the P&T system for removing PFCs and other target co-contaminants from the contaminated stormwater.

8.0 RESPONSIBILITY AND GENERAL REQUIREMENTS

- 1) Approach: The field trials will meet the objectives outlined in Sections 3.0 and 4.0 by taking a logical, structured and cost effective approach.
- 2) The Consultant is responsible for providing the labour and resources to fulfill the terms of the SOW to a satisfactory level of performance. This would include the necessary qualified personnel, management, supervision, laboratory facilities, materials, tools, equipment, office space, reference documents and data-processing supplies, computers and other incidentals.
- 3) The Consultant is to comply with all applicable Federal, Provincial and Municipal legislation during the conduct of this work.
- 4) Notifications/Permits: The Consultant is responsible for making the necessary arrangements for notifications and permits as required prior to site activities to fulfill the terms of this SOW including underground services locates. Unless authorized by DND, all existing utility services will be maintained in operating condition during the project work. If services are encountered during the investigation work, the details of the location and use are to be documented for DND reference.
- 5) Emergency Notification: If the Consultant discovers conditions that pose an immediate significant threat to human health or the environment, the Consultant is to notify DND/PWGSC immediately.
- 6) Working Hours: Unless advised otherwise, the work performed at the Base by the Consultant is to be carried out during normal working hours (as dictated by the contract representative) and will be carried out with least possible

interference or disturbance to building occupants, the public and Base activities/operations.

- 7) QA/QC: The Consultant is expected to demonstrate that adequate measures will be and have been taken to ensure good QA/QC procedures for all aspects of the project. The Consultant will use proven protocols with good historical performance records for the implementation of QA/QC procedures. This is to be documented in the Consultant's work plan and reports.
- 8) Clean Up: Upon completion of the work, the site is to be left clean with all waste materials, equipment and supplies removed. The Consultant is to restore the site to a level consistent with the surrounding environment.
- 9) The Consultant will assume responsibility for any accident or damage caused by its employees or equipment to DND property or personnel.
- 10) The Consultant will assume responsibility for the security of its equipment and materials during and after working hours. DND/PWGSC will not be liable for any vandalism, theft or loss.
- 11) DND/PWGSC assumes no responsibility whatsoever for any occurrence that takes place outside the confines of the work area.
- 12) Method of Payment: All invoices shall be submitted to the PWDGC Project Manager on a monthly basis. The final invoice shall be submitted on the same date as the final report.

9.0 HEALTH AND SAFETY PLAN

- 1) The Consultant must establish a Site-Specific Health and Safety Plan for the project. This Plan will outline potential hazard incidents, the Codes/Statutes to be met, rules of behavior, protective equipment and clothing to be provided, responsible individuals, and all related matters. A formal document shall be submitted for PWGSC acknowledgement prior to the start of field work.
- 2) The Consultant shall be responsible for ensuring that all employees, contractors and others in the vicinity of the fieldwork are aware of the work and any associated hazards, ensuring the health and safety of all personnel at the work site.
- 3) The Consultant will follow all applicable health and safety policies and procedures of the site owner (DND). The consultant is responsible for obtaining these policies as appropriate.
- 4) The Consultant is obliged to comply with applicable statutory requirements and industry standards.

- 5) The Consultant is aware of, and accepts, the appropriate health and safety jurisdiction.
- 6) The Consultant shall comply with all applicable workers' compensation legislation.
- 7) Either DND or PWGSC reserve the right to stop work on the contract if, in the opinion of either, the work is not being performed safely by the Consultant, or the work is being performed in a manner that is contrary to the requirements of applicable safety legislation.
- 8) The Consultant must confirm that an established and current safety program is in force for all employees under the contract.

10.0 SPECIAL REQUIREMENTS

- 1) Regulations: The Consultant will carry out the work in accordance with the most recent versions of municipal, provincial and federal requirements including directives, acts, regulations and guidelines relevant to this project. In the event of a conflict between acts and regulations, the more stringent one is to be observed.
- 2) DND documents may not be removed from the confines of DND without authorization of DND. Any classified DND document must be approved by DND for viewing by the Consultant.
- 3) Security: Procedures governing access to the Base will be prescribed by DND. Access to specific sites may be restricted and require escort or need to be coordinated with PWGSC/DND.
- 4) Smoking: Smoking is prohibited in the area of the Site and in all DND buildings.

11.0 DELIVERABLES

11.1 Tasks I and II

- The Field Trial Workplans, as per the requirements outlined in Sections 7.2.1 and 7.3.1.
- Project Meetings: For all meetings, the Consultant is to prepare and distribute minutes. After the contract is awarded, the following meetings will be held via teleconference between DND/PWGSC and the Consultant.
 - ◀ Pre-job meeting to formalize the terms of the contract and discuss access to the site;
 - ◀ Upon completion of field work and prior to preparation of the draft report; and

◀ Following DND/PWGSC's review of the draft report.

- Progress Reports: The Consultant is responsible for submitting progress reports every two weeks or after significant milestones. The report will be brief and include the following:
 - a) A statement to indicate if the project is on schedule compared to the timetable as originally proposed, and an explanation of any variations;
 - b) A summary of work completed since the last report, and planned activities for the next two weeks;
 - c) Any concerns which require input or assistance from the DND Project Manager; and
 - d) Significant findings, if any.
- Draft and Final Reports: The Consultant will submit draft and final reports. The draft report shall be submitted electronically. The final report shall be submitted in two (2) hard copies and two (2) electronic copies on CD-R in PDF file format, as well as native file formats (i.e. Microsoft Word/Excel).
- All Draft and Final reports, including workplans, notes, and supplements, are to be assembled for ease of handling in a series of individual volumes as indicated in the SOW, printed on both sides of 8.5" x 11" paper (excluding drawings), single spaced and bound. Covers are to show the project title, type of report, location, PWGSC contract number and date. Draft and Final Reports are to be annotated as such on every page.
- Draft reports will be prepared and submitted with the same content and quality standards as if they were final reports. If a draft report is submitted that is judged by DND/PWGSC not to meet the requirements set within this SOW, DND/PWGSC reserves the right to request an appropriately revised draft report from the Consultant at no cost to DND/PWGSC.

The draft and final report must meet the approval of DND/PWGSC. The report will, as a minimum, identify and summarize the work performed as detailed in Section 7.0.

Any other information necessary for the Consultant to meet the obligations of this SOW shall be included in the sections of the report or included as an annex.

12.0 EXECUTION OF WORK

- 1) Consultant will carry out the work without interruption until completed and accepted by DND/PWGSC. The following milestones are to be met, and are to be reflected in the proposed Workplans:

Timeline:

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- 2) Field Trial Workplans – within twenty (20) calendar days after contract award;
- 3) Meeting Minutes – within seven (7) calendar days after each meeting;
- 4) Progress Reports – every fourteen (14) calendar days award of the contract;
- 5) Health and Safety Plan - Within seven (7) calendar days following authorization to commence field work, and prior to site mobilization;
- 6) Draft Report Submitted – within 40 calendar days after field work is completed;
and
- 7) Final Report Submitted – within 14 calendar days after receipt of DND/PWGSC review of the draft report.

PFC Removal Technology Demonstration for Contaminated Groundwater and Stormwater
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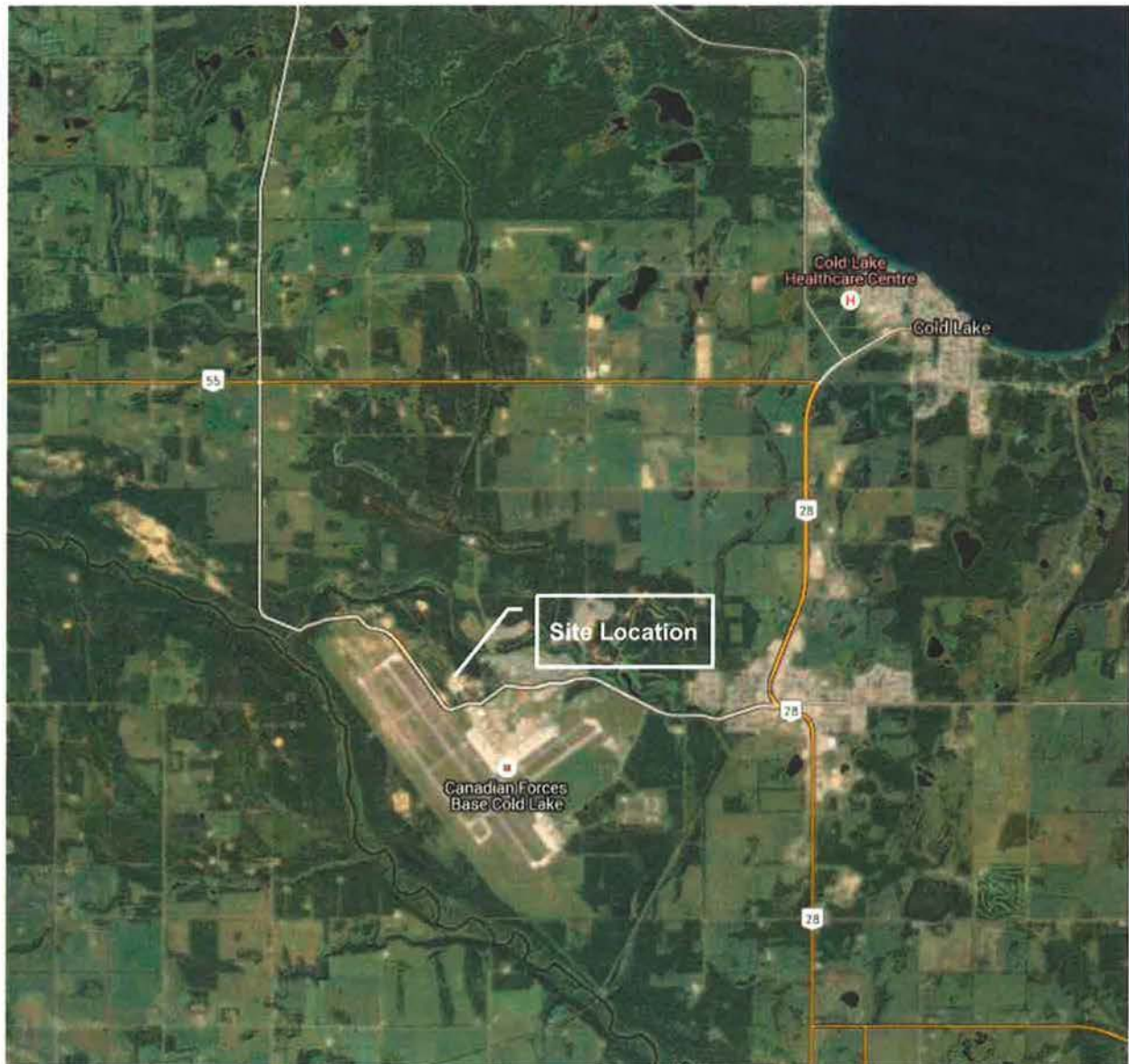


Figure 1. Site Location – Royal Roads Landfill 4 Wing Cold Lake, Cold Lake, Alberta (image taken from Google Maps).

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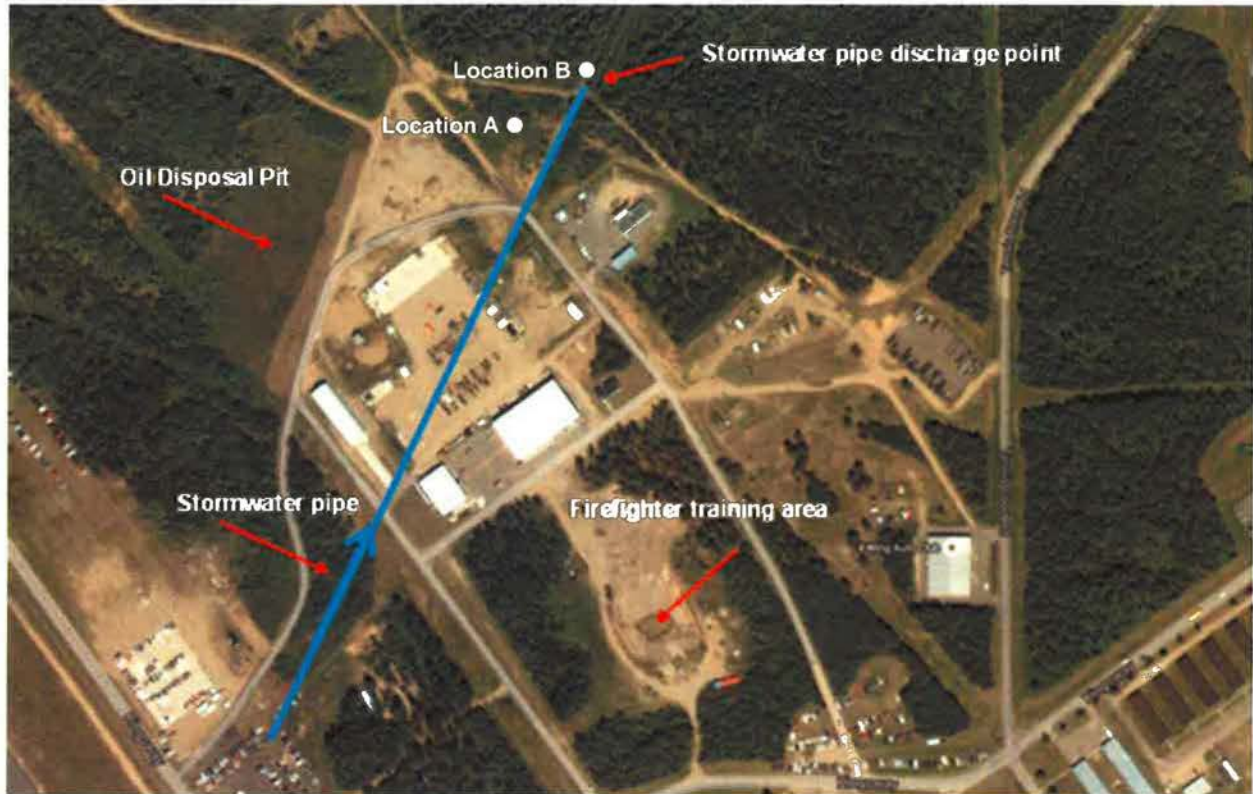


Figure 2. Site Plan – The Blue Line Refers to the Stormwater Pipe System (Location A – BH13-06 site; Location B - Stormwater Pipe Discharge Point).

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Figure 4. Location B - Stormwater Pipe Discharge Point to Drainage Ditch (Terminus of Pipe is Below the Water's Surface).

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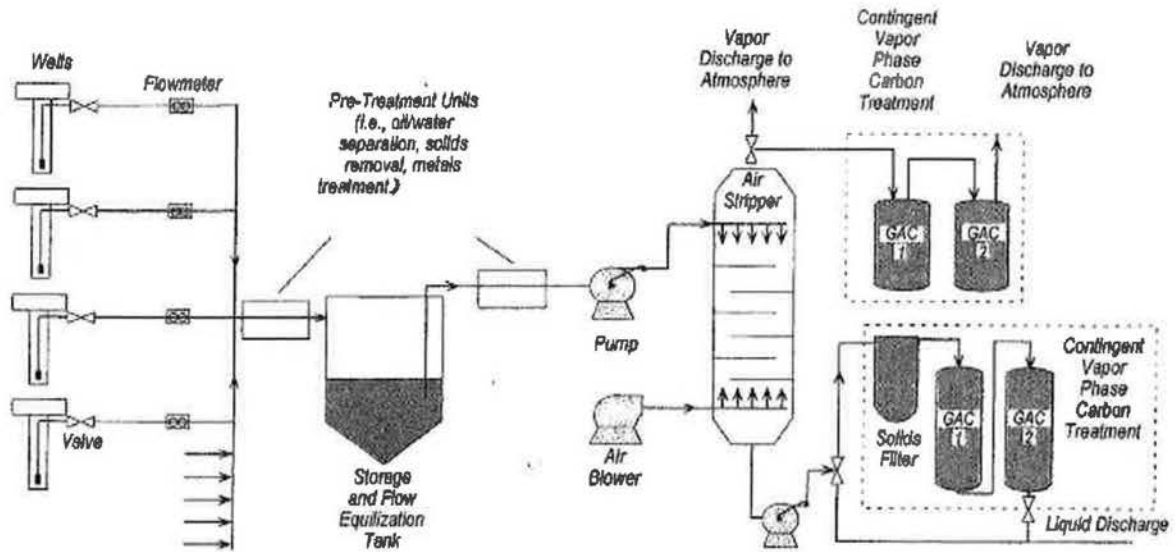


Figure 5. Concept of P&T System for PFC-contaminated Groundwater.

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Annex 1

Recommended Format for the Field Demonstration Report

PWGSC Project: XXX

The recommended report structure is as follows:

Title

Executive Summary

Table of Contents

List of Abbreviations

Introduction

- Project Background
- Project Objectives

Site Description

- Site Location
- Site Geology
- Site Hydrogeology

Methodology

- P&T System Design for Groundwater and Stormwater Treatment
- Establishment of Extraction/Monitoring Well Network and Construction of Stormwater Pool
- Establishment of Baseline Chemistry of the Plume
- Field Trial and Monitoring
- Analytical Methods for PFCs and Co-contaminants
- Evaluation of Post-test Groundwater Chemistry
- Off-site PFC Movement Monitoring
- Reference to Applicable Environmental Guidelines and Regulations
- QA/QC Plan

Results and Discussion

- Effectiveness of P&T Method for PFC-contaminated Groundwater
- Evaluation of P&T Method for PFC source removal
- Evaluation of P&T Method for PFC hydraulic containment
- Effectiveness of P&T Method for Typical Co-contaminants in Groundwater
- Effectiveness of P&T Method for PFC-contaminated Stormwater
- Effectiveness of P&T Method for Typical Co-contaminants in Stormwater

Conclusions and Recommendations

- For PFC-contaminated groundwater
- For PFC-contaminated stormwater pipe system

References

Appendices

- Figures/Maps/Drawings
- Summary of Extraction and Monitoring Well Construction Details (tabular compilation)
- Analytical Results (tabular compilation)
- Photo Record